Section 4.0 GIMTACS/SSGS-OGE Interface

This section describes the communication interfaces among the GIMTACS/SSGS, the OGE elements, and the AGC monitor and includes the following information:

a. Section 4.1 includes a general overview of the physical links and protocols used to transfer data between the various computer systems.

b. Section 4.2 contains a description of the GIMTACS/SSGS-OGE communication protocols, including Ethernet, Internet, and DECNet protocols.

c. Section 4.3 contains a description of the communication messages between the systems, including a list of messages no longer needed for SSGS, and a short description of the SSGS unique interactions.

4.1 Overview

GIMTACS consists of three components: TCS computers, CCs, and workstations. These components communicate with each other using the Ethernet protocol. Three of the five OGE subsystems identified in Section 1.2 interface with GIMTACS: the SPS, PM, and OATS. The AGC also has an OGE type interface with GIMTACS. A description of these interfaces follow.

The following details the interfaces at the CDAS in Wallops Island, VA:

a. The SPS console workstation has a full duplex RS-232 link to a GIMTACS CC for message exchange with GIMTACS, OATS, and PM. The TCP/IP network protocol is used.

b. PM computers have a full duplex RS-232 link to a GIMTACS CC for message exchange with OATS and the SPS. The TCP/IP network protocol is used.

c. OATS workstations and a WAN router are grouped as an Ethernet LAN segment on the DEChub 900 and bridged to the GIMTACS operational LAN. The bridge connection is normally off, with connectivity between the CDA and SOCC OATS workstations provided by the WAN connection to the OATS at SOCC. The bridge connection is activated only if there is a WAN failure, providing inter-OATS connectivity through the GIMTACS operational LAN.

d. One AGC monitor compiles receiver AGC voltage levels from active TACTSs for transfer to GIMTACS. The GIMTACS transfer occurs through an Ethernet connection using the IP and UDP protocols.

A backup CDAS is established at the NASA GSFC. This facility supports one GOES spacecraft with a single string configuration of RF, GIMTACS, SSGS, and OGE components functionally identical to those at the Wallops CDAS.

The Fairbanks CDAS can also assume all functions for a single satellite and is currently the backup CDAS for GOES-11. The FCDAS has two TACTS and two CCs, but it only has a single TCS, GTACS, SPS, and PM. It has no OATS. The single GOES capable antenna limits it to a single satellite stream.

The SOCC, located in Suitland, MD, interfaces as follows:

a. Each of the PMs has a full duplex RS-232 link to a GIMTACS CC for message exchange with OATS and the SPS. The TCP/IP network protocol is used. SSGS uses TCS/IP for communication between GTACS and the PMs.

b. The OATS workstations and their WAN router are grouped as an Ethernet LAN segment on the Cisco switch and bridged to the GIMTACS operational LAN. The bridge connection permits GIMTACS-OATS message exchange while isolating internal OATS traffic from the GIMTACS operational LAN.

T1 multiplexers and associated routers provide WAN connectivity between the CDASs and SOCC, and access to the Nascom network using TCP/IP. Nascom, in turn, provides connectivity to SS/L, the spacecraft contractor; and the DSN ground stations for launch, dwell telemetry, and spacecraft ranging support.

4.2 GIMTACS/SSGS - OGE Communication Protocol Descriptions

This section provides a general description of the IP, TCP, UDP, DECnet, and Ethernet LAN protocols used for OGE-GIMTACS and OGE-SSGS communications.

4.2.1 Ethernet (IEEE 802.3) LAN

The Institute of Electrical and Electronic Engineers (IEEE), under the auspices of the American Standards Institute (ANSI), organized the 802 Committee to establish LAN standards. In turn, the 802 Committee organized separate subcommittees to develop standards for the various existing LAN topologies, as well as to develop standards for new technologies. One of these subcommittees is 802.3, which is responsible for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) networks. The IEEE 802.3 standard is synonymous with the term Ethernet, a LAN concept originally developed by the XEROX Corporation.

The IEEE 802 LAN is a shared medium, peer-to-peer communication network in which information is received by all connected nodes. Direct point-to-point and multicast message exchange between nodes is provided through the common physical medium without any intermediate switching node.

The IEEE 802.3 standard corresponds to the lowest two layers of the Open System Interconnection (OSI) architecture, the physical and the data link layers. The physical layer performs signal encoding and decoding, synchronization by preamble generation and removal, and bit transmission and

reception. The data link layer provides one or more Service Access Points (SAPs) to the upper protocol layers, assembles data into frames with addresses and error control checksums, disassembles and error checks received frames, and governs access to the transmission medium. These two layers are described in the following subsections.

4.2.1.1 IEEE 802.3 Physical Layer

The IEEE 802.3 standard encompasses various physical media and topologies, both baseband and broadband. GIMTACS and the OGE elements use the 10BASET implementation with the following characteristics:

a. Ten Mbps data rate

b. Manchester-encoded baseband signaling

c. Unshielded Twisted Pair (UTP) cabling from stations (nodes) to a multiport repeater (i.e., DEChub 900)

d. Maximum segment length of 100 meters from any station to the hub.

The standard acknowledges the desirability of locating stations a distance away from the attachment point to the medium. The interface portion collocated with the DEChub is referred to in the standard as the Medium Attachment Unit (MAU). The interface between the MAU and the station is then provided by two UTPs, one for each direction of transmission. The MAU is responsible for transmitting and receiving signals to and from the medium and sensing the presence of a signal on the medium. The DEChub is responsible for repeating received signals to all stations, recognizing collisions, and transmitting a jamming signal, collision enforcement, to all stations to indicate a collision has occurred.

4.2.1.2 IEEE 802.3 Data Link Layer

In the IEEE 802 standards, the data link layer is comprised of two sublayers:

a. A Logical Link Control (LLC)
b. A Medium Access Control (MAC).

Division into two sublayers permits the same LLC sublayer implementation to support all the different IEEE 802 MAC implementations. Another reason for this division is the logic required to manage access to the shared medium does not exist in traditional layer 2 data link control protocols.

4.2.1.2.1 IEEE 802.3 Medium Access Control Sublayer

In the IEEE 802.3 MAC protocol, a station ready to transmit listens to the medium and waits until the medium is idle before transmitting. If a collision is subsequently detected, a jamming signal is transmitted to notify all network nodes. The transmitting node waits a random number of slot times (twice the medium's propagation time plus the MAC layer jam time) before retransmitting its packet.

Each time a station experiences a collision on a particular message, it waits a greater number of slot times before retransmitting. The transmitting node gives up and reports an error after 10 retransmission attempts. Thus, while the MAC sublayer does not guarantee delivery, it guarantees that packets have been transmitted without collision. Packet loss occurs due to receive failure at a receiving station, not due to transmission problems.

The MAC frame format is shown in Figure 4-1. The frame length ranges from 64 to 1518 octets. The Part Approval Document (PAD) field is used, as needed, to ensure a minimum length frame. The destination address may be a single destination, a multicast address, or a broadcast address. The length field is the length of the packet sent by the LLC layer. The FCS is a CRC based on all fields except the preamble and the Start Frame Delimiter (SFD).

4.2.1.2.2 IEEE 802.3 Logical Link Control (LLC) Sublayer

The LLC protocol is modeled after the OSI High-Level Data Link Control (HDLC) protocol. Three LLC protocols are defined in the standard and support the three service types, unacknowledged connectionless service, connection mode service, and acknowledged connectionless service. Stations can support more than one service type as indicated by the station class. The GIMTACS-OGE LANs are Class I, supporting unacknowledged connectionless service. Point-to-point guaranteed delivery service is provided at the network and transport levels by the DECnet and TCP protocols. These protocols perform flow control, error control, and acknowledgment. Multicasting is performed at the Ethernet MAC level.

All three LLC protocols use the same Protocol Data Unit (PDU) format shown in Figure 4-2. In the unacknowledged connectionless (Type 1) service, there is no flow control, acknowledgment or error control. Unnumbered Information (UI) frames are used and frames containing errors are discarded at the MAC level. The UI-frame control field format is as shown for a U-frame in Figure 4-2. All five M (modifier) bits are zero, as is the Poll/Final (P/F) bit, which has no significance. Thus, the control field is 11000000. Type 1 service has two other PDU types, an eXchange IDentification (XID) PDU and a TEST PDU. The XID PDU is used to exchange information on the types of services supported by a source and destination pair; and in the case of Type 2 service, the flow control window size. The TEST PDU is used to conduct loop-back tests of the transmission path between two LLC entities. Upon receipt of a TEST command PDU, the addressed LLC entity sends a TEST response PDU as soon as possible.

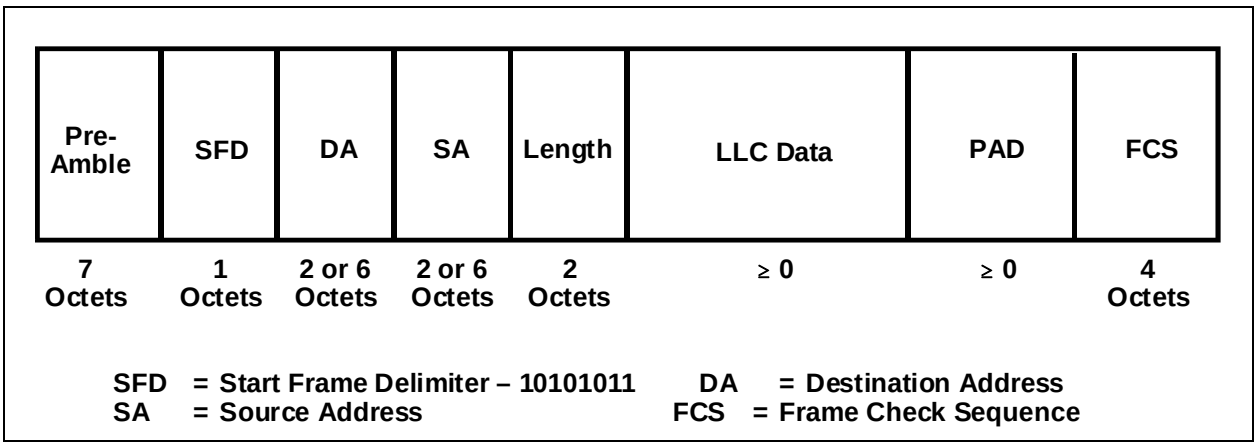


Figure 4-1. IEEE 802.3 MAC Layer Frame Format

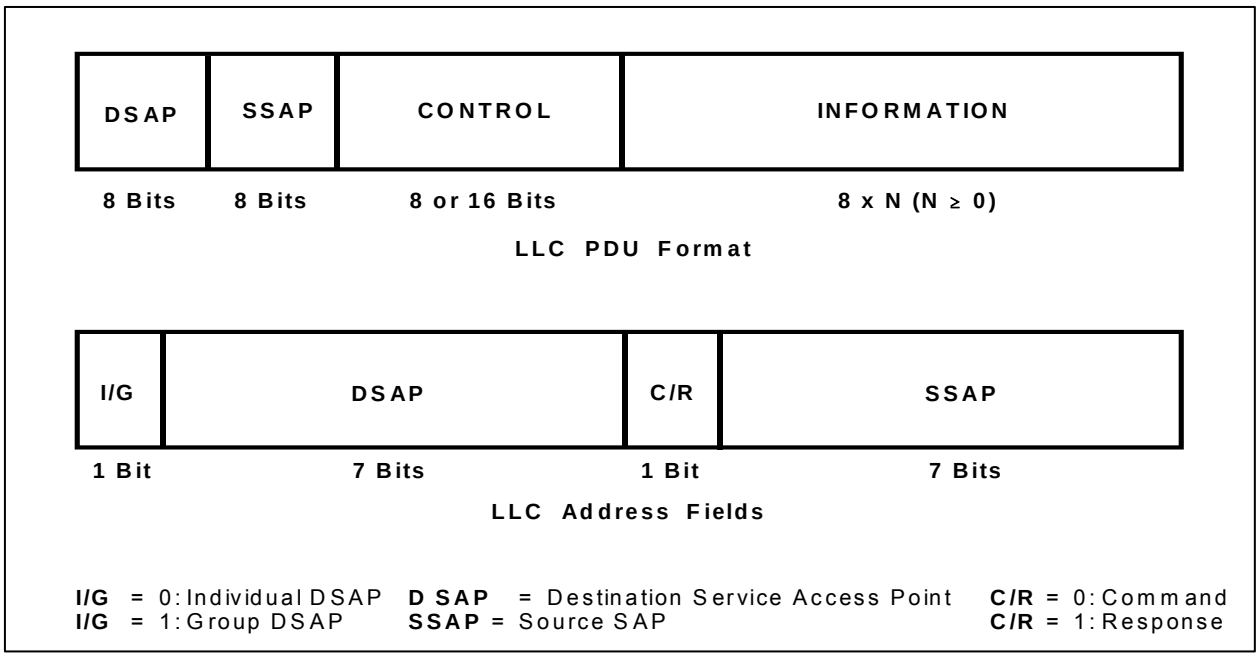


Figure 4-2. IEEE 802 LLC PDU Format

4.2.2 Internet Protocol Suite

Starting in the mid-1970s, the Defense Advanced Projects Agency (DARPA) funded the development of protocols that would allow communications across any set of networks. The end result of that funding effort was the Internet Protocol suite, of which TCP and IP are the best known.

Development and documentation of Internet protocols is accomplished through *Request for Comments (RFCs)* documents having a unique number. The RFCs are reviewed and analyzed by the Internet community, and refinements are published as new RFCs. Typically, the entire Internet protocol suite is termed TCP/IP, although is comprises application level protocols besides TCP and

IP. Figure 4-3 shows the relationship between the OSI reference model and the various protocols in the Internet suite. This brief introduction presents IP, TCP, UDP, FTP, Simple Network Management Protocol (SNMP), Remote Terminal Emulation Protocol (Telnet), and NFS protocols. These are the protocols used in the GOES ground system for data transfers between GIMTACS and the AGC, and within the SPS. SNMP, although virtually transparent to the user, is briefly described since it is used for configuration and management of the DEChubs and WAN circuit routers.

4.2.2.1 Internet Protocol

IP is the primary network layer protocol in the Internet suite. It provides routing, packet (datagram) fragmentation and reassembly, and error reporting. Figure 4-4 shows the IP packet format and field definitions. The address lengths are 32 bits, commonly written in a dotted decimal format with four fields. Due to the explosive growth of the Internet, the 32-bit IP address length is no longer sufficient to accommodate future growth. A new version of IP, IP Version 6, has been under development and will provide expanded address space as well as correcting other shortcomings of the current IPv4. IP addressing is not covered in this document.

An important field within the IP format is the protocol number, a 1-byte field identifying the upper-layer protocol within the receiving host where incoming packets should be routed; for example, TCP or UDP. This is the mechanism used by IP to multiplex all the upper layer processes using its services.

Within LANs the Address Resolution Protocol (ARP) and the Reverse ARP (RARP) are used to determine MAC addresses and network device IP addresses dynamically. ARP uses broadcast messages to determine the MAC-layer address of particular IP addresses. RARP, in turn, uses broadcasts messages to determine the IP address corresponding to particular MAC addresses, a necessity for networks in which IP addresses are assigned dynamically when devices log on. The addressed device replies to the broadcast, returning its IP and MAC addresses. The Internet Control Message Protocol (ICMP) provides echo requests and reply messages useful in testing node reachability, as is used by the *ping* program. Within an internetwork ICMP provides other control capabilities, primarily used by routers to find subnetwork addresses and redirect message flows more efficiently. The *ping* application uses these echo requests.

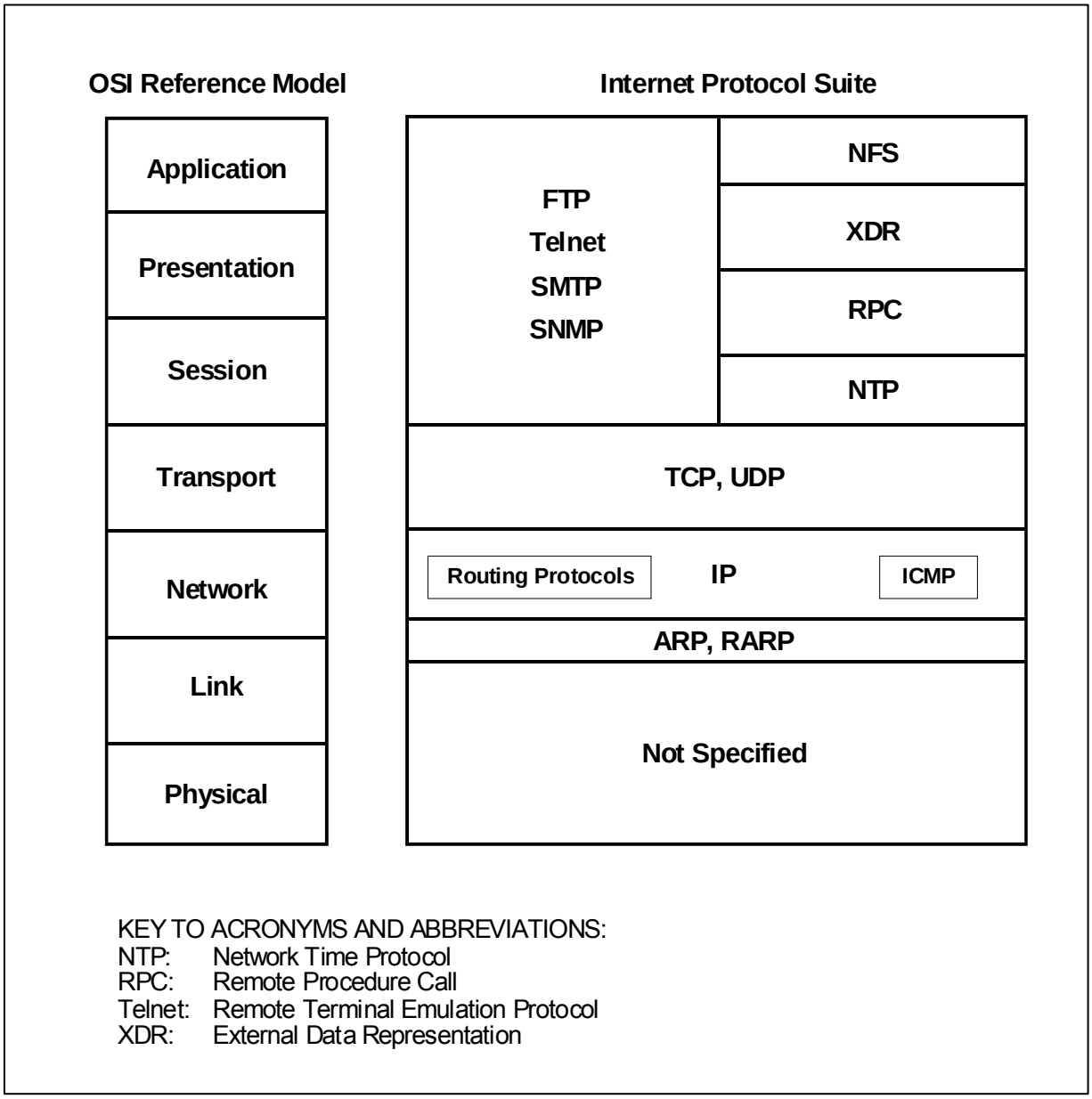
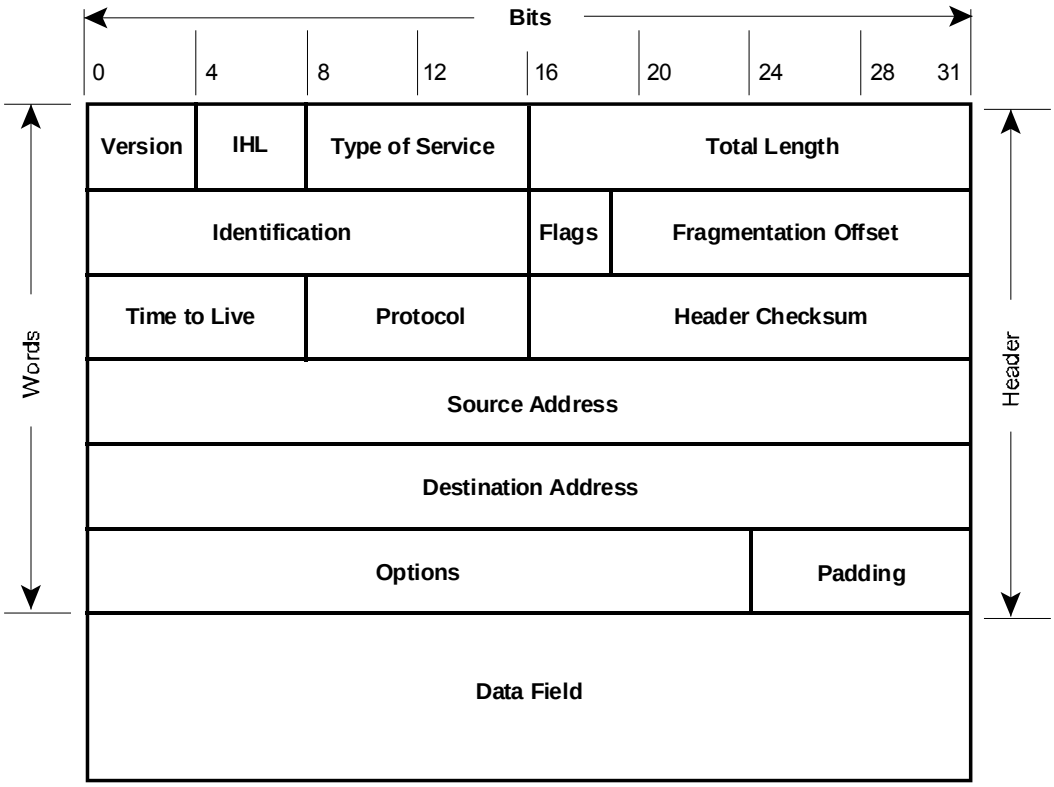


Figure 4-3. Internet Protocol Suite and OSI Reference Model Relationship



Field Definitions:

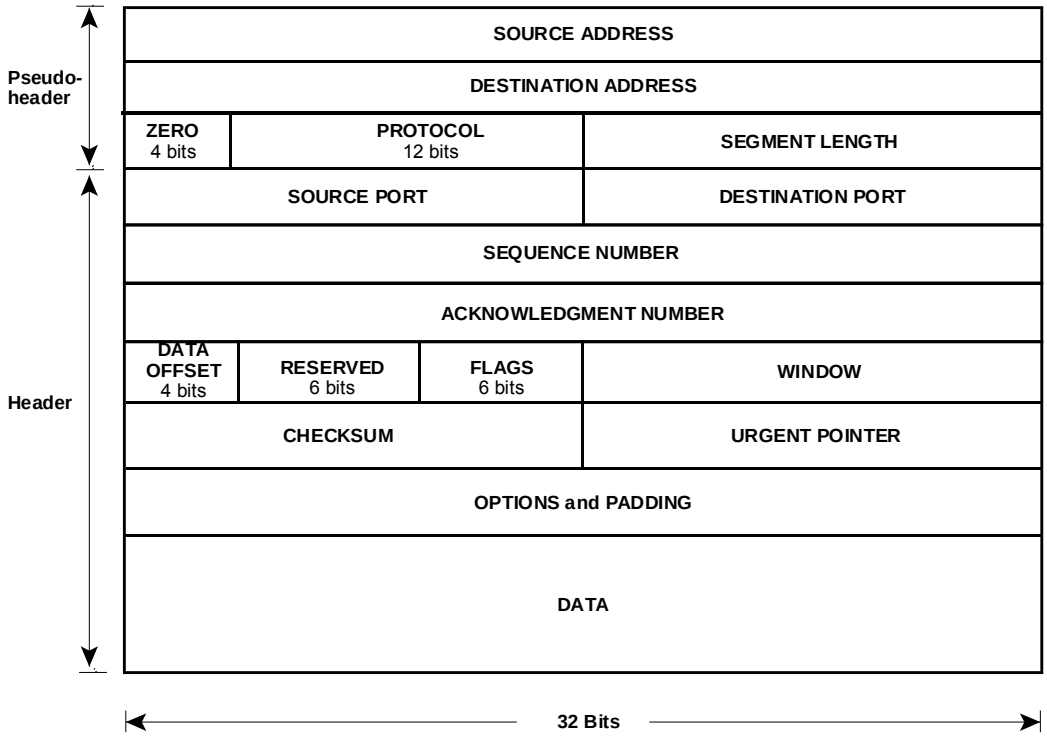
Version:	Version of IP in use.
IHL:	IP header length in 32-bit words.
Type of Service:	Importance level of packet as assigned by an upper layer protocol.
Total Length:	Total length of the packet, data and header, in octets.
Identification:	An integer identifying the current packet, used for reassembling packets.
Flags:	A 3-bit field used for fragmentation control.
Fragmentation Offset:	Position of a fragment in the original datagram, in multiples of 64 bits
Time to Live:	A number of hops counter used to control how long a packet stays in the network before being discarded.
Protocol:	Identification of the upper layer protocol to receive the incoming packets after IP processing is complete.
Hdr Checksum:	CRC for error detection.
Source Address:	Address of the sending node.
Dest. Address:	Address of the receiving node.
Options:	Specification of service options, such as security, supported for the packet.

Figure 4-4. IP Packet Format

4.2.2.2 Transmission Control Protocol (TCP)

TCP is the Internet suite's connection-oriented transport layer protocol. It provides full-duplex, acknowledged, and error- and flow-controlled data transport to upper layer protocols. Figure 4-5

shows the TCP data packet format. The first three rows in the figure comprise a 96-bit pseudo header containing the source and destination IP addresses, protocol identification, and TCP packet segment length in octets. This information is passed to IP as part of the Send primitive. The checksum in the TCP header is calculated prior to transmission and includes the pseudo header, which protects from misdelivery by IP.



Field Definitions

Source and Destination IP Addresses:	Same as in the IP Header (Figure 4-8)
Zero:	Field containing eight 0's
Protocol Identifier:	6 for TCP
Segment Length:	Length of the header and data in octets
Source and Destination Ports:	The TCP port numbers used for the connection
Sequence Number:	Sequence number of the first data octet in this segment. If SYN is set (see Flags), the sequence number value is the initial sequence number (ISN); and the first data octet is ISN + 1
Acknowledgment Number:	The sequence number of the next octet the TCP entity is expecting to receive
Data Offset (four bits):	The header length in 32-bit words
Reserved (six bits):	Field reserved for future use
Flags (six bits):	URG – The Urgent pointer field is significant ACK – The Acknowledgment field is significant PHS – Push function RST – Reset the connection SYN – Synchronize the sequence numbers FIN – No more data from sender
Window Size:	The number of data octets beginning with the one indicated in the ACK field that the sender will accept
Checksum:	Error detection for the pseudoheader, header and data
Urgent Pointer:	Points to the octet following the urgent data
Options:	Service options, such as the maximum acceptable segment size.

Figure 4-5. TCP Header and Pseudo Header Format

During connection establishment, TCP assigns a unique source port number to the upper layer protocol or process requesting its services. The source TCP then requests a connection to its peer TCP at the destination host through IP. The destination TCP assigns a unique destination port number to the destination process and returns this information to the source TCP. The combination of source and destination port numbers and the source and destination IP addresses uniquely identify a TCP connection; thus, allowing TCP to support multiple connections concurrently. It is this combination of port number and IP address that is referred to as a socket.

There are two types of TCP ports available. One type is referred to as a *well-known port*, assigned to particular network services commonly supported; for example, FTP always uses port number 21. The second type is called a *dynamically assigned port*. These port numbers are assigned to processes as needed.

When a process requests, for example an FTP connection to a remote host, TCP dynamically assigns a port number to the source process; and, the well-known port number is used for the destination port number. The source and destination sockets uniquely identify the FTP connection so the destination TCP can support multiple FTP requests.

4.2.2.3 User Datagram Protocol (UDP)

UDP is a connectionless version of TCP useful in situations where TCP's reliability is not needed. The UDP header contains four fields:

a. Source port numbers
b. Destination port numbers
c. Datagram length
d. Optional checksum.

The source and destination port fields are the same as in TCP. The datagram length includes the header and data, plus an octet of padding if the data field is not an even multiple of 16 bits. UDP also uses a pseudo header identical to the TCP pseudo header, except for protocol value 17 that is included in the checksum computation. If not used, the checksum field is zero filled. UDP is used to pass AGC Monitor data from the TACTS to GIMTACS.

4.2.2.4 Higher Layer Protocols

Higher layer protocols available in the Internet Protocol Suite, which are used in the GOES ground system, are described in the following sections.

4.2.2.4.1 SNMP

SNMP provides a remote monitoring and management mechanism for network devices. In GOES, SNMP is used by the DEChub console station to manage, monitor, and configure the hub switches and the WAN routers. The management console workstation acts as the SNMP client, and the

DEChub switches and routers are SNMP servers. The devices maintain a Management Information Base (MIB) containing all relevant configurations, diagnostic and performance data. In typical operation, the client polls the servers to obtain status data and issue commands. Devices can also concurrently run a separate SNMP client process. This client allows the devices to report critical data to a *trap* server process running on the management station that cannot wait until the next poll from the management station.

4.2.2.4.2 NFS

The NFS protocol is used in the SPS analysis system to allow devices to access files on the disk drives of remote devices as if the files were local. Devices can operate as:

a. NFS servers, exporting disks for access by other devices.
b. Clients, accessing NFS server device disks.
c. Both clients and servers, accessing and exporting information.

The NFS client contacts the desired NFS server to request access to a file system, a process called *mounting*. If the server determines the requesting client is allowed access, it gives the client a *file handle* for access to the requested file. Once a client has mounted the desired file system, it must send a request to the NFS server for each separate file it wants to access. This access request includes the file handle previously granted by the server and a description of what the client wants to do with the file. The NFS protocol does not include a mechanism that allows the server to cancel file handles. So, file handles remain active until the server process is reinitialized.

4.2.2.4.3 File Transfer Protocol

FTP is used to transfer all types of files across networks, such as downloading SPS data from the WCDAS to the SOCC SPS analysis workstations. FTP uses two separate TCP connections. One is called the command channel, which carries commands and returns results. The second is called the data channel, which carries the actual data files and directory listings. On the server end, the command channel uses Port 21 and the data channel uses Port 20. Typically, the client uses ports above 1023 for both channels.

To start an FTP session, the client allocates two channels. The first serves as the command channel, used to open a connection to the server. As part of the connection, the client notifies the server of the data channel port number. Then the server opens the data channel connection back to the client.

4.2.3 DECnet Protocol

DECnet supports a variety of standard and proprietary protocols, and media and link implementations, such as Ethernet. DECnet provides a datagram transport service through its routing layer. The transport layer is called the Network Services Protocol (NSP), which provides error control checking, flow control, and message retransmission. Within Ethernet LANs, a 21-byte

routing header is appended to source data packets. DECnet is used for point-to-point messages within the GIMTACS LANs.

4.3 Communication Messages

This section first describes the GOES N-P unique interfaces that are not described in the 504-02 message tables. Next it describes the generic message format including the format of the message header in detail, the store and forwarding of messages, and some significant message fields, coefficient sets. It then describes in detail each message by originating system in the following order: SPS, MRSS, PM, OATS, GIMTACS/GTACS, and AGC.

4.3.1 GOES N-P Unique Interfaces – No DRL 504-02 Heritage (SSGS)

This section describes the data exchanged among the SSGS elements. GTACS provides a data exchange service among the various SSGS elements; therefore, this section addresses these relationships with respect to the elements involved in the exchange rather than the function. Table 4-1 identifies which SSGS elements have maintained use of the 504-02-like messages.

Table 4-1. SSGS Interface Heritage

To / *From*	GTACS	NTACTS	OATS	MRS&S	DID	SPS	RPM
GTACS	N-P Unique	N-P Unique	504-02 format	504-02 format		504-02 format	504-02 format
NTACTS	N-P Unique						
OATS	504-02 format		504-02 format				
MRS&S	504-02 format				N-P Unique		
DID				N-P Unique			
SPS	504-02 format						
RPM	504-02 format						

4.3.1.1 GTACS/NTACTS

The interface between GTACS and NTACTS does not use the 504-02 message format for data exchange. The interface is that defined by the CORTEX^{NT} TCP/IP protocol. The primary exchange between the two elements consists of telemetry minor frames, S/C commands, NTACTS status, and CORTEX^{NT} control. Details of CORTEX^{NT} TCP/IP interfaces are defined in the *Command, Ranging & Telemetry Unit (CORTEX^{NT}) Generic Ethernet Interface* document. (When using the CORTEX^{NT} referenced material note that "Word" indicates a 32-bit computer word.)

4.3.1.1.1 PCM Telemetry Data

NT1694 and NT2209 from NTACTS are received by GTACS over a one-to-one socket-based connection. The use of TCP/IP socket protocol ensures data transmission integrity between elements. The primary data flow from NTACTS to GTACS consists of ground-receipt-time tagged PCM minor frames.

NTACTS bit-synchronizes a minor frame and time tags it to the last bit of the frame. A minor frame is 4096 bits or 512 words (bytes). The words are numbered 0-511. Normal and dwell PCM minor frames share a basic structure depicted in Table 4-2. The remaining 504 words (7-510) are available for other telemetry. A major frame consists of 32 minor frames.

Table 4-2. Telemetry Minor Frame Organization

Minor Frame Word	Bit	Function
0	0-7	Frame sync, hex (FA)
1	0-7	Frame sync, hex (F3)
2	0-7	Frame sync, hex (20)
3	0-7	Spacecraft ID
4	0	CTCU telemetry formatter ID: 0 = CTCU A 1 = CTCU B
	1	PCM stream ID: 0 = NT2209, 1 = NT1694
	2-4	Format ID: B2 B3 B4 Format 0 0 0 0 0 0 1 1 0 1 0 0 0 1 1 0 1 0 0 0 1 0 1 0 1 1 0 0 1 1 1 7 (unit test)
	5	Fixed logic 0
	6	Normal/dwell mode, 0 = normal
	7	Data bus select: 0 = bus A, 1 = bus B
5	0-2	Fixed logic 0
	3-7	Minor frame count (0-31)
6	0-7	Dwell word ID
511	0-7	Checksum (generated by adding all of the previous minor frame words together and transmitting the 8 least significant bits of the result)

Note: Unless otherwise specified, bit 0 is the MSB and the first bit transmitted.

The spacecraft is identified by virtue of S/C database definitions activated by the GTACS workstation. The workstation page containing the stream includes the corresponding Spacecraft ID and telemetry stream ID.

Minor frames are transmitted via the LAN from NTACTS to GTACS using CORTEX^{NT} TCP/IP messages. Each captured minor frame is a fixed-length message and is embedded in a TCP/IP packet. The complete NTACTS to GTACS minor frame transmission packet is described in Table 4-3. A 12-byte message header of the structure in Table 4-4 precedes the telemetry minor frame packaging. A 4-byte message trailer described in Table 4-5 terminates all TCP/IP messages.

Table 4-3. CORTEX^{NT} Minor Frame Packet

Word	Type	Value	Description
0 to 2	Integer	Size of message = 4*N	Standard CORTEX^{NT} header
3	Integer	First field (see Note 1)	Time-tag
4	Integer	Second field (see Note 1)	Time-tag
5	Integer	0 to FF FF FF FF_H	Sequence counter
6	Integer	Frame checking ON : 0 : OK 1 : Error Frame checking OFF & RS decoding ON 0 : Reed Solomon correction OK 1 : Correction capacity exceeded	Frame check result (see Note 2)
7	Integer	0 : Frame sync. OFF 1 : Frame sync. ON, LOCK 2 : Frame sync. ON, FLYWHEEL 3 : Frame sync. ON, SEARCH	Frame synchronizer status
8	Integer	0 : No bit slip 1 : Bit slip occurred	Bit slip status
9	Integer	0 to 1024 (see Note 3)	TLM delay
10 to 15		Unused	
16 to N-2	_	32-bit words (see Note 4)	Telemetry minor frame
N-1	Integer	-1234567890	Standard CORTEX^{NT} trailer

Note 1: Telemetry messages (more precisely the **last bit of each frame or block**) are time-tagged to within an accuracy of better than 1 ms.

Note 2: Not significant if the frame synchronizer is OFF.

Note 3: Delay, expressed in number of frames or blocks, between real-time telemetry and transmitted telemetry. (0 means real-time telemetry.)

Note 4: Telemetry frames and blocks are 32-bit aligned (LSBs of the last word are zero-filled if the frame or block length, in bytes, is not a multiple of 4).

Table 4-4. Standard CORTEXNT Message Header

Word	Type	Value	Description
0	Integer	1234567890	Start of message
1	Integer	X	Size of message in bytes (including header and trailer)
2	Integer	User Configurable	Flow identification

Table 4-5. Standard CORTEX^{NT} Message Trailer

Word	Type	Value	Description
---	Integer	-1234567890	End of message

4.3.1.1.2 NTACTS Status

GTACS uses the following message types for NTACTS specific interface exchanges. Each message listed below is described fully in the *Command, Ranging & Telemetry Unit (CORTEX^{NT}) Generic Ethernet Interface* document.

a. Monitoring messages used to monitor the T&C interactions/status:
   1. Software and ICD Version ID.
   2. Global CORTEX^{NT} Table.
   3. Telecommand Unit Table.
   4. Telemetry Simulator Table.
   5. Ranging Unit Table.
   6. IF Modulator Table.
   7. IF Receiver Table.
   8. Telemetry Unit Table.
   9. Noise Generator Table.
   10. All Components Table.

b. Control messages to initiate T&C actions:
   1. CORTEX^{NT} Initialization Command.
   2. "Carrier Acquisition Restart" Command.
   3. "Wait for Absolute Time" Abort Command.
   4. "Abort all pending TC operations" Command.
   5. "Stop Ranging Measurement" Command.

c. Telemetry data messages for telemetry collection:
   1. Telemetry Request.
   2. Telemetry Negative Acknowledgement Message.
   3. Telemetry Message.

d. Satellite Telecommand (TC) to control spacecraft commanding activities:
   1. Clear S/C TC Request.
   2. "Execute" Instruction.
   3. "Pause" Instruction.
   4. "Wait for Absolute Time" Instruction.
   5. "TCU Unlock" Instruction.
   6. "NOP" Instruction.
   7. "Stop Idling" Instruction.
   8. "Group" Instruction.

e. TC Acknowledgement messages to comply with CORTEX^{NT} protocol:
   1. Acknowledgement for Clear Satellite TC Request.
   2. Acknowledgement for "Execute" Instruction.
   3. Acknowledgement for "Pause" Instruction.
   4. Acknowledgement for "Wait for Absolute Time" Instruction.
   5. Acknowledgement for "TCU Unlock" Instruction.

6. Acknowledgement for "NOP" Instruction.
7. Acknowledgement for "Stop Idling" Instruction.
8. Acknowledgement for "Group" Instruction.

f. Logging data to maintain operational history and status:
   1. Configuration Change Event.
   2. TC Request or Instruction.
   3. TC Acknowledgement Event.

4.3.1.1.3 Spacecraft Commanding

GTACS transmits spacecraft commands to NTACTS over a one-to-one socket-based connection utilizing TCP/IP socket protocol. The primary data flow from GTACS to NTACTS is command messages in uplink format. GTACS interfaces with the encryption equipment, as required, to encrypt the commands before packaging for submission to NTACTS. Once encrypted, GTACS uses the CORTEX^{NT} clear command packet for transfer to NTACTS. Table 4-6 defines the format of the clear-command uplink request packet. The generic spacecraft command form is presented in Figure 4-8 for completeness, as specified by the *Specification for the GOES N-P Spacecraft - Spacecraft to Ground Database ICD*.

Table 4-6. Clear Command Uplink Request

Word	Type	Value	Description
0 to 2	Integer	Size of message = 4*N (operation dependent)	Standard CORTEX^{NT} header
3	Integer	1 (clear satellite TC request)	Request code
4	Integer	Any 32-bit word for logging purpose	Command tag
5	Integer	0 to 16384 (in bits)	TC message length
6	_	First word to send (MSB first)	Data 0
7	_	Next word to send if length > 32 bits	Data 1
...	_	...	...
N - 3	_	Last word to send	Data n
N - 2	Integer	X	Check-Sum
N – 1	Integer	-1234567890	Standard CORTEX^{NT} postamble

4.3.1.2 MRS&S/DID

This interface provides control of the MRS&S by the DID operator, requests for real-time and archived data by the DID from the MRS&S, and transmission of data from the MRS&S to the DID. This interface is fully defined in the *GOES N-P SSGS MRS&S to Client Interface Control Document*.

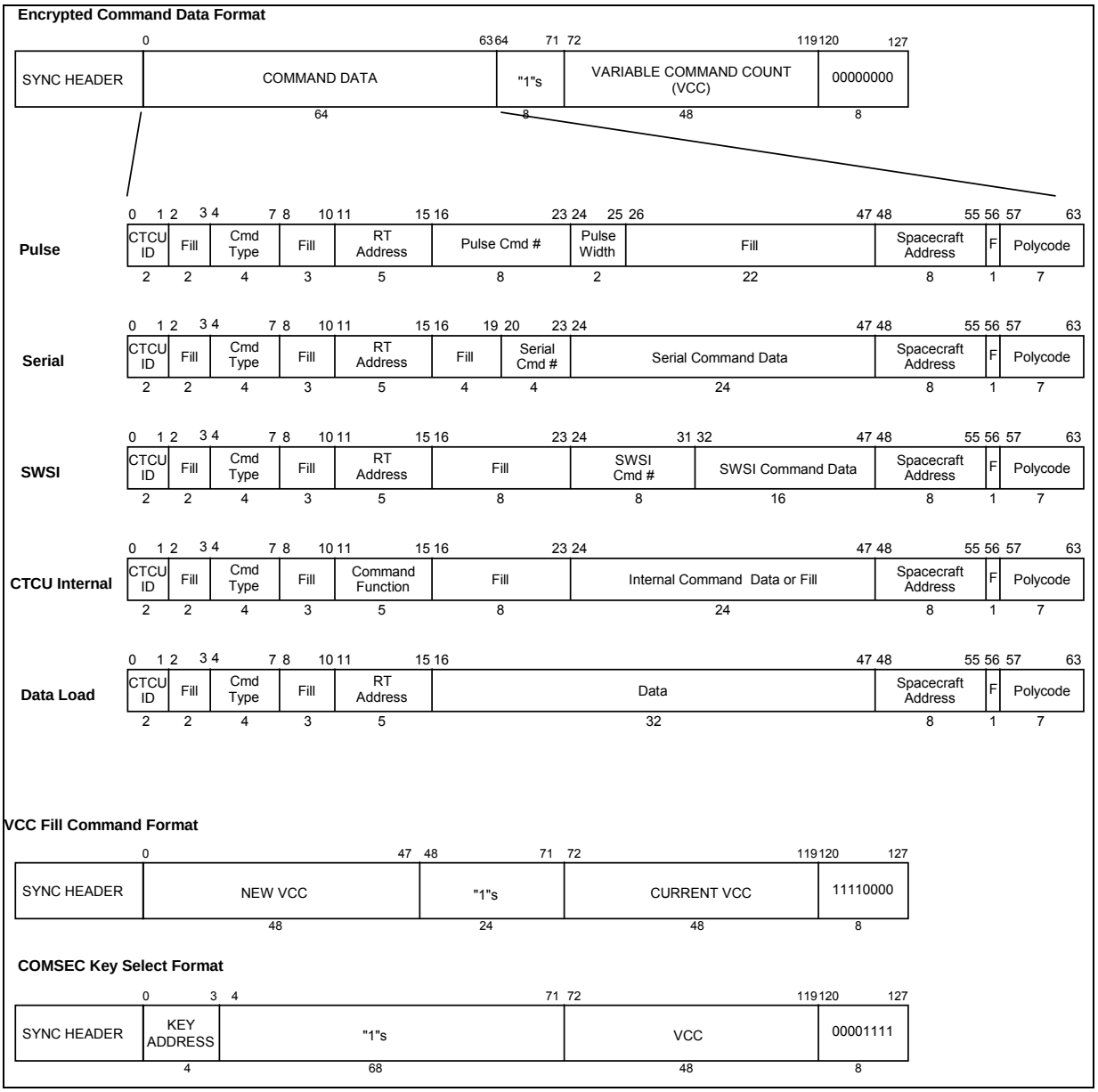


Figure 4-6. Uplink Command Format

4.3.2 Generic Message Format

The message format between GIMTACS/SSGS and OGE elements comprises of a 32-octet fixed-length header and a variable-length data block of up to 3552 octets (1776, sixteen-bit half-words). The GIMTACS/GTACS-OGE has a total maximum message length of 3584 octets. The basic message layout is shown in Figure 4-1. All header fields are binary. DRL 504-02 - like messages are retained in SSGS for communications between all SSGS elements except GTACS and NTACTS, as described in Section 4.3.1. The message numbers have been retained from GOES I-M where

appropriate; however, some messages have been deleted and others added. Table 4-7 lists the set of GOES I-M messages that have not been retained for GOES N-P due to spacecraft differences. For SSGS, although the message format has been retained, messages are passed using a point-to-point socket protocol. Therefore, messages are sent to a specific receiving system, not broadcast as in the GOES I-M system.

Table 4-7. Unused GOES I-M Messages (on SSGS)

Message No.	Source	Destination	Mode	Content	Rate	Data Blk Length (16-bit half wds)
53	OATS	GTACS	Sol	Look up Table	as required	1072
58	OATS	GTACS	Unsol	Trim Tab Command Data	1/day	12
61	OATS	GTACS	Unsol	DIRA Drift Command	7/yr	6
63	OATS	GTACS	Unsol	SSAA IMC Set Ready	As required	42
66	OATS	GTACS	Unsol	DIRA Data request	as required	variable
67	OATS	GTACS	Unsol	Trim Tab Data request	1/day	variable
81	OATS	GTACS	Unsol	MMC Scale Factors	2/yr	18
85	OATS	GTACS	Unsol	MMC Calibration Data request	2/yr	variable
87	OATS	GTACS	Unsol	SMC Data request	as required	variable
88	OATS	GTACS	Unsol	Thermal Snap data request	as required	variable
166	GTACS	OATS	Sol	DIRA data response	as required	variable
167	GTACS	OATS	Sol	Trim Tab data response	as required	variable
176	GTACS	OATS	Sol	DIRA data completion	as required	4
177	GTACS	OATS	Sol	Trim Tab data completion	as required	4
185	GTACS	OATS	Sol	MMC Calibration data response	as required	variable
187	GTACS	OATS	Sol	SMC data response	as required	variable
188	GTACS	OATS	Sol	Thermal Snap data response	as required	variable
190	GTACS	OATS	Unsol	S/C Equipment Status	as required	84
195	GTACS	OATS	Sol	MMC Calibration data completion	as required	4
197	GTACS	OATS	Sol	SMC data completion	as required	4
198	GTACS	OATS	Sol	Thermal Snap data completion	as required	4
205	GTACS	OATS	Unsol	Single Chord Notification	as required	4
301	AGC	GTACS	Unsol	AGC Monitor Telemetry	12/min	27

Figure 4-7 is an N2 chart of all the messages exchanged between each pair of the SSGS elements. The diagonal of the matrix contains the SSGS elements. The rows of the matrix (reading horizontally) contain messages issued from the corresponding element. Reading the columns identifies the message destination element on the diagonal. OATS Message 45 is a special message between OATS workstations.

GTACS	151, 153, 154, 155, 159, 160, 162, 164, 165, 168, 170, 175, 180, 199, 202	113, 114, 115	110, 111, 112	123,129
51, 53, 54, 55, 56, 57, 59, 60, 62, 70, 71, 72, 73, 75, 80, 81, 82	OATS (45)		33	41, 42
13, 14, 15, 16		MRS&S		
1, 2, 10, 11, 12	1, 3		SPS	5, 6
23,27	20, 21, 22		25, 26	RPM

Figure 4-7. SSGS Message Exchange

All GIMTACS/GTACS message fields are filled with valid data even if the message is an invalid message response; for example, FATAL. GIMTACS must be able to byte-swap all messages. Byte swapping converts Gould data formats to DEC formats and DEC formats into Gould data formats. Byte swapping also obtains valid data for that field.

The message lengths listed in the table are the maximum lengths of the message body in 16-bit half-words (i.e., excluding the 16-bit half-word header). Where the length is listed as Var, refer to the specific message description for the length. For some variable length messages, using message header confirmation fields continues the message.

A standard date-time stamp is used in many communication messages. It has the following generic four half-word format:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
N	YEAR															
N+1	F	DAY OF YEAR											HR(10s)			
N+2	HR(1s)				MINUTES								SEC(10s)			
N+3	SEC(1s)				MSECS											

Where:

DATA ITEM	FORMAT	VALIDATION	UNITS
F (TIME CODE FLAG)	BINARY	0-LOCK 1-FLYWHEEL	N/A
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS

The time code flag "F" is binary, located in the first bit (bit zero) of the second half-word. All other variables are BCD with the following word-bit relationship:

a. The first date-time stamp half-word contains YEAR in standard position order of thousandths, hundredths, tenths, and units (four bits each).

b. After the time code flag in the second half-word, DAY OF YEAR is in hundredths (three bits), tenths, and units order, starting in bit one through bit eleven.

c. HOUR begins in the least significant four bits of the second half-word with the tenths position. The unit's position is contained in the most significant four bits of the third half-word.

d. MINUTES are the eight middle bits (4-11) of the third half-word in tenths and units order.

e. SECONDS begins in the least significant four bits of the third half-word with the tenths position. The unit's position is contained in the most significant four bits of the fourth half-word.

f. Milliseconds (MSECS) takes the remaining twelve bits of the fourth half-word in standard hundredths, tenths, units order.

In general, when the counter within a message is zero, indicating that following data is absent, the data is not included in the message and the message terminates before the beginning of the message repeat section.

Additionally, all solicited responses to GIMTACS/GTACS echo the ROUTING ID, half-words 15 and 16, in the message header, obtained from the original GIMTACS/GTACS request message. This is similar to the echoing of the tracer field for incoming OATS messages.

A summary of message types and subtypes, origin and destination, nominal frequency, and message length is provided in Figure 4-8. The table has been updated to include messages for GIMTACS and SSGS. Not all messages are used for both SSGS and GIMTACS and differences will be noted. Although the message format has been retained for SSGS, messages are passed using a point-to-point socket protocol. Therefore, messages are sent to a specific receiving system, not broadcast as in the GOES I-M system.

Each message's data layout and block format is described in detail in Section 4.3.2 through 4.3.8. Each describes the messages originating from a specific system (i.e., SPS, PM, OATS). For messages with multiple subtypes, the subtype is indicated by the number after the dash; for example, Message 1-1 refers to Message 1, Subtype 1.

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7	8 9 10 11 12 13 14 LSB 15	
1	MESSAGE SEQUENCE NO.		HEADER
2	SATELLITE ID	SOURCE	
3 4	DESTINATION		
5 6	NUMBER OF 16-BIT HALF-WORDS		
7	MESSAGE TYPE (NUMBER)	MESSAGE SUBTYPE	
8 : 12	TRACER		
13	MESSAGE COUNT	END OF MESSAGE	
14	SPARE		
15 16	ROUTING ID		
17	DATA HALF-WORD 1		DATA BLOCK
:			
:	DATA HALF-WORD N		

Figure 4-8. Communication Message Format

Notes:

1. Message sequence number: 1–65535
2. Satellite ID

Satellite ID	S/C Reference
08	GOES-I, GOES-08
09	GOES-J, GOES-09
10	GOES-K, GOES-10
11	GOES-L, GOES-11
12	GOES-M, GOES-12
13	GOES-N, GOES-13
14	GOES-O, GOES-14
15	GOES-P, GOES-15

3. Source and Destination (plus location)

NODE ID	ELEMENT NODE NAME	LOCATION		NODE ID	ELEMENT NODE NAME	LOCATION
10	GIMTACS	*		56	SMRSS06	SOCC
11	RPM1	SOCC		57	SMRSS07	SOCC
12	RPM2	SOCC		58	CMRSS01	CDAS
13	RPM3	SOCC		59	CMRSS02	CDAS
14	RPM4	SOCC		60	CMRSS03	CDAS
15	RPM5	CDAS		61	CMRSS04	CDAS
16	RPM6	CDAS		62	CMRSS05	CDAS
17	RPM7	CDAS		63	GMRSS01	WBU
18	RPM8	WBU		64	FMRSS01	FCDAS
19	RPM9	FBK		65	BMRSS01	SWPC
20	SPS1	CDAS				
21	SPS2	CDAS		66	BMRSS02	SWPC
22	SPS3	CDAS		67	BMRSS03	SWPC
23	SPS4	CDAS		68	BMRSS04	SWPC
24	SPS5	CDAS		69	HMRSS01	BSS
25	SPS6	CDAS		70	HMRSS02	BSS
26	SPS7	FBK		75	SOAT11	SOCC
27	SPS8	WBU		76	SOAT12	SOCC
28	SPS9	CDAS		77	SOAT13	SOCC
29	RPM10	SOCC		78	SOAT14	SOCC
31	All SPSs	*		79	SOAT15	SOCC
32	All OATS	*		80	SOAT16	SOCC
33	All RPMs	*		81	SOAT17	SOCC
34	All MRS&S	*		82	COAT11	CDAS
41	I-M OATS 1	SOCC		83	COAT12	CDAS
42	I-M OATS 2	SOCC		84	COAT13	CDAS
43	I-M OATS 3	SOCC		85	GOAT11	WBU
44	I-M OATS 4	SOCC		90	SGTACS01	SOCC
45	I-M OATS 5	SOCC		91	SGTACS02	SOCC
46	I-M OATS 6	SOCC		92	SGTACS03	SOCC
47	I-M OATS 7	WCDA		93	SGTACS04	SOCC
48	I-M OATS 8	WCDA		94	SGTACS05	SOCC

NODE ID	ELEMENT NODE NAME	LOCATION		NODE ID	ELEMENT NODE NAME	LOCATION
49	I-M OATS 9	WCDA		95	CGTACS01	CDAS
50	I-M OATS 10	WBU		96	CGTACS02	CDAS
51	SMRSS01	SOCC		97	CGTACS03	CDAS
52	SMRSS02	SOCC		98	CGTACS04	CDAS
53	SMRSS03	SOCC		99	GGTACS01	WBU
54	SMRSS04	SOCC		100	BGTACS01	SWPC
55	SMRSS05	SOCC		101	FGTACS01	FCDAS

4. Number of data half-words: Number of 16-bit half-words in the data block of the current message.

5. Message type (number) and subtype (content): See Table 4-8.

6. Tracer: The tracer is a message-unique identifier included only with requests to GIMTACS/GTACS for telemetry and to the RPM for IMC quality checks data. This tracer is expected to be returned unaltered in the corresponding response message(s). The format of the tracer field is 10 ASCII characters beginning with a letter "T" and followed by nine numerals, i.e., Tnnnnnnnnn. One exception to this format is the message to terminate IMC quality check data, Message 42. For all other unsolicited incoming OATS messages, the tracer field should be all ASCII blanks.

7. Message count/end of message flag:

   In GIMTACS, while messages are sent using the TCP/IP protocol, the mechanism for receiving and sending messages was designed upon the X.25 protocol which limited packet size. Messages are broken into multiple pieces so as not to violate the packet size limitation, and reassembled by the receiver. Prior to going to the TCP/IP protocol, message count and the end of message flag allowed transmission of messages that exceeded the maximum allowable X.25 packet size, 1776 half-words of data plus 16 half-words of header. The message count, which ranges from 1 to 255, indicated the X.25 message number in the sequence. For example, if an application message required four X.25 messages to transmit an entire message, the packet count would range from one, for the first X.25 message, to four for the last. The end of message flag indicated the last packet in the sequence and is true when all bits, 8 – 15, are set to one. In all other X.25 packets in the sequence, the flag indicated a false condition by setting all bits to zero. If a message was within the X.25 message size limitation, the message count is set to one and the end of message flag is set.

   In GTACS, when used in combination, allows the receiver to handle messages which exceed the maximum allowable packet size (1776 half-words of data plus 16 half-words of header). The message count, which ranges from 1 to 255, indicates the message number in the sequence. For example, if an application message required four messages to transmit an entire message, the packet count would range from 1, for the first message, to 4 for the last. The end of message flag indicates the last packet in the sequence, and is true when all bits (bits 8–15) are set to one. In all other packets in the sequence, the flag indicates a false condition by setting all bits to zero. If a message is within the message size limitation, the message count is set to one and the end of message flag is set to true.

8. Routing ID:

   In GIMTACS, this is used for internal routing of solicited messages. The responder merely echoes the routing ID received in the request message. No unsolicited messages sent to GIMTACS require a specific routing ID; so in this case, the field is not used.

   In GTACS, the appropriate process controls the TCP/IP socket and receives the message directly from the external source; therefore, routing is not required. However, the Routing ID field is used internally by GOES N-P OATS.

Table 4-8. Communication Message List

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
1	Range Measurement	1 = Ground Path Delay 2 = Calib. Tower Delay 3 = Satellite Range	SPS	OATS	Unsol	2/day 4/year 2 or 4/ hour	22
2	Star Measurement	1 = Imager 2 = Sounder	SPS	GIM	Unsol	6/hour	296
				GTACS	Unsol	8-12 / hour	296
3	O&A Data Request	0	SPS	OATS	Unsol	As required	8
5	NLUT Data Request	1 = Imager 2 = Sounder	SPS	PM	Unsol	As required	8
6	CORT Data Request	1 = Imager	SPS	PM	Unsol	As required	8
10	SPS Health & Status	0	SPS	GIM, GTACS	Both	6/min	70
11	Wideband Telemetry	1 = Imager 2 = Sounder	SPS	GIM GTACS	Unsol	6/min	180
12	SPS Text Message	0	SPS	GIM	Unsol	As required	40
13	SXI Telemetry (GOES N-P)	AVS Telemetry 1 = AVS Telemetry 2 = AVS MSG Xmit Rate 3 = ADS Telemetry 4 = ADS MSG Xmit Rate	MRSS	GTACS	 Unsol Both Unsol Both	 60/min 6/min 60/min 6/min	 407 6 407 6
14	SXI Status (GOES N-P)	1	MRSS	GTACS	Sol	6/min As required	32
15	SXI Table Dump (GOES N-P)	APID(hex) Description 10 = Housekeeping 13 = Image Summary 14 = Data/Health Mon 15 = Sequence Data 20 = Observing Events 21 = Computer Events 31 = Memory Dump FE = PMC1 Telemetry FF = PMC2 Telemetry	MRSS	GTACS	Unsol	 15/min 1-6/min 1-6/min 1/min As required As required As required 58-59/min 58-59/min	 300 414 414 414 6 6 1776 262 262
16	SXI Error (GOES N-P)	SXI Data Msg Xmit Rate (for each subtype defined)	MRSS	GTACS	Both	6/min	6
20	Landmark Measurement	1 = Imager Visible 2 = Sounder Visible 3 = Imager IR	PM	OATS	Unsol	24/day 24/day As required	36
				N-OATS		10/hour/sc 10/hour/sc as required	
21	IMC Quality Check Response	1 = Imager 2 = Sounder	PM	OATS	Sol	1/day	834
				N-OATS		1+/request 1+/request	
22	IMC Qual Check Completion	0 = Success 1 = No Success 2 = Premature Completion 3 = Unable to fulfill	PM	OATS	Sol	2/day As required As required As required	4
				N-OATS		1/request	
23	PM Health & Status	0	PM	GIM GTACS	Unsol Sol	2/min As required	150
25	NLUT	1 = Imager 2 = Sounder	PM	SPS	Both	1/week	1040
26	Imager Co-registration Correction Message	1 = Imager	PM	SPS	Both	1/day	102

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
27	PM Text Message	0	PM	GIM	Unsol	As required	80
				GTACS			60
33	O&A Data Response	1 = Full Set 2 = New Orb Ref Set 3 = SSAA, Coupled Imager/Sounder 4 = SSAA, Uncoupled Imager/Sounder 5 = Post-SK Full Set 6 = SS O&A Adjust	OATS	SPS	Both	1/day As required As required As required 7/year As required	1230
		O&A Data Response: 1 = Full Set 2 = New Orbit Reference Set 3 = SSAA, Coupled Imager/Sounder 4 = SSAA, Uncoupled Imager/Sounder 5 = Post-SK Full Set 6 = Short Span Orbit & Attitude Adjust	N-OATS			1/IMC/sc As required As required As required As required As required	
41	IMC Quality Check Request	1 = Imager 2 = Sounder 3 = Both	OATS	PM	Unsol	1/day 1/day 2/year	6
			N-OATS			1/week 1/week 1/week	
42	Terminate IMC Qual Check	0	OATS	PM	Unsol	1/day	0
			N-OATS			As required	
45	OATS Inter-node Message	0	OATS	OATS	Unsol	As required	Var
51	Star View CMD Param Req	1 = Imager 2 = Sounder	OATS	GIM	Sol	6/day	Var
			N-OATS	GTACS		4/IMC 2/IMC	
53	IMC, SMC, or SCC Coefficient Data	1 = Full Set 2 = New Orbit Ref. Set 3 = SSAA, Coupled Imager/Sounder 4 = SSAA, Uncoupled Imager/Sounder 5 = Post-SK Full Set 6 = SSAA 101 = SMC Set 102 = SCC SET	OATS	GIM	Both	As required As required As required As required 7/day As required 1/day As required	1174 1174 1174 1174 1174 1174 Var 42
		IMC Coefficient Data: 1 = Full Set 2 = New Orbit Reference Set 3 = SSAA,Coupled Imager/Sounder 4 = SSAA, Uncoupled Imager/Sounder 5 = Post-SK Full Set 6 = Short Span Orbit & Attitude Adjust	N-OATS	GTACS	Sol	1/IMC/sc As required As required As required 7/year As required	1162

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
53-LUT	IMC, SMC, or SCC Coefficient Data LUT Format	1 = Full Set 2 = New Orbit Ref. Set 3 = SSAA, Coupled Imager/Sounder 4 = SSAA, Uncoupled Imager/Sounder 5 = Post-SK Full Set 6 = SSO&A Adjustment	OATS	GIM	Sol	As required	1072
54	OATS Status	1 = Response Requested 2 = Response	OATS N-OATS	GIM GTACS	Sol Unsol	As required 1/min	Var
55	Scan Frame Response	1 = Imager 2 = Sounder	OATS N-OATS	GIM GTACS	Sol	150/day 5/IMC/sc 5/IMC/sc	Var
56	SK CMD Parameters	1 = N-S Thruster 6/7 2 = E-W Thruster 2/3 3 = E-W Thruster 4/5	OATS	GIM	Unsol	1/year 3/year 3/year	Var
		SK CMD Data: 1 = NS Maneuver (N1/N4), or 2 = NS Maneuver (N2/N3) 3 = E-W Maneuver, Flushing, Open-loop (on-station) 4 = E-W Maneuver, Flushing (storage) 5 = N, Axial Thruster Flush (on-station) 6 = N, Axial Thruster Flush (storage) 7 = E-W Station Change, Closed-loop (on-station)	N-OATS	GTACS		1/year/sc 1/year/sc 3-4/year/sc 3-4/year/sc 2/year/sc 2/yr/sc As required	
57	Momentum Dump Command (GOES N-P)		N-OATS	GTACS	Unsol	1/day/sc	34
58	Trim Tab Command Params (GOES I-M)	0	OATS	GIM	Unsol	1/day/sc	12
59	Eclipse Predication Response	0	OATS N-OATS	GIM GTACS	Sol	1/day/sc	Var
60	Sensor Intrusion Response	0	OATS N-OATS	GIM GTACS	Sol	1/day/sc	Var
61	DIRA Drift Command (GOES I-M)	0	OATS	GIM	Unsol	7/year	6
62	IMC, SMC, or SCC Set Ready	1 = Normal Set 2 = Previous Set 101 = SMC Set 102 = SCC Set	OATS	GIM	Unsol	1+/day As required 1/day As required	14
		IMC Set Ready: 1 = Normal Set 2 = Post Housekeeping Set 3 = Eclipse Set 4 = Post Maneuver Set 5 = Post Yaw Flip Set 6 = Post Thruster Flushing Set 7 = Post Eclipse	N-OATS	GTACS	Both	1/day/sc 1/day/sc 1/day/sc (eclipse) 6/year/sc As required As required 1/day/sc (eclipse)	8

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
63	SSAA IMC Set Ready (GOES I-M)	3 = SSAA Coupled Imager/Sounder 4 = SSAA Uncoupled Imager/Sounder	OATS	GIM	Unsol	As required	42
66	DIRA Cal Data Request (GOES I-M)	1 = PID Request	OATS	GIM	Unsol	As required	Var
67	Trim Tab Data Request (GOES I-M)	1 = PID Request 2 = Thruster Data Req	OATS	GIM	Unsol	1/day	Var 8
70	Propulsion Subsys Data Req	1 = PID Request 2 = Thruster Data Req	OATS	GIM	Unsol	1/day	Var 8
		IMC Set Ready: 1 = Normal Set 2 = Post Housekeeping Set 3 = Eclipse Set 4 = Post Maneuver Set 5 = Post Yaw Flip Set 6 = Post Thruster Flushing Set 7 = Post Eclipse	N-OATS	GTACS	Both	1+/day/sc	
71	Star Window Request	1 = Normal Schedule 2 = Contingency Sched 3 = Normal Sched Return	OATS N-OATS	GIM GTACS	Unsol	As required	4
72	OATS Alarm Message	0	OATS N-OATS	GIM GTACS	Unsol	As required	40
73	Torque Table Updates (GOES N-P)		N-OATS	GTACS	Unsol	2/year/sc	76
75	IMC Scale Factor Calibration Schedule Response	1 = Imager 2 = Sounder	OATS	GIM	Sol	2/year/sc	Var
		IMCCAL Schedule Response: 1 = Imager 2 = Sounder	N-OATS	GTACS			
80	IMC Scale Factors	1 = Imager 2 = Sounder	OATS	GIM	Unsol	2/year/sc	4
81	MMC Scale Factors (GOES I-M)	0	OATS	GIM	Unsol	2/year/sc	18
		IMCCAL Scale Factors: 1 = Imager 2 = Sounder	N-OATS	GTACS			4
81	ISEC Scale Factors (GOES N-P)	IMCCAL Scale Factors: 1 = Imager 2 = Sounder	N-OATS	GTACS			4
82	OATS Response Error Text (GOES N-P)	Request Error Message	N-OATS	GTACS	Sol	As required	40
85	MMC Calibration Data Req (GOES I-M)	1 = PID Request	OATS	GIM	Unsol	2/year	Var
87	SMC Data Request (GOES I-M)	1 = PID Request	OATS	GIM	Unsol	As required	Var
88	Thermal Snap Data Request (GOES I-M)	1 = PID Request	OATS	GIM	Unsol	As required	Var

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
110	SPS Configuration Control	1 = Offline 2 = Online 3 = OPR 4 = Configuration 5 = IDLE 6 = Start 0&A 7 = Start Imager NLUT 8 = Start Sounder NLUT 9 = Start CORT	GIM GTACS	SPS	Unsol	As required	0 0 0 Var 0 8 8 8 8
111	SPS Status Request	0	GIM GTACS	SPS	Unsol	As required	0
112	GIMTACS/GTACS Text Message	0	GIM GTACS	SPS	Unsol	1/hour	Var
113	SXI Telemetry Data Rate Control	AVS Message Rate Cntrl 1 = AVS Rate 3 = ADS Rate	GTACS	MRSS	Unsol		2
114	SXI Status Request	MRS&S	GTACS	MRSS	Unsol	As required	0
115	SXI Table Dump Request	SXI Message Rate Control (for each subtype defined)	GTACS	MRSS		As required	2
123	PM Status Request	0	GIM GTACS	PM RPM	Unsol	As required	0
129	GTACS-RPM Text Message (GOES N-P)		GTACS	RPM	Unsol	As required	40
151	Star View CMD Param Req	1 = Imager 2 = Sounder	GIM GTACS	OATS N-OATS	Both Unsol	6/day 4/IMC/sc 2/IMC/sc	Var
153	IMC, SMC, or SCC Coefficient Request	1 = Normal Set 2 = Previous Set 101 = SMC Set 102 = SCC Set	GIM GTACS	OATS N-OATS	Unsol	1+/day As required As required As required 1/IMC/sc As required	8
154	OATS Health & Status Req	1 = Response Request 2 = Response	GIM GTACS	OATS N-OATS	Unsol	As required As required 1/min	Var 148
155	Scan Frame Request	1 = Imager 2 = Sounder	GIM GTACS	OATS N-OATS	Unsol	150/day 5/IMC/sc 5/IMC/sc	Var
159	Eclipse Prediction Request	0	GIM GTACS	OATS N-OATS	Unsol	1/day/sc	6
160	Sensor Intrusion Request	0	GIM GTACS	OATS N-OATS	Unsol	1/day/sc	6
162	IMC Set Request (GOES N-P)	1 = Normal Set 2 = Post Housekeeping Set 3 = Eclipse Set 4= Post Maneuver Set 5 = Post Yaw Flip Set 6 = Post Thruster Flushing Set 7 = Post Eclipse	GTACS	N-OATS	Unsol	1/day/sc 1/day/sc 1/day/sc (eclipse) 6/year/sc As required As required 1/day/sc (eclipse)	6

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
164	IMC, SMC, or SCC Set Enabled or Yaw Flip State	0 = IMC Set 101 = SMC Set 102 = SCC Set 103 = Yaw-Flip State	GIM GTACS	OATS N-OATS	Unsol	1+/day As required As required As required 1/IMC/sc	6
165	IMC/MMC Status Change	1 = Imager 2 = Sounder	GIM GTACS	OATS N-OATS	Unsol	As required 1/IMC/sc 1/IMC/sc	8
166	DIRA Data Response (GOES I-M)	7 = DIRA Data 8 = DIRA, DSS, & ES	GIM	OATS	Sol	7/year As required	Var
167	Trim Tab Data Response (GOES I-M)	1 = Tank Data 2 = Thruster Firing 4 = Trim Tab Position 5 = Mag Torquer 6 = Wheel Speeds 9 = Magnetometer	GIM	OATS	Sol	1/day	Var
168	Momentum Telemetry Responses (GOES N-P)		GTACS	N-OATS	Unsol	1/6 min/sc	118
170	Propulsion Data Response	1 = Tank Data 2 = Thruster Firing History 3 = SADA Data	GIM GTACS	OATS N-OATS	Sol	1/day 1+/request	Var
175	IMCCAL Scale Factor Calibration Schedule Request	1 = Imager 2 = Sounder	GIM GTACS	OATS N-OATS	Unsol	2/year/sc 2/year/sc	6
176	DIRA Data Completion (GOES I-M)	0 = Success 1 = Data Dropouts 2 = Premature Completion 3 = Unable to Fulfill 4 = Req Partially Filled	GIM	OATS	Sol	7/year As required As required As required As required	2
177	Trim Tab Data Completion (GOES I-M)	0 = Success 1 = Data Dropouts 2 = Premature Completion 3 = Unable to Fulfill 4 = Req Partially Filled	GIM	OATS	Sol	1/day As required As required As required As required	4
180	Propulsion Data Completion	0 = Success 1 = Data Dropouts 2 = Premature Completion 3 = Unable to Fulfill 4 = Req Partially Filled	GIM GTACS	OATS N-OATS	Sol	3/day As required As required As required As required 1/request	4
185	MMC Calibration Data Resp (GOES I-M)	6 = Wheel Speed 7 = DIRA Data	GIM	OATS	Sol	2/year	Var Var
187	SMC Data Response (GOES I-M)	10 = SMC Data	GIM	OATS	Sol	As required	Var
188	Thermal Snap Response (GOES I-M)	11 = Thermal Data	GIM	OATS	Sol	As required	Var
190	S/C Equipment Status (GOES I-M)	0	GIM	OATS	Unsol	As required	84
195	MMC Calibration Data Completion (GOES I-M)	0 = Success 1 = Data Dropouts 2 = Premature Completion 3 = Unable to Fulfill 4 = Req Partially Filled	GIM	OATS	Sol	4/year As required As required As required As required	2

Type	Message Description	Message Subtype	Comm Source	Dest	Mode	Nominal Freq.	No. of Half Words
197	SMC Data Completion (GOES I-M)	0 = Success 1 = Data Dropouts 2 = Premature Completion 3 = Unable to Fulfill 4 = Req Partially Filled	GIM	OATS	Sol	As required	2
198	Thermal Data Completion (GOES I-M)	0 = Success 1 = Data Dropouts 2 = Premature Completion 3 = Unable to Fulfill 4 = Req Partially Filled	GIM	OATS	Sol	As required	2
199	GTACS-OATS Text Message (GOES N-P)		GTAS	N-OATS	Unsol	As required	40
202	Labeled Star Measurement	1 = Imager Normal 2 = Sounder Normal 3 = Imager IMCCAL 4 = Sounder IMCCAL	GIM	OATS	Unsol	8/hour 6/hour As required As required	304
205	Single Chord Notification (GOES I-M)	1 = On 2 = Off	GIM	OATS	Unsol	As required	4
301	AGC Monitor Telemetry (GOES I-M)	0 = Rx Signal Strength	AGC	GIM	Unsol	12/Min	27

KEY TO ACRONYMS AND ABBREVIATIONS:
Freq. - Frequency IMC - Image Motion Compensation O&A - Orbit and Attitude SMC - Spacecraft Motion Compensation Sol - Solicited SSAA - Short Span Attitude Adjustment SCC - Single Chord Correction SSO&A - Short Span O&A Adjustment Unsol - Unsolicited Var - Variable

Notes:

1. An unsolicited message is defined as one without a precursor message, as a request. Unsolicited messages to GIMTACS/GTACS are sent to a generic host, while solicited messages are sent (returned) to the soliciting host. Internal routing of OATS, SPS, and PM solicited messages to GIMTACS/GTACS is handled by returning the routing ID in the response (see Figure 4-8).

2. The message lengths listed in the table are the maximum lengths of the message body in 16-bit half-words, excluding the 16-bit half-word header. Where the length is listed as Var, refer to the specific message description for the length. For some variable length messages, the message may be continued by using message header confirmation fields (see Section 4.3.2).

4.3.2.1 Message Store and Forward

Currently, SPSs and PMs store and forward messages in case of communication outages to the GIMTACS CCs, but GIMTACS, both the CCs and TCSs, does not have a store and forward capability. GOES Incident Report OPS-380E defines the store and forward capability described here. The GIMTACS CCs will perform a store and forward function on the messages shown in Table 4-9 when they cannot forward messages due to either a communication outage or a destination PM or SPS failure.

Table 4-9. GIMTACS to PM/SPS Store and Forward Messages

Origin	Destination	Type (Subtype)	Title	S&F Action
PM	OATS	20 (all)	Landmark Measurement	S&F all msgs
SPS	OATS	01 (all)	Range Measurement	S&F all msgs
SPS	TCS	02 (all)	Star Measurement	S&F all msgs
TCS	SPS	110 (6)	Start O&A	S&F last msg
TCS	SPS	110 (7)	Start Imager NLUT	S&F last msg
TCS	SPS	110 (8)	Start Sounder NLUT	S&F last msg
TCS	SPS	110 (9)	Start CORT	S&F last msg

GIMTACS TCSs will perform a store and forward function for the messages shown in Table 4-10 when they send OATS.

Table 4-10. GIMTACS to OATS Store and Forward Messages

Type (Subtype)	Title
164 (all)	IMC, SMC, or SCC Set Enabled
165 (all)	IMC Status Change
190 (all)	S/C Equipment Status
202 (all)	Labeled Star Message
205 (all)	Single Chord Notification

All store and forwarding is done First In First Out (FIFO) regardless of message type.

4.3.2.2 Coefficient Sets

Several Coefficient sets are generated by the OGE in support of INR. INR corrects for varying image motion over time caused by the orbital motion of the spacecraft and thermal effects on the spacecraft and its instruments. Corrections are determined on the ground by the OGE resulting in the coefficient sets that are then passed to GIMTACS/GTACS for uploading to the spacecraft's and Orbit Control Electronics (AOCE), which uses the coefficients to compensate for the effects of the disturbances.

4.3.2.2.1 IMC Set Identification

IMC, which is part of the original system design, corrects for the long-term thermal distortions of the spacecraft, Imager and Sounder instruments, and Earth Sensor, as well as spacecraft yaw and orbital deviations. Spacecraft range data (altitude) together with star and landmark observation data (angles) are used in the OGE OATS to determine spacecraft orbit and attitude. Using this information, OATS models long-term effects to compute IMC registration correction coefficients, which are passed to GIMTACS/GTACS for uploading to the spacecraft AOCE. The AOCE then computes an IMC analog signal that it applies to the Imager and Sounder drives to bias the mirrors in E-W and N-S directions, thus compensating for the effects of the disturbances.

A parent IMC set is generally effective during the entire image registration period. Due to various random natural phenomena or dynamic range limitations, the parent IMC set may be modified by small IMC subsets for varying subspans of the image registration period. The parent IMC set and its modifiers all have the same IMC epoch and all belong to a single IMC coefficients group.

The coefficient set is named *gnnn* where *g* is the group identification and *nnn* is the group sequence number. The group identification is an alphabetic character selected in order from A to Z, and the group sequence starts with 000 for the parent. For example, IMC identifiers G000 and J011 refer to the G group parent and the eleventh modifying set of the J group, respectively.

4.3.2.2.2 SMC Set Identification

In addition to the IMC signal sent to the Imager and Sounder, the on-board attitude and control processor has an alternate algorithm designed to correct for higher frequency spacecraft motion. The SMC was not part of the original design of the GOES spacecraft or the ground system, and was added as a reprogramming element for the GOES-8, 9, and 10 spacecraft. The GOES-11 and M spacecraft have the same logic incorporated into the onboard processors Programmable Read Only Memory (PROM). For all the spacecraft, the ground system has been modified to complement the spacecraft function by allowing for the collecting and processing of telemetry to derive coefficients for the uncompensated motion. Currently, the SMC is utilized to compensate for two attitude disturbance effects: 1) The periodic motion resulting from stray light striking the Earth sensors IR detectors, and 2) The thermal distortion of the spacecraft's solar sail. The Earth sensor-originated disturbance has been named the "bat-wing" effect, as its signature resembles a bat's wings. For both cases, the SMC coefficients are uploaded daily, during certain seasons of the year. The coefficient set is named *jjjx*, where *jjj* represents the Julian day and *x* denotes a Batwing effect with an 'A' or thermal snap with a 'B.'

4.3.2.2.3 SCC Set Identification

The GOES Earth sensor pointing is susceptible to thermal distortion within the sensor and external to the sensor (mounting). In addition, the Earth sensor's average chord length is very sensitive to the apparent Earth radius, which varies with orbital eccentricity. The combination of these error sources causes attitude errors, which can vary in magnitude dependent upon the time of day. When the Earth sensor is commanded to the single chord mode, these error sources are prevalent and have different characteristics than that of the normal sensor mode. The single chord mode is used at certain times when the Sun and/or Moon impinge on the Earth sensor scan FOV. During initial orbit checkout, these error sources are characterized as a Fourier series that is up-linked to the spacecraft. This feature is utilized through a reprogram patch algorithm to compensate for the errors while in single chord. The GOES-8, 9, and 10 spacecraft had the algorithm incorporated into reprogram and the GOES-11 and 12 spacecraft have the algorithm coded into the flight PROM. The SCC coefficients are generated and are up-linked to all spacecraft once each week. The coefficients are named *jjjC* where *jjj* identifies the Julian day of their creation.

4.3.3 SPS-Originated Messages

SPS originated messages are listed below in the order in which their detailed descriptions are provided in this section. Message Type and Subtype appear in the lower right hand corner of these pages to assist in easy identification of the pages describing a specific message.

Type	Description	Destination
1	Range Measurement	OATS
2	Star Measurement	GIMTACS/GTACS
3	O&A Data Request	OATS
5	NLUT Data Request	PM
6	CORT Data Request	PM
10	SPS Health & Status	GIMTACS/GTACS
11	Wideband Telemetry	GIMTACS/GTACS
12	SPS Text Message	GIMTACS/GTACS

Message 1 – Range Measurement (1 of 3)

The SPS performs ranging and sends range measurements to OATS, where the measurements are used in the O&A determination process. The range message provides OATS with a measurement of the one-way delay between the SPS and the spacecraft. Two calibration measurements are included in the message. The first is the ground path delay, which is the time delay associated with all of the ground equipment between the SPS and the receiving antenna. The second is the calibration tower delay, which is the time delay associated with the antenna feed and the spacecraft PDR transponder.

Each measurement consists of the antenna ID and supporting statistics, which include the number of samples, maximum and minimum range values, the RMS of the deviations, the standard deviation, the slope of the line, and the computed range. The Message 1 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
       MESSAGE SEQUENCE NO.        = 1-65535
       SATELLITE ID                = 8,9,10,11,12,13,14,15 (I-P)
       SOURCE                      = 20,21,22,23,24,25,26,27,28 (SPS)
       DESTINATION                 = 32 (ALL OATS)
       NO. OF HALF-WORDS           = 22
       MESSAGE TYPE                = 1
       MESSAGE SUBTYPE             = 1 GROUND PATH DELAY
                                   = 2 CALIBRATION TOWER DELAY
                                   = 3 SATELLITE RANGE
       TRACER                      = ASCII BLANKS
       MESSAGE COUNT               = 1
       END OF MESSAGE              = 255
       ROUTING ID                  = N/A


DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|_
      1  |                   YEAR                        | |
         |-----------------------------------------------| | CENTER
      2  |F|DAY OF YEAR                    |  HR (10s)   | | TIME OF
         |-----------------------------------------------| | RANGE
      3  |   HR (1s) |       MINUTES        |  SEC(10s)  | | MEASURE
         |-----------------------------------------------| | GROUP
      4  |   SEC(1s) |              MSECS                 | |
         |-----------------------------------------------|_
      5  |                  ANTENNA ID                   |
         |-----------------------------------------------|
      6  |              NUMBER OF SAMPLES                |
         |-----------------------------------------------|
      7  |              GROUND PATH DELAY                |
      8  |                                               |
         |-----------------------------------------------|
      9  |          CALIBRATION TOWER DELAY              |
     10  |                                               |
         |-----------------------------------------------|
     11  |                MAXIMUM VALUE                  |
     12  |                                               |
         |-----------------------------------------------|
     13  |                MINIMUM VALUE                  |
     14  |                                               |
         |-----------------------------------------------|
```

Message 1 – Range Measurement (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    15  |                RMS OF DEVIATIONS              |
    16  |                 FROM CURVE FIT                |
        |-----------------------------------------------|
    17  |               STANDARD DEVIATION              |
    18  |                 FROM CURVE FIT                |
        |-----------------------------------------------|
    19  |                 SLOPE OF LINE                 |
    20  |                 FROM CURVE FIT                |
        |-----------------------------------------------|
    21  |                 COMPUTED RANGE                |
    22  |                                               |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	1989-2025	YEAR
F (TIME CODE FLAG)	BINARY	0-LOCK 1-FLYWHEEL	N/A
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
ANTENNA ID	BINARY	1-8 (I-M)	N/A
	BINARY	1-10 (N-P) (See Notes)	N/A
NO. OF SAMPLES	BINARY	90-256	N/A
GROUND PATH DELAY	FLT.PT.	15000-20000	COUNTS
CALIB. TOWER DELAY	FLT.PT.	0.0-1000	COUNTS
MAX VALUE	FLT.PT.	1-7,500,000	COUNTS
MIN VALUE	FLT.PT.	1-7,500,000	COUNTS
RMS OF DEVIATIONS	FLT.PT.	0.0-100.0	COUNTS
STANDARD DEVIATION	FLT.PT.	0.0-100	COUNTS
SLOPE OF LINE	FLT.PT.	0.0-8340	DELTA COUNTS/SEC
COMPUTED RANGE	FLT.PT.	5,000,000-7,500,000	COUNTS

Notes:

1. All floating point values are in Gould single-precision format.

2. The Computed Range field contains ground path delay, calibration tower delay, or satellite range, as indicated by the message subtype. MIN, MAX, RMS, Standard Deviation, and Slope fields apply to the computed range.

3. Ground path delay contains the latest ground equipment delay measured by the SPS. If none is available, the field is null. When the ground path delay range measurement type is indicated, the ground path delay and computed range fields contain the same value.

4. Calibration tower delay contains the latest calibration tower measurement, which is the delay associated with the S/C transponder plus the antenna feed. If none is available, the field is null. When the calibration tower delay measurement type is indicated, the calibration tower delay and computed range fields contain the same value.

5. The satellite range is the latest one-way delay between the SPS and the S/C minus the sum of the latest ground path and calibration tower delays.

6. Each count is equal to 20 nanoseconds (ns).

Message 1 – Range Measurement (3 of 3)

7. Antenna IDs have a range from 1 to 10 as follows:

   GOES I-M:

   1 = 18 m/60 ft “A” antenna
   2 = 18 m/60 ft “B” antenna
   3 = 13 m/40 ft “C” antenna
   4 = 14 m/45 ft “G” tracking antenna
   5 = 16.4m/55 ft “J” antenna (hurricane rated)
   6 = 16.4m/55 ft “K” antenna (hurricane rated)
   7 = 16.4m/55 ft “L” antenna (hurricane rated) WBU
   8 = 21m/69ft antenna FCDA
   9 = unused

   GOES N-P:

   10 = unused

Message 2 – Star Measurement (1 of 3)

Star sense sequences occur an average of once every 30 minutes in groups of three or more on both the Imager and Sounder. The SPS extracts star sense data from the data stream, threshold-detects the data, and determines the center of peak amplitude time. The SPS then sends a star measurement message to GIMTACS/GTACS. The star measurement message contains instrument coordinates, duration, window threshold and mean value for detectors one through eight, number of detector one through eight events; and, four event records for each of the eight detectors. Each of the four event records contains the event mean value, duration of event, and the center time of the event. GIMTACS/GTACS adds the star ID and other star-view command data before forwarding the star measurement to OATS in a Message 202. The Message 2 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
       MESSAGE SEQUENCE NO.            = 1-65535
       SATELLITE ID                    = 8,9,10,11,12,13,14,15 (I-P)
       SOURCE                          = 20,21,22,23,24,25,26,27,28 (SPS)
       DESTINATION                     = 10 (GIMTACS)
                                       = 90-101 (GTACS)
       NO. OF HALF-WORDS               = 296
       MESSAGE TYPE                    = 2
       MESSAGE SUBTYPE                 = 1 (IMAGER) OR 2 (SOUNDER)
       TRACER                          = ASCII BLANKS
       MESSAGE COUNT                   = 1
       END OF MESSAGE                  = 255
       ROUTING ID                      = N/A
```

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|_
      1  |                   YEAR                        | |
         |-----------------------------------------------| |
      2  |F|DAY OF YEAR                    |  HR (10s)   | |  STAR
         |-----------------------------------------------| |  SENSE
      3  |   HR (1s) |       MINUTES       |  SEC(10s)   | |  START
         |-----------------------------------------------| |  TIME
      4  |   SEC(1s) |             MSECS                 | |
         |-----------------------------------------------|_
    5-6  |             STAR SENSE DURATION               |
         |-----------------------------------------------|
      7  |      NO. OF RAW PIXELS PER INPUT SAMPLE       |
         |-----------------------------------------------|
      8  |    NO. OF INPUT SAMPLES PER AVERAGED SAMPLE   |
         |-----------------------------------------------|_
      9  |                 E-W CYCLES                    | |
         |-----------------------------------------------| |
     10  |               E-W INCREMENTS                  | |  INSTR
         |-----------------------------------------------| |  COORDS
     11  |                 N-S CYCLES                    | |
         |-----------------------------------------------| |
     12  |               N-S INCREMENTS                  | |
         |-----------------------------------------------|_
     13  |   WINDOW THRESHOLD LEVEL FOR DETECTORS 1-8    |
      .  |                                               |
     20  |                                               |
         |-----------------------------------------------|
```

Message 2 – Star Measurement (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |---------------------------------------------|-
    21  |     DETECTOR MEAN VALUE FOR DETECTORS 1-8   |
     .  |                                             |
    28  |                                             |
        |---------------------------------------------|
    29  |        NO. OF EVENTS FOR DETECTORS 1-8      |
     .  |                                             |
    36  |                                             |
        |---------------------------------------------|
    37  |                   DATA LOSS                 |
        |---------------------------------------------|
    38  |                 YAW FLIP FLAG               |
        |---------------------------------------------|
  39-40 |                     SPARE                   |
        |---------------------------------------------|-
    41  |             EVENT MAXIMUM SIGNAL            | | EVENT
        |---------------------------------------------| | RECORD 1
    42  |             EVENT E-W SERVO ERROR           | |
        |---------------------------------------------| |
    43  |             EVENT N-S SERVO ERROR           | |
        |---------------------------------------------| |
    44  |        FULL WIDTH HALF MAXIMUM (FWHM)       | | DETECTOR
        |---------------------------------------------| | No.1
    45  |          CENTER TIME OF EVENT:  YEAR        | |
        |---------------------------------------------| |
    46  |F|         DAY OF YEAR            |  HR (10s) | |
        |---------------------------------------------| |
    47  |   HR (1s) |       MINUTES        |  SEC(10s) | |
        |---------------------------------------------| |
    48  |   SEC(1s) |             MSECS                 |
        |---------------------------------------------|-
    49  |       EVENT RECORDS 2-4 FOR DETECTOR 1      |
     .  |                                             |
    72  |                                             |
        |---------------------------------------------|
    73  |        EVENT RECORDS 1-4 FOR EACH OF        |
     .  |              DETECTORS 2-8                  |
   296  |                                             |
        |---------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	1989-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 - LOCK 1 - FLYWHEEL	N/A
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
STAR SENSE DURATION	BINARY	1000-64000	MSECS
RAW PIXELS/SAMPLE	BINARY	1-65535	N/A
SAMPLES/AVG SAMPLE	BINARY	1-65535	N/A
CYCLES	BINARY	0-128	CYCLES
INCREMENTS	BINARY	0-6135 (IMAGER) 0-2804 (SOUNDER)	INCREMENTS
WINDOW THRESHOLD	BINARY	0-65535 (IMAGER)	2^{-8} COUNTS
LEVEL		0-65535 (SOUNDER)	2^{-4} COUNTS
DETECTOR MEAN VALUE	BINARY	0-65535 (IMAGER) 0-65535 (SOUNDER)	2^{-8} COUNTS 2^{-4} COUNTS
NO. OF EVENTS	BINARY	0-4	N/A

Message 2 – Star Measurement (3 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
DATA LOSS	BINARY	= 0 - NO LOSS DETECTED	N/A
		= 65,535 (ALL ONES)	
		= -- LOSS DETECTED	
YAW FLIP FLAG	BINARY	= X '00' - NORMAL	N/A
		= X '3F' - FLIPPED	
EVENT MAXIMUM SIGNAL	BINARY	= 0-65535 (IMAGER)	2^{-6} COUNTS
		= 0-65535 (SOUNDER)	2^{-3} COUNTS
SERVO ERROR	BINARY	0-1023 (IMAGER)	COUNTS
		0-8191 (SOUNDER)	
FWHM	BINARY	0-65535	MSECS

Notes:

1. Minimum star sense duration, quantified in the validation range of the Data Block, is equal to the minimum star sense duration which can be executed by the instruments (1 second for the Imager, 4 seconds for the Sounder). The maximum star sense duration assumes the maximum number of star sense blocks are summed (1024 blocks); and, the SPS buffer allocated for the storage of these samples is filled (6400 samples).

2. Raw Imager pixels are averaged in SPS hardware before being passed to SPS software. The number of raw pixels included in each of the input samples is given by half-word 7.

3. The input samples provided by the hardware are subject to a moving window averaging filter by the SPS software. The number of input samples enclosed by the window is denoted by half-word eight. The values produced by the window averaging filter are the super pixels upon which the star detection algorithm operates.

4. For a given detector, records are time-ordered from earliest CDA time, record 1, to latest CDA time, record 4. If no data is available for an event record, the record content is null (binary 0).

5. E-W and N-S servo error data are the values received by the SPS at the time of each star crossing event.

6. Data loss indicates either an Imager or Sounder data block synchronization loss or parity error that occurred during star sense data ingest, and the loss makes the star sense data validity suspect.

7. The yaw-flip flag is set to 0 for a spacecraft in its normal upright orientation and hex 3F when it is rotated 180° about the yaw axis.

Message 3 – O&A Data Request

The SPS sends OATS a Message 3 to request new O&A parameters for a specific O&A set identifier. The Message 3 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
       MESSAGE SEQUENCE NO.                = 1-65535
       SATELLITE ID                        = 8,9,10,11,12,13,14,15 (I-P)
       SOURCE                              = 20,21,22,23,24,25,26,27,28 (SPS)
       DESTINATION                         = 32 (ALL OATS)
       NO. OF HALF-WORDS                   = 8
       MESSAGE TYPE                        = 3
       MESSAGE SUBTYPE                     = 0
       TRACER                              = ASCII BLANKS
       MESSAGE COUNT                       = 1
       END OF MESSAGE                      = 255
       ROUTING ID                          = N/A

DATA BLOCK LAYOUT:  N/A
      HALF-
      WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15
          |-------------------------------------------------------|
        1 |                O&A SET IDENTIFIER                     |
        2 |-------------------------------------------------------|
        3 |                                                       |
        . |                      SPARE                            |
        . |                                                       |
        8 |-------------------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
O&A SET IDENTIFIER	ASCII	0000,ANNN A = A-Z NNN = 000-999	N/A

Notes:

1. This message is used only when an SPS is initially brought on line, or when the SPS needs a set that it currently does not have. The IMC set identifier is identical to the IMC set identifier received from GIMTACS/GTACS in Message 110-6. If the IMC is set to all zeroes, OATS sends the set currently in use by the satellite.

2. Normally, O&A sets are sent by OATS as unsolicited Message 33s.

3. Refer to Section 4.3.2.2.1 for a description of the IMC identifier.

Message 5 – NLUT Data Request

The SPS uses Message 5 to inform the PMs that it needs a new NLUT. Message 5 contains only the NLUT set identifier of the requested table. Message 5 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 20,21,22,23,24,25,26,27,28 (SPS)
      DESTINATION                   = 33 (ALL PMs)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 5
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
    HALF-
    WORD NO. MSB                                          LSB
            0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
       1   |                  NLUT SET                     |
       .   |                 IDENTIFIER                    |
       4   |                                               |
           |-----------------------------------------------|
       5   |                                               |
       .   |                   SPARE                       |
       8   |                                               |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NLUT SET IDENTIFIER	ASCII	8-CHAR ASCII FREE-FORM TEXT	N/A

Notes:

1. This message is used only when an NLUT is initially brought on line, or when the SPS needs a set that it currently does not have. The NLUT set identifier is identical to the NLUT set identifiers received from GIMTACS/GTACS in Messages 110-7 and 110–8.

2. NLUTs are normally sent unsolicited by the PMs as Message 25s.

Message 6 – CORT Data Request

The SPS uses Message 6 to notify the PM that it needs a new Co-registration Table (CORT). Message 6 contains only the CORT identifier for the requested set of correction factors. The Message 6 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 20,21,22,23,24,25,26,27,28 (SPS)
      DESTINATION                   = 33 (ALL PMs)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 6
      MESSAGE SUBTYPE               = 1 - IMAGER
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
    HALF-
    WORD NO. MSB                                        LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |---------------------------------------------|
      1  |                  CORT SET                   |
      .  |                 IDENTIFIER                  |
      2  |---------------------------------------------|
      3  |                                             |
      .  |                   SPARE                     |
      8  |---------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
CORT SET IDENTIFIER	ASCII	8-CHAR ASCII	N/A

Notes:

1. This message is used only when a CORT is initially brought on-line, or when the SPS needs a set that it currently does not have. The CORT set identifier is identical to the CORT set identifiers received from the GIMTACS/GTACS in Message 110-9.

2. The PMs normally send CORTs to the SPSs as unsolicited Message 26s.

Message 10 – SPS Health and Status (1 of 5)

The SPS sends GIMTACS and GTACS a Message 10 every 10 seconds. SPS also sends the status message in response to a GIMTACS/GTACS status request when in OPR or IDLE mode. The Message 10 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 20,21,22,23,24,25,26,27,28 (SPS)
      DESTINATION                   = 10 (GIMTACS, GTACS)
      NO. OF HALF-WORDS             = 70
      MESSAGE TYPE                  = 10
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = RETURN ID RECEIVED WITH STATUS REQUEST
                                      (MESSAGE 111)

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |                     YEAR                      |
         |-----------------------------------------------|
      2  |F|DAY OF YEAR                    | HR (10s)    |
         |-----------------------------------------------|
      3  |  HR (1s)  |       MINUTES       | SEC(10s)    |
         |-----------------------------------------------|
      4  |  SEC(1s)  |             MSECS                 |
         |-----------------------------------------------|
      5  |                 SPS STATUS                    |
         |-----------------------------------------------|
      6  | ULI INPUT CHANNEL    |  KERNEL ID      |RC|RS|
         |-----------------------------------------------|
      7  |                  ANTENNA ID                   |
         |-----------------------------------------------|
    8&9  |           CURRENT COMMANDED IMC ID            |
         |-----------------------------------------------|
     10  |         MESSAGE 11 INTERVAL - IMAGER          |
         |-----------------------------------------------|
     11  |         MESSAGE 11 INTERVAL - SOUNDER         |
         |-----------------------------------------------|
     12  |           CURRENT (IN USE) IMAGER             |
      .  |               NLUT IDENTIFIER                 |
     15  |                                               |
         |-----------------------------------------------|
```

Message 10 – SPS Health and Status (2 of 5)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 LSB 15	
16 17	INSTRUMENT STATUS	IMAGER
18	E-W CYCLES	
19	E-W INCREMENTS	
20	N-S CYCLES	
21	N-S INCREMENTS	
22	SCAN LINE NUMBER	
23	SCAN PIXEL NUMBER	
24	BIAS CALIBRATION MODE | SDI INPUT CHANNEL	
25 26	BIT ERROR RATE	
27	SYNC LOSS COUNT	
28 . 35	DETECTOR SUBSTITUTION ARRAY	
36&37	CURRENT IMC ID IN USE	
38 39	CORT ID	
40	CURRENT E-W CORT VALUE	
41	CURRENT N-S CORT VALUE	
42	SCAN CLAMP LIMB CLIPPING BOUNDARY	
43	GAIN 1 CAL MODE | GAIN 2 CAL MODE	
44 45 46	INSTR STATUS	SOUNDER
47	E-W INCREMENTS	
48	N-S CYCLES	
49	N-S INCREMENTS	
50	SCAN LINE NUMBER	
51	SCAN PIXEL NUMBER	
52	BIAS CALIBRATION MODE | SDI INPUT CHANNEL	
53 54	BIT ERROR RATE	
55	SYNC LOSS COUNT	
56&57	CURRENT IMC ID IN USE	
58	GAIN 1 CAL MODE | GAIN 2 CAL MODE	

Message 10 – SPS Health and Status (3 of 5)

```
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
     59  |            CURRENT (IN USE) SOUNDER           |
      .  |                NLUT IDENTIFIER                |
     62  |                                               |
         |-----------------------------------------------|
     63  |                 INACTIVE IMAGER               |
      .  |                 NLUT IDENTIFIER               |
     66  |                                               |
         |-----------------------------------------------|
     67  |                INACTIVE SOUNDER               |
      .  |                 NLUT IDENTIFIER               |
     70  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	1989-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 - LOCK	N/A
		1 - FLYWHEEL	
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
SPS STATUS	BINARY	(SEE NOTES)	N/A
ULI CHANNEL	BINARY	1-3	N/A
KERNEL ID	BINARY	0-63	N/A
RESAMPLING COMMANDED	BINARY	0 – Not Active	N/A
		1 – Active	N/A
RESAMPLING ACTIVE	BINARY	0 – Not Active	N/A
		1 – Active	N/A
ANTENNA ID	BINARY	1-8 (I-M)	N/A
	BINARY	1-10 (N-P)	N/A
		(See Notes)	
CURR. CMD IMC ID	ASCII	(SEE NOTES)	N/A
MESSAGE 11 INTERVAL	BINARY	1-10	SECS
INSTRUMENT STATUS	BINARY	(SEE NOTES)	N/A
CYCLES	BINARY	0-128	CYCLES
INCREMENTS	BINARY	0-6135 (IMAGER)	INCREMENTS
		0-2804 (SOUNDER)	
VISIBLE SCAN LINE NO.	BINARY	1-15787(IMAGER)	LINES
		1-1582 (SOUNDER)	
SCAN PIXEL NO.	BINARY	1-30680(IMAGER)	PIXELS
		1-1758 (SOUNDER)	
BIAS CALIBRATION MODE	BINARY	1 (IMAGER)	N/A
		1-2 (SOUNDER)	N/A
SDI INPUT CHANNEL	BINARY	1-4	N/A
BIT ERROR RATE	FLTPT	0-1 (SEE NOTES)	N/A
SYNC LOSS COUNT	BINARY	0-10 (SEE NOTES)	N/A
DETECTOR SUB ARRAY	BINARY	(SEE NOTES)	N/A
CORT ID	ASCII	(SEE NOTES FOR IMC ID)	N/A
CURR. E-W CORT VALUE	BINARY	-64 TO +64	PIXELS
CURR. N-S CORT VALUE	BINARY	-8 TO +8	PIXELS
SCAN CLAMP LIMB			
CLIPPING BOUNDARY	BINARY	0 TO 30	0.1 DEGREES
GAIN 1 CAL MODE	BINARY	1-7	N/A
GAIN 2 CAL MODE	BINARY	1-3	N/A
NLUT IDENTIFICATION	ASCII	NONE (SEE NOTES)	N/A

Message 10 – SPS Health and Status (4 of 5)

Notes:

1. SPS status bits are as follows:

Bit	Value	Meaning
0	1	SPS operate
1	1	SPS idle
2	1	SPS configuration
3	1	Auto-range
4	1	SPS range calibration
5	1	SPS start
6	1	SPS error
7	1	GIMTACS/GTACS on-line
	0	GIMTACS/GTACS off-line
8	1	Yaw-flip processing enabled
	0	Yaw-flip processing disabled
9–15		Unassigned

2. Instrument status bits are as follows:

Bit	Meaning – If Set
0	Spacelook in progress
1	ECAL in progress (N/A for Imager)
2	BB-Cal in progress
3	Normal frame active
4	Priority 1 frame active
5	Priority 2 frame active
6	Scan direction E-W, else W-E
7	Scan direction S-N, else N-S
8	IMC active, else inactive
9	Dwell mode = 4 (Sounder only)
	Clamp mode = 9.2 Space (Imager only)
10	Dwell mode = 2 (Sounder only)
	Clamp mode = 36.6 Space (Imager only)
11	Dwell mode = 1 (Sounder only)
	Clamp mode = scan clamp (Imager only)
12	N-S step mode = double (Sounder only)
	Co-registration enabled, else disabled (Imager only)
13	Side 2 active, else side 1
14	Star sense in progress
15	E-W correction enabled, else disabled
16	Relativization enabled, else disabled
17–25	Unassigned

Bit	Meaning - If Set
26	Operational mode = routine
27	Operational mode = rapid
28	Operational mode = super rapid
29	In sync, else sync loss condition
30	Visible normalization enabled, else disabled
31	IR calibration enabled, else disabled

Message 10 – SPS Health and Status (5 of 5)

3. For GOES I-N, the 16 bytes set aside for Imager detector substitutions correspond to eight visible detectors, seven IR detectors, and one spare byte. For GOES-O and beyond, the 16 bytes set aside for Imager detector substitutions correspond to eight visible detectors and eight IR detectors. Each byte contains a detector number indicating which detector is the data source for the corresponding substituted detector, or zero if no substitution is currently active for the corresponding detector. Substitutions are only made within a channel. For example, detector substitution byte 9 containing a value of 10 substitutes IR channel 2 detector 2 for IR channel 2 detector 1.

   The bytes and detector numbers are assigned as follows:

Byte or Detector No.	Detector	S/C 12 -13
1–8	Visible 1–8	Visible 1–8
9	IR channel 2, Detector 1	IR channel 2, Detector 1
10	IR channel 2, Detector 2	IR channel 2, Detector 2
11	IR channel 3	IR channel 3, Detector 1
12	IR channel 4, Detector 1	IR channel 3, Detector 2
13	IR channel 4, Detector 2	IR channel 4, Detector 1
14	IR channel 5, Detector 1	IR channel 4, Detector 2
15	IR channel 5, Detector 2	IR channel 6, Detector 1
16	Spare–not used	Spare–not used

Byte or Detector No.	S/C 14 and beyond
1–8	Visible 1–8
9	IR channel 2, Detector 1
10	IR channel 2, Detector 2
11	IR channel 3, Detector 1
12	IR channel 3, Detector 2
13	IR channel 4, Detector 1
14	IR channel 4, Detector 2
15	IR channel 6, Detector 1
16	IR channel 6, Detector 2

4. IMC ID Validation – first four characters are ASCII; first character (A through Z); next three (000–999).
5. The currently commanded IMC ID, if not already in use, is implemented at the start of the next Imager or Sounder frame. The current IMC ID in use for the Imager or Sounder remains in use for the duration of the current Imager or Sounder frame.
6. BER (Bit Error Rate) is nominally computed over 500 Sounder turnaround blocks and five Imager turnaround sequences.
7. Sync loss count is accumulated since the last status report, nominally 10 seconds.
8. The SPS has two NLUTs in memory for each instrument. One is the current NLUT in use and, the other is referred to as the inactive NLUT. The NLUT assignments change under the following conditions:
   a. Whenever the RPM sends an NLUT to the SPS, the received NLUT is placed in the inactive slot.
   b. When the SPS command USE NLUT is issued, the current and inactive NLUT's are switched.
   c. When GIMTACS/GTACS commands the SPS to start an inactive NLUT, the SPS switches the current and inactive NLUT assignments.
   d. When GIMTACS/GTACS commands the SPS to start an NLUT that is not the inactive NLUT, the SPS requests the commanded NLUT from the RPM. When the SPS receives the NLUT, it places it into the inactive slot and then switches the current and inactive NLUT assignments.
9. Resampling Active/Inactive should be primarily controlled by the SPS operator regardless of GIMTACS being OFFLINE / ONLINE. A Kernel suite is a complete set of kernels for all channels. Each suite will be identified by a unique ID. The suite ID will also be inserted in the GVAR and serve as the index into the database for the GSU to obtain the proper kernel tables.

Message 11 – Wideband Telemetry (1 of 6)

The SPS sends GIMTACS/GTACS selected wideband telemetry data extracted from the Imager and Sounder data streams every 2 to 10 seconds, as long as valid telemetry is being processed in the SPS. The Message 11 interval is controlled by the SPS operator or by the SPS configuration command in Message 110-4. The telemetry message contains the latest values extracted from the Imager turnaround sequence telemetry blocks and the Sounder data block. Table 4-11 and Table 4-12 contain the Imager and Sounder telemetry lists, respectively. The ordering of the telemetry data points in the tables matches that of the wideband data formats. The Message 11 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 20,21,22,23,24,25,26,27,28(SPS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = 180
      MESSAGE TYPE                  = 11
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |---------------------------------------------|
      1  |                     YEAR                    |
         |---------------------------------------------|
      2  |F|DAY OF YEAR                    |  HR (10s) |
         |---------------------------------------------|
      3  |   HR (1s) |       MINUTES        |  SEC(10s) |
         |---------------------------------------------|
      4  |   SEC(1s) |             MSECS                |
         |---------------------------------------------|
      5  |               IMAGER OR SOUNDER             |
      .  |                  TELEMETRY                  |
    180  |                                             |
         |---------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	1989-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 - LOCK 1 - FLYWHEEL	N/A
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
TELEMETRY	BINARY	(SEE NOTES)	(SEE NOTES)

Message 11 – Wideband Telemetry (2 of 6)

Notes:

1. Imager telemetry and command echo data is in exactly the same format and units as received in the downlinked data stream. Listed in Table 4-11, these data items are each 10 bits wide, right-adjusted, and zero-filled within the 16-bit, half-word format of the message. The format and content of these words are specified in reference document SJ-572022.

2. The command echo data included in the Imager message, half-words 83 – 126, are extracted from the first four telemetry data blocks following a trailer data block in a turnaround sequence as follows:

   Data words:

83–93:	Command Echo Register 1
94–104:	Command Echo Register 2
105–115:	Command Echo Register 3
116–126:	Command Echo Register 4

3. Sounder telemetry data items are listed in Table 4-12. Each of these entries is 13-bits wide, right-adjusted, and zero-filled within the 16-bit, half-word size of the message. The most significant bit of each data half-word in the message is a good or bad parity indicator. If the bit is set to one, the parity of the originating raw data word was bad, and the value should be ignored. The most significant bit of the 13 data bits in each message half-word is the sign bit of the originating raw data block half-word. This bit only has meaning for the analog parameters reported in the message. The nature and content of each raw data word is defined in reference document SJ-572022.

4. The command echo data included in the Sounder telemetry message list, half-words 135 – 178, are extracted from the four most recent Sounder data blocks received by the SPS for which the raw data word parity was marked as valid. Note that the Sounder command echo words are packed by the instrument into the scan control words (15-25) of the raw Sounder data block. The format of these words is provided in Figure 3-8 of reference document SJ-572022. The SPS tracks the command echo words received and packs them into the message as follows:

   Data half-words:

135–145:	Command Echo Register 1
146–156:	Command Echo Register 2
157–167:	Command Echo Register 3
168–178:	Command Echo Register 4

Message 11 – Wideband Telemetry (3 of 6)

Table 4-11. Imager Telemetry List

Half Word Number	Description
5	E-W scan servo error
6	N-S scan servo error
7	E-W scan compensation
8	N-S scan compensation
9	Servo +25V
10	E-W scan servo current
11	Electronic +8V3
12	TLM -8V
13	Electronics temperature No. 1
14	Visible optics temperature
15–18	BB target temperature No. 1 – No. 4
19–20	Sensor assembly baseplate temperature No. 2, No. 5
21	Instrument current
22	Electronic side -17V
23	Electronic side +17V
24	N-S scan servo current
25	Servo side -8V
26	Servo side +8V
27	TLM side +11V
28	TLM side +17V
29	Telescope primary temperature
30	Louver radiator temperature
31–34	BB target temperature No. 5 – No. 8
35–36	Sensor assy baseplate temperature No. 1, No. 4
37	Electronics temperature No. 2
38	Telescope secondary temperature No. 1
39	Power supply temperature
40	Scan mirror temperature
41	Servo side -25V
42	Electronic side +8V2
43–44	Sensor assembly baseplate temperature No. 3, No. 6
45–53	Ref voltage +10V No. 1 – No. 9
54	Wide range IR detector temperature
55	Narrow range IR detector temperature
56	Cooler housing temperature
57	Cooler radiator temperature
58–63	Thermal baseplate control current No. 1 – No. 6
64	Signal ground
65	Heater bus voltage
66	Patch control voltage
67	TLM common +40V
68	Electronic cal voltage
69	Electronic side +8V1
70	Electronic side +12V
71	Servo side +7V1
72	Servo side +7V2

Message 11 – Wideband Telemetry (4 of 6)

Half Word Number	Description
73	Electronic side -8V
74–76	Spares – not used
77	Telescope secondary temperature No. 2
78	Primary baffle temperature No. 1
79	Primary baffle temperature No. 2
80	Spare temperature No. 4
81–82	Bi-level telemetry, half-word No. 1 and No. 2
83–126	Command echo
127	*E-W cycles
128	*E-W increments
129	*N-S cycles
130	*N-S increments
131–180	Spares – not used

Notes:

* Instrument positions, cycles or increments, are not included in wideband telemetry. The values in half-words 127 through 130 are those reported in the trailer data block preceding the wideband telemetry data blocks.

Table 4-12. Sounder Telemetry List

Half Word Number	Description
5	E-W scan servo current No. 1
6-7	Command status and bi-level telemetry
8	Instrument ID, flywheel sync
9	E-W scan position (high byte)
10	E-W scan position (low byte)
11	N-S scan position (high byte)
12	N-S scan position (low byte)
13	Time since previous spacelook
14	Time since previous BB-Cal
15-25	Spares – not used
26-29	E-W scan servo error No. 1 – No. 4
30	Spare – not used
31	N-S scan servo current
32-33	Thermal Control current No. 1 and No. 2
34-35	Filter wheel motor current No. 1 and No. 2
36	Instrument current
37	E-W scan servo error No. 5
38	Filter wheel period monitor
39	Electronic side +17V1
40	Electronic side +8V1

Message 11 – Wideband Telemetry (5 of 6)

Half Word Number	Description
41	Electronic side +8V2
42	Electronic side -17V
43	Electronic side -8V
44	Electronic side +12V
45	Electronic side +8V3
46	Filter wheel +18V No. 1
47	Filter wheel +18V No. 2
48	E-W scan servo error No. 6
49	Servo side +25V
50	Servo side +7V1
51	Servo side +7V2
52	Servo side +8V
53	Servo side -25V
54	Servo side -8V
55	TLM side +11V
56-57	Spares – not used
58	TLM side +17V
59	TLM common +40V
60	TLM side -8V
61-62	Spares – not used
63	Signal ground
64	Heater bus voltage
65	Visible optics temperature
66-71	BB target temperature No. 1 – No. 6
72	Spare – not used
73	E-W scan servo error No. 7
74-75	BB target temperature No. 7 – No. 8
76	Cooler housing temperature
77	Cooler radiator temperature
78-79	Electronics temperature No. 1 – No. 2
80	Filter wheel housing temperature
81	Filter wheel motor temperature
82	E-W scan servo current No. 2
83	Spare – not used
84	Filter wheel radiator temperature
85	Louver radiator temperature
86	Narrow range IR detector temperature

Message 11 – Wideband Telemetry (6 of 6)

Half Word Number	Description
87	Power supply temperature
88	Scan mirror temperature
89	Sensor assembly baseplate temperature No. 1
90-92	Spares – not used
93–95	Sensor assembly baseplate temperature No. 2 – No. 4
96	Spare – not used
97	E-W scan servo error No. 8
98–99	Sensor assembly baseplate No. 5 – No. 6
100	Telescope primary temperature
101	Telescope secondary temperature No. 1
102	Wide-range IR detector temperature
103	E-W scan compensation
104	Blank
105	Electronic cal voltage No. 1
106	Filter wheel control HTR voltage
107	N-S scan compensation
108	N-S scan servo error
109	Patch control voltage
110	Reference voltage +10V No. 1
111	Thermal control current No. 3
112	Thermal control current No. 4
113	Thermal control current No. 5
114	Thermal control current No. 6
115–116	Spares – not used
117	Telescope secondary temperature No. 2
118	Primary baffle temperature No. 1
119	Primary baffle temperature No. 2
120–123	Spares – not used
124–134	Attitude & Orbit Control Subsystem Electronics (AOCE) words No. 1 – No. 11
135–145	Command echo 1
146–156	Command echo 2
157–167	Command echo 3
168–178	Command echo 4
179–180	Spares – not used

Message 12 – SPS Text or Alarm Message

The SPS transmits messages to the GIMTACS operator not more often than once per second. Possible messages include responses to GIMTACS commands and data transmission errors or information concerning O&A sets. A text message consists of 51 ASCII characters, including a two-character alarm code. The Message 12 data block layout and specific character formats follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12(I-M)
      SOURCE                        = 20,21,22,23,24,25,26,27,28(SPS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 40
      MESSAGE TYPE                  = 12
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
  HALF-
  WORD NO. MSB                                                  LSB
           | 0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15 |
           |-------------------------------------------------------|
     1     |                                                       |
     .     |                    TEXT MESSAGE                       |
    40     |                                                       |
           |-------------------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TEXT MESSAGE	ASCII	N/A	N/A

```
TEXT MESSAGE FORMAT
1. Time (characters 1 through 15) formatted as
   DDD Sp  HH:MM:SS Sp Sp Sp (Sp = space or blank)

2. Test and alarm status field (character 16-66) defined as
   !  = normal status (character 16)
   !! = alarm status (character 17)
   In absence of an alarm, text starts from character 17.

3. Current scan and error code fields (characters 67-78) formatted as
   SCAN/AAA### where:
   SCAN  =  the current scan number (4 characters wide).  If the scan field is
            not included, spaces are substituted.
   AAA### = error code number.  The first three should identify the process from
            which the message originates, and the last three are, by convention,
            digits.  Example: SDX336
```

Notes:

Eight-bit ASCII character pairs are formatted into half-words by placing the first character in the MSB, bits 0 – 7, and the second character in the LSB, bits 8 – 15.

4.3.4 MRS&S-Originated Messages

MRS&S originated messages are listed below in the order in which their detailed descriptions are provided in this section. Message Type and Subtype appear in the lower right hand corner of these pages to assist in easy identification of the pages describing a specific message.

Type	Description	Destination
13-1	AVS Telemetry	GTACS
13-2	AVS Telemetry Status	GTACS
13-3	ADS Telemetry	GTACS
13-4	ADS Telemetry Status	GTACS
14-1	MRSS Status	GTACS
15-10	SXI Housekeeping	GTACS
15-13	SXI Image Summary	GTACS
15-20	SXI Observing Events	GTACS
15-21	SXI Computer Events	GTACS
15-31	SXI Memory Dump	GTACS
15-FE	PCM1 Telemetry	GTACS
15-FF	PCM2 Telemetry	GTACS
16-10	SXI Housekeeping (non-critical)	GTACS
16-13	SXI Image Summary (non-critical)	GTACS
16-20	SXI Observing Events (non-critical)	GTACS
16-21	SXI Computer Events (non-critical)	GTACS
16-31	SXI Memory Dump (non-critical)	GTACS
16-FE	PCM1 Telemetry (non-critical)	GTACS
16-FF	PCM2 Telemetry (non-critical)	GTACS

Message 13-1 & -3 – AVS/ADS Telemetry (GOES N-P Only) (1 of 2)

MRS&S uses message Type 13, Subtype 1 to pass AVS Telemetry and Subtype 2 to pass AVS Telemetry status. MRS&S uses message Type 13, Subtype 3 to pass ADS Telemetry and Subtype 4 to pass ADS Telemetry status. The latest received values of AVS or ADS telemetry are sent to GTACS at a rate commanded by GTACS using Message 113 of between six and sixty messages per minute. The status messages are sent to GTACS at a rate of six messages per minute. The following pages contain a description of Message 13's block layout and field definitions.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE #            = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 51 - 65 (MRS&S)
      DESTINATION                   = 10 (All GTACS)
      # OF DATA HALF-WORDS          = 811
      DATA TYPE                     = 13
      DATA SUBTYPE                  = 1 (AVS TELEMETRY)
                                    = 3 (ADS TELEMETRY)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1-12
      END OF MESSAGE                = 0 for 1-11
                                    = 255 for 12
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2	F	DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	ZERO FILL									Ms	Us	Qs	Mi	Ui	Qi	D
6	FILL			U	SXI AVS/ADS X-AXIS DATA SAMPLE 001											
7	FILL			U	SXI AVS/ADS Y-AXIS DATA SAMPLE 001											
8	FILL			U	SXI AVS/ADS Z-AXIS DATA SAMPLE 001											
9	FILL			U	IMAGER AVS/ADS X-AXIS DATA SAMPLE 001											
10	FILL			U	IMAGER AVS/ADS Y-AXIS DATA SAMPLE 001											
11	FILL			U	IMAGER AVS/ADS Z-AXIS DATA SAMPLE 001											
:	:															
805	FILL			U	SXI AVS/ADS X-AXIS DATA SAMPLE 134											
806	FILL			U	SXI AVS/ADS Y-AXIS DATA SAMPLE 134											

Message 13-1 & -3 – AVS/ADS Telemetry (GOES N-P Only) (2 of 2)

HALF-WORD NO.	MSB 0 1 2 3	4 5 6 7	8 9 10 11	12 13 14 LSB 15
807	FILL	U	SXI AVS/ADS Z-AXIS DATA SAMPLE 134	
808	FILL	U	IMAGER AVS/ADS X-AXIS DATA SAMPLE 134	
809	FILL	U	IMAGER AVS/ADS Y-AXIS DATA SAMPLE 134	
810	FILL	U	IMAGER AVS/ADS Z-AXIS DATA SAMPLE 134	
811	SPARE			

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	2000-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 = LOCK 1 = FLYWHEEL	N/A
DOY (DAY OF YEAR)	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MIN	BCD	0-59	MINUTES
SEC	BCD	0-59	SECONDS
MSEC	BCD	0-999	MSECS
ZERO FILL	BINARY	000000000	N/A
Ms (SXI MODE FLAG)	BINARY	0 = LO RANGE 1 = HI RANGE	N/A
Us (SXI MODE UPDATE)	BINARY	0 = NO UPDATE 1 = UPDATE	N/A
Qs (SXI MODE QUALITY)	BINARY	0 = CHKSUM BAD 1 = CHKSUM OKAY	N/A
Mi (IMAGER MODE FLAG)	BINARY	0 = LO RANGE 1 = HI RANGE	N/A
Ui (IMGR MODE UPDATE)	BINARY	0 = NO UPDATE 1 = UPDATE	N/A
Qi (IMGR MODE QUALITY)	BINARY	0 = CHKSUM BAD 1 = CHKSUM OKAY	N/A
D (DATA FLAG)	BINARY	0 = NO DATA 1 = DATA	N/A
FILL	BINARY	000	N/A
U (SAMPLE UPDATE FLAG)	BINARY	0 = NO UPDATE 1 = UPDATE	N/A
AVS/ADS SAMPLES	12 BITS	0 - 4095	AVS: raw angular rate counts. ADS: integrated angle. Scale depends on value of Mi or Ms
SPARE	I*2	0	N/A

Notes:

The time tag for this message reflects the time for the first group of AVS or ADS samples in the message (the six axial samples). All subsequent samples in the message have time tags found as follows:

sample time tag = message time tag + (sample – 1)*1.25 msec

If the update flag is not set for a sample, then it has not been updated since the last message was sent, so its time tag should not be updated (i.e., the message data for that sample is stale). Stale data within a message may result from loss of frame sync on the input MDL stream, leaving gaps in the updated AVS or ADS samples.

Message 13-2 & -4 – AVS/ADS Telemetry Status (GOES N-P Only)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE #            = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 51 - 65 (MRS&S)
      DESTINATION                   = 10 (All GTACS)
      # OF DATA HALF-WORDS          = 6
      DATA TYPE                     = 13
      DATA SUBTYPE                  = 2 (AVS TELEMETRY STATUS)
      DATA SUBTYPE                  = 4 (ADS TELEMETRY STATUS)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2	F	DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	AVS/ADS TELEMETRY MESSAGE INTERVAL															
6	SPARE															

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	2000-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 = LOCK 1 = FLYWHEEL	N/A
DOY (DAY OF YEAR)	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MIN	BCD	0-59	MINUTE
SEC	BCD	0-59	SECOND
MSEC	BCD	0-999	MSEC
AVS/ADS MSG INTERVAL	I*2	0 - 10	SECONDS
SPARE	I*2	0	N/A

Notes:

AVS/ADS Telemetry Message Interval indicates the currently selected time between issuing AVS or ADS Telemetry Messages (Type 13/1 and 13/3).

Message 14-1 – MRS&S Status (GOES N-P Only) (1 of 4)

MRS&S Status is provided in Message 14, Subtype 1. The status message is sent to GTACS periodically and in response to a Status Request Message (Message 114). The following contains a description of Message 14's block layout and field definitions.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE #            = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 51 - 65 (MRS&S)
      DESTINATION                   = 10 (All GTACS)
      # OF DATA HALF-WORDS          = 32
      DATA TYPE                     = 14
      DATA SUBTYPE                  = 1 (MRS&S STATUS)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A
```

Message 14-1 – MRS&S Status (GOES N-P Only) (2 of 4)

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2	F	DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	BIT ERROR RATE (MSH)															
6	BIT ERROR RATE (LSH)															
7	MDL CLOCK LOSS COUNT															
8	MDL DATA LOSS COUNT															
9	MDL SYNC LOSS COUNT															
10	NT2209 CLOCK LOSS COUNT															
11	NT2209 DATA LOSS COUNT															
12	NT2209 SYNC LOSS COUNT															
13	NT2209 BAD CHECKSUM COUNT															
14	NT1694 CLOCK LOSS COUNT															
15	NT1694 DATA LOSS COUNT															
16	NT1694 SYNC LOSS COUNT															
17	NT1694 BAD CHECKSUM COUNT															
18	SXI CLOCK LOSS COUNT															
19	SXI DATA LOSS COUNT															
20	SXI SYNC LOSS COUNT															
21	SXI BAD CRC COUNT															
22	IO1 CLOCK LOSS COUNT															
23	IO1 DATA LOSS COUNT															
24	IO1 SYNC LOSS COUNT															
25	IO1 BAD CRC COUNT															
26	IO2 CLOCK LOSS COUNT															
27	IO2 DATA LOSS COUNT															
28	IO2 SYNC LOSS COUNT															
29	IO2 BAD CRC COUNT															
30	NTP AND MRSS PROCESS STATUS															
31	CLOCK ERROR (MSH)															
32	CLOCK ERROR (LSH)															

Message 14-1 – MRS&S Status (GOES N-P Only) (3 of 4)

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	2000-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 = LOCK 1 = FLYWHEEL	N/A
DOY (DAY OF YEAR)	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MIN	BCD	0 - 59	MINUTE
SEC	BCD	0 - 59	SECOND
MSEC	BCD	0 - 999	MSEC
BIT ERROR RATE	R*4	0 - 1E-5	N/A
MDL CLOCK LOSS COUNT	I*2	0 - 2156	FRAMES
MDL DATA LOSS COUNT	I*2	0 - 2156	FRAMES
MDL SYNC LOSS COUNT	I*2	0 - 2156	FRAMES
NT2209 CLOCK LOSS COUNT	I*2	0 - 20	FRAMES
NT2209 DATA LOSS COUNT	I*2	0 - 20	FRAMES
NT2209 SYNC LOSS COUNT	I*2	0 - 20	FRAMES
NT2209 BAD CHKSUM COUNT	I*2	0 - 20	FRAMES
NT1694 CLOCK LOST COUNT	I*2	0 - 20	FRAMES
NT1694 DATA LOSS COUNT	I*2	0 - 20	FRAMES
NT1694 SYNC LOST COUNT	I*2	0 - 20	FRAMES
NT1694 BAD CHKSUM COUNT	I*2	0 - 20	FRAMES
SXI CLOCK LOSS COUNT	I*2	0 - 295	FRAMES
SXI DATA LOSS COUNT	I*2	0 - 295	FRAMES
SXI SYNC LOSS COUNT	I*2	0 - 295	FRAMES
SXI BAD CRC COUNT	I*2	0 - 295	FRAMES
IO1 CLOCK LOSS COUNT	I*2	0 - 295	FRAMES
IO1 DATA LOSS COUNT	I*2	0 - 295	FRAMES
IO1 SYNC LOSS COUNT	I*2	0 - 295	FRAMES
IO1 BAD CRC COUNT	I*2	0 - 295	FRAMES
IO2 CLOCK LOSS COUNT	I*2	0 - 295	FRAMES
IO2 DATA LOSS COUNT	I*2	0 - 295	FRAMES
IO2 SYNC LOSS COUNT	I*2	0 - 295	FRAMES
IO2 BAD CRC COUNT	I*2	0 - 295	FRAMES
TIME CODE`	BINARY	0 = NONE 1 = NTP	N/A
TIME INIT ERROR	BINARY	0 = NONE 1 = INIT ERR	N/A
TIME SYSTEM ERROR	BINARY	0 = NONE 1 = SYSTEM ERR	N/A
TIME FLYWHEEL	BINARY	0 = NO 1 = FLYWHEEL	N/A
TIME MAX DELTA	BINARY	0 = NO 1 = MAX DELTA	N/A

Message 14-1 – MRS&S Status (GOES N-P Only) (4 of 4)

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME PRIVILEGE	BINARY	0 = OK 1 = PRIV ERR	N/A
TIME SOURCE	BINARY	0 = NONE 1 = NTP	N/A
SPARE	BINARY	0	N/A
SPARE	BINARY	0	N/A
SERVER STATUS	BINARY	0 = OFF 1 = ON	N/A
TLM FMT STATUS	BINARY	0 = OFF 1 = ON	N/A
ARCHIVE STATUS	BINARY	0 = OFF 1 = ON	N/A
DEMUX STATUS	BINARY	0 = OFF 1 = ON	N/A
FSYNC STATUS	BINARY	0 = OFF 1 = ON	N/A
CONFIG STATUS	BINARY	0 = OFF 1 = ON	N/A
CLOCK ERROR (MSH)	I*2	0-255	N/A
CLOCK ERROR (LSH)	I*2	0-255	N/A

Notes:

1. Clock loss count is the estimated total number of frames of data lost due to clock loss since the last status report was sent. (Clock loss indicates that no data is being received.)
2. Data loss count is the estimated total number of frames of data lost due to data loss since the last status report was sent. (Data loss indicates that no sync code data is being received.)
3. Sync loss count is the estimated total number of frames of data lost due to sync loss since the last status report was sent. (Sync loss indicates the absence of a sync code for one or more frames.)
4. Estimated frame counts are found by dividing time span by expected time per frame.
5. Bad Checksum Count is the total number of synced PCM telemetry minor frames received with bad checksum values since the last status report was sent.
6. Bad CRC Count is the total number of synced instrument transfer frames received with bad CRC values since the last status report was sent.

Message 15 (Subtypes 10-FF) – MDL Telemetry Messages (GOES N-P Only) (1 of 2)

The SXI downlinks a variety of non-image data types (e.g., housekeeping telemetry, HASS data, and computer events) in packets identified by APID (Application ID). The MRS&S Message 15 provides a capability to transmit the contents of any of these packets by defining a subtype for desired APIDs. Message 15s can also be used for instrument of opportunity source packets or PCM minor frames by defining appropriate message subtypes. The message frequency is commanded by GTACS using a Message 115. The following pages contain a description of Message 15's block layout and field definitions.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 51 - 65 (MRS&S)
      DESTINATION                   = 10 (All GTACS)
      NO. OF HALF-WORDS             = 6 up to 426
      DATA TYPE                     = 15
      DATA SUBTYPE
      APID(hex):                    = 10 - SXI HOUSEKEEPING
                                    = 13 - SXI IMAGE SUMMARY
                                    = 20 - SXI OBSERVING EVENTS
                                    = 21 - SXI COMPUTER EVENTS
                                    = 31 - SXI MEMORY DUMP
                                    = FE - PCM1 Telemetry
                                    = FF - PCM2 Telemetry
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = (1 to 255, as defined for the subtype)
      END OF MESSAGE                = (if message count is equal to the max
                                       count defined for the subtype, then 255,
                                       else 0)
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2	F	DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	ZERO FILL													U	Q	D
6	SOURCE PKT BYTE 001							SOURCE PKT BYTE 002								
:	:															
5+n/2	SOURCE PKT BYTE n-1							SOURCE PKT BYTE n								
6+n/2	SPARE ENTRY															

Message 15 (Subtypes 10-FF) – MDL Telemetry Messages (GOES N-P Only) (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	2000-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 = LOCK 1 = FLYWHEEL	N/A
DOY (DAY OF YEAR)	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MIN	BCD	0-59	MINUTE
SEC	BCD	0-59	SECOND
MSEC	BCD	0-999	MSEC
ZERO FILL	BINARY	0000000000000	N/A
U (UPDATE FLAG)	BINARY	0 = NOT UPDATED 1 = UPDATED	N/A
Q (QUALITY FLAG)	BINARY	0 = CRC or CHECKSUM BAD 1 = CRC or CHECKSUM OKAY	N/A
D (DATA FLAG)	BINARY	0 = NO DATA 1 = DATA	N/A
SOURCE PKT DATA	BYTE	1 – 255	N/A
SPARE	I*2	0	N/A

n = number of bytes of source packet or minor frame data defined for the message

The spare entry will be added only to ensure an even number of half-words (i.e., to guarantee the data block size is a 4-byte multiple). Therefore, if n/2 is an odd number, the spare entry will not be added.

Notes:

Message count is the number of messages in the transmission. It can be used to chain multiple source packets.

Message 16 (Subtype 10-FF) – MDL Telemetry Transmission Rate (GOES N-P Only) (1 of 2)

MDL message transmission rates are selected by GTACS using message Type 115. Message Type 16 identifies to GTACS the current selected rate. This message is transmitted every 10 seconds and immediately in response to a requested rate change. The following contains a description of message Type 16's block layout and field descriptions.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 51 - 65  (MRS&S)
      DESTINATION                   = 10 (All GTACS)
      NO. OF HALF-WORDS             = 6
      DATA TYPE                     = 16
      DATA SUBTYPE
      APID(hex):                    = 10 - SXI HOUSEKEEPING (non-critical)
                                    = 13 - SXI IMAGE SUMMARY (non-critical)
                                    = 20 - SXI OBSERVING EVENTS (non-critical)
                                    = 21 - SXI COMPUTER EVENTS (critical)
                                    = 31 - SXI MEMORY DUMP (non-critical)
                                    = FE - PCM1 TELEMETRY (non-critical)
                                    = FF - PCM2 TELEMETRY (non-critical)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO. (MSB 0 … LSB 15)																
1	YEAR															
2	F	DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	MDL MESSAGE TRANSMISSION INTERVAL															
6	SPARE															

Message 16 (Subtype 10-FF) – MDL Telemetry Transmission Rate (GOES N-P Only) (2 of 2)

Data Item	Format	Validation	Units
YEAR	BCD	2000-2025	YEARS
F (TIME CODE FLAG)	BINARY	0 = LOCK 1 = FLYWHEEL	N/A
DOY (DAY OF YEAR)	BCD	1-366	DAYS
HOUR	BCD	0-23	HOURS
MIN	BCD	0-59	MINUTES
SEC	BCD	0-59	SECONDS
MSEC	BCD	0-999	MSECS
MDL MESSAGE INTERVAL	I*2	0-10	SECONDS
SPARE	I*2	0	N/A

Notes:

For SXI Housekeeping data, the range of values for MDL message interval is 0 – 10. For all other subtypes, the range of values for MDL message interval is 0 – 1. A transmission rate of 1 requests data at the maximum rate at which MRS&S can serve the data after receiving the specified data from the spacecraft. A transmission rate of 0 shuts off the flow of non-critical data; flow of critical data is not stopped, regardless of the message interval.

4.3.5 PM-Originated Messages

PM originated messages are listed below in the order in which their detailed descriptions are provided in this section. Message Type and Subtype appear in the lower right hand corner of these pages to assist in easy identification of the pages describing a specific message.

Type	Description	Destination
20	Landmark Measurement	OATS
21	IMC Quality Check Response	OATS
22	IMC Qual Check Completion	OATS
23	PM Health & Status	GIMTACS/GTACS
25	Normalization Look-Up Table (NLUT)	SPS
26	Imager Co-registration Correction Message	SPS
27	PM Text Message	GIMTACS/GTACS

Message 20 – Landmark Measurement (1 of 3)

OATS uses landmark measurements in the O&A estimation process. Message 20 from the PM to OATS includes the landmark ID, landmark latitude, landmark longitude, landmark lines and pixels, and spacecraft ID and time. Message 20 has three subtypes: Imager visible, Sounder visible, and Imager IR. The Message 20 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION                   = 32 (ALL OATS)
      NO. OF HALF-WORDS             = 36
      MESSAGE TYPE                  = 20
      MESSAGE SUBTYPE               = 1 - IMAGER VISIBLE
                                    = 2 - SOUNDER VISIBLE
                                    = 3 - IMAGER IR
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A
```

Message 20 – Landmark Measurement (2 of 3)

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |---------------------------------------------|
      1  |                LANDMARK ID                  |
      .  |                                             |
      4  |                                             |
         |---------------------------------------------|
      5  |  SCAN TIME:       YEAR                      |
         |---------------------------------------------|
      6  |F|DAY OF YEAR                    |  HR (10s) |
         |---------------------------------------------|
      7  |   HR (1s) |       MINUTES        |  SEC(10s) |
         |---------------------------------------------|
      8  |   SEC(1s) |             MSECS                 |
         |---------------------------------------------|
      9  |              LANDMARK LATITUDE              |
     10  |                                             |
         |---------------------------------------------|
     11  |              LANDMARK LONGITUDE             |
     12  |                                             |
         |---------------------------------------------|
     13  |              LANDMARK ALTITUDE              |
     14  |                                             |
         |---------------------------------------------|
     15  |       DETECTOR NO.    |    IR CHANNEL NO.   |
         |---------------------------------------------|
     16  |                 YAW-FLIP FLAG               |
         |---------------------------------------------|
     17  |            INITIAL ESTIMATED LINE           |
     18  |                                             |
         |---------------------------------------------|
     19  |           INITIAL ESTIMATED PIXEL           |
     20  |                                             |
         |---------------------------------------------|
     21  |            MEASURED LANDMARK LINE           |
     22  |                                             |
         |---------------------------------------------|
     23  |            MEASURED LANDMARK PIXEL          |
     24  |                                             |
         |---------------------------------------------|
     25  |            GOODNESS-OF-FIT MEASURE          |
     26  |                                             |
         |---------------------------------------------|
  27&28  |              IMC IDENTIFIER                 |
         |---------------------------------------------|
     29  |                                             |
      .  |                   SPARE                     |
     34  |                                             |
         |---------------------------------------------|
     35  | CORR. PERF. FLAG     |   SCAN DIR E-W FLAG  |
         |---------------------------------------------|
     36  | SIDE 2 ACTIVE FLAG   |        SPARE         |
         |---------------------------------------------|
```

Message 20 – Landmark Measurement (3 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
LANDMARK ID	ASCII	N/A	N/A
YEAR	BCD	1989-2025	YEAR
F (TIME CODE FLAG)	BINARY	0-LOCK 1-FLYWHEEL	N/A
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
DETECTOR	BINARY	1-8	N/A
IR CHANNEL	BINARY	2,3,4 OR 5	N/A
YAW FLIP FLAG	BINARY	+1 - NORMAL -1 - FLIPPED	N/A
LATITUDE	I*4	-90*10E6 TO +90*10E6	µDEG +NORTH
LONGITUDE	I*4	-180*10E6 TO +180*10E6	µDEG +EAST
ALTITUDE	FLT.PT.	-10 TO +10	KM
LINE	FLT.PT.	1-15787 (IMAGER) 1-3948 4-KM IR 1-1974 8-KM IR 1-1582 (SOUNDER)	VIS LINES LINES LINES LINES
PIXEL	FLT.PT.	1-30680 (IMAGER) 1-7670 1-1758 (SOUNDER)	VIS PIXELS ALL IR PIX PIXELS
GOODNESS-OF-FIT	FLT.PT.	0.0 - 1.0	N/A
IMC ID	ASCII	ANNN	N/A
FLAGS	BINARY	0-1	N/A

Notes:

1. The spare half-word is provided for 32-bit full word bounding. Its contents are null.
2. If no landmark ID is defined for a given landmark measurement, the field is null.
3. The scan time is the time when the landmark image data was received and time-tagged by the SPS.
4. Latitude, longitude, and altitude are given with respect to a reference ellipsoid defined by the *Earth Location User's Guide (ELUG)*.
5. The IR channel field is null for message subtypes 1 and 2.
6. The initial estimate of a landmark's location is calculated from its defined latitude and longitude location and the O&A. If no initial estimate is available, the field contains nulls.
7. The measured landmark location is determined by the operator or by landmark correlation.
8. The Goodness-of-Fit (GOF) measure indicates the degree of correlation achieved. If no correlation was performed for a given landmark measurement, the GOF field contains nulls.
9. The Flag fields are defined as follows:

   Meaning (If set)
   Correlation performed
   Scan direction E-W, else W-E
   Side 2 active, else side 1

Messages 21 and 22 – IMC Quality Check (1 of 3)

The SPS collects IMC terms on a continuous basis for transmission to the PM. Upon request from OATS, the PM buffers and transmits the terms for verification that the IMC has been done correctly. Message 21 contains the N-S and E-W cycles and increments, N-S IMC, E-W IMC, N-S servo error, E-W servo error, and the SPS time tag. Upon completion of the IMC quality check data transmission, the PM issues a Message 22 signaling completion. The Message 21 and 22 data block layouts and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = UP TO 834
      MESSAGE TYPE                  = 21
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = RETURN REQUEST MESSAGE (TYPE 41) TRACER
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |              YAW-FLIP FLAG                    |
         |-----------------------------------------------|
      2  |            NUMBER OF RECORDS                  |
         |-----------------------------------------------|_
      3  |            INSTRUMENT STATUS                  | |
         |-----------------------------------------------| |
      4  |  SAMPLE TIME:     YEAR                        | |
         |-----------------------------------------------| |
      5  |F|DAY OF YEAR                    |  HR (10s)   | |  IMC
         |-----------------------------------------------| |  QUALITY
      6  |   HR (1s) |       MINUTES       |  SEC(10s)   | |  CHECK
         |-----------------------------------------------| |  RECORD
      7  |   SEC(1s) |             MSECS                 | |  No.1
         |-----------------------------------------------| |
      8  |                E-W CYCLES                     | |
         |-----------------------------------------------| |
      9  |              E-W INCREMENTS                   | |
         |-----------------------------------------------| |
     10  |                N-S CYCLES                     | |
         |-----------------------------------------------| |
     11  |              N-S INCREMENTS                   | |
         |-----------------------------------------------| |
     12  |        N-S IMAGE MOTION COMPENSATION          | |
         |-----------------------------------------------| |
     13  |        E-W IMAGE MOTION COMPENSATION          | |
         |-----------------------------------------------| |
     14  |                N-S SERVO ERROR                | |
         |-----------------------------------------------| |
     15  |                E-W SERVO ERROR                | |
         |-----------------------------------------------|_
     16  |       IMC QUALITY CHECK RECORDS NO. 2-64      |
      :  |                                               |
    834  |                                               |
         |-----------------------------------------------|
```

Messages 21 and 22 – IMC Quality Check (2 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
YAW FLIP FLAG	BINARY	+1 - NORMAL -1 - FLIPPED	N/A
NUMBER OF RECORDS	BINARY	1-64	N/A
INSTRUMENT STATUS	BINARY	(SEE NOTES)	N/A
YEAR	BCD	1989-2025	YEAR
F (TIME CODE FLAG)	BINARY	0 - LOCK 1 - FLYWHEEL	N/A
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
CYCLES	BINARY	0-128	CYCLES
INCREMENTS	BINARY	0-6135(IMAGER) 0-2804 (SOUNDER)	INCREMENTS
N-S IMAGE MOTION COMP	BINARY	0-1023(IMAGER) 0-8191 (SOUNDER)	COUNTS
E-W IMAGE MOTION COMP	BINARY	0-1023(IMAGER) 0-8191 (SOUNDER)	COUNTS
N-S SERVO ERROR	BINARY	0-1023(IMAGER) 0-8191 (SOUNDER)	COUNTS
E-W SERVO ERROR	BINARY	0-1023(IMAGER) 0-8191 (SOUNDER)	COUNTS

Notes:

1. The yaw flip flag is set to +1 for a spacecraft in its normal upright orientation and –1 when it is rotated 180° about the yaw axis.

2. Instrument status bits are as follows:

Bit	Meaning – If Set
0	Spacelook in progress
1	ECAL in progress (N/A for the Imager)
2	BB-Cal in progress
3	Normal frame active
4	Priority 1 frame active
5	Priority 2 frame active
6	Scan direction E-W, else W-E
7	Scan direction S-N, else N-S
8	IMC active, else inactive
9	Dwell mode = 4 (Sounder only)
10	Dwell mode = 2 (Sounder only)
11	Dwell mode = 1 (Sounder only)
12	N-S step mode = double (Sounder only)
13	Side 2 active, else side 1
14	Star sense in progress
15	Slew active

3. Bits 8 and 13 are obtained from SPS configuration flags. All other bits are determined directly from the downlinked data.

4. Sample time represents time when IMC and SERVO data is received at the SPS.

5. For the Sounder, IMC and servo error data is in A/D format, as received in the downlinked data.

Message 22 – IMC Quality Check Completion (3 of 3)

```
HEADER BLOCK FIELDS:
   MESSAGE SEQUENCE NO.  = 1-65535
   SATELLITE ID          = 8,9,10,11,12,13,14,15 (I-P)
   SOURCE                = 11,12,13,14,15,16,17,18,19,29 (PM)
   DESTINATION           = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                         = 75-85 (N-P OATS)
   NO. OF HALF-WORDS     = 4
   MESSAGE TYPE          = 22
   MESSAGE SUBTYPE       = 0 - SUCCESSFUL COMPLETION
                         = 1 - SATELLITE NOT SUPPORTED
                         = 2 - PREMATURE COMPLETION
                         = 3 - UNABLE TO FULFILL REQUEST
   TRACER                = RETURN REQUEST MESSAGE TRACER (MESSAGE 41)
   MESSAGE COUNT         = 1
   END OF MESSAGE        = 255
   ROUTING ID            = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                                LSB
            0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15
           |-------------------------------------------------------|
      1    |                                                       |
      .    |              NUMBER OF MESSAGES SENT                  |
      4    |                                                       |
           |-------------------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*8	N/A	N/A

Notes:

1. The subtypes and their definition are as follows:

   0 Successful completion: Indicates a successful completion of the IMC data for the period of time requested. If IMC blocks are lost during this period due to possible network congestion, the request is still considered successful.

   1 Satellite not supported: Indicates the satellite requested is not currently supported. If the PM initially supported the requested satellite but changed satellites during the transfer period, the subtype reflects a premature completion.

   2 Premature completion: Indicates when the transfer period expired there was no IMC data being transmitted. This subtype could occur for the following reasons:
   a. The SPS stopped transmitting IMC blocks for the requested instrument.
   b. The GVAR uplink was disconnected.
   c. The satellite supported by the PM changed.

   3 Unable to fulfill request: The request message was considered invalid for the following reasons:
   a. The start time was in the past, not in the future.
   b. The duration period was less than one.
   c. A request is already in progress for instrument specified.

Message 23 – PM Health & Status (1 of 3)

Each PM server sends GIMTACS/GTACS this message every 30 seconds. The PM also sends the status message in response to a GIMTACS/GTACS status request. The message data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION                   = 10 (GIMTACS, GTACS)
      NO. OF HALF-WORDS             = 150
      MESSAGE TYPE                  = 23
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = RETURN ID RECEIVED WITH
                                    STATUS REQUEST

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |                    YEAR                       |
         |-----------------------------------------------|
      2  |F|DAY OF YEAR                    |  HR (10s)   |
         |-----------------------------------------------|
      3  |   HR (1s) |       MINUTES       |  SEC(10s)   |
         |-----------------------------------------------|
      4  |   SEC(1s) |             MSECS                 |
         |-----------------------------------------------|
      5  |                   SERVER ID                   |
      .  |                                               |
      8  |                                               |
         |-----------------------------------------------|
      9  |      Server Status    |    Prime Flag         |
         |-----------------------------------------------|
     10  |  AUTO LMARK Status    |    Stripe Status      |
         |-----------------------------------------------|
     11  |     GVAR Port ID      |      RAID ID          |
         |-----------------------------------------------|
     12  |     Current Satellite |   Current SPS ID      |
         |-----------------------------------------------|
     13  |                   CRC Errors                  |
     14  |                                               |
         |-----------------------------------------------|
     15  |                 Bit Error Rate                |
     16  |                                               |
         |-----------------------------------------------|
     17  |       Number of Lines Dropped - Imager        |
         |-----------------------------------------------|
     18  |             Last Imager Image ID              |
      .  |                                               |
     21  |                                               |
         |-----------------------------------------------|
     22  |             Last Sounder Image ID             |
      .  |                                               |
     25  |                                               |
         |-----------------------------------------------|
     26  |        Number of Lines Dropped - Sounder      |
         |-----------------------------------------------|
```

Message 23 – PM Health & Status (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |---------------------------------------------|
    27  |        Number of Workstations Attached      |
        |---------------------------------------------|
    28  |        ID of Attached Workstation (1)       |
     .  |                                             |
    32  |                                             |
        |---------------------------------------------|
    33  |        ID of Attached Workstation (2)       |
     .  |                                             |
    37  |                                             |
        |---------------------------------------------|
     .  |                      .                      |
        |---------------------------------------------|
    93  |        ID of Attached Workstation (14)      |
     .  |                                             |
    97  |                                             |
        |---------------------------------------------|
    98  |                    Spare                    |
     .  |                                             |
   150  |                                             |
        |---------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
Year	BCD	2000-2037	Year
F (Time Code Flag)	Binary	0-Lock 1-Flywheel	N/A
Day of Year	BCD	1-366	Days
Hours	BCD	0-23	Hours
Minutes	BCD	0-59	Minutes
Seconds	BCD	0-59	Seconds
Msecs	BCD	0-999	Milliseconds
Server ID	ASCII str	None	N/A
Server Status	Bit flags	0-3	N/A
Prime Flag	Binary	0-1	TBD
AUTO LMARK Status	Binary	0-4	N/A
Stripe Status	Binary	0-3	N/A
GVAR Port ID	Binary	1-4	N/A
RAID ID	Binary	1-4	N/A
Current Satellite	Binary	8-16	N/A
Current SPS ID	Binary	1-9	N/A
CRC Errors	Binary	0-2147483647 (I-M) 0-2247483647 (N-P)	# of CRC errors
Bit Error Rate	Fl. Pt.	0-maximum IEEE fl. pt. num.	Errors per million bits normalized
# of Lines Dropped - Imager	Binary	0-1974	N/A
Last Imager Image ID	same as Msg date	same as Msg date	same as Msg date
Last Sounder Image ID	same as Msg date	same as Msg date	same as Msg date
# of Lines Dropped - Sounder	Binary	0-396	N/A
# of Workstations Attached	Binary	0-10	N/A
ID of Attached Workstations	ASCII str	None	N/A

Message 23 – PM Health & Status (3 of 3)

Notes:

The following information will be in the status message:

Message Time	Time that the status message was formatted, in NOAA BCD format.
Server Id	ASCII string identifying the server (i.e., ASCII characters will be terminated with a null). Examples: srpmsv1, crpmsv3 and grpmsv1
Server Status	A series of bit flags designating the status of the server. Bit 7 (LSB) – 1 = Ingest enabled, 0 = ingest disabled Bit 6 – 1 = archiving enabled, 0 = archiving disabled
Prime Flag	A flag indicating whether this server is designated as the “prime” and is sending landmarking information to OATS. 1 = Prime
Auto LMARK Status	An integer designating the status of the automatic landmarking functionality. 0 = Autolandmarking disabled, 3 = Type 3 enabled, 4 = Type 4 enabled
Stripe Status	An integer indicating whether the automatic stripe detection is enabled or not. 0 = disabled for both Imager & Sounder, 1 = Imager only, 2 = Sounder only, 3 = enabled for both
GVAR port Id	An integer (1-4) designating which of the four possible ports is being used by the server to ingest the GVAR stream.
RAID Id	An integer (1-4) designating which of the four possible RAID areas is being used by this server.
Current Sat Id	An integer (8-16) number of the satellite id extracted from the GVAR stream.
SPS Id	An integer (1-9) representing the SPS Id that is the source of the GVAR stream being received by the PM server.
CRC	An integer number representing the number of CRC error received in the last sampling period.
BER	A floating point number representing the bit error rate. This is the number of bit errors per million bits averaged over the operator specified sample period.
Lines dropped Imager	An integer representing the number of lines dropped in the last Imager image.
Last Imager Image Id	A BCD representation of the date/time of the last Imager image was ingested and placed in the PM archive.
Last Sounder Image Id	A BCD representation of the date/time of the last Sounder image was ingested and placed in the PM archive.
Lines dropped Sounder	An integer representing the number of lines dropped in the last Sounder image.
# of ws	The integer number of the client workstations that are connected to this server.
WS ids	ASCII string identifying each of the client workstations connected to this server (i.e., ASCII string will be terminated with a null). Each of the 14 slots will use 10 bytes. Unused slots will be zero. Examples: srpmws1
Spare	An arbitrary amount of spare for growth.

Message 25 – Imager or Sounder NLUT Message

Approximately once per week, the PM sends the SPS unsolicited Messages 25-1 and 25-2, containing respectively NLUTs for the Imager and Sounder visible detectors. The NLUT values correct the raw visible detector values to remove striping caused by differences in the visible detector responsivities. Each Message 25 contains a detector number, reference detector number, and the NLUT values. Message 25-1, Imager NLUT, and Message 25-2, Sounder NLUT, data block layout and field definitions follow.

Message 25-1 – Imager NLUT Message (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.  = 1-65535
      SATELLITE ID          = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION           = 20,21,22,23,24,25,26,27,28 (SPS) OR 31 (ALL SPS)
      NO. OF HALF-WORDS     = 1040
      MESSAGE TYPE          = 25
      MESSAGE SUBTYPE       = 1 - IMAGER
      TRACER                = ASCII BLANKS
      MESSAGE COUNT         = 1
      END OF MESSAGE        = 255
      ROUTING ID            = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |---------------------------------------------|
      1  |              DETECTOR NUMBER                |
         |---------------------------------------------|
      2  |          REFERENCE DETECTOR NUMBER          |
         |---------------------------------------------|
      3  |                   YEAR                      |
         |---------------------------------------------|
      4  |F|DAY OF YEAR                    |  HR (10s) |
         |---------------------------------------------|
      5  |   HR (1s) |       MINUTES       |  SEC(10s) |
         |---------------------------------------------|
      6  |   SEC(1s) |             MSECS               |
         |---------------------------------------------|
      7  |                 NLUT VALUES                 |
      .  |           (ONE VALUE PER HALF-WORD)         |
   1030  |                                             |
         |---------------------------------------------|
   1031  |                    SPARE                    |
   1032  |                                             |
         |---------------------------------------------|
   1033  |                     NLUT                    |
      .  |                  IDENTIFIER                 |
   1036  |                                             |
         |---------------------------------------------|
   1037  |                                             |
      .  |                    SPARE                    |
   1040  |                                             |
         |---------------------------------------------|
```

Message 25-1 – Imager NLUT Message (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
DETECTOR NUMBER	BINARY	1-8	N/A
REFERENCE DET NUMBER	BINARY	1-8	N/A
F (TIME CODE FLAG)	BINARY	0 - LOCK 1 - FLYWHEEL	N/A
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
NLUT VALUE	BINARY	0-1023	COUNTS
NLUT IDENTIFIER	ASCII	NONE	N/A

Notes:

The PM sends one Imager NLUT message per visible detector, for a total of eight messages, in sequence. The value corresponding to zero counts appears in half-word seven. The value corresponding to 1023 counts appears in half-word 1030. All values are right adjusted.

Message 25-2 – Sounder NLUT Message (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.  = 1-65535
      SATELLITE ID          = 8,9,10,11,12,13,14,15,16 (I-P)
      SOURCE                = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION           = 20,21,22,23,24,25,26,27,28 (SPS) OR 31 (ALL SPS)
      NO. OF HALF-WORDS     = 1040
      MESSAGE TYPE          = 25
      MESSAGE SUBTYPE       = 2 - SOUNDER
      TRACER                = ASCII BLANKS
      MESSAGE COUNT         = 1-8
      END OF MESSAGE        = 255/0
      ROUTING ID            = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          |0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15|
          |-----------------------------------------------|
      1   |               DETECTOR NUMBER                 |
          |-----------------------------------------------|
      2   |           REFERENCE DETECTOR NUMBER           |
          |-----------------------------------------------|
      3   |             NLUT SEGMENT NUMBER               |
          |-----------------------------------------------|
      4   |                    YEAR                       |
          |-----------------------------------------------|
      5   |F|DAY OF YEAR                    |  HR (10s)   |
          |-----------------------------------------------|
      6   |   HR (1s) |       MINUTES       |  SEC(10s)   |
          |-----------------------------------------------|
      7   |   SEC(1s) |             MSECS                 |
          |-----------------------------------------------|
      8   |                 NLUT VALUES                   |
      .   |            (ONE VALUE PER HALF-WORD)          |
   1031   |                                               |
          |-----------------------------------------------|
   1032   |                   SPARE                       |
          |-----------------------------------------------|
   1033   |                   NLUT                        |
     .    |                IDENTIFIER                     |
   1036   |                                               |
          |-----------------------------------------------|
   1037   |                                               |
     .    |                   SPARE                       |
   1040   |                                               |
          |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
DETECTOR NUMBER	BINARY	1-4	N/A
REFERENCE DET NUMBER	BINARY	1-4	N/A
NLUT SEGMENT NUMBER	BINARY	1-8	N/A
F (TIME CODE FLAG)	BINARY	0 - LOCK 1 - FLYWHEEL	N/A
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
NLUT VALUE	BINARY	0-8191	COUNTS
NLUT IDENTIFIER	ASCII	NONE	N/A

Message 25-2 – Sounder NLUT Message (2 of 2)

Notes:

1. The spare half-word is provided for 32-bit full word bounding—its contents are null.

2. PM sends eight Sounder NLUT messages per detector, for a total of 32 messages, in sequence. Each message contains 1/8 of an NLUT, referred to as an NLUT segment. Segment 1 contains NLUT entries 0 – 1023, Segment 2 contains NLUT entries 1024 – 2047. This pattern continues for all eight segments.

3. A Sounder NLUT requires eight transmissions of 1024 NLUT values. The first transmission contains count equivalent values for 0 – 1023 counts; the second transmission 1024 – 2047 counts. This pattern continues until the last transmission, which contains values for 7168 – 8191 counts. All values are right-justified. The end-of-message field in the header is set to 255 in the last message transmitted.

Message 26 – Imager Co-registration Correction

The PM transmits an unsolicited Message 26 to the SPS containing co-registration correction factors about once per month. The PM also sends a Message 26 in response to receipt of a Message 6, CORT Data Request, from the SPS. The correction factors define the amount of shifting required within the SPS to align the Imager's visible channel imagery with that generated by the IR channels. Message 26 contains 48 pairs of correction factors, one pair for each half-hour interval of the day. The first pair corresponds to the interval from 00:00:00 to 00:29:59, and the last pair is assigned to the interval 23:30:00 to 23:59:59. The Message 26 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.  = 1-65535
      SATELLITE ID          = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION           = 20,21,22,23,24,25,26,27,28 (SPS) OR 31 (ALL SPS)
      NO. OF HALF-WORDS     = 102
      MESSAGE TYPE          = 26
      MESSAGE SUBTYPE       = 1 - IMAGER
      TRACER                = N/A
      MESSAGE COUNT         = 1
      END OF MESSAGE        = 255
      ROUTING ID            = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |                   CORT ID                     |
      2 |                                               |
        |-----------------------------------------------|
      3 |                     YEAR                      |
        |-----------------------------------------------|
      4 |           DAY OF YEAR           | HR (10s)    |
        |-----------------------------------------------|
      5 |  HR (1s)  |       MINUTES       | SEC(10s)    |
        |-----------------------------------------------|
      6 |  SEC(1s)  |             MSECS                 |
        |-----------------------------------------------|
      7 |                     E-W                       |
      . |                CO-REGISTRATION                |
     54 |                     TERMS                     |
        |-----------------------------------------------|
     55 |                     N-S                       |
      . |                CO-REGISTRATION                |
    102 |                     TERMS                     |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
CORT TABLE ID	ASCII	ANNN	N/A
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
E-W CO-REGISTRATION TERMS	INTEGER	-64 to +64	VIS PIXELS
N-S CO-REGISTRATION TERMS	INTEGER	-8 to +8	VIS DETECTOR LINES

Message 27 – PM Status or Alarm Message

The PM transmits messages to the GIMTACS/GTACS operator, not more often than once per second. A text message consists of 87 ASCII characters including a two-character alarm code. The Message 27 data block layout and specific character formats are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 11,12,13,14,15,16,17,18,19,29 (PM)
      DESTINATION                   = 10 (GIMTACS, GTACS)
      NO. OF HALF-WORDS             = 80
      MESSAGE TYPE                  = 27
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |                                               |
      . |                TEXT MESSAGE                   |
     80 |                                               |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TEXT MESSAGE	ASCII	N/A	N/A

TEXT MESSAGE FORMAT

1. Time (characters 1 through 17) formatted as: YEAR/DDD HH:MM:SS
2. Spacecraft id (characters 19 & 20) formatted as:
   nn = where nn is the spacecraft number 8, 10, 12, etc.
3. Message origin (characters 22 through 28) formatted as:
   aaaaaaa = indicates the platform that originated the message. (wrpmsv1,2 &3, srpmsv 1,2,3 & 4, rpmws1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17)
4. Message id (characters 30 through 35) formatted as:
   aaannn = where aaa is code for which process and nnn is a three digit number.
5. Alarm field (characters 37 and 38) defined as:
   ! = normal status
   !! = alarm
6. Text (characters 39-160) Actual message is ASCII and remainder of space is 0 filled.

Notes:

Eight-bit ASCII character pairs are formatted into half-words by placing the first character in the most significant byte (bits 0–7) and the second character in the least significant byte (bits 8–15).

4.3.6 OATS-Originated Messages

OATS originated messages are listed below in the order in which their detailed descriptions are provided in this section. Message Type and Subtype appear in the lower right hand corner of these pages to assist in easy identification of the pages describing a specific message.

Type	Description	Destination
33	O&A Data Response	SPS
41	IMC Quality Check Request	PM
42	Terminate IMC Qual Check	PM
45	OATS Inter-node Message	OATS
51	Star View CMD Parameter Request	GIMTACS/GTACS
53	IMC, SMC, or SCC Coefficient Data	GIMTACS/GTACS
53-LUT	IMC, SMC or SCC Look-Up Table Format	GIMTACS/GTACS
54	OATS Status	GIMTACS/GTACS
55	Scan Frame Response	GIMTACS/GTACS
56	SK CMD Parameters	GIMTACS/GTACS
57	Momentum Dump Command	GTACS
58	Trim Tab Command Params	GIMTACS
59	Eclipse Prediction Response	GIMTACS/GTACS
60	Sensor Intrusion Response	GIMTACS/GTACS
61	DIRA Drift Command	GIMTACS
62	IMC, SMC, or SCC Set Ready	GIMTACS/GTACS
63	SSAA IMC Set Ready	GIMTACS
66	DIRA Cal Data Request	GIMTACS
67	Trim Tab Data Request	GIMTACS
70	Propulsion Subsystem Data Request	GIMTACS/GTACS
71	Star Window Request	GIMTACS/GTACS
72	OATS Alarm Message	GIMTACS/GTACS
73	Torque Table Update	GTACS
75	IMC Scale Factor Calibration Schedule Response	GIMTACS/GTACS
80	IMC Scale Factors	GIMTACS/GTACS
81	MMC Scale Factors	GIMTACS/GTACS
82	Request Error Message	GTACS
85	MMC Calibration Data Request	GIMTACS
87	SMC Data Request	GIMTACS
88	Thermal Snap Data Request	GIMTACS

Message 33 – O&A Data Response (1 of 5)

Message 33 originates from OATS and is sent to the SPSs. The message contains orbital position and instrument attitude references, as well as dynamic coefficients representing orbital and attitude motions. These data are used by the SPS to Earth locate and grid the Imager and Sounder data. If IMC is in effect, the SPS uses the reference position and instrument attitudes as constants. If IMC is turned off, the SPS dynamically evaluates the orbital position and instrument attitudes from the coefficients and the related reference data. Message 33 is sent unsolicited to all active SPSs each time a new IMC coefficient set is computed. The SPSs then put the newly received set into effect when they receive a Message 110-6 from GIMTACS/GTACS. Message 33 is also sent to the requesting SPS in response to a Message 3. The Message 33 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO. = 1-65535
      SATELLITE ID         = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE               = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                           = 75-85 (N-P OATS)
      DESTINATION          = 20,21,22,23,24,25,26,27,28(SPS) or 31 (ALL SPSs)
      NO. OF HALF-WORDS    = UP TO 1230
      MESSAGE TYPE         = 33
      MESSAGE SUBTYPE      = 1 - FULL SET (24 HR)
                           = 2 - NEW ORBIT REFERENCE SET
                           = 3 - SSAA, COUPLED IMAGER/SOUNDER
                           = 4 - SSAA UNCOUPLED IMAGER/SOUNDER
                           = 5 - POST-STATIONKEEPING FULL SET
                           = 6 - SHORT SPAN O&A ADJUST
      TRACER               = ASCII BLANKS
      MESSAGE COUNT        = 1
      END OF MESSAGE       = TRUE
      ROUTING ID           = N/A
```

Message 33 – O&A Data Response (2 of 5)

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |              IMC SET IDENTIFIER               |
      2 |
        |-----------------------------------------------|
      3 |                    SPARE                      |
      . |
      6 |
        |-----------------------------------------------|
      7 |                 YAW FLIP FLAG                 |
      8 |
        |-----------------------------------------------|
      9 |              REFERENCE LONGITUDE              |
     10 |
        |-----------------------------------------------|
     11 |    REFERENCE RADIAL DIFFERENCE FROM NOMINAL   |
     12 |
        |-----------------------------------------------|
     13 |               REFERENCE LATITUDE              |
     14 |
        |-----------------------------------------------|
     15 |               REFERENCE ORBIT YAW             |
     16 |
        |-----------------------------------------------|
     17 |              REFERENCE IMAGER ROLL            |
     18 |
        |-----------------------------------------------|
     19 |              REFERENCE IMAGER PITCH           |
     20 |        |
        |-----------------------------------------------|
     21 |              REFERENCE IMAGER YAW             |
     22 |
        |-----------------------------------------------|
     23 |             REFERENCE SOUNDER ROLL            |
     24 |
        |-----------------------------------------------|
     25 |             REFERENCE SOUNDER PITCH           |
     26 |
        |-----------------------------------------------|
     27 |             REFERENCE SOUNDER YAW             |
     28 |
        |-----------------------------------------------|_
     29 |                      YEAR                     | |
        |-----------------------------------------------| | EPOCH
     30 |  |           DAY OF YEAR          |  HR (10s) | | DATE
        |-----------------------------------------------| | AND
     31 |  HR (1s)  |        MINUTES         |  SEC (10s)| | TIME
        |-----------------------------------------------| |
     32 |  SEC (1s) |            MSEC                   | |
        |-----------------------------------------------|_
     33 |   RECOMMENDED IMC SET ENABLE TIME FROM EPOCH  |
     34 |
        |-----------------------------------------------|
     35 |       SPACECRAFT COMPENSATION - ROLL          |
     36 |
        |-----------------------------------------------|
     37 |       SPACECRAFT COMPENSATION - PITCH         |
     38 |
        |-----------------------------------------------|
     39 |      SPACECRAFT COMPENSATION - YAW            |
     40 |
        |-----------------------------------------------|
     41 |      CHANGE IN LONGITUDE FROM REFERENCE       |
      . |                13 COEFFICIENTS                |
     66 |
        |-----------------------------------------------|
     67 |   CHANGE IN RADIAL DISTANCE FROM REFERENCE    |
      . |                11 COEFFICIENTS                |
     88 |
```

Message 33 – O&A Data Response (3 of 5)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB
89 . 106	SINE OF GEOCENTRIC LATITUDE (TOTAL) 9 COEFFICIENTS
107 . 124	SINE OF ORBIT YAW (TOTAL) 9 COEFFICIENTS
125 126	DAILY SOLAR RATE
127 128	EXPONENTIAL START TIME FROM IMC EPOCH
129 130	HALF-WORD NO. WHERE SOUNDER COEFFS BEGIN
131 132	EXPONENTIAL MAGNITUDE
133 134	EXPONENTIAL TIME CONSTANT
135 136	CONSTANT MEAN ATTITUDE ANGLE
137 138	NUMBER OF FOURIER AND PHASE ANGLES (K)
139 140	MAGNITUDE OF FIRST-ORDER FOURIER
141 142	PHASE ANGLE OF FIRST-ORDER FOURIER
143 . 4K+138	MAGNITUDES AND PHASE ANGLES OF SECOND THROUGH K-TH ORDER FOURIER
4K+139 4K+140	NUMBER OF MONOMIAL SINUSOIDS (N)
4K+141 4K+142	ORDER OF SINUSOID
4K+143 4K+144	ORDER OF MONOMIAL
4K+145 4K+146	MAGNITUDE OF SINUSOID
4K+147 4K+148	PHASE ANGLE OF MONOMIAL SINUSOID
4K+149 4K+150	ANGLE FROM EPOCH WHERE MONOMIAL IS ZERO
4K+151 . 4K+140 +10N	ORDERS, MAGNITUDES, PHASE ANGLES, AND LOCATION ANGLES FROM EPOCH FOR UP TO THREE ADDITIONAL MONOMIAL SINUSOIDS

Message 33 – O&A Data Response (4 of 5)

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
YAW FLIP FLAG	I*4	+1, -1	N/A
REFERENCE LONGITUDE	R*4	-π TO +π	RAD +EAST
REFERENCE RADIAL DIFFERENCE	R*4	-1000 TO +1000	KM
REFERENCE LATITUDE	R*4	-.065 To +.065	RAD +NORTH
REFERENCE ORBIT YAW	R*4	-.065 To +.065	RAD
REFERENCE IMAGER & SOUNDER			
ROLL, PITCH, YAW	R*4	-.002 TO +.002	RAD
EPOCH DATE AND TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MIN
SECOND	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
RECOMMENDED ENABLE TIME FROM			
IMC EPOCH	R*4	-720 to 1440, 9999	
		See Note 13 below	MIN
SPACECRAFT COMPENSATION			
ROLL, PITCH, YAW	R*4	-.004 TO +.004	RAD
CHANGE IN LONGITUDE FROM REF.	R*4	-0.1 To +0.1	RAD
CHANGE IN RADIAL DISTANCE	R*4	-2700 To +2700	KM
SINE OF GEOCENTRIC LATITUDE	R*4	-0.1 TO +0.1	N/A
SINE OF ORBIT YAW	R*4	-0.1 TO +0.1	N/A
DAILY SOLAR RATE	R*4	.00433 TO .00440 (I-M)	RAD/MIN
	R*4	.00433 To 0.027 (N-P)	RAD/MIN
EXPONENTIAL START TIME			
FROM IMC EPOCH	R*4	-1440 TO +1440	MIN
HALF-WORD NO. FOR SDR DATA	I*4	131 TO 681	HALF-WORDS
EXPONENTIAL MAGNITUDE	R*4	-.004 TO +.004	RAD
EXPONENTIAL TIME CONSTANT	R*4	13 TO 1440	MIN
MEAN ATTITUDE ANGLE	R*4	-.01 TO +.01	RAD
NUMBER OF FOURIER, ANGLES	I*4	0-15	N/A
MAGNITUDE OF FOURIER	R*4	-0.01 TO +0.01	RAD
PHASE ANGLE OF FOURIER	R*4	-π TO +π	RAD
NUMBER OF MONOMIAL SINUSOID	I*4	0-4	N/A
ORDER OF SINUSOID	I*4	0-15	N/A
ORDER OF MONOMIAL	I*4	1-15	N/A
MAG OF MONOMIAL SINUSOID	R*4	-.001 TO +.001	RAD
PHASE ANGLE OF SINUSOID	R*4	-π TO +π	RAD
ANGLE FROM EPOCH	R*4	-π TO +π (I-M)	RAD
	R*4	-5π TO +5π (N-P)	RAD

Notes:

1. The yaw flip flag is set to +1 for a spacecraft in its normal upright orientation and –1 when it is rotated 180° about the yaw axis.
2. Half-words 131 through $4K + 10N + 140$ are repeated for each Imager attitude angle in order of roll, pitch, yaw, roll misalignment, and pitch misalignment. This information is then repeated for the Sounder in the same order, for a total of 10 blocks of attitude angles.
3. The message length is given by $130 + 10(4K + 10N + 10)$, with a maximum length of 1230, 16-bit half-words when $K = 15$ and $N = 4$.
4. A parent IMC set is generally effective throughout the entire registration period. Because of various random phenomena and dynamic range limitations, the parent IMC set may be modified by small IMC subsets for varying subspans of the registration period. The parent IMC set and its modifiers all have the same IMC epoch. All subtypes of Message 33 sent to the SPSs are full length and contain the entire message.

Message 33 – O&A Data Response (5 of 5)

5. The IMC set identifier and validation is described in Section 4.3.2.2.1.
6. A normal parent IMC set, Subtype 1, includes the entire data set as shown. For this subtype the spacecraft compensation terms are zero.
7. A medium-term IMC set, Subtype 2, is used only when the dynamic range cannot be maintained over a 24-hour period. The day is then broken into four or five shorter periods. For the first period, the entire message is sent as a Subtype 1. For each subsequent period, a Subtype 2 message is used in which the reference orbit changes. The epoch for the Subtype 2 message is the same as for the associated Subtype 1 message, and should not be uploaded.
8. A short-term IMC set, Subtype 3, is used only when compensating for Earth sensor errors due to clouds or radiance gradients, when operating with an Earth sensor inhibited due to Sun or Moon intrusions, or when compensating for yaw attitude variation due to magnetic storms, or other similar occurrences, etc. For this case, only the spacecraft compensation terms change. The epoch is the same as that for the currently active coefficient set.
9. A thermally induced IMC set, Subtype 4, is used when compensating for misalignments caused by nonrepeatable on-board thermally induced changes to Imager or Sounder pointing. The spacecraft compensation terms are the same as in the parent set.
10. A post-maneuver parent IMC set, Subtype 5, indicates that a new set of coefficients should be put into effect following a maneuver that is planned and expected to be executed. This provides the best estimate of the IMC coefficients until the post-maneuver orbit and attitude are determined, at which time a new set of coefficients is generated. This message uses all the data fields shown.
11. A medium-term IMC set, Subtype 6, is used only when a short span orbit and attitude adjust is required after a stationkeeping maneuver. The Subtype 6 may modify either a Subtype 5 or a Subtype 1 parent set. The epoch for the Subtype 6 message is the same as for the associated parent set.
12. The recommended enable time is in minutes and is relative to the epoch time. The enable time is commonly a negative number, indicating that the recommended enable time is before the epoch time.
13. The recommended enable times have different validation ranges for each message subtype, as follows:
    Subtype 1: –720 to +1440 min from IMC epoch
    Subtype 2: –720 to +1440 min from IMC epoch
    Subtype 3: 9999 enable as soon as possible (ASAP)
    Subtype 4: 9999 enable ASAP
    Subtype 5: –720 to +1440 min from IMC epoch

Message 41 – IMC Quality Check Request

OATS requests data from the PM to verify that the Imager and Sounder IMC corrections being applied on the spacecraft agree with the current IMC coefficients that OATS has provided to GIMTACS/GTACS. The request may include data from the Imager, the Sounder, or both. The PM responds to the request with one or more Message 21s containing the data for the Imager or the Sounder, although the time spans for the two instruments are identical. The Message 41 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 11,12,13,14,15,16,17,18,19,29 (PM)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 41
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
                                    = 3 - BOTH
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|_
      1  |                     YEAR                      | |
         |-----------------------------------------------| |
      2  |  |         DAY OF YEAR            |  HR (10s) | | DATA
         |-----------------------------------------------| | SPAN
      3  |  HR (1s)  |        MINUTES         |  SEC (10s)| | START
         |-----------------------------------------------| | TIME
      4  |  SEC (1s) |               MSECS               | |
         |-----------------------------------------------|_
      5  |               DATA SPAN DURATION              |
      6  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
DATA SPAN START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	1-120	MIN

Message 42 – Terminate IMC Quality Check Data

OATS sends Message 42 to the PMs to prematurely terminate transmission of the previously requested IMC quality check data. Message 42 has no data block. The Message 42 layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 11,12,13,14,15,16,17,18,19,29 (PM)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 42
      MESSAGE SUBTYPE               = 0
      TRACER                        = SEE NOTES
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A


DATA BLOCK LAYOUT: N/A
```

Notes:

1. Message 42 is normally sent to cancel transmission when IMC quality check data is arriving at the OATS with an unknown tracer. In this case, the Message 42 tracer is the same as for the IMC quality check data Message 21 received.

2. Message 42 may also be sent unsolicited from the OATS to the PM to cancel a pending request for IMC quality check data. In this case, the value of the tracer field is one of the following special character strings. Each string is left-justified and right-padded with blanks to fill the 10-byte tracer field.

"Imager_ _ _ _"	To cancel request for Imager data
"Sounder_ _ _"	To cancel request for Sounder data
"Both_ _ _ _ _ _"	To cancel request for all data

Message 45 – OATS Inter-node Message (1 of 2)

Message 45 allows processes on one OATS node to communicate with processes on another OATS node. The message data block is the complete inter-process message, including the header and data blocks. The Message 45 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
                                    = 20,21,22,23,24 (N-P virtual S/C)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M (OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = VARIABLE (SEE NOTES)
      MESSAGE TYPE                  = 45
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |          INTERPROCESS MESSAGE TYPE            |
      .  |                                               |
      4  |                                               |
         |-----------------------------------------------|
      5  |         INTERPROCESS MESSAGE SUBTYPE          |
      .  |                                               |
      8  |                                               |
         |-----------------------------------------------|
      9  |               INTERPROCESS MESSAGE            |
      .  |                  SATELLITE NODE               |
     12  |                                               |
         |-----------------------------------------------|
     13  |        INTERPROCESS MESSAGE SATELLITE         |
      .  |                                               |
     16  |                                               |
         |-----------------------------------------------|
     17  |           INTERPROCESS MESSAGE LENGTH         |
      .  |                                               |
     20  |                                               |
         |-----------------------------------------------|
     21  |           INTERPROCESS MESSAGE SENDER         |
      .  |                                               |
     28  |                                               |
         |-----------------------------------------------|
     29  |         INTERPROCESS MESSAGE RECEIVER         |
      .  |                                               |
     34  |                                               |
         |-----------------------------------------------|
     35  |                    SPARE                      |
      .  |                                               |
     40  |                                               |
         |-----------------------------------------------|
     41  |              INTERPROCESS MESSAGE             |
      .  |                      BODY                     |
      .  |                                               |
         |-----------------------------------------------|
```

Message 45 – OATS Inter-node Message (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
INTERPROCESS MESSAGE TYPE	I*8		N/A
INTERPROCESS MESSAGE SUBTYPE	I*8	N/A	
INTERPROCESS MESSAGE SAT NODE	I*8	41-50 (I-M)	N/A
	I*8	75-85 (N-P)	N/A
INTERPROCESS MESSAGE SAT	I*8	8-12, 20-24 (I-M)	N/A
	I*8	13-17,20-24 (N-P)	N/A
INTERPROCESS MESSAGE LENGTH	I*8		N/A
INTERPROCESS MESSAGE SENDER	C*16		N/A
INTERPROCESS MESSAGE RECEIVER	C*16		N/A
SPARE	I*8		N/A
INTERPROCESS MESSAGE DATA			N/A

Notes:

1. The message length depends upon the length of the interprocess message being sent.

2. Virtual satellites are acceptable since this message stays within the OATS environment.

   OATS node numbers are as follows:

41 = SOAT01	42 = SOAT02
43 = SOAT03	44 = SOAT04
45 = SOAT05	46 = SOAT06
47 = COAT01	48 = COAT02
49 = GOAT01	50 = GOAT02
75 = SOAT11 (SOCC)	76 = SOAT12 (SOCC)
77 = SOAT13 (SOCC)	78 = SOAT14 (SOCC)
79 = SOAT15 (SOCC)	80 = SOAT16 (SOCC)
81 = SOAT17 (SOCC)	82 = COAT11 (CDAS)
83 = COAT12 (CDAS)	84 = COAT13 (CDAS)
85 = GOAT11 (WBU)	

Message 51 – Star View Command Parameter Response (1 of 3)

OATS responds to a Message 151 from GIMTACS/GTACS with command execute times, sensor coordinates, and dwell times for star commands within the Message 151 star command viewing windows. The message may support more than one window, and, for each window, more than one star may be included. For each star, one or more looks are indicated in the message. Since this message has the capacity to exceed the maximum physical message size, multiple messages are transmitted until the entire response is complete.

Half-words 13 – 18 and 25 – 32 in Message 51 are replicated by GIMTACS/GTACS into a Message 202 sent back to OATS. This Message 202 contains measurement data from Message 2 star view command (sets) actually transmitted to the spacecraft and for which the SPS has received star measurement data. The Message 51 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = VARIABLE (SEE NOTES)
      MESSAGE TYPE                  = 51
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1-255
      END OF MESSAGE                = TRUE/FALSE
      ROUTING ID                    = AS PROVIDED IN MSG 151

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |               IMC SET IDENTIFIER              |
      2   |
          |-----------------------------------------------|
      3   |                      SPARE                    |
      4   |
          |-----------------------------------------------|
      5   |           NO. OF WINDOWS IN MESSAGE (N)       |
      6   |
          |-----------------------------------------------|
      7   |         NUMBER OF UNACCEPTABLE WINDOWS        |
      8   |
          |-----------------------------------------------|
      9   |               WINDOW SEQUENCE NO.             |
          |-----------------------------------------------|
     10   |             WINDOW ACCEPTABLE FLAG            |
          |-----------------------------------------------|
     11   |           NO. OF STARS IN WINDOW (K)          |
     12   |
          |-----------------------------------------------|
     13   |                     STAR ID                   |
     14   |
          |-----------------------------------------------|
     15   |            NO. OF LOOKS FOR STAR (J)          |
     16   |
```

Message 51 – Star View Command Parameter Response (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    17  |            LOOK NO. IN CMD SEQUENCE           |
    18  |                                               |
        |-----------------------------------------------|
    19  |                 LOOK DWELL REPEATS            |
    20  |                                               |
        |-----------------------------------------------|_
    21  |                      YEAR                     | |
        |-----------------------------------------------| |
    22  |  |         DAY OF YEAR          | HR (10s)    | | STAR
        |-----------------------------------------------| | COMMAND
    23  | HR (1s)  |        MINUTES        | SEC (10s)   | | EXECUTE
        |-----------------------------------------------| | TIME
    24  | SEC (1s) |             MSECS                   |_|
        |-----------------------------------------------|_
    25  |                   E-W CYCLES                  |
    26  |                                               |
        |-----------------------------------------------|
    27  |                 E-W INCREMENTS                |
    28  |                                               |
        |-----------------------------------------------|
    29  |                   N-S CYCLES                  |
    30  |                                               |
        |-----------------------------------------------|
    31  |                 N-S INCREMENTS                |
    32  |                                               |
        |-----------------------------------------------|
    33  |  ADDITIONAL LOOKS FOR THIS STAR REPEAT WORDS  |
16(J+1) |           17 THRU 32 FOR J LOOKS              |
        |-----------------------------------------------|
     .  |  ADDITIONAL STARS AND LOOKS FOR THIS WINDOW   |
     .  |         REPEAT FROM WORD 13 TO ABOVE          |
        |-----------------------------------------------|
     .  |     ADDITIONAL WINDOWS, STARS, AND LOOKS      |
     .  |         REPEAT FROM WORD 9 TO ABOVE           |
     .  |                  SEE NOTES                    |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
NO. OF WINDOWS IN MESSAGE	I*4	0-72	N/A
NUMBER UNACCEPTABLE WINDOWS	I*4	0-50	N/A
WINDOW SEQUENCE NO.	I*2	1-65535	N/A
WINDOW ACCEPTABLE FLAG	I*2	1 - YES (SEE NOTES)	N/A
		2 - NO (SEE NOTES)	N/A
NO. OF STARS IN WINDOW	I*2	1-100 (SEE NOTES)	N/A
STAR ID (YALE CAT BS NO.)	I*4	1-9999	N/A
NO. OF LOOKS FOR STAR	I*4	1-16	N/A
LOOK NUMBER IN CMD SEQUENCE	I*4	1-16	N/A
LOOK DWELL REPEATS	I*4	0-63 (IMAGER)	N/A
		0-15 (SOUNDER	N/A
STAR COMMAND EXECUTE			
TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTE	BCD	0-59	MIN
SECOND	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
E-W CYCLES	I*4	0-5 (I-M)	CYCLES
		0-7 (N-P)	CYCLES

Message 51 – Star View Command Parameter Response (3 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
E-W INCREMENTS	I*4	0-6135 (IMAGER)	INCREMENTS
		0-2405 (SOUNDER)(I-M)	INCREMENTS
		0-2804 (SOUNDER)(N-P)	INCREMENTS
N-S CYCLES	I*4	0-9	CYCLES
N-S INCREMENTS	I*4	0-6135 (IMAGER)	INCREMENTS
		0-2405 (SOUNDER)(I-M)	INCREMENTS
		0-2804 (SOUNDER)(N-P)	INCREMENTS

Notes:

1. An Imager dwell is 1 second; each Sounder dwell is 4 seconds.

2. The number of windows in a message is equal to zero if the satellite is not supported. All remaining items after half-word eight are omitted.

3. Window acceptable flag
   1 = Acceptable (requisite number of stars found)
   2 = Unable to command the requisite number of stars

4. Number of stars in window
   0 = No stars in window, all remaining items for the window are omitted
   N = Number of stars selected for window

5. Message 51 is multiply nested in the order [window [star [look]]] for each look at a star, for each star in a window, and for all windows in the message.

6. If there is more than one look at a star, a star sequence is implied.

7. Half-words 17 – 32 are repeated for each look in a star view.

8. Half-words from 13 on are repeated for each star in a given window.

9. Half-words from nine on are repeated for each window in the message.

10. The message length depends on the number of looks in each sequence, the number of stars in each window, and the number of windows in the message. The message length using the validation limits is given by $8 + N(4 + K(4 + J(16)))$. The maximum length is 824,204 16-bit half-words, when $N = 50$, $K = 100$, and $J = 10$, greater than the maximum frame length limit.

11. Each message contains an integral number of windows and all the nested data associated with those windows. The total number of messages and the number of windows in each message is dependent on the values in the requesting message.

12. The IMC set identifier is identical to the identifier in the associated Message 151. For an explanation of the IMC set identifier, see the notes for Message 151.

Message 53 – IMC Coefficient Command Parameter Response (GOES N-P) (1 of 4)

For GOES N-P, in response to a Message 153 from GTACS requesting a superset of IMC coefficients by a specific ID, OATS returns the requested spacecraft and instrument attitude motion compensation coefficients. The spacecraft ACE evaluates these coefficients repeatedly as the running parameters to compute the instantaneous instrument correction values.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (GOES N-P)
      SOURCE                        = 75 – 85 (OATS)
      DESTINATION                   = 90 – 101 (GTACS)
      NO. OF HALF-WORDS             = 1162
      MESSAGE TYPE                  = 53
      MESSAGE SUBTYPE               = 1 - FULL SET (24 HR)
                                    = 2 - NEW ORBIT REFERENCE SET
                                    = 3 - SSAA, COUPLED IMGR/SNDR
                                    = 4 - SSAA, UNCOUPLED
                                    = 5 - POST-SK FULL SET
                                    = 6 - SHORT SPAN O&A ADJUST
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A (used internally by OATS)
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15	
1	YEAR																UTC EPOCH DATE AND TIME
2		DAY OF YEAR											HR(10s)				
3	HR(1s)				MINUTES								SEC(10s)				
4	SEC(1s)				MSECS												
5	DYNAMIC RANGE FLAG																
6	IMC TYPE																
7	IMC SET IDENTIFIER																
8																	
9	YAW FLIP FLAG																
10																	
11	EPOCH DAY (REFERENCED TO JD2000)																
12																	
13	EPOCH TIME OF DAY (SECONDS FROM EPOCH DAY)																
14																	

Message 53 – IMC Coefficient Command Parameter Response (GOES N-P) (2 of 4)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB
15 16	FUNDAMENTAL FOURIER FREQUENCY
17 18	NOMINAL EARTH RATE
19 : 66	24 ORBITAL COEFFICIENTS
67 68	SPACECRAFT LONGITUDE REFERENCE
69 70	TRUE GREENWICH HOUR ANGLE (at t_0)
71 72	NOMINAL GEOSYNCH RADIUS
73 74	PRECESSION AND NUTATION QUARTERNION (at t_0) q_1
75 76	PRECESSION AND NUTATION QUARTERNION (at t_0) q_2
77 78	PRECESSION AND NUTATION QUARTERNION (at t_0) q_3
79 80	PRECESSION AND NUTATION QUARTERNION (at t_0) q_4
81 82	EXPONENTIAL START TIME FROM IMC EPOCH
83 84	EXPONENTIAL MAGNITUDE
85 86	EXPONENTIAL TIME CONSTANT
87 88	MAGNITUDE OF ZEROTH ORDER FOURIER
89 : 118	MAGNITUDE OF 1st THROUGH 15th ORDER FOURIER SINE
119 : 148	MAGNITUDE OF 1st THROUGH 15th ORDER FOURIER COSINE
149 150	NUMBER OF MONOMIAL SINUSOIDS (N)

Message 53 – IMC Coefficient Command Parameter Response (GOES N-P) (3 of 4)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB
151 : 158	ORDER OF 1st THROUGH 4th SINUSOID
159 : 166	ORDER OF 1st THROUGH 4th MONOMIAL
167 : 174	MAGNITUDE OF 1st THROUGH 4th MONOMIAL SINUSOID
175 : 182	PHASE ANGLE OF 1st THROUGH 4th SINUSOID
183 : 190	ANGLE FROM EPOCH WHERE MONOMIAL IS ZERO FOR 1st THROUGH 4th TERMS
191 : 1162	WORDS 83-190 ARE REPEATED FOR PITCH, YAW AND THE MISALIGNMENTS FOR THE IMAGER FOLLOWED BY THE FIVE SOUNDER ANGLES

DATA ITEM	FORMAT	VALIDATION	UNITS
UTC EPOCH DATE AND TIME - YEAR	BCD	2001 TO 2049	YEAR
DAY OF YEAR	BCD	1 TO 366	DAY
HOUR	BCD	0 TO 23	HOUR
MINUTES	BCD	0 TO 59	MIN
SECONDS	BCD	0 TO 59	SECS
MILLISECONDS	BCD	0 TO 999	MSECS
DYNAMIC RANGE FLAG	I*2	1 = LOW 2 = HIGH	N/A
IMC TYPE	I*2	1 – 7	N/A
IMC SET IDENTIFIER	ASCII	ANNN	N/A
YAW FLIP FLAG	I*4	+1 – Normal -1 – Inverted	N/A
EPOCH DAY	I*4	0 TO 10000	N/A
EPOCH TIME OF DAY	R*4	0.0 TO 86400.0	SECONDS
FUNDAMENTAL FOURIER FREQUENCY	R*4	.00001- TO .000437	RAD/SEC
NOMINAL EARTH RATE	R*4	.000010 TO .000073	RAD/SEC
ORBITAL COEFFICIENTS	R*4	-.0065 TO +0.0065	SEE NOTE
SPACECRAFT LONGITUDE REFERENCE	R*4	$-\pi$ TO $+\pi$	RAD
TRUE GREENWICH HOUR ANGLE	R*4	$-\pi$ TO $+\pi$	RAD
PRECESSION AND NUTATION QUATERNION	R*4	-1.0 TO +1.0	N/A
NOMINAL GEOSYNCH RADIUS	R*4	4.E7 TO 4.5E7	METERS

Message 53 – IMC Coefficient Command Parameter Response (GOES N-P) (4 of 4)

DATA ITEM	FORMAT	VALIDATION	UNITS
EXPONENTIAL START TIME	R*4	-43200 TO +43200	SEC FROM EPOCH
EXPONENTIAL MAGNITUDE	R*4	-0.00327 TO +0.00327	RAD
DATA ITEM	FORMAT	VALIDATION	UNITS
EXPONENTIAL TIME CONSTANT	R*4	780 TO 86400	SEC
MAGNITUDE OF ZEROTH TERM	R*4	-0.00327 TO 0.00327	RAD
MAGNITUDE OF COSINE	R*4	-0.0065 TO +0.0065	RAD
MAGNITUDE OF SINE	R*4	-0.0065 TO +0.0065	RAD
NUMBER OF MONOMIAL SINUSOID	R*4	0 TO 4	N/A
ORDER OF SINUSOID	R*4	0 TO 15	N/A
ORDER OF MONOMIAL	R*4	1 TO 15	N/A
MAG OF MONOMIAL SINUSOID	R*4	-0.00065 TO +0.00065	RAD
PHASE ANGLE OF SINUSOID	R*4	$-\pi$ TO $+\pi$	RAD
ANGLE FROM EPOCH	R*4	-5π TO $+5\pi$	RAD

Notes:

1. The yaw flip flag is set to +1 for a spacecraft in its normal upright orientation and –1 when it is rotated 180° about the yaw axis (yaw flipped).
2. Half-words 83 through 190 are repeated for each Imager attitude angle in roll, pitch, yaw, roll misalignment, and yaw misalignment order. This information is then repeated for the Sounder, in the same order, for a total of 10 blocks of attitude angles.
3. The message length is 82 + 10(108), with a length of 1162 16-bit half-words.
4. A parent IMC superset is generally effective throughout the entire image registration period. Because of various random natural phenomena or dynamic range limitations, the parent IMC superset may be modified by small IMC subsets for varying sub-spans of the coregistration period. The parent IMC superset and its modifiers all have the same IMC epoch.
5. The IMC superset identifier and validation is described in Section 4.3.2.2.1.
6. An IMC superset includes the entire set of data as shown.
7. All the Fourier and monomial sinusoid coefficients are included in the table even though many are not used and are set to zero.
8. The EPOCH time is sent in the standard external message format and in the JD2000 format needed by the spacecraft. This form is a 32-bit integer JD2000 day and a 32-bit floating point seconds of JD2000 day.

   The orbital coefficients have various units and limits as indicated:

COEFFICIENT	UNITS	LIMIT
CF1	RAD	±0.065
CF2	NONE	±0.065534
CF3	1/RAD	±0.00032767
CF4–CF6	RAD	±0.065
CF7-CF12	RAD	±0.0032767
CF13–CF14	NONE	±0.0032767
CF15–CF18	RAD	±0.065
CF19-CF20	RAD	±0.0032767
CF21–CF22	NONE	±0.0032767
CF23–CF24	RAD	±0.0032767

The data in half-words 7-1162 constitute the IMC set to be uploaded to the spacecraft IMC buffer.

Message 53 – IMC, SMC, or SCC Coefficient Command Parameter Response (GOES I-M)

For GOES I-M, OATS sends this message either in response to a Message 153 from GIMTACS or as a result of an automatic Short Span Attitude Adjustment (SSAA), In response to a Message 153 from GIMTACS requesting a set of IMC, SMC, or SCC coefficients by a specific ID, OATS sends one of the various Message 53 subtypes containing the requested spacecraft and instrument attitude motion compensation coefficients. Subtypes 1 – 6 are used for IMC sets. Subtype 101 is used for SMC coefficient sets, normally sent once per day during the summer and winter seasons, and Subtype 102 is used for SCC coefficient sets. The spacecraft AOCE evaluates these coefficients repeatedly as the running parameters to compute the instantaneous instrument correction values. In the event programmed functions in the AOCE prove inadequate to model the attitude behavior of the instruments, an alternate set of data can be provided in LUT form by way of a Message 53-LUT. As currently programmed, OATS computes the LUT form of the message only with the current attitude basis function. Should other, as yet unidentified functions be required, both the OATS and the SPS would have to be updated to incorporate these functions. When sent unsolicited as a result of an automatic SSAA, Message 53 is preceded by a Message 63, SSAA IMC Set Ready, to inform GIMTACS that a revised IMC set is on the way. The Message 53 generated from an SSAA always provides an IMC coefficient set and never an SMC or SCC coefficient set. The data block layout and field definitions for the various Message 53 subtypes and the Message 53-LUT follow.

Message 53-1 to 53-6 – IMC Coefficient Command Parameter Response (GOES I-M) (1 of 5)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (GOES I-M)
      SOURCE                        =41,42,43,44,45,46,47,48,48,49,50 (I-M OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 1174
      MESSAGE TYPE                  = 53
      MESSAGE SUBTYPE               = 1 - FULL SET (24 HR)
                                    = 2 - NEW ORBIT REFERENCE SET
                                    = 3 - SSAA, COUPLED IM/SDR
                                    = 4 - SSAA UNCOUPLED IM/SDR
                                    = 5 - POST-SK FULL SET
                                    = 6 – SSO&A ADJUST
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 153
```

Message 53-1 to 53-6 – IMC Coefficient Command Parameter Response (GOES I-M) (2 of 5)

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |                IMC SET IDENTIFIER             |
      2  |                                               |
         |-----------------------------------------------|
      3  |                SSAA USAGE FLAG                |
      4  |                                               |
         |-----------------------------------------------|
      5  |                     SPARE                     |
      6  |                                               |
         |-----------------------------------------------|
      7  |                 YAW FLIP FLAG                 |
      8  |                                               |
         |-----------------------------------------------|
      9  |            DATA FORMAT INDICATOR              |
         |-----------------------------------------------|
     10  |              DYNAMIC RANGE FLAG               |
         |-----------------------------------------------|
     11  |   RECOMMENDED IMC SET ENABLE TIME FROM EPOCH  |
     12  |                                               |
         |-----------------------------------------------|_
     13  |                     YEAR                      | |
         |-----------------------------------------------| |
     14  |  |         DAY OF YEAR            |  HR (10s)  | | EPOCH
         |-----------------------------------------------| | DATE AND
     15  |  HR (1s)  |        MINUTES         |  SEC (10s) | | TIME
         |-----------------------------------------------| |
     16  |  SEC (1s) |               MSECS                | |
         |-----------------------------------------------|_
     17  |         SPACECRAFT COMPENSATION - ROLL        |
     18  |                                               |
         |-----------------------------------------------|
     19  |         SPACECRAFT COMPENSATION - PITCH       |
     20  |                                               |
         |-----------------------------------------------|
     21  |         SPACECRAFT COMPENSATION - YAW         |
     22  |                                               |
         |-----------------------------------------------|—Subtype 3
     23  |    ATTITUDE CONSTANTS - ROLL, PITCH, YAW,     |
      .  |     ROLL MISALIGNMENT, PITCH MISALIGNMENT     |
     42  |        (5 EACH FOR IMAGER THEN SOUNDER)       |
         |-----------------------------------------------|—Subtype 4
     43  |                                               |
      .  |           24 ORBITAL COEFFICIENTS             |
     90  |                                               |
         |-----------------------------------------------|—Subtypes 2 & 6
     91  |           ADJUSTMENT TO ON-BOARD              |
     92  |              DAILY SOLAR RATE                 |
         |-----------------------------------------------|
     93  |    EXPONENTIAL START TIME FROM UTC MIDNIGHT   |
     94  |                                               |
         |-----------------------------------------------|
     95  |             EXPONENTIAL MAGNITUDE             |
     96  |                                               |
         |-----------------------------------------------|
     97  |           EXPONENTIAL TIME CONSTANT           |
     98  |                                               |
         |-----------------------------------------------|
     99  |    NUMBER OF FOURIER AND PHASE ANGLES (K)     |
    100  |                                               |
```

Message 53-1 to 53-6 – IMC Coefficient Command Parameter Response (GOES I-M) (3 of 5)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
   101  |       MAGNITUDE OF FIRST-ORDER FOURIER        |
   102  |                                               |
        |-----------------------------------------------|
   103  |      PHASE ANGLE OF FIRST-ORDER FOURIER       |
   104  |                                               |
        |-----------------------------------------------|
   105  |  MAGNITUDES AND PHASE ANGLES OF 2-ND THROUGH  |
     .  |             K-TH ORDER FOURIER                |
 4K+100 |                                               |
        |-----------------------------------------------|
 4K+101 |        NUMBER OF MONOMIAL SINUSOIDS (N)       |
 4K+102 |                                               |
        |-----------------------------------------------|
 4K+103 |               ORDER OF SINUSOID               |
 4K+104 |                                               |
        |-----------------------------------------------|
 4K+105 |               ORDER OF MONOMIAL               |
 4K+106 |                                               |
        |-----------------------------------------------|
 4K+107 |         MAGNITUDE OF MONOMIAL SINUSOID        |
 4K+108 |                                               |
        |-----------------------------------------------|
 4K+109 |           PHASE ANGLE OF SINUSOID             |
 4K+110 |                                               |
        |-----------------------------------------------|
 4K+111 |               ANGLE FROM EPOCH                |
 4K+112 |            WHERE MONOMIAL IS ZERO             |
        |-----------------------------------------------|
 4K+113 |ORDERS, MAGNITUDES, PHASE ANGLES, AND LOCATION |
     .  | ANGLES FROM EPOCH FOR UP TO THREE ADDITIONAL  |
 4K+112 |               MONOMIAL SINUSOIDS              |
   +10N |-----------------------------------------------|—Subtypes 1 & 5
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
YAW FLIP FLAG	I*4	-1, +1	N/A
SSAA USAGE FLAG	I*4	0 - NOT A REACTIVE SET 1 - BOTH IMC AND STAR SENSE DELTA 2 - IMC ONLY 3 - STAR SENSE DELTA ONLY	N/A
DATA FORMAT INDICATOR	I*2	0 - COEFFICIENT	N/A
DYNAMIC RANGE FLAG	I*2	1 - LOW, 2 - HIGH	N/A
RECOMMENDED ENABLE TIMER FROM IMC EPOCH	R*4	SEE NOTE BELOW	MIN
EPOCH DATE AND TIME- YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MIN
SECOND	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
SPACECRAFT COMPENSATION ROLL, PITCH, YAW	R*4	-.004 TO +.004	RAD
ATTITUDE CONSTANTS	R*4	-0.00327 TO +0.00327	RAD
ORBITAL COEFFICIENTS	R*4	SEE NOTE #15	
DAILY SOLAR RATE ADJUSTMENT	R*4	-0.0000065 TO +0.0000065	RAD/SEC

Message 53-1 to 53-6 – IMC Coefficient Command Parameter Response (GOES I-M) (4 of 5)

DATA ITEM	FORMAT	VALIDATION	UNITS
EXPONENTIAL START TIME FROM UTC MIDNIGHT	R*4	0.0 TO 1092	MIN
EXPONENTIAL MAGNITUDE	R*4	-0.00327 TO +0.00327	RAD
EXPONENTIAL TIME CONSTANT	R*4	13 TO 1440	MIN
NUMBER OF FOURIER ANGLES	I*4	0-15	N/A
MAGNITUDE OF FOURIER	R*4	-0.0065 TO +0.0065	RAD
PHASE ANGLE OF FOURIER	R*4	$-\pi$ TO $+\pi$	RAD
NUMBER OF MONOMIAL SINUSOID	I*4	0-4	N/A
ORDER OF SINUSOID	I*4	0-15	N/A
ORDER OF MONOMIAL	I*4	1-15	N/A
MAG OF MONOMIAL SINUSOID	R*4	-0.00065 TO +0.00065	RAD
PHASE ANGLE OF SINUSOID	R*4	$-\pi$ TO $+\pi$	RAD
ANGLE FROM EPOCH	R*4	$-\pi$ TO $+\pi$	RAD

Notes:

1. The yaw flip flag is set to +1 for a spacecraft in its normal upright orientation and –1 when it is rotated 180° about the yaw axis.
2. Half-words 95 through $4K + 102 + 10N$ are repeated for each Imager attitude angle in roll, pitch, yaw, roll misalignment, and yaw misalignment order. This information is then repeated in the same order for the Sounder for a total of 10 blocks of attitude angles.
3. The message length is $94 + 10(4K + 10N + 8)$ with a maximum length of 1174 sixteen-bit half-words, when $K = 15$ and $N = 4$.
4. A parent IMC set is generally effective throughout the entire image registration period. Because of various random natural phenomena or dynamic range limitations, the parent IMC set may be modified by small IMC subsets for varying subspans of the co-registration period. The parent IMC set and its modifiers all have the same IMC epoch.
5. The IMC set identifier and validation is described in Section 4.3.2.2.1.
6. A normal parent IMC set, Subtype 1, includes the entire set of data as shown. For this subtype, the spacecraft compensation terms will be zero.
7. A medium-term IMC set, Subtype 2, is used only when the dynamic range cannot be maintained over a 24-hour period and the day is broken into four or five shorter periods. For the first period, the entire message is sent as Subtype 1. For each subsequent period, a Subtype 2 is sent in which the reference orbit changes, and the message terminates with half-word 90. All remaining items are kept the same as the parent set. The epoch for the Subtype 2 message is the same as the associated Subtype 1 message and should not be uploaded.
8. A short-term IMC set, Subtype 3, is used only when compensating for Earth sensor errors due to clouds, radiance gradients, or when operating with an Earth sensor inhibited due to Sun and Moon intrusions, or when compensating for yaw attitude variations due to magnetic storms. For this case, only the spacecraft compensation terms change, and the message terminates with half-word 22. The epoch is the same as that for the currently active coefficient set and should not be uploaded.
9. A thermal induced IMC set, Subtype 4, is used when compensating for misalignments caused by nonrepeatable on-board, thermal changes to Imager or Sounder pointing. The spacecraft compensation terms are the same as in the parent set, and the 10 attitude constants give the correction for Imager and Sounder. The message terminates at half-word 42.
10. A post-maneuver parent IMC set, Subtype 5, indicates that a new set of coefficients are to be put into effect following a planned maneuver. This provides the best estimate of the IMC coefficients until the post-maneuver orbit and attitude are determined, at which time a new set of coefficients is generated. This message uses all the data fields shown.
11. A medium-term IMC set, Subtype 6, is used only when a short span orbit and attitude adjustment is required after a stationkeeping maneuver. Although, a Subtype 5 parent set is generally in effect at this time, the Subtype 6 set may also modify a Subtype 1 parent set. The message contains changes to the three spacecraft compensation attitude terms (half-words 17 to 18, 19 to 20, 21 to 22) and four orbit coefficients (half-words 43 to 44, 49 to 50, 75 to 76, and 77 to 78) with all other items remaining unchanged from the parent set. The message terminates with half-word 90. The Subtype 6 message epoch is the same as for the associated parent set and should not be uploaded.
12. The recommended enable time is in minutes and is relative to the epoch time. The enable time is commonly a negative number, indicating that the recommended enable time is before the epoch time.

Message 53-1 to 53-6 – IMC Coefficient Command Parameter Response (GOES I-M) (5 of 5)

13. All subtypes have the same epoch as the parent type. Subtypes 3, 4, and 6 should be loaded as early as possible. A parent IMC set (subtypes 1 or 5) may be modified at a specific time by a modifying IMC set (Subtype 3, 4, or 6). These modifying IMC sets may be in effect sequentially in any order, but only one modifying set may be in effect at a given time. When the operator changes from one modifying subtype to another, the transition IMC set OATS generates (Subtype 4 or 6) ensures the integrity of the entire IMC process—including the on-board IMC scan correction process and the GIMTACS star commanding correction process. Because of uploading constraints, summation is from i = 1 to 10 of $(2k(i) + 3n(i))$ 380, where the i are the roll, pitch, yaw, roll misalignment, and pitch misalignment for the Imager and Sounder.

14. The recommended enable times have different validation ranges for each message subtype, as follows:

    Subtype 1: –720 to +720 min from IMC epoch
    Subtype 2: –720 to +720 min from IMC epoch
    Subtype 3: 9999 enable as soon as possible (ASAP)
    Subtype 4: 9999 enable ASAP
    Subtype 5: –720 to +720 min from IMC epoch
    Subtype 6: 9999 enable ASAP

15. The orbital coefficients have the following ranges and units:

Orbital Coefficient	Range		Units
CF01	-0.065	+0.065	RAD
CF02	-0.0065536	+0.0065534	NONE
CF03	-0.00032768	+0.00032767	1/RAD
CF04–CF06	-0.065	+0.065	RAD
CF07–CF12	-0.0032768	+0.0032767	RAD
CF13–CF14	-0.0032768	+0.0032767	NONE
CF15–CF18	-0.065	+0.065	RAD
CF19–CF20	-0.0032768	+0.0032767	RAD
CF21–CF22	-0.0032768	+0.0032767	NONE
CF23–CF24	-0.0032768	+0.0032767	RAD

Message 53-101 – SMC Coefficient Command Parameter Response (GOES I-M)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 250
      MESSAGE TYPE                  = 53
      MESSAGE SUBTYPE               = 101 - SMC SET
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 153

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |                SMC SET IDENTIFIER             |
      2  |                                               |
         |-----------------------------------------------|
      3  |          TIME INTERVAL BETWEEN POINTS         |
      4  |                                               |
         |-----------------------------------------------|
      5  |                SMC START TIME                 |
      6  |                                               |
         |-----------------------------------------------|
      7  |                   ROLL VALUES                 |
    126  |                                               |
         |-----------------------------------------------|
    127  |                   PITCH VALUES                |
    246  |                                               |
         |-----------------------------------------------|
    247  |               ROLL SCALE FACTOR               |
    248  |                                               |
         |-----------------------------------------------|
    249  |               PITCH SCALE FACTOR              |
    250  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SMC SET IDENTIFIER	ASCII	NNNA	N/A
TIME INTERVAL BETWEEN POINTS	I*4	512-1464320	MILLISEC
SMC START TIME	I*4	0-86400000	MILLISEC
ROLL VALUES	I*4	-125 to 125	N/A
PITCH VALUES	I*4	-125 to 125	N/A
ROLL SCALE FACTOR	R*4	-.000008 to .00008	RAD
PITCH SCALE FACTOR	R*4	-.000016 to .000016	RAD

Notes:

1. LSB for time interval is 512 msec.
2. LSB for start time is 3072 msec.
3. Roll and pitch values are in the order: 2, 1, 4, 3 … 60, and 59.

Message 53-102 – SCC Coefficient Command Parameter Response (GOES I-M)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 42
      MESSAGE TYPE                  = 53
      MESSAGE SUBTYPE               = 102 - SCC SET
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 153

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |                SCC SET IDENTIFIER             |
      2  |                                               |
         |-----------------------------------------------|
      3  |                MAGNITUDE VALUES               |
     22  |                                               |
         |-----------------------------------------------|
     23  |                  PHASE VALUES                 |
     42  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SCC SET IDENTIFIER	ASCII	NNNC	N/A
MAGNITUDE VALUES	R*4	-.000008 to .00008	RAD
PITCH SCALE FACTOR	R*4	-.000016 to .000016	RAD

Message 53 – LUT – IMC, SMC, or SCC LUT Format (GOES I-M) (1 of 5)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.     = 1-65535
      SATELLITE ID             = 8,9,10,11,12 (I-M)
      SOURCE                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION              = 10 (GIMTACS)
      NO. OF HALF-WORDS        = UP TO 1072
      MESSAGE TYPE             = 53-LUT
      MESSAGE SUBTYPE          = 1 - FULL SET (24 HR)
                               = 2 - NEW ORBIT REFERENCE SET
                               = 3 - SSAA, COUPLED IM/SDR.
                               = 4 - (NOT APPLICABLE)
                               = 5 - POST-SK FULL SET
                               = 6 - SSO&A ADJUST
      TRACER                   = BLANKS
      MESSAGE COUNT            = 1
      END OF MESSAGE           = TRUE
      ROUTING ID               = AS PROVIDED IN MSG 153

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |               IMC SET IDENTIFIER              |
      2   |-----------------------------------------------|
      3   |                SSAA USAGE FLAG                |
      4   |-----------------------------------------------|
      5   |                    SPARE                      |
      6   |-----------------------------------------------|
      7   |                 YAW FLIP FLAG                 |
      8   |-----------------------------------------------|
      9   |            DATA FORMAT INDICATOR              |
          |-----------------------------------------------|
     10   |              DYNAMIC RANGE FLAG               |
          |-----------------------------------------------|
     11   |   RECOMMENDED IMC SET ENABLE TIME FROM EPOCH  |
     12   |-----------------------------------------------|_
     13   |                      YEAR                     | |
          |-----------------------------------------------| |
     14   |  |         DAY OF YEAR            |  HR (10s)  | | EPOCH
          |-----------------------------------------------| | DATE AND
     15   |  HR (1s)  |        MINUTES         |  SEC (10s) | | TIME
          |-----------------------------------------------| |
     16   |  SEC (1s) |               MSECS                | |
          |-----------------------------------------------|_
     17   |        SPACECRAFT COMPENSATION - ROLL         |
     18   |-----------------------------------------------|
     19   |        SPACECRAFT COMPENSATION - PITCH        |
     20   |-----------------------------------------------|
     21   |        SPACECRAFT COMPENSATION - YAW          |
     22   |-----------------------------------------------|— Subtype 3
     23   |                                               |
      .   |           24 ORBITAL COEFFICIENTS             |
     70   |                                               |
```

Message 53 – LUT – IMC, SMC, or SCC LUT Format (GOES I-M) (2 of 5)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|— Subtypes 2 & 6
    71  |            ADJUSTMENT TO ON-BOARD             |
    72  |               DAILY SOLAR RATE                |
        |-----------------------------------------------|
    73  |          GAIN VALUE FOR IMAGER ROLL           |
    74  |                                               |
        |-----------------------------------------------|
    75  |         OFFSET VALUE FOR IMAGER ROLL          |
    76  |                                               |
        |-----------------------------------------------|
    77  |                                               |
     .  |                  IMAGER ROLL                  |
   172  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   173  |            GAIN VALUE FOR IMAGER PITCH        |
   174  |                                               |
        |-----------------------------------------------|
   175  |           OFFSET VALUE FOR IMAGER PITCH       |
   176  |                                               |
        |-----------------------------------------------|
   177  |                                               |
     .  |                 IMAGER PITCH                  |
   272  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   273  |             GAIN VALUE FOR IMAGER YAW         |
   274  |                                               |
        |-----------------------------------------------|
   275  |            OFFSET VALUE FOR IMAGER YAW        |
   276  |                                               |
        |-----------------------------------------------|
   277  |                                               |
     .  |                  IMAGER YAW                   |
   372  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   373  |      GAIN VALUE FOR IMAGER ROLL MISALIGNMENT  |
   374  |                                               |
        |-----------------------------------------------|
   375  |    OFFSET VALUE FOR IMAGER ROLL MISALIGNMENT  |
   376  |                                               |
        |-----------------------------------------------|
   377  |                                               |
     .  |           IMAGER ROLL MISALIGNMENT            |
   472  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   473  |     GAIN VALUE FOR IMAGER PITCH MISALIGNMENT  |
   474  |                                               |
        |-----------------------------------------------|
   475  |   OFFSET VALUE FOR IMAGER PITCH MISALIGNMENT  |
   476  |                                               |
        |-----------------------------------------------|
   477  |                                               |
     .  |           IMAGER PITCH MISALIGNMENT           |
   572  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   573  |           GAIN VALUE FOR SOUNDER ROLL         |
   574  |                                               |
        |-----------------------------------------------|
   575  |         OFFSET VALUE FOR SOUNDER ROLL         |
   576  |                                               |
        |-----------------------------------------------|
```

Message 53 – LUT – IMC, SMC, or SCC LUT Format (GOES I-M) (3 of 5)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|— Subtypes 2 & 6
   577  |                                               |
     .  |                SOUNDER ROLL                   |
   672  |                (48 VALUES)                    |
        |-----------------------------------------------|
   673  |           GAIN VALUE FOR SOUNDER PITCH        |
   674  |                                               |
        |-----------------------------------------------|
   675  |         OFFSET VALUE FOR SOUNDER PITCH        |
   676  |                                               |
        |-----------------------------------------------|
   677  |                                               |
     .  |                SOUNDER PITCH                  |
   772  |                 (48 VALUES)                   |
        |-----------------------------------------------|
   773  |            GAIN VALUE FOR SOUNDER YAW         |
   774  |                                               |
        |-----------------------------------------------|
   775  |          OFFSET VALUE FOR SOUNDER YAW         |
   776  |                                               |
        |-----------------------------------------------|
   777  |                                               |
     .  |                  SOUNDER YAW                  |
   872  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   873  |     GAIN VALUE FOR SOUNDER ROLL MISALIGNMENT  |
   874  |                                               |
        |-----------------------------------------------|
   875  |   OFFSET VALUE FOR SOUNDER ROLL MISALIGNMENT  |
   876  |                                               |
        |-----------------------------------------------|
   877  |                                               |
     .  |           SOUNDER ROLL MISALIGNMENT           |
   972  |                  (48 VALUES)                  |
        |-----------------------------------------------|
   973  |    GAIN VALUE FOR SOUNDER PITCH MISALIGNMENT  |
   974  |                                               |
        |-----------------------------------------------|
   975  |  OFFSET VALUE FOR SOUNDER PITCH MISALIGNMENT  |
   976  |                                               |
        |-----------------------------------------------|
   977  |                                               |
     .  |            SOUNDER PITCH MISALIGNMENT         |
  1072  |                  (48 VALUES)                  |
        |-----------------------------------------------|— Subtypes 1,2,4&5
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
YAW FLIP FLAG	I*4	-1, +1	N/A
SSAA USAGE FLAG	I*4	0 - NOT A REACTIVE SET 1 - BOTH IMC AND STAR SENSE DELTA 2 - IMC ONLY 3 - STAR SENSE DELTA ONLY	N/A
DATA FORMAT INDICATOR	I*2	1 - LOOKUP TABLE	N/A
DYNAMIC RANGE FLAG	I*2	1 - LOW, 2-HIGH	N/A
RECOMMENDED ENABLE TIME FROM IMC EPOCH	R*4	SEE NOTE BELOW	MIN
EPOCH DATE AND TIME- YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY

Message 53 – LUT – IMC, SMC, or SCC LUT Format (GOES I-M) (4 of 5)

DATA ITEM	FORMAT	VALIDATION	UNITS
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MIN
SECOND	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
SPACECRAFT COMPENSATION			
ROLL, PITCH, YAW	R*4	-.004 TO .004	RAD
ORBITAL COEFFICIENTS	R*4	SEE NOTE #14	
DAILY SOLAR RATE ADJUSTMENT	R*4	-0.0000065 TO +0.0000065	RAD/SEC
GAIN VALUE FOR ANGLES	I*4	1-255	N/A
OFFSET VALUE FOR ANGLES	I*4	0-255	N/A
ATTITUDE VALUES	R*4	0-255	N/A

Notes:

1. The yaw flip flag is set to +1 for a spacecraft in its normal upright orientation and –1 when it is rotated 180° about the yaw axis.

2. A parent IMC set is generally effective throughout the entire registration period. Because of various random phenomena and dynamic range limitations, the parent IMC set may be modified by small IMC subsets for varying subspans of the registration period. The parent IMC set and its modifiers all have the same IMC epoch.

3. The IMC set identifier and validation is described in Section 4.3.2.2.1.

4. A normal set, Subtype 1, includes the entire set of data as shown and spans a 24-hour period. The 48 values for each angle are spaced at half-hour intervals and values are obtained in between by interpolation in the AOCE. For this subtype, the spacecraft compensation terms are zero.

5. A medium-term IMC set, Subtype 2, is used only when the dynamic range cannot be maintained over a 24-hour period, and the day is broken into two or three periods. For the first period, the entire message is sent as Subtype 1. For the second and third periods, the message is a Subtype 2, and either the reference orbital position only is changed and the message terminates at the end of half-word 70, or else both the reference orbit and the reference attitude change, in which case, the entire message is sent. This pattern is repeated until there is a corrective orbital maneuver. The Subtype 2 message epoch is the same as for the associated Subtype 1 message and should not be uploaded.

6. A short-term IMC set, Subtype 3, is used only when compensating for Earth sensor errors due to clouds, radiance gradients, when operating with an Earth sensor, when inhibited due to Sun or Moon intrusions, or when compensating for yaw attitude variations due to magnetic storms. For this case, only the spacecraft compensation terms change, and the message terminates with half-word 22. The epoch is the same as that for the currently active parent coefficient set and should not be uploaded.

7. When compensation for misalignments caused by nonrepeatable on-board thermal changes to Imager or Sounder pointing are required, it is not possible to send a short-term message (Subtype 4) to modify the LUT. Instead, a full IMC set is sent.

8. A post-maneuver parent IMC set, Subtype 5, indicates that a new set of coefficients should be put into effect following a maneuver that is planned and expected to be executed. This provides the best estimate of the IMC coefficients until the post-maneuver orbit and attitude are determined. Once the post-maneuver orbit and attitude are determined, a new set of coefficients is generated. This message uses all the data fields shown and the entire message is sent.

9. A medium-term IMC set, Subtype 6, is used only when a short span orbit and attitude adjustment is required after a stationkeeping maneuver. Although a Subtype 5 parent set is generally in effect at this time, the Subtype 6 set may also modify a Subtype 1 parent set. The message contains changes to the three spacecraft compensation attitude terms (half-words 17 to 18, 19 to 20, 21 to 22) and four orbit coefficients (half-words 23 to 24, 29 to 30, 55 to 56, and 57 to 58) with all other items remaining unchanged from the parent set. The message terminates with half-word 70. Epoch for the Subtype 6 message is the same as for the associated parent set and should not be uploaded.

10. The recommended enable time is in minutes and is relative to the epoch time. The enable time is commonly a negative number, indicating that it is before the epoch time.

11. A parent IMC set, Subtypes 1 or 5, may be modified at a specific time by a modifying IMC set, Subtype 3 or 6. These modifying IMC sets may be sequentially in effect in any order, but only one modifying set may be active at a given time. When the operator changes from one modifying subtype to another, the transition IMC set (Subtype 6) that OATS generates ensures the integrity of the entire IMC process, including the on-board IMC scan correction process and the GIMTACS star commanding correction process.

Message 53 – LUT – IMC, SMC, or SCC LUT Format (GOES I-M) (5 of 5)

12. To maintain consistency in the words representing Imager and Sounder attitude, words 73 – 1072 are in integer format ready to be packed into the spacecraft command. Words 73 – 1072 are an exception to the rule that OATS passes data only in engineering units.

13. The recommended enable times have different validation ranges for each message subtype, as follows:

    Subtype 1: –720 to +720 min from IMC epoch
    Subtype 2: –720 to +720 min from IMC epoch
    Subtype 3: 99999 enable ASAP
    Subtype 4: 99999 enable ASAP
    Subtype 5: –720 to +720 min from IMC epoch
    Subtype 6: 99999 enable ASAP

14. The orbital coefficients have the ranges and units indicated below:

Coefficient	Range		Units
CF01	-0.065	+0.065	RAD
CF02	-0.0065536	+0.0065534	NONE
CF03	-0.00032768	+0.00032767	1/RAD
CF04–CF06	-0.065	+0.065	RAD
CF07–CF12	-0.0032768	+0.0032767	RAD
CF13–CF14	-0.0032768	+0.0032767	NONE
CF15–CF18	-0.065	+0.065	RAD
CF19–CF20	-0.0032768	+0.0032767	RAD
CF21–CF22	-0.0032768	+0.0032767	NONE
CF23–CF24	-0.0032768	+0.0032767	RAD

Message 54 – OATS Status (GOES I-M) (1 of 3)

OATS sends GIMTACS a Message 54-2 in response to a status request. OATS also sends GIMTACS/GTACS unsolicited Message 54-1s at an operator-selectable rate. The Message 54 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 264 (SEE NOTE 7)
      MESSAGE TYPE                  = 54
      MESSAGE SUBTYPE               = 1 - RESPONSE REQUESTED
                                    = 2 - RESPONSE MESSAGE
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 154 IF REQUESTED

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|_
      1 |                     YEAR                      | |
        |-----------------------------------------------| | TIME
      2 |  |         DAY OF YEAR            |  HR (10s) | | STAMP
        |-----------------------------------------------| | FOR
      3 |  HR (1s)  |        MINUTES         |  SEC (10s)| | THIS
        |-----------------------------------------------| | MESSAGE
      4 |  SEC (1s) |               MSECS               | |
        |-----------------------------------------------|_
      5 |               OATS NODE NUMBER                |
      6 |
        |-----------------------------------------------|
      7 |                   OATS TYPE                   |
      8 |
        |-----------------------------------------------|
      9 |                   OATS MODE                   |
     10 |
        |-----------------------------------------------|
     11 |               HEARTBEAT INTERVAL              |
     12 |
        |-----------------------------------------------|
     13 |        NUMBER (N) OF SUPPORTED SATELLITES     |
     14 |
        |-----------------------------------------------|
     15 |                SATELLITE NUMBER               |
     16 |
        |-----------------------------------------------|
     17 |                 IMAGER STATUS                 |
     18 |
```

Message 54 – OATS Status (GOES I-M) (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    19  |                SOUNDER STATUS                 |
    20  |                                               |
        |-----------------------------------------------|
    21  |           CURRENT IMC SET IDENTIFIER          |
    22  |                                               |
        |-----------------------------------------------|
    23  |           SPACECRAFT YAW FLIP STATUS          |
    24  |                                               |
        |-----------------------------------------------|
    25  |      SPACECRAFT EQUIPMENT STATUS              |
     :  |                                               |
    64  |                                               |
        |-----------------------------------------------|
    65  |  REPEAT WORDS 15-64 FOR UP TO FOUR ADDITIONAL |
     :  |              SUPPORTED SATELLITES             |
   264  |                                               |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MINUTES
SECONDS	BCD	0-59	SECONDS
N-SS	BCD	0-999	MSEC
OATS NODE NUMBER	I*4	41-50	N/A
OATS TYPE	I*4	0 - NORMAL 1 - SIMULATION 2 - TEST	N/A
OATS MODE	I*4	0 - PRIMARY 1 - BACKUP	N/A
HEARTBEAT INTERVAL	I*4	1 - 86400	SEC
NO. OF SUPPORTED SATELLITES	I*4	1-5	N/A
SATELLITE NO.	I*4	8-12	N/A
IMAGER STATUS	I*4	0 - OFF 1 - ON	N/A
SOUNDER STATUS	I*4	0 - OFF 1 - ON	N/A
CURRENT IMC SET IDENTIFIER	ASCII	ANNN	N/A
SPACECRAFT YAW FLIP STATE	I*4	1 - FLIPPED 0 - NORMAL	N/A
SPACECRAFT EQUIPMENT STATUS	I*4	0 - OFF 1 - ON	N/A

Notes:

1. The satellite ID in the header is not relevant in this message, since the status of all supported satellites is contained in the message body. However, OATS uses the satellite ID for the first active satellite (in the order 8, 9, 10, 11, and 12) or in the case of no active satellite, satellite ID 8.

2. The time stamp is the time at which this response was generated.

Message 54 – OATS Status (GOES I-M) (3 of 3)

3. The following are OATS node numbers:

41 = SOAT01	42 = SOAT02
43 = SOAT03	44 = SOAT04
45 = SOAT05	46 = SOAT06
47 = COAT01	48 = COAT02
49 = GOAT01	50 = GOAT02

4. The following are OATS types:

   0 – Normal: OATS external message reception and transmission is enabled. What messages are actually allowed to be sent is further restricted by the primary or backup designation. All other OATS processing is enabled.

   1 – Simulation: same as type 'Normal' with additional ingest (and output) external messages from (to) a local file.

   2 – Test: OATS external message reception and transmission is disabled. All other OATS processing is still enabled. The test configuration provides isolated OATS processing.

5. The following are OATS modes:

   0 – Primary: OATS currently supports GOES satellite command and data process. Only one OATS is designated the primary at any one time.

   1 – Backup: One OATS is designated as primary and all other OATS are configured as backup. The backup OATS can be used to support the primary in GOES satellite commanding and data processing. These OATS can become primary at any time by operator command. The OATS health and status is sent from these nodes by way of a Message 54.

6. The heartbeat interval is the time between OATS Message 54s to GIMTACS. GIMTACS generates an alarm if it does not receive a Message 54 at the end of this period. OATS nodes that are shut down or in test mode do not send Message 54s to GIMTACS.

7. OATS can support up to five real satellites concurrently. To be supported, a satellite must have a satellite-dependent database and a minimum set of default run parameter files. The Message 54 length is $50N + 14$ half-words, where N is the number of satellites supported. With $N = 5$, the maximum message length is 264 half-words. Each node can also support five virtual satellites. These are work areas and satellite information for them is not reported to GIMTACS.

8. OATS also reports the yaw flip state of the spacecraft.

9. Provisions have been made for up to 20 pieces of equipment on each satellite. The values represent a copy of results stored in the OATS database updated by way of Message 190.

Message 54 – OATS Status (GOES N-P) (1 of 4)

OATS sends GTACS a Message 54-2 in response to a status request. OATS also sends GTACS unsolicited Message 54-1s at an operator-selectable rate. The Message 54 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.    = 1-65535
      SATELLITE ID            = 13,14,15 (N-P)
      SOURCE                  = 75 – 85 (OATS)
      DESTINATION             = 90 – 101 (GTACS)
      NO. OF HALF-WORDS       = UP TO 64 (SEE NOTE 7)
      MESSAGE TYPE            = 54
      MESSAGE SUBTYPE         = 1 - RESPONSE REQUESTED
                              = 2 - RESPONSE MESSAGE
      TRACER                  = ASCII BLANKS
      MESSAGE COUNT           = 1
      END OF MESSAGE          = TRUE
      ROUTING ID              = N/A (used internally by OATS)
```

Message 54 – OATS Status (GOES N-P) (2 of 4)

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 LSB 15	
1	YEAR	TIME STAMP FOR THIS MESSAGE
2	DAY OF YEAR (bits 1–9) / HR(10s) (bits 10–13)	
3	HR(1s) (bits 0–3) / MINUTES (bits 4–9) / SEC(10s) (bits 10–13)	
4	SEC(1s) (bits 0–3) / MSECS (bits 4–15)	
5 6	OATS NODE NUMBER	
7 8	OATS TYPE	
9 10	OATS MODE	
11 12	HEARTBEAT INTERVAL	
13 14	NUMBER (N) OF SUPPORTED SATELLITES	
15 16	SATELLITE NUMBER	
17 18	IMAGER STATUS	
19 20	SOUNDER STATUS	
21 22	CURRENT IMC SET IDENTIFIER	
23 24	SPACECRAFT YAW FLIP STATUS	
25 : 54	REPEAT WORDS 15-24 FOR UP TO FOUR ADDITIONAL SUPPORTED SATELLITES	

Message 54 – OATS Status (GOES N-P) (3 of 4)

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MILLISECONDS	BCD	0-999	MSECS
OATS NODE NUMBER	I*4	75-85	N/A
OATS TYPE	I*4	0 = PRIMARY 1 = BACKUP	N/A
OATS MODE	I*4	0 = NORMAL 1 = TEST	N/A
HEARTBEAT INTERVAL	I*4	1 - 86400	SEC
NO. OF SUPPORTED SATELLITES	I*4	1-5	N/A
SATELLITE NO	I*4	13-16	N/A
IMAGER STATUS	I*4	0 = OFF 1 = ON	N/A
SOUNDER STATUS	I*4	0 = OFF 1 = ON	N/A
CURRENT IMC SET IDENTIFIER	ASCII	ANNN	N/A
SPACECRAFT YAW FLIP STATE	I*4	1 = FLIPPED 0 = NORMAL	N/A

Notes:

1. The satellite ID in the header is not relevant in this message, since the status of all supported satellites is contained in the message body. However, OATS uses the satellite ID for the first active satellite (in the order 13, 14, 15, 16) or in the case of no active satellite, satellite ID is 13.

2. The time stamp is simply the time at which this response was generated.

3. OATS type:

   0 – PRIMARY: The OATS currently supporting GOES satellite commanding and data processing. Only one OATS is designated the primary at any one time.

   1 – BACKUP: All other OATS beside the primary will be configured as backup. These OATS can be used to support the primary in GOES satellite commanding and data processing. These OATS can become primary at any time by operator command. The OATS health and status is sent from these nodes via a Message 54.

4. OATS node numbers:

   75 = SOAT11 (SOCC) 76 = SOAT12 (SOCC)
   77 = SOAT13 (SOCC) 78 = SOAT14 (SOCC)
   79 = SOAT15 (SOCC) 80 = SOAT16 (SOCC)
   81 = SOAT17 (SOCC) 82 = COAT11 (CDAS)
   83 = COAT12 (CDAS) 84 = COAT13 (CDAS)
   85 = GOAT11 (WBU)

Message 54 – OATS Status (GOES N-P) (4 of 4)

5. OATS mode:

   0 – NORMAL: OATS external message reception and transmission is enabled. What messages are actually allowed to be sent is further restricted by the primary/backup designation. All other OATS processing is enabled.

   1 – TEST: OATS external message reception and transmission is disabled. All other OATS processing is still enabled. The test configuration provides isolated OATS processing.

6. The heartbeat interval is the time between OATS Message 54s to GTACS. GTACS generates an alarm if it does not receive a Message 54 at the end of this period. OATS nodes that are shut down or in test mode do not send Message 54s to GTACS.

7. OATS can support up to five real satellites concurrently. To be supported a satellite must have a satellite-dependent database and a minimum set of default run parameter files. The Message 54 length is 10N + 14 half-words, where N is the number of satellites supported. With N = 5, the maximum message length is 64 half-words. Each node can also support five virtual satellites. These are work areas and satellite information for them is not reported to GTACS.

8. OATS also reports the yaw flip state of the spacecraft.

Message 55 – Scan Frame Response (1 of 4)

In response to a Message 155 from GIMTACS/GTACS, OATS converts Imager and Sounder scan frame definition coordinates into cycles and increments. The coordinates in the request message may be in either latitude and longitude for on-Earth coordinates, or scan line and pixel numbers for off-Earth coordinates. The Message 55 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.       = 1-65535
      SATELLITE ID               = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                     = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                 = 75-85 (N-P OATS)
      DESTINATION                = 10 (GIMTACS)
                                 = 90-101 (GTACS)
      NO. OF HALF-WORDS          = UP TO 1608 (SEE NOTES)
      MESSAGE TYPE               = 55
      MESSAGE SUBTYPE            = 1 - IMAGER
                                 = 2 - SOUNDER
      TRACER                     = BLANKS
      MESSAGE COUNT              = 1
      END OF MESSAGE             = TRUE
      ROUTING ID                 = AS PROVIDED IN MSG 155
```

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |               IMC SET IDENTIFIER              |
      2  |
         |-----------------------------------------------|
      3  |     NUMBER OF SCAN FRAMES IN MESSAGE (J)      |
      4  |
         |-----------------------------------------------|
      5  |                     SPARE                     |
      6  |
         |-----------------------------------------------|
      7  |                   IMC STATUS                  |
      8  |
         |-----------------------------------------------|
      9  |                     YEAR                      |
         |-----------------------------------------------|_
     10  |  |         DAY OF YEAR            |  HR (10s)  | |
         |-----------------------------------------------| | FRAME
     11  |  HR (1s)  |        MINUTES         |  SEC (10s) | | START
         |-----------------------------------------------| | TIME
     12  |  SEC (1s) |               MSECS                | |
         |-----------------------------------------------|_
     13  |               FRAME DURATION                  |
     14  |
         |-----------------------------------------------|
     15  |               SCAN FREQUENCY                  |
     16  |
         |-----------------------------------------------|
     17  |               COORDINATE TYPE                 |
     18  |
         |-----------------------------------------------|
     19  |           SPACELOOK SIDE SELECTION            |
     20  |
         |-----------------------------------------------|
     21  |                SPACELOOK MODE                 |
     22  |
```

Message 55 – Scan Frame Response (2 of 4)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    23  |                DEFAULT FRAME FLAG             |
    24  |
        |-----------------------------------------------|
    25  |              SOUNDER STEPPING MODE            |
    26  |
        |-----------------------------------------------|
    27  |                 OUTPUT STATUS                 |
    28  |
        |-----------------------------------------------|
    29  |            CRITICAL LIMIT INDICATOR           |
    30  |
        |-----------------------------------------------|
    31  |       COMMANDED SCAN START E-W CYCLES         |
    32  |
        |-----------------------------------------------|
    33  |     COMMANDED SCAN START E-W INCREMENTS       |
    34  |
        |-----------------------------------------------|
    35  |       COMMANDED SCAN START N-S CYCLES         |
    36  |
        |-----------------------------------------------|
    37  |    COMMANDED SCAN START N-S INCREMENTS        |
    38  |
        |-----------------------------------------------|
    39  |        COMMANDED SCAN STOP E-W CYCLES         |
    40  |
        |-----------------------------------------------|
    41  |      COMMANDED SCAN STOP E-W INCREMENTS       |
    42  |
        |-----------------------------------------------|
    43  |       COMMANDED SCAN STOP N-S CYCLES          |
    44  |
        |-----------------------------------------------|
    45  |       COMMANDED SCAN STOP N-S INCREMENTS      |
    46  |
        |-----------------------------------------------|
    47  |                    SPARE                      |
    48  |
        |-----------------------------------------------|
    49  |  ADDITIONAL SCAN FRAMES REPEAT WORDS 9 TO 48  |
 40*J+8 |     FOR J-1 SCANS.  SEE NOTES.                |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
NO. OF SCAN FRAMES IN MSG	I*4	1-40	N/A
IMC STATUS	I*4	0 - ENABLED 1 - DISABLED	N/A
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MINUTES
SECONDS	BCD	0-59	SECONDS
MSEC	BCD	0-999	MSEC
FRAME DURATION	R*4	>0.0	MIN
SCAN FREQUENCY	R*4	0-5	HZ
COORDINATE TYPE	I*4	1 - LAT/LONG 2 - SCAN LINE/PIXEL 3 – SRSO (GOES I-M)	N/A

Message 55 – Scan Frame Response (3 of 4)

DATA ITEM	FORMAT	VALIDATION	UNITS
SPACELOOK SIDE SELECTION	I*4	1 - EAST SIDE 2 - WEST SIDE	N/A
SPACELOOK MODE	I*4	0 - N/A SOUNDER 1 - FAST SPACE (9.2-SEC INTERVAL) CLAMP 2 - SLOW SPACE (36.6-SEC INTERVAL) CLAMP 3 - SCAN CLAMP	N/A
DEFAULT FRAME FLAG	I*4	0 - USED DATA PROVIDED 1 - USE DEFAULT 1 2 - USE DEFAULT 2 3 - USE DEFAULT 3	N/A
SOUNDER STEPPING MODE	I*4	-1 - N/A IMAGER 0 - NORMAL STEP MODE 1 - 0.2 SEC DWELL 2 - 0.4 SEC DWELL 3 - SKIP MODE	N/A
OUTPUT STATUS	I*4	0-14 (SEE NOTES) (I-M) 0-16 (SEE NOTES) (N-P)	N/A N/A
CRITICAL LIMIT INDICATION	I*4	0-5 (SEE NOTES)	N/A
CMD SCAN START E-W CYCLES	I*4	0-5	CYCLES
CMD SCAN START E-W INC.	I*4	0-6135 (IMAGER) 0-2805 (SOUNDER) (I-M) 0-2804 (SOUNDER) (N-P)	INCREMENTS
CMD SCAN START N-S CYCLES	I*4	0-9	CYCLES
CMD SCAN START N-S INC.	I*4	0-6135 (IMAGER) 0-2805 (SOUNDER) (I-M) 0-2804 (SOUNDER) (N-P)	INCREMENTS
CMD SCAN STOP E-W CYCLES	I*4	0-5	CYCLES
CMD SCAN STOP E-W INC.	I*4	0-6135 (IMAGER) 0-2805 (SOUNDER) (I-M) 0-2804 (SOUNDER) (N-P)	INCREMENTS
CMD SCAN STOP N-S CYCLES	I*4	0-9	CYCLES
CMD SCAN STOP N-S INC.	I*4	0-6135 (IMAGER) 0-2805 (SOUNDER) (I-M) 0-2804 (SOUNDER) (N-P)	INCREMENTS

Notes:

1. The computed scan stop time is approximated.

2. IMC set identifier, IMC status, and Sounder stepping mode are returned as found in the request message and are used in the calculation (see Message 155).

   The output status is:

   0: Successful completion
   1: Warning scan time for Imager was increased, see critical limit indicator
   2: Warning excessive frame duration
   3: Fatal, invisible start latitude and longitude point
   4: Fatal, invisible stop latitude and longitude point
   5: Fatal, maximum number of iterations exceeded, no convergency
   6: Fatal, negative frame duration
   7: Fatal, wrong input latitude
   8: Fatal, wrong input longitude
   9: Fatal, pixel value outside valid limits

Message 55 – Scan Frame Response (4 of 4)

10: Fatal, line value outside valid limits
11: Fatal, unable to get orbit, attitude, or IMC data
12: Warning, requested spacelook side contains intrusion
13: Warning, frame width exceeds SPS max (19.2°)
14: Fatal, one or more values violated validation limits
15: Sun Intrusion into frame (N-P only)
16: Frame scan period entirely within eclipse umbra (N-P only).

The following are critical limit indications:

0: Scan frequency is not within any of the four pairs of critical limits.

1–4: Indicates the requested frame size results in a scan frequency within one of the four pairs (minimum or maximum) of critical limits. The frame boundaries returned by scan represent a large frame size outside of the frequency limit range.

5: Indicates the minimum instrument scan size has been violated and the frame boundaries returned by scan represent a large frame size that does not violate this condition.

Critical limit indications are valid only for the Imager when Sounder stepping mode equals –1, otherwise, these fields are zero. Scan frequency is valid for both the Imager and Sounder.

3. The maximum number of scan frames returned in this message is 40. This is determined by taking the maximum number of half-words (1608), subtracting half-words 1 through 8 (which are not repeated for each scan), dividing the result by the half-words repeated for each scan (40), and discarding the remainder.

Message 56 – Stationkeeping CMD Parameters (GOES I-M) (1 of 2)

OATS uses Message 56 to send computed stationkeeping maneuver thruster parameters to GIMTACS. The Message 56 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 204 (SEE NOTES)
      MESSAGE TYPE                  = 56
      MESSAGE SUBTYPE               = 1 - N-S MANEUVER, THRUSTERS 6/7
                                    = 2 - E-W MANEUVER, THRUSTERS 2/3
                                    = 3 - E-W MANEUVER, THRUSTERS 4/5
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB	
1	TOTAL NUMBER OF FIRINGS IN MANEUVER (K)	
2		
3	POST-MANEUVER	
4	YAW DIRA OFFSET BIAS	
5	SEQUENCE NUMBER OF THIS FIRING	
6		
7	PRE-FIRING	
8	YAW DIRA OFFSET BIAS	
9	YEAR	FIRING START TIME
10	DAY OF YEAR | HR (10s)	
11	HR (1s) | MINUTES | SEC (10s)	
12	SEC (1s) | MSECS	
13	FIRST ROLL THRUSTER ID	
14	SECOND ROLL THRUSTER ID	
15	FIRST PITCH THRUSTER ID	
16	SECOND PITCH THRUSTER ID	
17	FIRST YAW THRUSTER ID	
18	SECOND YAW THRUSTER ID	
19	PULSE TIME SCALE (RESOLUTION)	
20		
21	PULSE RANGE MULTIPLIER	
22		
23	SPARE	
24		

Message 56 – Stationkeeping CMD Parameters (GOES I-M) (2 of 2)

```
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
         |         REPEAT WORDS 5 THRU 24 FOR            |
4+20(K)  |         THE REMAINING K-1 FIRINGS             |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF FIRINGS	I*4	1-10	N/A
POST-MANEUVER YAW DIRA			
OFFSET BIAS	R*4	-2.0 TO +2.0	DEG
SEQUENCE NO. THIS FIRING	I*4	1-10	N/A
PRE-FIRING YAW DIRA			
OFFSET BIAS	R*4	-2.0 TO +2.0	DEG
FIRING START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
N-SS	BCD	0-999	MSEC
FIRST ROLL THRUSTER ID	CHAR*2	6A, 6B, 7A, 7B	N/A
SECOND ROLL THRUSTER ID	CHAR*2	6A, 6B, 7A, 7B	N/A
FIRST PITCH THRUSTER ID	CHAR*2	4A, 4B, 5A, 5B	N/A
SECOND PITCH THRUSTER ID	CHAR*2	4A, 4B, 5A, 5B	N/A
FIRST YAW THRUSTER ID	CHAR*2	2A, 2B, 3A, 3B	N/A
SECOND YAW THRUSTER ID	CHAR*2	2A, 2B, 3A, 3B	N/A
PULSE TIME SCALE	I*4	5, 100, 5000	MSEC
PULSE RANGE MULTIPLIER	I*4	1-1023	N/A

Notes:

1. The message length depends on the number of thruster firings (*K*) and is given by 4 + 20*K*. The message length for 10 firings is 204 16-bit half-words.

2. GIMTACS can calculate the duration of the firing by multiplying the pulse time scale by the multiplier. OATS selects pulse time scales and multipliers to minimize the firing error.

Message 56 – Stationkeeping CMD Parameters (GOES N-P) (1 of 4)

OATS uses Message 56 to send computed stationkeeping maneuver thruster parameters to GTACS. The Message 56 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.     = 1-65535
      SATELLITE ID             = 13,14,15 (N-P)
      SOURCE                   = 75 – 85 (OATS)
      DESTINATION              = 90 – 101 (GTACS)
      NO. OF HALF-WORDS        = 58
      MESSAGE TYPE             = 56
      MESSAGE SUBTYPE          = 1 – N-S MANEUVER, THRUSTERS N1/N4
                               = 2 – N-S MANEUVER, THRUSTERS N2/N3
                               = 3 – E-W MANEUVER OR THRUSTER FLUSHING, OPEN-
                                     LOOP, ON-STATION, THRUSTERS E1/E2 OR W1/W2
                               = 4 – E-W MANEUVER OR THRUSTER FLUSHING, WHEEL
                                     CONTROL, STORAGE MODE, THRUSTERS E1/E2 OR
                                     W1/W2
                               = 5 – NORTH OR AXIAL THRUSTER FLUSHING,
                                     ON-STATION, THRUSTERS N1/N2/N3/N4,
                                     N1/N4, N2/N3, A1/A2/A3/A4, A1/A4, or
                                     A2/A3.
                               = 6 – NORTH OR AXIAL THRUSTER FLUSHING,
                                     STORAGE MODE, THRUSTERS N1/N2/N3/N4,
                                     N1/N4, N2/N3, A1/A2/A3/A4, A1/A4, or
                                     A2/A3.
                               = 7 - E-W STATION CHANGE MANEUVER, CLOSED-LOOP,
                                     ON-STATION
      TRACER                   = ASCII BLANKS
      MESSAGE COUNT            = 1
      END OF MESSAGE           = TRUE
      ROUTING ID               = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 LSB 15
1 2	TOTAL NUMBER OF FIRINGS IN MANEUVER (K)
3 4	SOLAR ARRAY BIAS ENABLE
5 6	SOLAR ARRAY PAUSE ENABLE
7 8	SOLAR ARRAY BIAS COMMAND
9	CONSTANT LINEAR ACCELERATION – ORBIT X

Message 56 – Stationkeeping CMD Parameters (GOES N-P) (2 of 4)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB		
10			
11 12	CONSTANT LINEAR ACCELERATION – ORBIT Y		
13 14	CONSTANT LINEAR ACCELERATION – ORBIT Z		
15 16	LATCH VALUE CONFIGURATION – A, B, D, OR E		
17 18	NS SK TRANSITION 2 SUBPHASE 1 DELTA-H – BODY X (ROLL)		
19 20	NS SK TRANSITION 2 SUBPHASE 1 DELTA-H – BODY Y (PITCH)		
21 22	NS SK TRANSITION 2 SUBPHASE 1 DELTA-H – BODY Z (YAW)		
23 24	NS SK TRANSITION 2 SUBPHASE 2 DELTA-H – BODY X		
25 26	NS SK TRANSITION 2 SUBPHASE 2 DELTA-H – BODY Y		
27 28	NS SK TRANSITION 2 SUBPHASE 2 DELTA-H – BODY Z		
29 30	NS SK TRANSITION 2 SUBPHASE 3 DELTA-H – BODY X		
31 32	NS SK TRANSITION 2 SUBPHASE 3 DELTA-H – BODY Y		
33 34	NS SK TRANSITION 2 SUBPHASE 3 DELTA-H – BODY Z		
35 36	JET # FOR NSSK DELTA-H SUBPHASE 1		
37 38	JET # FOR NSSK DELTA-H SUBPHASE 2		
39 40	JET # FOR NSSK DELTA-H SUBPHASE 3		
41 42	SEQUENCE NUMBER OF THIS FIRING		
43	YEAR		
44	DAY OF YEAR		HR(10s)
45	HR(1s)	MINUTES	SEC(10s)
46	SEC(1s)	MSECS	
47	FIRST THRUSTER ID		
48	SECOND THRUSTER ID		

Message 56 – Stationkeeping CMD Parameters (GOES N-P) (3 of 4)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB
49	THIRD THRUSTER ID
50	FOURTH THRUSTER ID
51 52	NUMBER OF PULSES
53 54	PULSE WIDTH (SEC)
55 56	CYCLE DURATION (SEC)
57 58	OTS TABLE #
59	YAW BIAS

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF FIRINGS	I*4	1	N/A
SOLAR ARRAY BIAS ENABLE	I*4	0-1	N/A
SOLAR ARRAY PAUSE ENABLE	I*4	0-1	N/A
SOLAR ARRAY BIAS COMMAND	R*4	-90.0 to +90.0	DEGREES
LINEAR ACCELERATION - ORBIT X	R*4	-0.05 to +0.05	M/S2
LINEAR ACCELERATION - ORBIT Y	R*4	-0.05 to +0.05	M/S2
LINEAR ACCELERATION - ORBIT Z	R*4	-0.05 to +0.05	M/S2
NS SK DELTA-H – BODY X	R*4	-72.0 to +72.0	NMS
NS SK DELTA-H – BODY Y	R*4	-72.0 to +72.0	NMS
NS SK DELTA-H – BODY Z	R*4	-72.0 to +72.0	NMS
JET # FOR NSSK DELTA-H	I*4	1 to 12	N/A
FIRING START TIME YEAR	BCD	1989 – 2025	YEAR
DAY OF YEAR	BCD	1 – 366	DAY
HOUR	BCD	0 – 23	HOUR
MINUTES	BCD	0 – 59	MIN
SECONDS	BCD	0 – 59	SECS
MILLISECONDS	BCD	0 – 999	MSECS
LATCH VALVE CONFIGURATION	CHAR*4	A, B, D, or E	N/A
FIRST THRUSTER ID	CHAR*2	N1, N2, A1, A2, E1, W1	N/A
SECOND THRUSTER ID	CHAR*2	N2, N3, N4, A2, A3, A4, E2, W2	N/A
THIRD THRUSTER ID	CHAR*2	Blank, N3, A3	N/A
FOURTH THRUSTER ID	CHAR*2	Blank, N4, A4	N/A
NUMBER OF PULSES	I*4	1 – 12000	N/A
PULSE WIDTH	R*4	0.05 – 7200.0	SEC
CYCLE DURATION	R*4	0.05 – 6000.0	SEC
OTS TABLE #	I*4	0-9	N/A
YAW BIAS	R*4	N/A	DEGREES

Message 56 – Stationkeeping CMD Parameters (GOES N-P) (4 of 4)

Notes:

1. For N-P, only one firing is allowed.
2. GTACS can calculate the Transition 1 duration of pulsed firing by multiplying the number of pulses by the cycle duration.
3. For N-S maneuvers, the Pulse Width and Cycle Duration are set to the total on-time (maneuver duration), since the burn is continuous.
4. The commanded thruster pulses do not include the autonomous attitude hold pulses.
5. The Solar Array Bias Enable is set to 1 (TRUE) if array biasing is needed due to thruster constraints, and set to 0 (FALSE) if not needed. The Solar Array Pause Enable is set to 1 (TRUE) if the array is biased and solar tracking is paused due to thruster constraints, and set to 0 (FALSE) if not needed.
6. The constant linear acceleration in orbit coordinates is only used for the N-S Maneuver and is calculated as the constant body acceleration that will best approximate an impulsive ECI Δv at the mid-time of the maneuver. The commanded thruster on-times are chosen so that the sum of the commanded and expected attitude-hold thrusting will produce the constant body acceleration. The x, y and z axes are defined as the orbital coordinate system where y = orbit angular momentum, z = toward Earth center, and x = y cross z. The linear acceleration fields will be zero when the message subtype is 3 through 6. The number of pulses must be 1 for message subtypes 1, 2 or 7.
7. During the Burn 1 phase of the NS maneuver, the s/c attempts to hold angular momentum constant so that the total H at the beginning of transition 2 is equal to the initial H + ΔH. The NS stationkeeping final ΔH in body coordinates is the change in angular momentum that will be applied in transition 2 phase at the end of stationkeeping mode. This is applied as for a normal momentum-dump, i.e., in three phases where only a single jet is fired in the each phase. The listed phase delta-h is the value generated by an integer number of thruster pulses based on the current S/C torque table. **Note: The delta-h values in Message 56 will be zero because OATS has not yet implemented this option.**
8. Validated for the maneuver subtype. The valid thruster IDs for the subtypes are:

Message Subtype	First Thruster IDs	Second Thruster IDs	Third Thruster IDs	Fourth Thruster IDs
1	N1	N4	-	-
2	N2	N3	-	-
3	E1	E2	-	-
	W1	W2		
4	E1	E2	-	-
	W1	W2		
5	N1	N2	N3	N4
	N1	N4		
	N2	N3		
	A1	A2	A3	A4
	A1	A4		
	A2	A3		
6	N1	N2	N3	N4
	N1	N4		
	N2	N3		
	A1	A2	A3	A4
	A1	A4		
	A2	A3		
7	E1	E2		
	W1	W2		

9. The E-W maneuver transition 2 phase requires approximately the same time as transition 1 phase to remove the momentum added to the system from transition 1 phase. Since the total maneuver time for E-W SK and thruster flushing must be less than 6 minutes, a minimum of three minutes must be reserved for transition 2 phase. Assuming a fractional on-time of 0.40, the maximum maneuver on-time for E-W SK and thruster flushing transition 1 phase is 69.9 seconds.
10. The latch valve configuration is selected by the OATS operator to balance tank usage. The four configurations are defined as: A= Fuel 1, Oxidizer 2; B = Fuel 2, Oxidizer 1; D = Fuel 1, Oxidizer 1; or E = Fuel 2, Oxidizer 2.

Message 57 – Momentum Dump Command (GOES N-P) (1 of 2)

OATS uses Message 57 to send computed momentum-dumping maneuver momentum change parameters to GTACS. The Message 57 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.     = 1-65535
      SATELLITE ID             = 13,14,15 (N-P)
      SOURCE                   = 75 - 85 (OATS)
      DESTINATION              = 90 - 101 (GTACS)
      NO. OF HALF-WORDS        = 34
      MESSAGE TYPE             = 57
      MESSAGE SUBTYPE          = 0
      TRACER                   = ASCII BLANKS
      MESSAGE COUNT            = 1
      END OF MESSAGE           = TRUE
      ROUTING ID               = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2		DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	TOTAL NUMBER OF TRANSITION 2 SUBPHASES (1-3)															
6																
7	LATCH VALVE CONFIGURATION – A,B,D, OR E															
8																
9	SPARE															
10																
11	SUBPHASE 1 THRUSTERS: 0=NONE, 1=N1-4, OR 2=A1-4															
12																
13	SUBPHASE 1 BODY MOMENTUM CHANGE - ROLL															
14																
15	SUBPHASE 1 BODY MOMENTUM CHANGE - PITCH															
16																
17	SUBPHASE 1 BODY MOMENTUM CHANGE - YAW															
18																
19	SUBPHASE 2 THRUSTERS 0=NONE, 1=N1-4, OR 2=A1-4															
20																
21	SUBPHASE 2 BODY MOMENTUM CHANGE - ROLL															
22																

Message 57 – Momentum Dump Command (GOES N-P) (2 of 2)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 LSB
23 24	SUBPHASE 2 BODY MOMENTUM CHANGE - PITCH
25 26	SUBPHASE 2 BODY MOMENTUM CHANGE - YAW
27 28	SUBPHASE 3 THRUSTERS 0=NONE, 1=N1-4, OR 2=A1-4
29 30	SUBPHASE 3 BODY MOMENTUM CHANGE - ROLL
31 32	SUBPHASE 3 BODY MOMENTUM CHANGE - PITCH
33 34	SUBPHASE 3 BODY MOMENTUM CHANGE - YAW

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
TOTAL NUMBER OF TRANSITION 2 SUBPHASES	I*4	1-3	N/A
LATCH VALVE CONFIGURATION – A, B, D OR E	CHAR*4	A, B, D, or E	N/A
SUBPHASE THRUSTERS	I*4	0-2	N/A
SUBPHASE BODY MOMENTUM CHANGE – ROLL	R*4	-72 to +72	Nms
SUBPHASE BODY MOMENTUM CHANGE – PITCH	R*4	-72 to +72	Nms
SUBPHASE BODY MOMENTUM CHANGE – YAW	R*4	-72 to +72	Nms

Notes:

1. The subphase durations are calculated from the commanded momentum changes. The sum of the magnitudes of the commanded momentum changes must be less than 71 Nms in order to not violate the 6-minute transition 2 subphase limit.

2. Validation of the maneuver duration is performed as part of the momentum-dump planning process. Hence the magnitude validation is simply 72 Nms.

3. The roll, pitch and yaw body axes are defined in the S/C body coordinate system.

4. The latch valve configuration is selected by the OATS operator to balance tank usage. The four configurations are defined as A = Fuel 1, Oxidizer 2; B = Fuel 2, Oxidizer 1; D = Fuel 1, Oxidizer 1; or E = Fuel 2, Oxidizer 2.

Message 58 – Trim Tab Command Parameters (GOES I-M)

On a daily basis, OATS sends GIMTACS a Message 58 containing the information necessary to command the trim tab. Message 58 is unsolicited on the assumption that the trim tab calculation function in OATS runs at approximately the same time each day, and that provision is made for this command in the daily schedule. The Message 58 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 12
      MESSAGE TYPE                  = 58
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|-
      1  |                      YEAR                     | | TRIM
         |-----------------------------------------------| | TAB
      2  |  |         DAY OF YEAR            |  HR (10s) | | COMMAND
         |-----------------------------------------------| | START
      3  |  HR (1s)  |        MINUTES         |  SEC (10s)| | TIME
         |-----------------------------------------------| |
      4  |  SEC (1s) |               MSECS                | |
         |-----------------------------------------------|-
      5  |           TRIM TAB COMMAND DIRECTION           |
      6  |
         |-----------------------------------------------|
      7  |           TRIM TAB COMMAND DURATION            |
      8  |
         |-----------------------------------------------|
      9  |              TRIM TAB SLEW RATE                |
     10  |
         |-----------------------------------------------|
     11  |             TARGET TRIM TAB ANGLE              |
     12  |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TRIM TAB CMD START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
TRIM TAB COMMAND DIRECTION	I*4	1 - FWD 2 - RVS	N/A
TRIM TAB COMMAND DURATION	I*4	0-6000	MSEC
TRIM TAB SLEW RATE	I*4	0 - LOW 1 - HI	N/A
TARGET TRIM TAB ANGLE	R*4	-180 TO +24	DEG

Message 59 – Eclipse Prediction Response (1 of 2)

In response to a Message 159 from GIMTACS/GTACS, OATS sends a Message 59 containing eclipse entrance and exit time predictions. Message 59 provides for two types of eclipses of the satellite, which are shadowing by the Earth and shadowing by the Moon. Both umbral and penumbral entrance and exit times are provided. The Message 59 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = UP TO 204 (SEE NOTES)
      MESSAGE TYPE                  = 59
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 159

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |           NUMBER OF ECLIPSE EVENTS (N)        |
      2 |
        |-----------------------------------------------|
      3 |               ECLIPSE STATUS FLAG             |
      4 |
        |-----------------------------------------------|
      5 |                 INTRUDING BODY                |
      6 |
        |-----------------------------------------------|
      7 |                     SPARE                     |
      8 |
        |-----------------------------------------------|_
      9 |                     YEAR                      | |
        |-----------------------------------------------| |
     10 |  |         DAY OF YEAR            |  HR (10s) | | PENUMBRAL
        |-----------------------------------------------| | ENTRANCE
     11 |  HR (1s)  |        MINUTES         |  SEC (10s)| | TIME
        |-----------------------------------------------| |
     12 |  SEC (1s) |               MSECS               |_|
        |-----------------------------------------------|_
     13 |                     YEAR                      | |
        |-----------------------------------------------| |
     14 |  |         DAY OF YEAR            |  HR (10s) | | UMBRAL
        |-----------------------------------------------| | ENTRANCE
     15 |  HR (1s)  |        MINUTES         |  SEC (10s)| | TIME
        |-----------------------------------------------| |
     16 |  SEC (1s) |               MSECS               |_|
        |-----------------------------------------------|_
```

Message 59 – Eclipse Prediction Response (2 of 2)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    17  |                     YEAR                      |
        |-----------------------------------------------|
    18  |  |         DAY OF YEAR            |  HR (10s)  |   UMBRAL
        |-----------------------------------------------|   EXIT
    19  |  HR (1s)  |        MINUTES         |  SEC (10s) |   TIME
        |-----------------------------------------------|
    20  |  SEC (1s) |              MSECS                 |
        |-----------------------------------------------|
    21  |                     YEAR                      |
        |-----------------------------------------------|
    22  |  |         DAY OF YEAR            |  HR (10s)  |   PENUMBRAL
        |-----------------------------------------------|   EXIT
    23  |  HR (1s)  |        MINUTES         |  SEC (10s) |   TIME
        |-----------------------------------------------|
    24  |  SEC (1s) |              MSECS                 |
        |-----------------------------------------------|
    25  |         ADDITIONAL BODY IDENTIFIERS,           |
        |            ENTRANCE AND EXIT TIMES             |
 20N+4  |                                                |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF ECLIPSE EVENTS	I*4	0-10	N/A
ECLIPSE STATUS FLAG	I*4	-2, -1, 0 (SEE NOTES)	N/A
INTRUDING BODY	I*4	1 - EARTH 2 - MOON	N/A
ENTRANCE/EXIT TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC

Notes:

1. The following are eclipse status flags:

   -2 Unable to respond to a request outside the bounds of operational support, number of events equals zero.
   -1 Request extends beyond range of operational support. Any events in requested range and in range of operational support are given.
   0 Request within range of operational support. All events in requested range are given.

2. Half-words 5 through 24 are repeated for each eclipse event as required. The maximum message length is given by 20*N* + 4, or 204 half-words when *N* = 10.

3. This message supports up to 10 days of eclipse prediction responses.

Message 60 – Sensor Intrusion Response (GOES I-M) (1 of 3)

In response to a Message 160 from GIMTACS, OATS furnishes Sun and Moon intrusion predictions for the North and South Earth sensors, the Imager East and West FOV edges, the Sounder East and West FOV edges, and CDAS antenna RF interference (Sun only). The Message 60 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 496 (SEE NOTES)
      MESSAGE TYPE                  = 60
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 160
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |       NUMBER OF EARTH SENSOR INTRUSIONS (J)   |
      2 |
        |-----------------------------------------------|
      3 |          EARTH SENSOR STATUS FLAG             |
      4 |
        |-----------------------------------------------|
      5 |                 INTRUDING BODY                |
      6 |
        |-----------------------------------------------|
      7 |                EARTH SENSOR ID                |
      8 |
        |-----------------------------------------------|—
      9 |                     YEAR                      | | EARTH
        |-----------------------------------------------| | SENSOR
     10 |  |         DAY OF YEAR            |  HR (10s) | | SINGLE
        |-----------------------------------------------| | CHORD OP
     11 |  HR (1s)  |        MINUTES         |  SEC (10s)| | START
        |-----------------------------------------------| | TIME
     12 |  SEC (1s) |               MSECS               |
        |-----------------------------------------------|—
     13 |                     YEAR                      | | EARTH
        |-----------------------------------------------| | SENSOR
     14 |  |         DAY OF YEAR            |  HR (10s) | | SINGLE
        |-----------------------------------------------| | CHORD OP
     15 |  HR (1s)  |        MINUTES         |  SEC (10s)| | STOP
        |-----------------------------------------------| | TIME
     16 |  SEC (1s) |               MSECS               |
        |-----------------------------------------------|—
     17 |         NUMBER OF IMAGER INTRUSIONS (K)       |
     18 |
        |-----------------------------------------------|
     19 |         IMAGER INTRUSION STATUS FLAG          |
     20 |
        |-----------------------------------------------|
     21 |                  INTRUDING BODY               |
     22 |
        |-----------------------------------------------|
     23 |               EAST OR WEST EDGE ID            |
     24 |
        |-----------------------------------------------|
```

Message 60 - Sensor Intrusion Response (2 of 3)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7	8 9 10 11 12 13 14 15 LSB	
25	YEAR		IMAGER INTRUSION START TIME
26	DAY OF YEAR	HR (10s)	
27	HR (1s) MINUTES	SEC (10s)	
28	SEC (1s) MSECS		
29	YEAR		IMAGER INTRUSION STOP TIME
30	DAY OF YEAR	HR (10s)	
31	HR (1s) MINUTES	SEC (10s)	
32	SEC (1s) MSECS		
33	NUMBER OF SOUNDER INTRUSIONS (L)		
34			
35	SOUNDER INTRUSION STATUS FLAG		
36			
37	INTRUDING BODY		
38			
39	EAST OR WEST EDGE ID		
40			
41	YEAR		SOUNDER INTRUSION START TIME
42	DAY OF YEAR	HR (10s)	
43	HR (1s) MINUTES	SEC (10s)	
44	SEC (1s) MSECS		
45	YEAR		SOUNDER INTRUSION STOP TIME
46	DAY OF YEAR	HR (10s)	
47	HR (1s) MINUTES	SEC (10s)	
48	SEC (1s) MSECS		
49	NUMBER OF SUN IN STATION ANTENNA		
50	FOV INTRUSIONS (N)		
51	SUN INTRUSION STATUS FLAG		
52			
53	ANTENNA ID		
54			
55	SPARE		
56			
57	YEAR		SUN IN STATION ANTENNA INTRUSION START TIME
58	DAY OF YEAR	HR (10s)	
59	HR (1s) MINUTES	SEC (10s)	
60	SEC (1s) MSECS		

Message 60 - Sensor Intrusion Response (3 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    61  |                   YEAR                        |
        |-----------------------------------------------|
    62  |  |        DAY OF YEAR            |  HR (10s)  |
        |-----------------------------------------------|
    63  |  HR (1s)  |       MINUTES         |  SEC (10s) |
        |-----------------------------------------------|
    64  |  SEC (1s) |                 MSECS               |
        |-----------------------------------------------|
```

SUN IN STATION ANTENNA INTRUSION STOP TIME

DATA ITEM	FORMAT	VALIDATION	UNITS
NO. OF EARTH SENSOR INTRSNS	I*4	0-10	N/A
EARTH SENSOR STATUS FLAG	I*4	-2, -1, 0	N/A
INTRUDING BODY	I*4	1 - SUN 2 - MOON	N/A
EARTH SENSOR ID	I*4	1 - NORTH 2 - SOUTH	N/A
INTRUSION TIMES YEAR	BCD	1989-2025	YEAR
DAY	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
NO. OF IMAGER INTRUSIONS	I*4	0-10	N/A
IM INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
INTRUDING BODY	I*4	1 - SUN 2 - MOON	N/A
E-W EDGE ID	I*4	1 - EAST 2 - WEST	N/A
NO. OF SOUNDER INTRUSIONS	I*4	0-10	N/A
SDR INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
INTRUDING BODY	I*4	1 - SUN 2 - MOON	N/A
E-W EDGE ID	I*4	1 - EAST 2 - WEST	N/A
NO. OF SUN INTRUSIONS INTO ANTENNA	I*4	0-10	N/A
SUN INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
ANTENNA ID	I*4	1-20	N/A

Notes:

1. The following are status flags:
   - -2 Unable to respond to a request outside the bounds of operational support.
   - -1 Request extends beyond range of operational support. Any events in requested range and in range of operational support are given.
   - 0 Request within range of operational support. All events in requested range are given.
   - N Events in request span, where *N* may be 1 through 10.
2. Half-words 5 through 16 are repeated for each Earth sensor intrusion event *J*.
3. Half-words 21 through 32 are repeated for each Imager intrusion event K.
4. Half-words 37 through 48 are repeated for each Sounder intrusion L.
5. Half-words 53 through 64 are repeated for each station antenna FOV intrusion event N.
6. The message length will vary with the total number of events of the four types. The message length is determined using the equation 16 + 12J + 12K + 12L + 12N, with a maximum length of 496, 16-bit half-words when J = K = L = N = 10.
7. Earth sensor single-chord operation start and stop times include OATS database-specified boundary considerations.

Message 60-1 – Sensor and Frame Intrusion Response (GOES N-P) (1 of 3)

In response to a Message 160 Subtype 1 from GTACS, OATS furnishes Sun and Moon intrusion predictions for the Imager East and West FOV edges, the Sounder East and West FOV edges, and CDAS antenna RF interference (Sun only). The Message 60 Subtype 1 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 75 - 85 (OATS)
      DESTINATION                   = 90 - 101 (GTACS)
      NO. OF HALF-WORDS             = UP TO 732 (SEE NOTES)
      MESSAGE TYPE                  = 60
      MESSAGE SUBTYPE               = 1
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A (used internally by OATS)
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15	
1	NUMBER OF IMAGER INTRUSIONS (K)																
2																	
3	IMAGER INSTRUSION STATUS FLAG																
4																	
5	INTRUDING BODY																
6																	
7	EAST OR WEST EDGE ID																
8																	
9	YEAR																IMAGER INTRUSION START TIME
10		DAY OF YEAR													HR(10s)		
11	HR(1s)				MINUTES										SEC(10s)		
12	SEC(1s)				MSECS												
13	YEAR																IMAGER INTRUSION STOP TIME
14		DAY OF YEAR													HR(10s)		
15	HR(1s)				MINUTES										SEC(10s)		
16	SEC(1s)				MSECS												
17	NUMBER OF SOUNDER INTRUSIONS (L)																
18																	

Message 60-1 – Sensor and Frame Intrusion Response (GOES N-P) (2 of 3)

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15	
19	SOUNDER INTRUSION STATUS FLAG																
20																	
21	INTRUDING BODY																
22																	
23	EAST OR WEST EDGE ID																
24																	
25	YEAR																SOUNDER INTRUSION START TIME
26		DAY OF YEAR												HR(10s)			
27	HR(1s)				MINUTES									SEC(10s)			
28	SEC(1s)				MSECS												
29	YEAR																SOUNDER INTRUSION STOP TIME
30		DAY OF YEAR												HR(10s)			
31	HR(1s)				MINUTES									SEC(10s)			
32	SEC(1s)				MSECS												
33	NUMBER OF SUN IN STATION ANTENNA FOV INTRUSIONS (N)																
34																	
35	SUN INSTRUSION STATUS FLAG																
36																	
37	ANTENNA ID																
38																	
39	SPARE																
40																	
41	YEAR																SUN IN STATION ANTENNA INTRUSION START TIME
42		DAY OF YEAR												HR(10s)			
43	HR(1s)				MINUTES									SEC(10s)			
44	SEC(1s)				MSECS												
45	YEAR																SUN IN STATION ANTENNA INTRUSION STOP TIME
46		DAY OF YEAR												HR(10s)			
47	HR(1s)				MINUTES									SEC(10s)			
48	SEC(1s)				MSECS												

Message 60-1 – Sensor and Frame Intrusion Response (GOES N-P) (3 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
INTRUDING BODY	I*4	1 = SUN 2 = MOON	N/A
INTRUSION TIMES YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MILLISECONDS	BCD	0-999	MSECS
NO. OF IMAGER INTRUSIONS	I*4	0-20	N/A
IM INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
INTRUDING BODY	I*4	1 = SUN 2 = MOON	N/A
EAST OR WEST EDGE ID	I*4	1 = EAST 2 = WEST	N/A
NO. OF SOUNDER INTRUSIONS	I*4	0-20	N/A
SDR INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
INTRUDING BODY	I*4	1 = SUN 2 = MOON	N/A
EAST OR WEST EDGE ID	I*4	1 = EAST 2 = WEST	N/A
NO. OF SUN INTRUSIONS INTO ANTENNA	I*4	0-20	N/A
SUN INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
ANTENNA ID	I*4	1-20	N/A

Notes:

1. All status flags:
   -2: Unable to respond to a request outside the bounds of operational support.
   -1: Request extends beyond range of operational support. Any events in requested range and in range of operational support are given.
   0: Request within range of operational support. All events in requested range are given.
2. Half-words 5-16 are repeated for each Imager intrusion event K.
3. Half-words 21-32 are repeated for each Sounder intrusion L.
4. Half-words 37-48 are repeated for each station antenna FOV intrusion event N.
5. The message length, therefore, will vary with the total number of events of the three types.
   The message length is given by: 12 + 12K + 12L + 12N, with a maximum length of 732 16-bit half-words when K = L = N = 20.
6. This message supports up to 10 days of intrusion predictions.

Message 60-2 – Sensor and Frame Intrusion Prediction Response (GOES N-P) (1 of 2)

In response to a Message 160 Subtype 2 from GTACS, OATS furnishes Sun intrusion predictions for a set of pre-defined frames. The Message 60 Subtype 2 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 75 - 85 (OATS)
      DESTINATION                   = 90 - 101 (GTACS)
      NO. OF HALF-WORDS             = UP TO 1776 (SEE NOTES)
      MESSAGE TYPE                  = 60
      MESSAGE SUBTYPE               = 2
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1-10
      END OF MESSAGE                = FALSE/TRUE
      ROUTING ID                    = N/A (used internally by OATS)
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 LSB 15
1	NUMBER OF REMAINING FRAMES
2	
3	NUMBER OF FRAMES IN THIS MESSAGE (K)
4	
5	FRAME NAME
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Message 60-2 – Sensor and Frame Intrusion Prediction Response (GOES N-P) (2 of 2)

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7	8 9 10 11	12 13 14 LSB 15	
21	INTRUSION STATUS FLAG			
22	FOR THIS FRAME			
23	NUMBER OF INTRUSIONS			
24	FOR THIS FRAME (N)			
25	YEAR			FRAME INTRUSION START TIME
26	DAY OF YEAR		HR(10s)	
27	HR(1s)	MINUTES	SEC(10s)	
28	SEC(1s)	MSECS		
29	YEAR			FRAME INTRUSION STOP TIME
30	DAY OF YEAR		HR(10s)	
31	HR(1s)	MINUTES	SEC(10s)	
32	SEC(1s)	MSECS		
33				
34				
.				
.				
.				

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF REMAINING FRAMES	I*4	1-20	N/A
NUMBER OF FRAMES IN THIS MESSAGE (K)	I*4	1-20	N/A
FRAME NAME	ASCII	N/A	N/A
INTRUSIONS STATUS FLAG	I*4	-2, -1, 0	N/A
NUMBER OF INTRUSIONS (N)	I*4	0-90	N/A
INTRUSION TIMES YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MILLISECONDS	BCD	0-999	MSECS

Notes:

1. Status flag:
   - -2: No intrusions in requested time span.
   - -1: Intrusions exist outside of requested time span. Any intrusion in requested range is given.
   - 0: All intrusions lie within the requested time span. Any intrusion in requested range is given.
2. NUMBER OF REMAINING FRAMES includes the frames in this message. As many messages as are necessary will be sent. No frame will have its data split over two messages. In the last message, the NUMBER OF REMAINING FRAMES will be the same as the NUMBER OF FRAMES IN THIS MESSAGE.
3. Half-words 5-8*N+24 are repeated for each frame in message K.
4. Half-words 25-32 are repeated for each Frame intrusion N. N may be different for different frames.
5. OATS has storage for 20 frames for 90 days. A maximum of 10 messages would be necessary to send all the data. If requests are limited to 10 days duration, the currently defined 10 frames will all be contained in one message.

Message 61 – DIRA Drift Command (GOES I-M)

After running the DIRA calibration process and before a stationkeeping maneuver, OATS sends Message 61 to GIMTACS. This message contains no command times. It is intended to be part of a stationkeeping maneuver command sequence, and the commands associated with this message should be sent just prior to sending the actual thruster commands. The Message 61 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 61
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
       1  |       ROLL DIRA DRIFT RATE COMMAND BIAS       |
       2  |                                               |
          |-----------------------------------------------|
       3  |      PITCH DIRA DRIFT RATE COMMAND BIAS       |
       4  |                                               |
          |-----------------------------------------------|
       5  |       YAW DIRA DRIFT RATE COMMAND BIAS        |
       6  |                                               |
          |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
ROLL DIRA DRIFT RATE BIAS	R*4	-15 TO +15	DEG/HR
PITCH DIRA DRIFT RATE BIAS	R*4	-15 TO +15	DEG/HR
YAW DIRA DRIFT RATE BIAS	R*4	-15 TO +15	DEG/HR

Notes:

1. No commanding time is associated with this command. It should be sent just before the associated stationkeeping maneuver command as part of the maneuver preparation.

2. The DIRA drift rate command bias in degrees per hour is what should be commanded to the spacecraft. This bias equals the negative of the DIRA drift rate.

Message 62 – IMC, SMC, or SCC Set Ready (GOES I-M) (1 of 2)

OATS sends GIMTACS an unsolicited Message 62 after generating a new IMC, SMC, or SCC coefficient set. In general, Message 62 is sent on a daily basis. However, when dealing with Earth sensor single chord operation, Shenk clouds, radiance gradients, or magnetic storms, the message may be sent more often. The Message 62 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 14
      MESSAGE TYPE                  = 62
      MESSAGE SUBTYPE               = 1 - NORMAL SET
                                    = 2 - REQUESTED PREVIOUSLY
                                          ENABLED SET
                                    = 101 - SMC SET
                                    = 102 - SCC SET
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

```
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
       1  |          IMC, SMC, or SCC SET IDENTIFIER      |
       2  |
          |-----------------------------------------------|
       3  |                 SSAA USAGE FLAG               |
       4  |
          |-----------------------------------------------|
       5  |                      SPARE                    |
       8  |
          |-----------------------------------------------|_
       9  |                      YEAR                     | |
          |-----------------------------------------------| |
      10  |  |         DAY OF YEAR            |  HR (10s) | | IMC SET
          |-----------------------------------------------| | EPOCH
      11  |  HR (1s)  |        MINUTES         |  SEC (10s)| | DATE
          |-----------------------------------------------| |
      12  |  SEC (1s) |               MSECS                | |
          |-----------------------------------------------|_
      13  |            IMC/SMC/SCC SET SUBTYPE             |
      14  |
          |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC/SMC/SCC SET ID	ASCII	ANNN FOR IMC	N/A
		NNNA FOR SMC	N/A
		NNNC FOR SCC	N/A
SSAA USAGE FLAG	I*4	0 - NOT A REACTIVE SET	N/A
		1 - BOTH IMC & STAR SENSE DELTA	
		2 - IMC ONLY	
		3 - STAR SENSE DEL ONLY	
EPOCH DATE YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY

Message 62 - IMC, SMC, or SCC Set Ready (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
IMC/SMC/SCC SET SUBTYPE	I*4	1 - FULL SET (24 HR)	N/A
		2 - NEW ORBIT REF. SET	
		3 - SSAA, COUPLED IM/SDR	
		4 - SSAA, UNCOUPLED IM/SDR	
		5 - POST-SK FULL SET	
		6 – SSO&A ADJUST	
		101 - SMC SET	
		102 - SCC SET	

Notes:

1. If the IMC set subtype is 1, the entire O&A prediction products have been updated. GIMTACS should request eclipse times, intrusion events, and star sighting commands.

2. A Subtype 101 indicates an SMC coefficients set, which is normally sent daily during the summer and winter seasons (valid only for I-M).

3. A Subtype 102 indicates an SCC coefficients set, which is sent at random times during the year. An analyst determines the timing of this message by looking at the times of single chord operation and the magnitude of changes from the current set (valid only for I-M).

Message 62 – IMC Set Ready (GOES N-P) (1 of 2)

OATS sends GTACS a Message 62 after generating a new IMC coefficient set. In general, Message 62 is sent in response to a Message 162. However, the message may be unsolicited after an SSAA. The Message 62 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 75 - 85 (OATS)
      DESTINATION                   = 90 - 101 (GTACS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 62
      MESSAGE SUBTYPE               = 1 - NORMAL SET
                                    = 2 - POST HOUSEKEEPING SET
                                    = 3 - ECLIPSE SET
                                    = 4 - POST MANEUVER SET
                                    = 5 - POST YAW FLIP SET
                                    = 6 - POST THRUSTER FLUSHING SET
                                    = 7 - POST ECLIPSE
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15	
1	IMC SET IDENTIFIER																
2																	
3	IMC SET SUBTYPE																
4																	
5	YEAR																EPOCH DATE
6		DAY OF YEAR											HR(10s)				
7	HR(1s)				MINUTES								SEC(10s)				
8	SEC(1s)				MSECS												

Message 62 – IMC Set Ready (GOES N-P) (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET ID	ASCII	ANNN FOR IMC	N/A
IMC SET SUBTYPE	I*4	1 - FULL SET (24 HR) 2 - NEW ORBIT REF. SET 3 - SSAA, COUPLED IM/SDR 4 - SSAA, UNCOUPLED IM/SDR 5 - POST - SET (Housekeeping, maneuver, yaw flip) 6 - SSAA	N/A
EPOCH DATE YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MILLISECONDS	BCD	0-999	MSECS

Notes:

If the IMC set subtype is 1, the entire O&A prediction products have been updated. GTACS should request eclipse times, intrusion events, and star sighting commands.

Message 63 – SSAA IMC Set Ready (GOES I-M) (1 of 2)

OATS sends GIMTACS an unsolicited Message 63 after generating a new IMC coefficient set as a result of an automatic Short Span Attitude Adjust (SSAA). This message informs GIMTACS that a Message 53, providing a new IMC coefficient set, is coming immediately. The Message 63 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = VARIABLE (SEE NOTES)
      MESSAGE TYPE                  = 63
      MESSAGE SUBTYPE               = 3 - SSAA, COUPLED IMGR/SNDR
                                    = 4 - SSAA, UNCOUPLED IMGR/SNDR
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = AS PROVIDED IN MSG 153

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
       1 |                IMC SET IDENTIFIER             |
       2 |                                               |
         |-----------------------------------------------|
       3 |                 SSAA USAGE FLAG               |
       4 |                                               |
         |-----------------------------------------------|
       5 |                      SPARE                    |
       6 |                                               |
         |-----------------------------------------------|
       7 |                  YAW FLIP FLAG                |
       8 |                                               |
         |-----------------------------------------------|
       9 |              DATA FORMAT INDICATOR            |
         |-----------------------------------------------|
      10 |                DYNAMIC RANGE FLAG             |
         |-----------------------------------------------|
      11 |   RECOMMENDED IMC SET ENABLE TIME FROM EPOCH  |
      12 |                                               |
         |-----------------------------------------------|-
      13 |                       YEAR                    | |
         |-----------------------------------------------| |
      14 |   |        DAY OF YEAR           |  HR (10'S) | | EPOCH
         |-----------------------------------------------| | DATE AND
      15 |  HR (1'S) |       MINUTES        | SEC (10'S) | | TIME
         |-----------------------------------------------| |
      16 | SEC (1'S) |                MSEC                | |
         |-----------------------------------------------|-
      17 |          SPACECRAFT COMPENSATION - ROLL       |
      18 |                                               |
         |-----------------------------------------------|
      19 |         SPACECRAFT COMPENSATION - PITCH       |
      20 |                                               |
         |-----------------------------------------------|
      21 |          SPACECRAFT COMPENSATION - YAW        |
      22 |                                               |
         |-----------------------------------------------| - Subt. 3
      23 |     ATTITUDE CONSTANTS - ROLL, PITCH, YAW,    |
       :  |     ROLL MISALIGNMENT, PITCH MISALIGNMENT     |
      42 |        (5 EACH FOR IMAGER THEN SOUNDER)       |
         |-----------------------------------------------| - Subt. 4
```

Message 63 – SSAA IMC Set Ready (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN FOR IMC	N/A
SSAA USAGE FLAG	I*4	0 - NOT A REACTIVE SET	
		1 - BOTH IMAC AND START SENSE DELTA	
		2 - IMC ONLY	
		3 - START SENSE DELTA ONLY	
DATA FORMAT INDICATOR	I*2	0 - COEFFICIENT	N/A
DYNAMIC RANGE FLAG	I*2	1 - LOW, 2 - HIGH	N/A
RECOMMENDED ENABLE TIMER FROM IMC EPOCH	R*4	SEE NOTE BELOW	MIN
EPOCH DATE AND TIME - YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MINUTE
SECOND	BCD	0-59	SECOND
MILLISECOND	BCD	0-999	MSEC
SPACECRAFT COMPENSATION ROLL, PITCH, YAW	R*4	-.004 TO +.004	RAD
ATTITUDE CONSTANTS	R*4	-0.00327 TO +0.00327	RAD

Notes:

1. The yaw-flip flag will be +1 for normal spacecraft and -1 for flipped spacecraft.
2. A parent IMC set is generally effective throughout the entire image registration period. Because of various random natural phenomena or dynamic range limitations, the parent IMC set may be modified by small IMC subsets for varying subspans of the co-registration period. The parent IMC set and its modifiers all have the same IMC epoch.
3. The IMC set identifier and validation is described in Section 4.3.2.2.1.
4. A short-term IMC set (Subtype 3 is used only when compensating for Earth sensor errors due to clouds, or radiance gradient, or when operating with an Earth sensor inhibited due to magnetic storms, etc. For this case, only the spacecraft compensation terms change, and the message terminates with half-word 22. The epoch will be the same as that for the currently active coefficient set, and should not be uploaded.
5. A thermal induced IMC set (Subtype 4) is used when compensating for misalignments caused by non-repeatable on board thermal changes to Imager or Sounder pointing. The spacecraft compensation terms will be the same as the parent set and the ten attitude constants will give the correction for Imager and Sounder. The message terminates at word 42.
6. The recommended enable time is in minutes and is relative to the epoch time. It commonly may be a negative number, which indicates that the recommended enable time is before the epoch time.
7. All subtypes will have the same epoch of the parent type. Types 3 and 4 should be loaded as early as possible. A parent IMC set may be modified at a specific time by a modifying IMC set (Subtype 3 or 4). These modifying IMC sets may be in effect sequentially in any order, but only one modifying set may be in effect at a given time. When the operator changes from one modifying subtype to another, the transition IMC set OATS generates (Subtype 4) ensures the integrity of the entire IMC process – including the on-board IMC scan correction process as well as the GIMTACS star commanding correction.

Message 66 – DIRA Calibration Data Request (GOES I-M) (1 of 2)

OATS sends GIMTACS an unsolicited Message 66 whenever it needs telemetry data relating to the DIRAs. The Message 66 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 224 (SEE NOTES)
      MESSAGE TYPE                  = 66
      MESSAGE SUBTYPE               = 1 - PID REQUEST
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|—
      1  |                      YEAR                     |  |
         |-----------------------------------------------|  | DATA
      2  |  |         DAY OF YEAR            |  HR (10s)|  |
         |-----------------------------------------------|  | START
      3  |  HR (1s)  |        MINUTES        |  SEC (10s)|  |
         |-----------------------------------------------|  | TIME
      4  |  SEC (1s) |             MSECS                 |  |
         |-----------------------------------------------|—
      5  |               DATA SPAN DURATION              |
      6  |
         |-----------------------------------------------|
      7  |      NUMBER OF DATA SETS (N) IN REQUEST       |
      8  |
         |-----------------------------------------------|
      9  |          RESPONSE SUBTYPE FOR SET NO. 1       |
     10  |   (MESSAGE SUBTYPE TO BE USED IN RESPONSE)    |
         |-----------------------------------------------|
     11  |      DATA THINNING CONSTANT FOR SET NO.1      |
     12  |
         |-----------------------------------------------|
     13  |       NUMBER OF PIDS (M) IN DATA SET NO.1     |
     14  |
         |-----------------------------------------------|
     15  |
      .  |        LIST OF M PIDS FOR DATA SET NO.1       |
  14+2M  |
         |-----------------------------------------------|
  15+2M  |   RESPONSE SUBTYPES, DATA THINNING CONSTANTS, |
      .  |       NUMBER OF PIDS, AND PID LISTS FOR       |
      .  |                DATA SETS 2-N                  |
    8+   |
 N(6+2M) |-----------------------------------------------|
```

Message 66 – DIRA Calibration Data Request (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
DATA SPAN START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	1-120	MIN
NUMBER OF DATA SETS	I*4	0-12	N/A
RESPONSE SUBTYPE	I*4	7,8	N/A
DATA THINNING CONSTANTS	I*4	1-120	N/A
NUMBER OF PIDS IN SET	I*4	1-7	N/A
DATA PIDS	I*4	1-9999	N/A

Notes:

1. The time stamp is the time at which this response was generated.

3. The following are OATS node numbers:
   41 = SOAT01 42 = SOAT02
   43 = SOAT03 44 = SOAT04
   45 = SOAT05 46 = SOAT06
   47 = COAT01 48 = COAT02
   49 = GOAT01 50 = GOAT02

4. The message length varies with the number of data sets in the message and the number of parameter identifiers (PIDs) in each data set. This flexible format has been chosen to facilitate future changes. The message length is given by $8 + N(6 + 2M)$, with a maximum length of 224, sixteen-bit half-words when $N = 12$ and $M = 6$.

5. A Parameter Identification (PID) is a unique identifier associated with a single telemetry parameter. Each parameter is assumed to have a unique PID. The following lists the parameters required for DIRA calibration along with their description and location in the post code modulation (PCM) frame.

Parameter	TLM Word	PID
DIRA Accumulated Roll Data	26, 27 (AOCS Format No.1)	0031
DIRA Accumulated Pitch Data	31, 32 (AOCS Format No.1)	0082
DIRA Accumulated Yaw Data	33, 34 (AOCS Format No.1)	0103
DSS Pitch	35-6 Bits 7, 8	0008
	35-7 Bits 1–7	
DSS Yaw	35-7 Bit 8	0310
	35-8 Bits 1–8	
ES Roll Data	29, 30 Bits 1-4 (AOCS Format No.2)	0055
TLM Format Selection	24 Bits 1-3	0324

6. The tracer is expected to be returned unchanged in the response message for identification.

7. The thinning constant indicates that only every K^{th} value of the parameter is to be returned, where K is the thinning constant value with respect to the location of the parameter in the telemetry stream minor or major frame.

8. The response subtype is specified for requested telemetry data only. It is used internally by OATS and does not need to be used by GIMTACS to identify the data requested. However, GIMTACS must echo this response subtype in the Message 166.

Message 67 – Trim Tab Data Request (GOES I-M) (1 of 3)

OATS sends GIMTACS an unsolicited Message 67-1 when it needs telemetry data, and a Message 67-2 to obtain thruster firing history data that both relate to the trim tab control calculation. Each data request is interpreted by GIMTACS as a separate request. The Message 67 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE No.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 560 (SEE NOTES)
      MESSAGE TYPE                  = 67
      MESSAGE SUBTYPE               = 1 - PID REQUEST
                                    = 2 - THRUSTER DATA REQUEST
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                     YEAR                      |
          |-----------------------------------------------|
      2   |         DAY OF YEAR           |  HR (10s)     |
          |-----------------------------------------------|
      3   |  HR (1s)  |        MINUTES    |  SEC (10s)    |
          |-----------------------------------------------|
      4   |  SEC (1s) |              MSECS                |
          |-----------------------------------------------|
      5   |              DATA SPAN DURATION               |
      6   |
          |-----------------------------------------------|
      7   |      NUMBER OF DATA SETS (N) IN REQUEST       |
      8   |
          |-----------------------------------------------|
      9   |         RESPONSE SUBTYPE FOR SET NO.1         |
     10   |  (MESSAGE SUBTYPE TO BE USED IN RESPONSE)     |
          |-----------------------------------------------|
     11   |       DATA THINNING CONSTANT FOR SET NO.1     |
     12   |
          |-----------------------------------------------|
     13   |       NUMBER OF PIDS (M) IN DATA SET NO.1     |
     14   |
          |-----------------------------------------------|
     15   |
      .   |        LIST OF M PIDS FOR DATA SET NO.1       |
  14+2M   |
          |-----------------------------------------------|
  15+2M   |        RESPONSE SUBTYPES, DATA THINNING       |
      .   |         CONSTANTS, NUMBER OF PIDS, AND        |
      .   |           PID LISTS FOR DATA SETS 2-N         |
    8+    |
 N(6+2M)  |-----------------------------------------------|
```

DATA START TIME

Message 67 – Trim Tab Data Request (2 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	1-1500	MIN
NUMBER OF DATA SETS	I*4	0-12	N/A
RESPONSE SUBTYPE	I*4	1,4,5,6	N/A
DATA THINNING CONSTANTS	I*4	1-2400	N/A
NUMBER OF PIDS IN SET	I*4	1-20	N/A
DATA PIDS	I*4	1-9999	N/A

Notes:

1. The time stamp is simply the time that the response was generated.

   The following are OATS node numbers:

   41 = SOAT01 42 = SOAT02
   43 = SOAT03 44 = SOAT04
   45 = SOAT05 46 = SOAT06
   47 = COAT01 48 = COAT02
   49 = GOAT01 50 = GOAT02

2. The message length varies with the number of data sets in the message and the number of PIDs in each data set, a flexible format selected to facilitate future changes. The message length is given by $8 + N(6 + 2M)$ with a maximum length of 560 16-bit half-words when $N = 12$ and $M = 20$.

3. A PID is a unique identifier associated with a single telemetry parameter. Each parameter is assumed to have a unique PID. The following is a parameter list required for trim tab calibration along with their description and location in the PCM frame.

Propellant Tank Parameter	TLM Word	PID
Oxidizer Tank Temperature 1	113-15	5193
Oxidizer Tank Temperature 2	113-16	5194
Fuel Tank Temperature 1	113-17	5195
Fuel Tank Temperature 2	113-18	5196
Fuel Tank Pressure (Ext Range)	88-15	3010
Oxidizer Tank Pressure (Ext Range)	88-16	3011
Fuel Line Pressure (Ext Range)	88-13	3008
Oxidizer Line Pressure (Ext Range)	88-14	3009
Fuel Tank Pressure	88-10	3005
Oxidizer Tank Pressure	88-11	3006

Message 67 – Trim Tab Data Request (3 of 3)

Propellant Tank Parameter	TLM Word	PID
Thruster Firing History (on-time and activity)	AOCS Format No. 5	(Msg 67-2)
Trim Tab Position-Primary	Trim Tab Pseudo PID 1	9602
Trim Tab Position-Backup	Trim Tab Pseudo PID 2	9603
Magnetic Torquer 1 Current	Trim Tab Pseudo PID 3	9600
Magnetic Torquer 2 Current	Trim Tab Pseudo PID 4	9601
Magnetometer Data	18, 19	
X-Axis	20, 21	7300
Y-Axis	22, 23	7301
Z-Axis		7303
Momentum Wheel	33, 34 (Format No. 2)	
No. 1 Speed	26, 27 (Format No. 2)	0104
No .2 Speed		0032
Reaction Wheel Speed	33, 34 or 26, 27 (Format No. 2)	0105 or 0034

4. The primary trim tab position referenced by Trim Tab Pseudo PID 1 is based on TLM words 88–17, 88–18, and 88–19; the backup trim tab position referenced by Trim Tab pseudo PID 2 is based on TLM words 100–2, 100–3, and 100–4.

5. The magnitude of magnetic torquer 1 current referenced by Trim Tab Pseudo PID 3 is obtained from TLM word 120 and bits 1 and 2 of word 121. The sign of the current is obtained from TLM bit 7 of word 34 in format 4. The magnitude of magnetic torquer 2 current referenced by Trim Tab Pseudo PID 4 is obtained from TLM word 122 and bits 1 and 2 of word 123. The sign of the current is obtained from TLM bit 8 of word 34 in format 4.

6. The tracer is expected to be returned unchanged in the response message for identification.

7. The thinning constant indicates that only every K^{th} value of the parameter is to be returned, where *K* is the thinning constant value with respect to the location of the parameter in the telemetry stream minor or major frame.

8. Telemetry data is only requested through a Message 67-1.

9. The response subtype, half-word 9, is specified for requested telemetry data only. It is used internally by OATS and does not need to be used by GIMTACS to identify the data requested. However, GIMTACS must echo this response subtype in the Message 167.

10. Thruster firing history data is only requested by a Subtype 2 of this message. In that case, the message ends at half-word 8 and the number of data sets in the request equals zero. All thruster activity during the requested span, exclusive of firings during the AOCS stationkeeping mode, should be sent.

11. GIMTACS responds with a Message 167-2 for thruster firing history data.

Message 70 – Propulsion Subsystem Data Request (1 of 3)

OATS sends GIMTACS/GTACS an unsolicited Message 70-1 to obtain propulsion system telemetry data, and a 70–2 for thruster firing history data relating to propulsion subsystem processing. Each data request is interpreted by GIMTACS/GTACS as a separate request. The Message 70 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = UP TO 560 (SEE NOTES)
      MESSAGE TYPE                  = 70
      MESSAGE SUBTYPE               = For GOES I-M
                                    = 1 - PID REQUEST
                                    = 2 - THRUSTER DATA REQUEST
                                    = For GOES N-P
                                    = 1 - LRV REQUEST
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|_
      1   |                     YEAR                      | |
          |-----------------------------------------------| | DATA
      2   |  |         DAY OF YEAR            |  HR (10s) | | START
          |-----------------------------------------------| | TIME
      3   |  HR (1s)  |        MINUTES         |  SEC (10s)| |
          |-----------------------------------------------| |
      4   |  SEC (1s) |               MSECS               | |
          |-----------------------------------------------|_
      5   |               DATA SPAN DURATION              |
      6   |
          |-----------------------------------------------|
      7   |      NUMBER OF DATA SETS (N) IN REQUEST       |
      8   |
          |-----------------------------------------------|
      9   |         RESPONSE SUBTYPE FOR SET NO.1         |
     10   |  (MESSAGE SUBTYPE TO BE USED IN RESPONSE)     |
          |-----------------------------------------------|
     11   |     DATA THINNING CONSTANT FOR SET NO.1       |
     12   |
          |-----------------------------------------------|
     13   |   NUMBER OF PIDS/LRV (M) IN DATA SET NO.1     |
     14   |
          |-----------------------------------------------|
     15   |
      .   |    LIST OF M PIDS/LRV FOR DATA SET NO.1       |
  14+2M   |
          |-----------------------------------------------|
  15+2M   |        RESPONSE SUBTYPES, DATA THINNING       |
      .   |    CONSTANTS, NUMBER OF PIDS/LRV, AND         |
      .   |     PID/LRV LISTS FOR DATA SETS 2-N           |
    8+    |
 N(6+2M)  |-----------------------------------------------|
```

Message 70 – Propulsion Subsystem Data Request (2 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	1-120	MIN
NUMBER OF DATA SETS	I*4	0-12	N/A
RESPONSE SUBTYPE	I*4	1,3,6	N/A
DATA THINNING CONSTANTS	I*4	1-2400	N/A
NUMBER OF PIDS IN SET	I*4	1-20	N/A
DATA PIDS/LRVS	I*4	1-9999 (I-M PIDS)	N/A
	I*4	10000-99999 (N-P LRVS)	N/A

Notes:

1. The time stamp is the time that the response was generated.

2. The message length varies with the number of data sets in the message and the number of PIDs in each data set, a flexible format selected to facilitate future changes. The message length is determined by $8 + N(6 + 2M)$, with a maximum length of 560 16-bit half-words when $N = 12$ and $M = 20$.

3. (For GOES I-M) A PID is a unique identifier associated with a single telemetry parameter. Every parameter is assumed to have a unique PID. The following lists the parameters required for DIRA calibration along with their description and location in the PCM frame:

Propellant Tank Parameter	TLM Word	PID
Oxidizer Tank Temperature 1	113-15	5193
Oxidizer Tank Temperature 2	113-16	5194
Fuel Tank Temperature 1	113-17	5195
Fuel Tank Temperature 2	113-18	5196
Fuel Tank Pressure (Ext Range)	88-15	3010
Oxidizer Tank Pressure (Ext Range)	88-16	3011
Fuel Line Pressure (Ext Range)	88-13	3008
Oxidizer Line Pressure (Ext Range)	88-14	3009
Fuel Tank Pressure	88-10	3005
Oxidizer Tank Pressure	88-11	3006
Thruster Firing History (on time and activity)	AOCS Format No. 5	Msg 70-2
SADA Output Position Channel A	Word 59	9604
SADA Output Position Channel B	Word 60	9604

Message 70 – Propulsion Subsystem Data Request (3 of 3)

4. (For GOES N-P) A LRV is a unique identifier associated with a single telemetry parameter. Every parameter is assumed to have a unique LRV. The following is a list of the parameters required for maneuver validation. The listed ACE LRVs use "n" to designate the first digit where n is either 1 or 2 corresponding to the active ACE.

PARAMETER	LRV
Oxidizer Tank 1 Temp A, B, C	42064, 42065, 42074
Oxidizer Tank 2 Temp A, B, C	42066, 42067, 42075
Fuel Tank 1 Temp A, B, C	42060, 42061, 42072
Fuel Tank 2 Temp A, B, C	42062, 42063, 42073
Fuel Tank 1 Pressure	32010
Fuel Tank 2 Pressure	32011
Oxidizer Tank 1 Pressure	32012
Oxidizer Tank 2 Pressure	32013
ECI-to-body quaternion	n2025-n2028
Roll, pitch, yaw momentum in ECI	n2150-n2152
Roll, pitch, yaw momentum in body	n2068-n2070
Yaw-flip flag	n8793
Thruster on-time (cumulative)	n4440, 4441, 4442,…, 1451
Thruster pulses (cumulative)	n4460, 4461, 4462,…, 4471
Thruster active jets	n4480, 4481, 4482,…, 4491
Thruster commanded pulse width	n4591
Thruster cycle duration	n4433
Thruster selected jets	n4410, 4411, 4412,…, 4421
Tank Latch valve status - fuel	32000, 32001
Tank Latch valve status – oxi.	32002, 32003
Solar Array Drive Angle	n3148
Minor Frame Count	30059

5. (GOES I-M) Solar Array Drive Assembly (SADA) output position is reported as one pseudo PID.

6. The tracer is expected to be returned unchanged in the response message for identification.

7. The thinning constant indicates that only every K^{th} value of the parameter is to be returned, where *K* is the thinning constant value with respect to the location of the parameter in the telemetry stream minor or major frame.

8. Telemetry data is only requested by a Message 70-1.

9. The response subtype (half-word 9) is specified for requested telemetry data only. It is used internally by OATS and does not need to be used by GIMTACS/GTACS to identify the data requested. However, GIMTACS/GTACS must echo this subtype in the Message 170.

10. (GOES I-M only) Thruster firing history data is only requested by a Message 70-2. In that case, the message ends at half-word 8 and the number of data sets in the request equals zero. All thruster activity during the AOCS stationkeeping mode should be sent.

11. GIMTACS responds with a Message 170-2 for thruster firing history data.

Message 71 – Star Window Request (1 of 2)

Whenever OATS determines that the attitude uncertainty mode has changed, it requests star windows from GIMTACS/GTACS by way of one of three Message 71 subtypes. GIMTACS/GTACS responds with a Message 151.

Subtype 1 indicates OATS needs to change the number of looks required for each star without changing the current window schedule. GIMTACS/GTACS should respond by sending the remaining windows in its normal operating schedule for OATS to provide new starlook command data.

Subtype 2 indicates the attitude uncertainty has degenerated to the point where an extended search for stars is required. In this case, GIMTACS/GTACS should send its star window contingency schedule, which provides larger windows than a normal schedule. OATS responds with new starlook command data for these contingency schedule windows.

Subtype 3 indicates the attitude uncertainty has returned to an acceptable level so a contingency schedule of windows is no longer needed. GIMTACS/GTACS should respond with the remaining windows in its normal operating schedule. OATS, in turn, responds with starlook command data for these windows.

The Message 71 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50(I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = 4
      MESSAGE TYPE                  = 71
      MESSAGE SUBTYPE               = 1 - NORMAL WINDOWS REQUIRED
                                    = 2 - CONTINGENCY WINDOWS REQUIRED
                                    = 3 - MAY RETURN TO NORMAL WINDOWS
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |                IMC SET IDENTIFIER             |
      2 |
        |-----------------------------------------------|
      3 |                      SPARE                    |
      4 |
        |-----------------------------------------------|
```

Message 71 – Star Window Request (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A

Notes:

1. A Subtype 1 message indicates OATS requires larger starlook areas, which generally means more looks per star sighting. The current windows are adequate, and GIMTACS/GTACS needs simply to resend the remaining windows in its current working schedule.

2. A Subtype 2 message indicates OATS requires larger starlook areas which are not supportable by the current window schedule. GIMTACS/GTACS must send OATS its contingency star viewing schedule, which provides larger and possibly more frequent viewing windows.

3. A Subtype 3 message indicates OATS no longer requires the larger starlook areas. GIMTACS/GTACS may resend the remaining windows in its nominal working schedule to receive the nominal commands.

4. The IMC set identifier represents the parent IMC set for the currently enabled IMC group. This identifier is reflected back to OATS in the corresponding Message 151.

Message 72 – OATS Alarm Text

OATS sends GIMTACS/GTACS an unsolicited Message 72 whenever an alarm message is generated by any task within OATS. The message contains an ASCII text version of the OATS alarm sent to GIMTACS/GTACS for informational purposes only. The Message 72 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = 40
      MESSAGE TYPE                  = 72
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |                                               |
      .  |             CURRENT ALARM MESSAGE             |
     40  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
CURRENT ALARM MESSAGE	ASCII	N/A	N/A

Notes:

The assembled alarm message is 80 characters in length with the following data in the designated bytes. Bytes not specified are blank.

1-19	Time stamp in the form yy/ddd_hh:mm:ss.sss
21-22	Satellite ID, eg. '_8' or '12' or '14'
24-31	Reporting task name
33-80	Text of message

The '_' represents a blank.

Message 73 – Torque Table Updates (GOES N-P) (1 of 2)

The torque table is the best estimate of torque in the body frame produced by each thruster. OATS calculates the torque table using current estimates of propellant tank pressures, S/C center of mass, and thruster calibration factors. OATS will normally send Message 73 to GTACS just before and after the N-S SK maneuvers for upload to the S/C.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 75 - 85 (OATS)
      DESTINATION                   = 90 - 101 (GTACS)
      NO. OF HALF-WORDS             = 76
      MESSAGE TYPE                  = 73
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2		DAY OF YEAR										HR(10s)				
3	HR(1s)			MINUTES								SEC(10s)				
4	SEC(1s)			MSECS												
5 6	TORQUE FOR THRUSTER #1 – ROLL AXIS															
7 8	TORQUE FOR THRUSTER #1 – PITCH AXIS															
9 10	TORQUE FOR THRUSTER #1 – YAW AXIS															
11 : 76	REPEAT WORDS 5 THROUGH 10 FOR THE REMAINING 11 THRUSTERS															

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	2000-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MILLISECONDS	BCD	0-999	MSEC
TORQUE	R*4	-20 to + 20	Nm

Notes:

1. The torque table is defined as the best estimate of torque in the manufacturing frame (equivalent to body frame) produced by each thruster. It is used by OATS to calculate the change in momentum caused by the thrusters. The torque table will normally be uploaded just before and after the N-S SK maneuvers.

Message 73 – Torque Table Updates (GOES N-P) (2 of 2)

2. The roll, pitch and yaw body axes are defined in the S/C body coordinate system.

3. A nominal torque table is shown below:

Thruster	Jet ID	Roll	Pitch	Yaw
1	N1	8.73625	0.123340	-9.51834
2	N2	8.73625	-0.167574	9.76301
3	N3	-6.41743	-0.210284	-9.37198
4	N4	-6.41743	0.245923	9.61816
5	E1	0.339670	0.471259	-9.56956
6	E2	1.33307	0.325303	9.09248
7	W1	0.348589	-0.468979	9.53327
8	W2	-0.340164	-0.335688	-9.18442
9	A1	-7.82087	12.1440	0.000000
10	A2	10.7921	10.3899	0.000000
11	A3	-7.82087	-12.3968	0.000000
12	A4	10.7921	-10.6426	0.000000

Message 75 – IMC Scale Factor Calibration Schedule Response (1 of 3)

OATS responds to a GIMTACS/GTACS Message 175 with a Message 75 containing the requested IMC scale factors, star view window commands and schedule after their calculation. The Message 75 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = VARIABLE (SEE NOTES)
      MESSAGE TYPE                  = 75
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1-255
      END OF MESSAGE                = TRUE/FALSE
      ROUTING ID                    = AS PROVIDED IN MSG 175
```

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|-
      1 |                    YEAR                       | |
        |-----------------------------------------------| | DATA
      2 |  |         DAY OF YEAR            |  HR (10s) | | START
        |-----------------------------------------------| | TIME
      3 |  HR (1s)  |        MINUTES         |  SEC (10s) | |
        |-----------------------------------------------| |
      4 |  SEC (1s) |               MSECS                | |
        |-----------------------------------------------|-
      5 |          NUMBER OF OFFSET CHANGES (N)          |
      6 |
        |-----------------------------------------------|
      7 |                    SPARE                       |
      8 |
        |-----------------------------------------------|
      9 |             FIRST IMC OFFSET                   |
     10 |
        |-----------------------------------------------|
     11 |      NO. OF STARS FOR THIS IMC OFFSET (K)      |
     12 |
        |-----------------------------------------------|
     13 |                    STAR ID                     |
     14 |
        |-----------------------------------------------|
     15 |           NO. (J) OF LOOKS FOR STAR            |
     16 |
        |-----------------------------------------------|
     17 |           LOOK NO. IN CMD SEQUENCE             |
     18 |
        |-----------------------------------------------|
     19 |                LOOK DWELL REPEATS              |
     20 |
        |-----------------------------------------------|-
     21 |                    YEAR                       | |
        |-----------------------------------------------| | COMMAND
     22 |  |         DAY OF YEAR            |  HR (10s) | | EXECUTE
        |-----------------------------------------------| | TIME
     23 |  HR (1s)  |        MINUTES         |  SEC (10s) | |
        |-----------------------------------------------| |
     24 |  SEC (1s) |               MSECS                | |
        |-----------------------------------------------|-
     25 |                   E-W CYCLES                   |
     26 |
        |-----------------------------------------------|
```

Message 75 – IMC Scale Factor Calibration Schedule Response (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    27  |                 E-W INCREMENTS                |
    28  |                                               |
        |-----------------------------------------------|
    29  |                   N-S CYCLES                  |
    30  |                                               |
        |-----------------------------------------------|
    31  |                 N-S INCREMENTS                |
    32  |                                               |
        |-----------------------------------------------|
    33  | ADDITIONAL LOOKS FOR THIS STAR REPEATS WORDS  |
 16+16J |           17 THRU 32 FOR J LOOKS              |
        |-----------------------------------------------|
     .  | ADDITIONAL STARS AND LOOKS FOR THIS IMC OFFSET|
     .  |      REPEATS FROM WORD 13 TO ABOVE            |
        |-----------------------------------------------|
     .  | ADDITIONAL IMC OFFSETS, STARS, AND LOOKS      |
     .  |      REPEATS FROM WORD 9 TO ABOVE             |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
START YEAR	BCD	1989 - 2025	YEAR
DAY OF YEAR	BCD	1 - 366	DAY
HOURS	BCD	0 - 23	HOUR
MINUTES	BCD	0 - 59	MINUTE
SECONDS	BCD	0 - 59	SEC
NUMBER OF OFFSET CHANGES	I*4	1-200	N/A
IMC CALIBRATION OFFSET	R*4	-.008 TO +.008	RAD
NO. OF STARS FOR IMC OFFSET	I*4	0-100 (SEE NOTES)	N/A
STAR ID	I*4	-1, 1-9999 (SEE NOTES)	N/A
NO. OF LOOKS FOR STAR	I*4	1-16	N/A
LOOK IN COMMAND SEQUENCE	I*4	1-16	N/A
LOOK DWELL REPEATS	I*4	0-63 (IMAGER)	N/A
		0-15 (SOUNDER)	N/A
COMMAND EXECUTE TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTE	BCD	0-59	MIN
SECOND	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
E-W CYCLES	I*4	0-5 (I-M)	CYCLES
	I*4	0-7 (N-P)	CYCLES
E-W INCREMENTS	I*4	0-6135 (IMAGER)	INCREMENTS
		0-2405 (SOUNDER)	INCREMENTS
N-S CYCLES	I*4	0-9	CYCLES
N-S INCREMENTS	I*4	0-6135 (IMAGER)	INCREMENTS
		0-2405 (SOUNDER)	INCREMENTS

Notes:

1. The following are numbers of stars for IMC offset:

   0 - No stars in window, all remaining items for the window are omitted.
   N - Number of stars selected for window star ID = -1 for a Moon sight, and ID = 1 to 9999, for star sight.

Message 75 – IMC Scale Factor Calibration Schedule Response (3 of 3)

2. The message length depends on the number of looks in each sequence and the number of stars for each IMC offset in the IMCCAL window. The message length using the validation limits is given by $8 + N(4 + K(4 + 16J))$. The maximum length is 3,280,808 16-bit half-words when $N = 200$, $K = 100$, and $J = 10$, which exceeds the maximum message length limit. As necessary, multiple messages are transmitted until the entire response is complete. Messages are separated at the offset level. Each frame contains an integral number of offsets and all the nested data associated with those offsets. The total number of messages and the number of offsets in each message depends on the values in the requesting message.

3. The message count and end of message flag in half-word 13 of the header are used to keep track of multiple messages (see Section 4.3.1).

4. Message 75 is multiply nested in the order [offset [star [look]]] for each look at a star, for each star in an offset, and for all offsets in the IMCCAL window.

Message 80 – IMC Scale Factors

OATS send an unsolicited Message 80 to GIMTACS/GTACS after calculating new IMC scale factor offsets. The Message 80 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      DESTINATION                   = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      NO. OF HALF-WORDS             = 4
      MESSAGE TYPE                  = 80
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |      E-W COMPENSATION SCALE FACTOR            |
      2 |                                               |
        |-----------------------------------------------|
      3 |           N-S COMPENSATION                    |
      4 |                 SCALE FACTOR                  |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC COMPENSATION SCALE FACTORS	R*4	0-1.638	N/A

Notes:

Message 80 is sent unsolicited. It is the product of a special process scheduled in close cooperation with GIMTACS/GTACS.

Message 81 – MMC Scale Factors (GOES I-M)

OATS sends an unsolicited Message 81 to GIMTACS after calculating new MMC scale factors. The Message 81 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 18
      MESSAGE TYPE                  = 81
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
      1  |        S/C PITCH MOMENTUM SCALE FACTOR        |
      2  |                                               |
         |-----------------------------------------------|
      3  |         ROLL MMC OUTPUT SCALE FACTOR          |
      4  |                                               |
         |-----------------------------------------------|
      5  |         YAW MMC OUTPUT SCALE FACTOR           |
      6  |                                               |
         |-----------------------------------------------|
      7  |      ROLL MOMENT OF INERTIA SCALE FACTOR      |
      8  |                                               |
         |-----------------------------------------------|
      9  |        YAW MOMENT OF INERTIA SCALE FACTOR     |
     10  |                                               |
         |-----------------------------------------------|
     11  |       PITCH MMC OUTPUT SCALE FACTOR           |
     12  |                                               |
         |-----------------------------------------------|
     13  |       PITCH MOMENT OF INERTIA SCALE FACTOR    |
     14  |                                               |
         |-----------------------------------------------|
     15  |       X-Z INERTIA COUPLING SCALE FACTOR       |
     16  |                                               |
         |-----------------------------------------------|
     17  |       X-Y INERTIA COUPLING SCALE FACTOR       |
     18  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
MMC SCALE FACTORS	R*4	-16.4 TO +16.4	N/A

Message 81 – ISEC Scale Factors (GOES N-P)

OATS sends an unsolicited Message 81 to GTACS after calculating new Instrument Systematic Error Compensation (ISEC) scale factors. The Message 81 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 75 - 85 (OATS)
      DESTINATION                   = 90 - 101 (GTACS)
      NO. OF HALF-WORDS             = 4
      MESSAGE TYPE                  = 81
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
     HALF-     MSB                                                LSB
     WORD NO.  0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15
        1
        2      EAST-WEST ISEC SCALE FACTOR
        3
        4      NORTH-SOUTH ISEC SCALE FACTOR
```

DATA ITEM	FORMAT	VALIDATION	UNITS
ISEC COMPENSATION SCALE FACTORS	R*4	-0.001 to +0.001	rad/rad

Notes:

1. This message is sent unsolicited.
2. At this time, the North-South ISEC scale factor will always be 0.0.

Message 82 – OATS Response Error Text (GOES N-P Only)

OATS sends the Scheduler workstation a Message 82 whenever OATS cannot fulfill a request. The message contains an ASCII text message detailing the reason for the failure. The Message 82 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 75 - 85 (OATS)
      DESTINATION                   = 90 - 101 (GTACS)
      NO. OF HALF-WORDS             = 40
      MESSAGE TYPE                  = 82
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
     HALF-     MSB                                                LSB
     WORD NO.   0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15
         1    +-------------------------------------------------------------+
         :    |                  RESPONSE ERROR MESSAGE                     |
        40    +-------------------------------------------------------------+
```

DATA ITEM	FORMAT	VALIDATION	UNITS
RESPONSE ERROR MESSAGE	ASCII	N/A	N/A

Message 85 – MMC Calibration Data Request (GOES I-M) (1 of 2)

OATS sends an unsolicited Message 85 to GIMTACS whenever it needs telemetry data relating to the MMC calibration. The Message 85 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 224 (SEE NOTES)
      MESSAGE TYPE                  = 85
      MESSAGE SUBTYPE               = 1 - PID REQUEST
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                     YEAR                      |
          |-----------------------------------------------|
      2   |         DAY OF YEAR           |  HR (10s)     |
          |-----------------------------------------------|
      3   |  HR (1s)  |        MINUTES        |  SEC (10s)|
          |-----------------------------------------------|
      4   |  SEC (1s) |               MSECS               |
          |-----------------------------------------------|
      5   |               DATA SPAN DURATION              |
      6   |
          |-----------------------------------------------|
      7   |      NUMBER OF DATA SETS IN REQUEST (N)       |
      8   |
          |-----------------------------------------------|
      9   |         RESPONSE SUBTYPE FOR SET NO.1         |
     10   |   (MESSAGE SUBTYPE TO BE USED IN RESPONSE)    |
          |-----------------------------------------------|
     11   |     DATA THINNING CONSTANT FOR SET NO.1       |
     12   |
          |-----------------------------------------------|
     13   |       NUMBER OF PIDS IN DATA SET NO.1 (M)     |
     14   |
          |-----------------------------------------------|
     15   |
      .   |        LIST OF M PIDS FOR DATA SET NO.1       |
  14+2M   |
          |-----------------------------------------------|
  15+2M   |         RESPONSE SUBTYPES, DATA THINNING      |
      .   |         CONSTANTS, NUMBER OF PIDS, AND PID    |
      .   |             LISTS FOR DATA SETS 2-N           |
     8+   |
 N(6+2M)  |-----------------------------------------------|

                                                  DATA
                                                  START
                                                  TIME
```

Message 85 – MMC Calibration Data Request (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME OF YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	1-120	MIN
NUMBER OF DATA SETS	I*4	0-12	N/A
RESPONSE SUBTYPE	I*4	6,7	N/A
DATA THINNING CONSTANTS	I*4	1-120	N/A
NUMBER OF PIDS IN SET	I*4	1-6	N/A
DATA PIDS	I*4	1-9999	N/A

Notes:

1. The time stamp is the time that the response was generated.

2. The following are OATS node numbers:
   41 = SOAT01 42 = SOAT02
   43 = SOAT03 44 = SOAT04
   45 = SOAT05 46 = SOAT06
   47 = COAT01 48 = COAT02
   49 = GOAT01 50 = GOAT02

3. The message length varies with the number of data sets in the message and the number of PIDs in each data set, a flexible format chosen to facilitate future changes. The message length is given by $8 + N(6 + 2M)$, with a maximum length of 224 16-bit half-words when $N = 12$ and $M = 6$.

4. A PID is a unique identifier associated with a single telemetry parameter. Every parameter is assumed to have a unique PID. The following lists the parameters required for MMC calibration along with their description and location in the PCM frame:

Parameter	TLM Word	PID
DIRA Accumulated Roll Data	26, 27 (AOCS Format No.1)	0031
DIRA Accumulated Pitch Data	31, 32 (AOCS Format No.1)	0082
DIRA Accumulated Yaw Data	33, 34 (AOCS Format No.1)	0103
Momentum Wheel No. 1 Speed	33, 34	0104
Momentum Wheel No. 2 Speed	26, 27	0032

5. The tracer is expected to be returned unchanged in the response message for identification.

6. The thinning constant indicates that only every K^{th} value of the parameter is to be returned, where K is the thinning constant value with respect to the location of the parameter in the telemetry stream minor or major frame.

7. The response subtype (half-word 9) is specified for requested telemetry data only. It is used internally by OATS and does not need to be used by GIMTACS to identify the data requested. However, GIMTACS must echo this subtype in its Message 185.

Message 87 – SMC Data Request (GOES I-M) (1 of 2)

OATS sends an unsolicited Message 87 to GIMTACS whenever it needs SMC-related telemetry data. The Message 87 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = UP TO 28 (SEE NOTES)
      MESSAGE TYPE                  = 87
      MESSAGE SUBTYPE               = 1 - PID REQUEST
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                     YEAR                      |
          |-----------------------------------------------|
      2   |         DAY OF YEAR            |  HR (10s)   |
          |-----------------------------------------------|
      3   |  HR (1s)  |        MINUTES      |  SEC (10s)  |
          |-----------------------------------------------|
      4   |  SEC (1s) |               MSECS               |
          |-----------------------------------------------|
      5   |               DATA SPAN DURATION              |
      6   |
          |-----------------------------------------------|
      7   |      NUMBER OF DATA SETS (N) IN REQUEST       |
      8   |
          |-----------------------------------------------|
      9   |         RESPONSE SUBTYPE FOR SET NO.1         |
     10   |  (MESSAGE SUBTYPE TO BE USED IN RESPONSE)     |
          |-----------------------------------------------|
     11   |     DATA THINNING CONSTANT FOR SET NO.1       |
     12   |
          |-----------------------------------------------|
     13   |       NUMBER OF PIDS (M) IN DATA SET NO.1     |
     14   |
          |-----------------------------------------------|
     15   |
      .   |        LIST OF M PIDS FOR DATA SET NO.1       |
  14+2M   |
          |-----------------------------------------------|
  15+2M   |         RESPONSE SUBTYPES, DATA THINNING      |
      .   |         CONSTANTS, NUMBER OF PIDS, AND PID    |
      .   |             LISTS FOR DATA SETS 2-N           |
    8+    |
 N(6+2M)  |-----------------------------------------------|

                                                  DATA
                                                  START
                                                  TIME
```

Message 87 – SMC Data Request (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	REQUEST DEPENDENT	MIN
NUMBER OF DATA SETS	I*4	1	N/A
RESPONSE SUBTYPE	I*4	10	N/A
DATA THINNING CONSTANTS	I*4	1-120	N/A
NUMBER OF PIDS IN SET	I*4	7	N/A
DATA PIDS	I*4	1-9999	N/A

Notes:

1. The time stamp is the time that the response was generated.

2. The following are OATS node numbers:

41 = SOAT01	42 = SOAT02
43 = SOAT03	44 = SOAT04
45 = SOAT05	46 = SOAT06
47 = COAT01	48 = COAT02
49 = GOAT01	50 = GOAT02

3. The message length varies with the number of data sets in the message and the number of PIDs in each data set, a flexible format chosen to facilitate future changes. The message length is given by $8 + N(6 + 2M)$, with a maximum length of 28, sixteen-bit half-words when $N = 1$ and $M = 7$.

4. A PID is a unique identifier associated with a single telemetry parameter. Every parameter is assumed to have a unique PID. The following lists the parameters required for SMC calibration along with their description and location in the PCM frame:

Parameter	TLM Word	PID
Momentum Wheel No. 1 Speed	33, 34 (AOCS Format No. 2)	0104
Momentum Wheel No. 2 Speed	26, 27 (AOCS Format No. 2)	0032
Reaction Wheel No. 1 Speed	26, 37 (AOCS Format No. 2)	0034
Reaction Wheel No. 2 Speed	33, 34 (AOCS Format No. 2)	0105
Momentum Wheel Carry Bit	31 (AOCS Format No. 2)	0410
SADA Sun Angle	100-06 Bits 1-8	7623
DSS Pitch	35-6 bits 7-8	
	35-7 Bits 1-7	0415

5. The tracer is expected to be returned unchanged in the response message for identification.

6. The thinning constant indicates that only every Kth value of the parameter is to be returned, where K is the thinning constant value with respect to the location of the parameter in the minor or major frame telemetry stream.

7. The response subtype is specified for requested telemetry data only. It is used internally by OATS and does not need to be used by GIMTACS to identify the data requested. However, GIMTACS must echo this response subtype in its Message 187.

Message 88 – Thermal Snap Data Request (GOES I-M Only) (1 of 2)

OATS sends an unsolicited Message 88 to GIMTACS whenever it needs thermal snap-related telemetry data. The Message 88 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 41,42,43,44,45,46,47,48,49,50 (OATS)
      DESTINATION                   = 10 (GIMTACS)
      NO. OF HALF-WORDS             = 20 (SEE NOTES)
      MESSAGE TYPE                  = 88
      MESSAGE SUBTYPE               = 1 - PID REQUEST
      TRACER                        = UNIQUE ID SUPPLIED BY OATS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                      YEAR                     |
          |-----------------------------------------------|
      2   |  |         DAY OF YEAR            | HR (10s)  |
          |-----------------------------------------------|
      3   | HR (1s)   |        MINUTES         | SEC (10s) |
          |-----------------------------------------------|
      4   | SEC (1s)  |               MSECS                |
          |-----------------------------------------------|
      5   |               DATA SPAN DURATION               |
      6   |
          |-----------------------------------------------|
      7   |      NUMBER OF DATA SETS (N) IN REQUEST        |
      8   |
          |-----------------------------------------------|
      9   |         RESPONSE SUBTYPE FOR SET NO.1          |
     10   |    (MESSAGE SUBTYPE TO BE USED IN RESPONSE)    |
          |-----------------------------------------------|
     11   |       DATA THINNING CONSTANT FOR SET NO.1      |
     12   |
          |-----------------------------------------------|
     13   |       NUMBER OF PIDS (M) IN DATA SET NO.1      |
     14   |
          |-----------------------------------------------|
     15   |
      .   |        LIST OF M PIDS FOR DATA SET NO.1        |
  14+2M   |
          |-----------------------------------------------|
  15+2M   |         RESPONSE SUBTYPES, DATA THINNING       |
      .   |        CONSTANTS, NUMBER OF PIDS, AND PID      |
      .   |            LISTS FOR DATA SETS 2-N             |
     8+   |
 N(6+2M)  |-----------------------------------------------|

                                                  DATA
                                                  START
                                                  TIME
```

Message 88 – Thermal Snap Data Request (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DATA SPAN DURATION	R*4	REQUEST DEPENDENT	MIN
NUMBER OF DATA SETS	I*4	1	N/A
RESPONSE SUBTYPE	I*4	11	N/A
DATA THINNING CONSTANTS	I*4	1-120	N/A
NUMBER OF PIDS IN SET	I*4	3	N/A
DATA PIDS	I*4	1-9999	N/A

Notes:

1. The time stamp is the time that the response was generated.

2. The following are OATS node numbers:
   41 = SOAT01 42 = SOAT02
   43 = SOAT03 44 = SOAT04
   45 = SOAT05 46 = SOAT06
   47 = COAT01 48 = COAT02
   49 = GOAT01 50 = GOAT02

3. The message length varies with the number of data sets in the message and the number of PIDs in each data set, a flexible format chosen to facilitate future changes. The message length is given by $8 + N(6 + 2M)$, with a maximum length of 20 16-bit half-words when $N = 1$ and $M = 3$.

4. A PID is a unique identifier associated with a single telemetry parameter. Every parameter is assumed to have a unique PID. The following lists the parameters required for SMC calibration along with their descriptions and locations in the PCM frame:

Parameter	TLM Word	PID
Earth Sensor roll data	A2RLESDT	55
Imager BB-Cal Status	IBBCALPS	4035
Sounder BB-Cal Status	SBBCALPS	4523

5. The tracer is expected to be returned unchanged in the response message for identification.

6. The thinning constant indicates that only every K^{th} value of the parameter is to be returned, where K is the thinning constant value with respect to the location of the parameter in the telemetry stream minor or major frame.

7. The response subtype is specified for requested telemetry data only. It is used internally by OATS and does not need to be used by GIMTACS to identify the data requested. However, GIMTACS must echo this subtype in its Message 188.

4.3.7 GIMTACS/GTACS-Originated Messages

GIMTACS/GTACS originated messages are listed below in the order in which their detailed descriptions are provided in this section. Message Type and Subtype appear in the lower right hand corner of these pages to assist in easy identification of the pages describing a specific message.

Type	Description	Destination
110-1	SPS Configuration Control – Offline	SPS
110-2	SPS Configuration Control – Online	SPS
110-3	SPS Configuration Control – Operate	SPS
110-4	SPS Configuration Control – Configure	SPS
110-5	SPS Configuration Control – Idle	SPS
110-6	SPS Configuration Control – Start O&A	SPS
110-7	SPS Configuration Control – Start Imager NLUT	SPS
110-8	SPS Configuration Control – Start Sounder NLUT	SPS
110-9	SPS Configuration Control – Start CORT	SPS
111	SPS Status Request	SPS
112	GIMTACS/GTACS Text Message	SPS
113	AVS/ADS Telemetry Rate Control	MRS&S
114-1	MRS&S Status Request	MRS&S
115	MDL Telemetry Message Rate Control	MRS&S
123	PM Status Request	PM
151	Star View Command Parameter Request	OATS
153	IMC, SMC, or SCC Coefficient Request	OATS
154	OATS Health and Status Request	OATS
155	Scan Frame Request	OATS
159	Eclipse Prediction Request	OATS
160	Sensor Intrusion Request	OATS
164	IMC, SMC, or SCC Set Enabled or Yaw Flip State	OATS
165	IMC/MMC Status Change	OATS
166	DIRA Data Response	OATS
167	Trim Tab Data Response	OATS
170	Propulsion Data Response	OATS
175	IMC Scale Factor Calibration Schedule Request	OATS
176	DIRA Data Completion	OATS
177	Trim Tab Data Completion	OATS
180	Propulsion Data Completion	OATS
185	MMC Calibration Data Response	OATS
187	SMC Data Response	OATS
188	Thermal Snap Response	OATS
190	S/C Equipment Status	OATS
195	MMC Calibration Data Completion	OATS
197	SMC Data Completion	OATS
198	Thermal Data Completion	OATS
202	Labeled Star Measurement	OATS
205	Single Chord Notification	OATS

Message 110 – SPS Configuration Control

GIMTACS/GTACS has the capability of controlling the SPS state and configuration through the use of the SPS configuration control message. Listed below are descriptions of Messages 110-1 through 110-9. The descriptions include the contents of each message subtype and the layout of the data blocks for the CONFIGURE, START O&A, START IMAGER NLUT, START SOUNDER NLUT, and START IMAGER CORT commands. Included in the Message 110-4 description are Table 4-13, SPS Configuration Bit Map and Items, and
Table 4-14, GIMTACS/GTACS -to-SPS Command Timing Constraints. None of the other configuration control commands have a data block. The Message 110 data block layouts and field definitions follow.

Message 110-1 – SPS Configuration Control – Offline Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 1 (OFFLINE COMMAND): INHIBIT PROCESSING
                                      OF ANY OTHER GIMTACS/GTACS MESSAGES
                                      (EXCEPT ON LINE)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:  N/A
```

Notes:

The offline command is executed immediately by the SPS. If the SPS is in Operate (OPR) mode, the corresponding status would normally be reported in the next Message 10. Due to the asynchronous timing relationship, offline status could be reported in the second Message 10.

Message 110-2 – SPS Configuration Control – Online Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 2 (ONLINE COMMAND): ALLOW PROCESSING OF
                                        ALL GIMTACS/GTACS MESSAGES
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:  N/A
```

Notes:

The online command is executed immediately by the SPS. If the SPS is in OPR mode, the corresponding status would normally be reported in the next Message 10. Due to the asynchronous timing relationship, offline status could be reported in the second Message 10.

Message 110-3 – SPS Configuration Control – Operate Command

```
HEADER BLOCK:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 3 (OPERATE COMMAND):  ENTER OPR STATE
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:  N/A
```

Notes:

The operate command is executed immediately by SPS. Status is nominally reported in the very next Message 10 sent to GIMTACS/GTACS every 10 seconds. However, the report could occur in a following Message 10 due to the asynchronous timing relationship.

Message 110-4 – SPS Configuration Control – Configure Command (1 of 6)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = UP TO 54
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 4 (CONFIGURE COMMAND):  SEE DATA
                                        ITEM DEFINITION AND NOTES.
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
            0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
        1  |                                               |
        .  |                  BIT MAP                      |
        6  |                                               |
           |-----------------------------------------------|
        7  |                                               |
        .  |                 DATA ITEMS                    |
       N+6 |                                               |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
BIT MAP	BINARY	(SEE NOTES)	N/A
ANTENNA ID	BINARY	1-8 (I-M)	N/A
	BINARY	1-10 (N-P)	N/A
MSG. TYPE 11 INTERVAL	BINARY	1-10	SEC
SCAN CLAMP LIMB CLIPPING OFFSET	BINARY	0-30	0.1 DEG
SATELLITE ID	BINARY	8-12 (I-M)	N/A
	BINARY	13-16 (N-P)	N/A
ULI INPUT CHANNEL	BINARY	1-3	N/A
RANGING FUNCTION	BINARY	0 - DISABLE 1 - ENABLE	N/A
IMGR/SDR IMC ON/OFF	BINARY	0 - OFF 1 - ON	N/A
RANGE MEASUREMENTS	BINARY	1-2 OR 5	N/A
IMAGER CO-REGISTRATION	BINARY	0 - DISABLE 1 - ENABLE	N/A
OPERATIONAL MODE - IMAGER	BINARY	1 – ROUTINE/NORMAL 2 – RAPID/RSO 3 – SUPERRAP/SRSO 4 - TEST	N/A
IMAGER VIS NORM	BINARY	0 - DISABLE 1 - ENABLE	N/A
IMAGER IR CALIBRATION	BINARY	0 - DISABLE 1 - ENABLE	N/A

Message 110-4 – SPS Configuration Control – Configure Command (2 of 6)

IMAGER IR BIAS CAL MODE	BINARY	1	N/A
IMAGER SDI CHANNEL	BINARY	1-4	N/A
IMAGER ELEC CONFIG	BINARY	1-2	N/A
IMAGER DET SUBSTIT	BINARY	1-15 (I-M)	N/A
	BINARY	1-16 (N-P)	N/A
IMAGER IR GAIN 1 CAL MODE		1-7	N/A
IMAGER IR GAIN 2 CAL MODE		1-3	N/A
IMAGER E-W CORRECTION	BINARY	0 - DISABLE 1 - ENABLE	N/A
OPERATIONAL MODE - SOUNDER	BINARY	1 – ROUTINE/NORMAL 2 – RAPID/RSO 3 – SUPERRAP/SRSO 4 - TEST	N/A
SOUNDER VIS NORM	BINARY	0 - DISABLE 1 - ENABLE	N/A
SOUNDER IR CALIBR	BINARY	0 - DISABLE 1 - ENABLE	N/A N/A
SOUNDER IR BIAS CAL MODE	BINARY	1-2	N/A
SOUNDER SDI CHANNEL	BINARY	1-4	N/A
SOUNDER ELEC CONFIG	BINARY	1-2	N/A
SOUNDER IR GAIN 1 CAL MODE		1-7	N/A
SOUNDER IR GAIN 2 CAL MODE		1-3	N/A
SOUNDER E-W CORRECTION	BINARY	0 - DISABLE 1 – ENABLE	N/A
IMAGER RELATIVIZATION	BINARY	0 – DISABLE 1 – ENABLE	N/A
SOUNDER RELATIVIZATION	BINARY	0 – DISABLE 1 – ENABLE	N/A
SPS YAW FLIP PROCESSING	BINARY	0 - DISABLE 1 – ENABLE	N/A
IMAGER DET SUB, 8th IR DET	BINARY	1-16	N/A
RESAMPLING	BINARY	0 – DISABLE 1 – ENABLE	N/A N/A

Notes:

1. The bit map designates which data items are present in the data block. Each bit corresponds to a different item. If the bit is set, the data is present. The order of the data items corresponds to the order of the set bits in the bit map. Bit map assignments are shown in Table 4-13. As in the message header, satellite IDs 8 through 12 correspond to GOES I-M and satellite IDs 13-16 correspond to GOES N-P.

2. A one-time normal range measurement may be initiated (equals 2); a normal range measurement response is generated for delivery to OATS (see Message 1).

3.

4. Table 4-14 provides the GIMTACS/GTACS-to-SPS command timing constraints.

Message 110-4 – SPS Configuration Control – Configure Command (3 of 6)

4. Bias calibration mode definitions are as follows:

Mode	Definition
1	Standard algorithm bias computed at spacelook
2	Bias updated based on history of bias versus optics temperatures (Sounder only)

5. First-order gain calibration mode definitions are as follows:

Mode	Definition
1	Standard algorithm gain computed at BB event
2	Gain updated as a function of patch temperature
3	Diurnally averaged gain
4	Gain updated based on history of gain versus temperatures
5	Mode 3 and 4 combined
6	Gain updated as a function of time (linear algorithm)
7	Gain updated as a function of time (quadratic algorithm)

6. Second-order gain calibration mode definitions are as follows:

Mode	Definition
1	Factory measured terms
2	Gain interpolated as a function of patch temperature
3	Gain interpolated as a function of patch and baseplate temperatures

7. For Imager or Sounder electronic configuration, 1 = side one, and 2 = side two.

8. Resampling Active/Inactive should be primarily controlled by the SPS operator regardless of GIMTACS being OFFLINE/ ONLINE.

Message 110-4 – SPS Configuration Control – Configure Command (4 of 6)

Table 4-13. SPS Configuration Bit Map and Items

Bit	Data Item	No. of Bits
0 - 7	Spares - not used	32
8	Antenna ID	16
9	Message 11 Interval - Imager	16
10	Message 11 Interval - Sounder	16
11 - 14	Spares - not used	16
15	Scan Clamp Frame Limb Offset	16
16	Satellite ID	8
17	Uplink Interface (ULI) Input Channel	8
18	Ranging Function Enable or Disable	8
19	Imager IMC On or Off	8
20	Sounder IMC On or Off	8
21	Perform Range Measurements	8
22	Imager Co-registration Enable or Disable	8
23	Imager Instrument Mode	8
24	Imager VIS Normalization Enable or Disable	8
25	Imager IR Calibration Enable or Disable	8
26	Imager IR Bias Calibration Mode	8
27	Imager SDI Channel	8
28	Imager Electronic Configuration	8
29 - 43	Imager Detector Substitutions	8
44	Imager Gain 1 Calibration Mode	8
45	Imager Gain 2 Calibration Mode	8
46	Imager E-W Correction Enable or Disable	8
47	Sounder Instrument Mode	8
48	Sounder VIS Normalization Enable or	8
49	Sounder IR Calibration Enable or Disable	8
50	Sounder IR Calibration Mode	8
51	Sounder SDI Channel	8
52	Sounder Detector Configuration	8
53	Sounder Gain 1 Calibration Mode	8
54	Sounder Gain 2 Calibration Mode	8
55	Sounder E-W Correction Enable or Disable	8
56	Imager Relativization Enable or Disable	8
57	Sounder Relativization Enable or Disable	8
58	SPS Yaw Flip Processing Enable or Disable	8
59	Imager Detector Substitution, 8th IR detector	8
60	Resampling Enable or Disable	8
61 - 63	Spares - not used	8

Message 110-4 – SPS Configuration Control – Configure Command (5 of 6)

Notes:

1. The scan clamp frame limb offset establishes the distance E-W from the equatorial limb of the Earth that the SPS clips to crop space data from the GVAR transmission. A value of 30 (3˚) means that image cropping occurs for data lying in excess of 3˚ from the plane tangent to the Earth's equatorial limb. Cropping is performed only on the spacelook side selected for the instrument.

2. The 15 bits set aside in bits 29-43 for Imager detector substitutions correspond to eight visible and seven IR detectors. Bit 59 corresponds to the eighth IR detector (IR Channel 6, Detector 2 for GOES-O and beyond). If a detector's bit is set in the bit map, a detector number is provided in the data items indicating which detector is to be the data source for the substitution. A detector number of zero indicates substitution is to be canceled for the detector whose bit was set in the bit map. Detector numbers are assigned as follows:

Detector No.	Detector, S/C 8-11	S/C 12 and 13	Bit No. (In Bit Map)
1-8	Visible 1-8	Visible 1-8	29-36
9	IR channel 2, Detector 1	IR channel 2, Detector 1	37
10	IR channel 2, Detector 2	IR channel 2, Detector 2	38
11	IR channel 3	IR channel 3, Detector 1	39
12	IR channel 4, Detector 1	IR channel 3, Detector 2	40
13	IR channel 4, Detector 2	IR channel 4, Detector 1	41
14	IR channel 5, Detector 1	IR channel 4, Detector 2	42
15	IR channel 5, Detector 2	IR channel 6, Detector 1	43

Detector No.	Detector, S/C 14 and Beyond	Bit No. (In Bit Map)
1-8	Visible 1-8	29-36
9	IR channel 2, Detector 1	37
10	IR channel 2, Detector 2	38
11	IR channel 3, Detector 1	39
12	IR channel 3, Detector 2	40
13	IR channel 4, Detector 1	41
14	IR channel 4, Detector 2	42
15	IR channel 6, Detector 1	43
16	IR channel 6, Detector 2	59

Table 4-14. GIMTACS/GTACS-to-SPS Command Timing Constraints

Control Point Description	Execution Time Conditions
Configure:	
Antenna ID	Immediate
Message Type 11 Interval	Immediate
Scan Clamp Frame Limb Offset	Immediate; effective start of next frame
Satellite ID	Six minutes if configured for new satellite
ULI Input Channel	Immediate if in IDLE
Range Enable or Disable	Immediate
Imager or Sounder IMC On or Off	Immediate; effective start of next frame
Satellite Range (2)	Immediate if Calibration range is inactive
Co-registration Enable or Disable	Immediate; effective start of next frame
Operational Mode (Imager or Sounder)	Immediate; effective in next output scan
Imager VIS Normal IR Calibration	Immediate; effective in next SDI input scan
Imager IR Calibration mode	Immediate; effective at next Calibration event
Imager SDI Channel	Immediate if in IDLE; else ignored
Imager ELEC Configuration	Six minutes if new side commanded and in IDLE

Message 110-4 – SPS Configuration Control – Configure Command (6 of 6)

Control Point Description	Execution Time Conditions
Imager Detector Substitution	Immediate; effective in next input scan
Imager Relativization	Immediate; effective in next input scan
Imager E-W Correction Enable or Disable	Immediate; effective at next BB-Cal event
Sounder VIS Normal IR Calibration	Immediate; effective in next input scan
Sounder IR Calibration Mode	Immediate; effective at next Calibration event
Sounder SDI Channel	Immediate if in IDLE; else ignored
Sounder E-W Correction Enable or Disable	Immediate; effective at next BB-Cal event
Sounder ELEC Configuration	6 minutes if new side commanded and in IDLE
Sounder Relativization	Immediate; effective in next input scan
Yaw flip processing	Immediate if in IDLE; else ignored
Resampling	Immediate; effective start of next frame

Notes:

1. The SPS ignores GIMTACS/GTACS configure commands received while reconfiguring in response to a previous configure command. Control points responded to immediately are of no concern. Precautions should be implemented because of several points requiring significant reconfiguration time (e.g., Sounder ELEC CONFIG, Imager ELEC CONFIG, etc). Therefore, GIMTACS/GTACS is required to verify each reconfiguration through the SPS health and status Message 10 prior to issuing the next reconfiguration message.

2. In the worst case, the corresponding status is received in the second SPS Message 10 for immediate responses if in the OPR mode.

3. Corresponding status of configuration actions requiring a 6-minute response time will appear in a subsequent SPS Message 10 during the 6-minute response time.

4. (GOES N-P) Antenna IDs have a range from 1 to 10 as follows:
   1 = 18 m/60 ft “A” antenna
   2 = 18 m/60 ft “B” antenna
   3 = 13 m/40 ft “C” antenna
   4 = 14 m/45 ft “G” tracking antenna
   5 = 16.4m/55 ft “J” antenna (hurricane rated)
   6 = 16.4m/55 ft “K” antenna (hurricane rated)
   7 = 16.4m/55 ft “L” antenna (hurricane rated) WBU
   8 = 21m/69ft antenna FCDA
   9 = unused
   10 = unused

Message 110-5 – SPS Configuration Control – IDLE Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 5 (IDLE COMMAND):  ENTER IDLE STATE
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:  N/A
```

Notes:

The IDLE command is executed immediately by the SPS. To verify execution, GIMTACS/GTACS requests that the SPS provide status. The SPS responds to with a Message 10.

Message 110-6 – SPS Configuration Control – Start O&A Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 6 (START O&A COMMAND):  BEGIN USING
                                        SPECIFIED O&A AT NEXT START-OF-FRAME.
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
            0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
        1  |                     IMC SET                   |
        2  |                    IDENTIFIER                 |
           |-----------------------------------------------|
        3  |                                               |
        .  |                      SPARE                    |
        8  |                                               |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
O&A ID	ASCII	ANNN	N/A

Notes:

1. The IMC set identifier uniquely identifies the O&A coefficient set.

2. Response to the Start O&A Command is immediate. If the requested O&A set is available, it is put into effect at the start of the next frame. If unavailable, the SPS:

   a. Issues a request to OATS with a Message 3.
   b. Puts the O&A set into effect at the start of the next frame, after receiving the set from OATS.
   c. Reports the current O&A set in effect in a Message 10.

Message 110-7 – SPS Configuration Control – Start Imager NLUT Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 7 (START IMAGER NLUT COMMAND): BEGIN
                                        USING SPECIFIED IMAGER NLUT AT START
                                        OF NEXT LINE
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
            0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
        1  |                     NLUT SET                  |
        .  |                    IDENTIFIER                 |
        4  |-----------------------------------------------|
        5  |                                               |
        .  |                      SPARE                    |
        8  |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NLUT SET IDENTIFIER	ASCII	8-CHAR ASCII FREE-FORM TEXT	N/A

Notes:

1. The NLUT set identifier uniquely identifies the NLUT set.

2. Response to the Start Configure command is immediate. If the requested NLUT set is available, it is put into effect at the start of the next line. If it is unavailable, the SPS:

   a. Issues a Message 5-1 to the PMs.
   b. Puts the NLUT set into effect, starting with the next line, after receiving the set from PM.
   c. Reports the current and latest NLUTs resident in a Message 10.

Message 110-8 – SPS Configuration Control – Start Sounder NLUT Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 8 (START SOUNDER NLUT COMMAND):  BEGIN
                                        USING SPECIFIED SOUNDER NLUT AT START
                                        OF NEXT LINE
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
     HALF-
     WORD NO. MSB                                          LSB
              0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
             |-----------------------------------------------|
          1  |                     NLUT SET                  |
          .  |                    IDENTIFIER                 |
          4  |-----------------------------------------------|
          5  |                                               |
          .  |                      SPARE                    |
          8  |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NLUT SET IDENTIFIER	ASCII	8-CHAR ASCII FREE-FORM TEXT	N/A

Notes:

1. The NLUT set identifier uniquely identifies the NLUT set.

2. Response to the Start Configure Command is immediate. If the requested NLUT set is available, it is put into effect at the start of the next line. If it is unavailable, the SPS:

   a. Issues a Message 5-2 to the PMs.
   b. Puts the NLUT set into effect, starting with the next line, after receiving the set from PM.
   c. Reports the current and latest NLUTs resident in a Message 10.

Message 110-9 – SPS Configuration Control – Start Imager CORT Command

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28 (SPS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 110
      MESSAGE SUBTYPE               = 9 (START IMAGER CORT COMMAND):  BEGIN
                                        USING SPECIFIED IMAGER CORT AT START
                                        OF NEXT FRAME
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                     CORT SET                  |
      .   |                    IDENTIFIER                 |
      2   |-----------------------------------------------|
      3   |                                               |
      .   |                      SPARE                    |
      8   |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
CORT SET IDENTIFIER	ASCII	4-CHAR ASCII	N/A

Notes:

1. The CORT set identifier uniquely identifies the CORT set.

2. Response to the start configure command is immediate. If the requested CORT set is available, it is put into effect at the start of the next frame. If it is unavailable, the SPS:

   a. Issues a Message 6 request to the PMs.
   b. Puts the CORT into effect, starting with the next frame, after receiving the set from PM.
   c. Reports the current and latest CORTs resident in a Message 10.

Message 111 – SPS Status Request

GIMTACS/GTACS uses Message 111 to request status from the SPS (see Message 10). The Message 111 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28,31 (SPS)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 111
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = UNIQUE ID SUPPLIED BY
                                      GIMTACS/GTACS

DATA BLOCK LAYOUT:  N/A
```

Notes:

The SPS Message 10 response should occur within 2 seconds.

Message 112 – GIMTACS/GTACS Text Message

GIMTACS/GTACS uses Message 112 to send text messages to the SPS for inclusion in the GVAR auxiliary block. Text messages can contain up to 11,850 ASCII characters (5925 data words). If a text message is sent that exceeds the X.25 message length limitation of 3584 bytes, the message count and end of message fields of the header portion of the data field (see Figure 4-8) are used to sequence the resulting multiple X.25 messages for transmission. The Message 112 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 20,21,22,23,24,25,26,27,28,31 (SPS)
      NO. OF HALF-WORDS             = 2 TO 1776
      MESSAGE TYPE                  = 112
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = SEE NOTE 2
      END OF MESSAGE                = SEE NOTE 2
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO.  MSB                                                LSB
              0  1  2  3  4  5  6  7  8  9  10  1  12  13  14  15
            |-------------------------------------------------|
        1   |                                                 |
        .   |                 TEXT MESSAGE                    |
      1776  |-------------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TEXT MESSAGE	ASCII	N/A	N/A

Notes:

1. Message count and end of message indicators in the header data field (see Figure 4-8) allow the SPS to identify the first and last X.25 messages in a sequence in the event the text message exceeds 1776 half-words, the maximum X.25 data message size. If the text message contains an odd number of characters, a blank character must be added to ensure the message ends on a half-word boundary.

2. The message count and end of message values are dependent on message size.

Message 113 – AVS/ADS Telemetry Rate Control (GOES N-P)

GTACS can control the rate at which it receives AVS or ADS telemetry data (Message 13) from the MRS&S. Message 113 is used for this purpose.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE #            = 1-65535
      SATELLITE ID                  = 13, 14, 15, 16 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 51 - 70 (MRS&S)
      # OF DATA HALF-WORDS          = 2
      DATA TYPE                     = 113
      DATA SUBTYPE                  = 1 (AVS TELEMETRY)
                                    = 3 (ADS TELEMETRY)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	AVS/ADS TELEMETRY MESSAGE INTERVAL															
2	SPARES															

DATA ITEM	FORMAT	VALIDATION	UNITS
AVS/ADS RATE	I*2	0 - 10	SECS
SPARE	I*2	0	N/A

Notes:

1. AVS/ADS Telemetry Message Interval indicates the desired time between AVS or ADS Telemetry Messages (Type 13) from the MRS&S.
2. Message 13 is primarily a diagnostic message used in the spacecraft integration and test environment.

Message 114-1 – MRS&S Status Request (GOES N-P)

MRS&S Status (Message 14) is requested by GTACS at any time, by issuing a Message 114. The following is the Message 114, Subtype 1 block layout.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE #            = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 51 - 70 (MRS&S)
      # OF DATA HALF-WORDS          = 0
      DATA TYPE                     = 114
      DATA SUBTYPE                  = 1 (MRS&S STATUS)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT: N/A
```

Message 115 – MDL Telemetry Message Rate Control

MDL telemetry message rate control messages (Type 115) correspond to the MDL telemetry subtypes identified in Message 15. GTACS receives the MDL telemetry subtype data from the MRS&S at the rate GTACS identifies in the Message 115. The following page contains a description of Message 115's block layout and field definitions.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 51 - 70 (MRS&S)
      NO. OF HALF-WORDS             = 2
      DATA TYPE                     = 115
      DATA SUBTYPE                  APID (hex):
                                    = 10 - SXI HOUSEKEEPING (non-critical)
                                    = 13 - SXI IMAGE SUMMARY (non-critical)
                                    = 20 - SXI OBSERVING EVENTS (non-critical)
                                    = 21 - SXI COMPUTER EVENTS (critical)
                                    = 31 - SXI MEMORY DUMP (non-critical)
                                    = FE - PCM1 TELEMETRY (non-critical)
                                    = FF - PCM2 TELEMETRY (non-critical)
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
       HALF-    MSB                                                  LSB
       WORD NO.  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          1     MDL TELEMETRY MESSAGE TRANSMISSION INTERVAL
          2     SPARE
```

DATA ITEM	FORMAT	VALIDATION	UNITS
MDL MESSAGE INTERVAL	I*2	0-10	SECONDS
SPARE	I*2	0	N/A

Notes:

For SXI Housekeeping data, the range of values for MDL message interval is 0 – 10. For all other subtypes, the range of values for MDL message interval is 0 – 1. A transmission rate of 1 requests data at the maximum rate at which MRS&S can serve the data after receiving the specified data from the spacecraft. A transmission rate of 0 shuts off the flow of non-critical data; flow of critical data is not stopped, regardless of the message interval.

Message 123 – PM Status Request

GIMTACS/GTACS requests the PM server status asynchronously via this message. The PM sends the status message within 2 seconds of receiving this message. The message data block layout and filed definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS, GTACS)
      DESTINATION                   = 11,12,13,14,15,16,17,18,19,29 (PM) or 33
                                    (All PM)
      NO. OF HALF-WORDS             = 0
      MESSAGE TYPE                  = 123
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:  N/A
```

Message 129 – GTACS-RPM Text Message (GOES N-P)

GTACS uses Message 129 to send text messages to the RPM concerning operations, configuration, and status. Text messages can contain up to 65 ASCII characters. The Message 129 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P) SOURCE
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 11 - 19, 29 (RPM)
      NO. OF HALF-WORDS             = 40
      MESSAGE TYPE                  = 129
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
       HALF-     MSB                                                LSB
       WORD NO.  0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15
           1
           :                          TEXT MESSAGE
          40
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TEXT MESSAGE	ASCII	N/A	N/A

Notes:

Eight-bit ASCII character pairs are formatted into half-words by placing the first character in the most significant byte (bits 0–7) and the second character in the least significant byte (bits 8–15).

Message 151 – Star View Command Parameter Request (1 of 2)

During its normal scheduling activity, GIMTACS/GTACS sends OATS a Message 151 to obtain star command data for the daily schedule. GIMTACS/GTACS may also send this message for standby or other schedules being generated. GIMTACS/GTACS sends a Message 151 in response to Message 71 from OATS. OATS sends this request whenever it determines that the attitude uncertainty mode has changed. The Message 151 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = (SEE NOTES)
      MESSAGE TYPE                  = 151
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
        1  |                IMC SET IDENTIFIER             |
        2  |                                               |
           |-----------------------------------------------|
        3  |          NO. OF WINDOWS IN MESSAGE (N)        |
           |-----------------------------------------------|
        4  |                                               |
        5  |                     SPARES                    |
        6  |                                               |
           |-----------------------------------------------|
        7  |                WINDOW SEQUENCE NO.            |
        8  |                                               |
           |-----------------------------------------------|—
        9  |                      YEAR                     | |
           |-----------------------------------------------| |
       10  |  |         DAY OF YEAR            |  HR (10s) | |  WINDOW
           |-----------------------------------------------| |  START
       11  |  HR (1s)  |        MINUTES         |  SEC (10s) |  TIME
           |-----------------------------------------------| |
       12  |  SEC (1s) |               MSECS                | |
           |-----------------------------------------------|—
       13  |                WINDOW DURATION                |
       14  |                                               |
           |-----------------------------------------------|
       15  | ADDITIONAL WINDOW SEQUENCE No.s, START TIMES, |
        :  |                AND DURATIONS                  |
     8N+6  |-----------------------------------------------|
```

Message 151 – Star View Command Parameter Request (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
NO. OF WINDOWS IN MESSAGE	I*2	1-200	N/A
WINDOW SEQUENCE NO.	I*4	1-65535	N/A
WINDOW START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
WINDOW DURATION	R*4	0.2-1440.	MIN

Notes:

1. Half-words 7 through 14 repeat for each window in the message. The message length is given by $8N + 6$, with a maximum length of 1606, 16-bit half-words when $N = 200$.

2. Window sequence numbers are arbitrary and repeated in the response message.

3. The IMC identifier is required because GIMTACS/GTACS and OATS deal with more than one IMC set. The star commands must be consistent with the parent IMC set to be in effect on the spacecraft at the time the commands are invoked. This ensures a correct application of the short span attitude adjustment. Thus, GIMTACS/GTACS may request one star command set to support current operations and another star command set for scheduling future operations. Star commands in the OATS Message 71 are based strictly on the parent IMC set as OATS cues on the group identifier portion of the IMC set identifier only. In the case of current operations support, GIMTACS/GTACS can send either the parent identifier or the currently enabled set identifier—whichever is most convenient—and be assured of getting the appropriate star data, based on the current parent set.

Message 153 – IMC, SMC, or SCC Coefficient Request

OATS uses Messages 62 and 63 to notify GIMTACS/GTACS that OATS has computed a new IMC, SMC, or SCC coefficient set. GIMTACS/GTACS sends OATS a Message 153 to request the set. The Message 153 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 153
      MESSAGE SUBTYPE               = 1 - NORMAL REQUEST
                                    = 2 - PREVIOUSLY ENABLED SET
                                    = 101 - SMC SET (GOES I-M)
                                    = 102 - SCC SET (GOES I-M)
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
         1 |           IMC/SMC/SCC SET IDENTIFIER          |
         2 |                                               |
           |-----------------------------------------------|
         3 |                    SPARE                      |
         8 |                                               |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC/SMC/SCC SET IDENTIFICATION	ASCII	ANNN FOR IMC	N/A
		NNNA FOR SMC	N/A
		NNNC FOR SCC	N/A

Notes:

The IMC, SMC, or SCC set identifier must be provided. GIMTACS/GTACS requests a specific set by its ID, which has been previously furnished by OATS in a Message 62 or 63. See Section 4.3.2.2.1 for a description of the IMC set identifier.

Message 154 – OATS Health and Status Request (1 of 3)

GIMTACS/GTACS sends Message 154 to OATS to advise OATS of the current RPM and SPS status. Additionally, Messages 154 is used to request health and status advisories from OATS. The Message 154 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = UP TO 148
      MESSAGE TYPE                  = 154
      MESSAGE SUBTYPE               = 1 - RESPONSE REQUESTED
                                      2 - RESPONSE MESSAGE
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                                  LSB
            0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15
          |-----------------------------------------------------|_
        1 |                      YEAR                           | | TIME
          |-----------------------------------------------------| | STAMP
        2 |  |         DAY OF YEAR            |  HR (10s)       | | FOR
          |-----------------------------------------------------| | THIS
        3 |  HR (1s)  |        MINUTES         |  SEC (10s)      | | MESSAGE
          |-----------------------------------------------------| |
        4 |  SEC (1s) |               MSECS                     | |
          |-----------------------------------------------------|_
        5 |                    NO. (N) OF SPSs                  |
        6 |
          |-----------------------------------------------------|
        7 |                     NO. (K) OF PMs                  |
        8 |
          |-----------------------------------------------------|
        9 |                      SPS1 STATUS                    |
       10 |
          |-----------------------------------------------------|
       11 |                     SPS1 SATELLITE                  |
       12 |
          |-----------------------------------------------------|
       13 |                   SPS1 COMM CON ID/SERVER ID        |
       14 |
          |-----------------------------------------------------|
       15 |
       16 |                 SPS1 COMM CON NAME/SERVER NAME      |
       17 |
       18 |
          |-----------------------------------------------------|
       19 |                       STATUS                        |
        . |                 SATELLITE SUPPORTED                 |
        . |                     COMM CON ID/SERVER ID           |
        . |                    COMM CON NAME/SERVER NAME        |
        . |                        FOR                          |
        . |                   SPSN (2 <= N <= 5)                |
   10N+ 8 |           (10 HALF-WORDS EACH, AS FOR SPS1)         |
          |-----------------------------------------------------|
   10N+ 9 |                      PM1 STATUS                     |
   10N+10 |
          |-----------------------------------------------------|
   10N+11 |                     PM1 SATELLITE                   |
   10N+12 |
          |-----------------------------------------------------|
```

Message 154 – OATS Health and Status Request (2 of 3)

```
HALF-
WORD NO. MSB                                                    LSB
         0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15
        |-----------------------------------------------------|—
10N+13  |                  PM1 COMM CON ID/SERVER ID          |
10N+14  |                                                     |
        |-----------------------------------------------------|
10N+15  |                 PM1 COMM CON NAME/SERVER NAME       |
10N+16  |                                                     |
10N+17  |                                                     |
10N+18  |                                                     |
        |-----------------------------------------------------|
10N+19  |                       STATUS                        |
     .  |                SATELLITE SUPPORTED                  |
     .  |                    COMM CON ID/SERVER ID            |
     .  |                   COMM CON NAME/SERVER NAME         |
     .  |                         FOR                         |
     .  |                   PMK (2 <= K <= 9)                 |
10(N+K)+8 |          (10 HALF-WORDS EACH, AS FOR PM1)         |
        |-----------------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
FRAME START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MINUTES
SECONDS	BCD	0-59	SECONDS
MSEC	BCD	0-999	MSEC
NO. (N) OF SPSs	I*4	0-5	N/A
NO. (K) OF PMs	I*4	0-9	N/A
STATUS	I*4	0 - ACTIVE	N/A
		1 - STATIC	N/A
		2 – UNKNOWN (N-P)	N/A
SATELLITE ID	I*4	8-12 (I-M)	N/A
	I*4	13-16 (N-P)	N/A
COMM CON ID/SERVER ID	I*4	(SEE NOTES)	N/A
COMM CON NAME/SRVR NAME	C*8	(SEE NOTES)	N/A

Notes:

1. The satellite ID in the header is not relevant in this message. However, GIMTACS/GTACS uses the satellite ID for the first active satellite (in the order 8, 9, 10, 11, 12)/(13, 14, 15). In the case of no active satellite, it uses satellite ID 8 for I-M and satellite ID 13 for N-P.

2. The time stamp is the time that the response was generated.

3. The following are OATS node numbers:

41 = SOAT01	42 = SOAT02	GOES I-M
43 = SOAT03	44 = SOAT04	
45 = SOAT05	46 = SOAT06	
47 = COAT01	48 = COAT02	
49 = GOAT01	50 = GOAT02	
75 = SOAT11	76 = SOAT12	GOES N-P
77 = SOAT13	78 = SOAT14	
79 = SOAT15	80 = SOAT16	
81 = SOAT17	82 = COAT11	
83 = COAT12	84 = COAT13	
85 = GOAT11		

Message 154 – OATS Health and Status Request (3 of 3)

4. The following are OATS status levels:
   0: ACTIVE - Equipment is currently up and communicating with GIMTACS/GTACS. For GTACS, it is communicating with the server that is primary for the satellite connected to this equipment.

   1: STATIC - Equipment is no longer communicating with GIMTACS/GTACS. Satellite information is possibly incorrect. This status is only reported in the first response message following disconnection from the equipment.

   2: UNKNOWN - (GOES N-P) This equipment is either not connected to the GTACS server, or the GTACS server is not primary for the satellite connected with this equipment.

5. The following are satellite IDs:
   8-16: The number of the satellite connected to this equipment. If the equipment STATUS is STATIC, this information is possibly incorrect.

6. (GOES I-M) The CC ID is the Router Table number of the CC actually connected to this equipment and is used by OATS in the Router Header to send any messages destined for this equipment. If no connection to this hardware is ACTIVE, the value is -1.

7. (GOES I-M) The CC name is the name of the CC actually connected to this equipment. The first character of the name is “S” for SOCC or “C” for CDA. The fourth and fifth characters of the name are the numeric designation of the CC. If no connection to this hardware is ACTIVE, the value is blank.

8. Server ID:
   (GOES N-P) This identifier contains the server connection number (1 or 2) being used. If the server connection is inactive, the entry is –1.

9. Server Name:
   (GOES N-P) This contains the name of the GTACS acting as server. When no connection is active the name is blank.

Message 155 – Scan Frame Request (1 of 3)

GIMTACS/GTACS uses Message 155-1 and 155-2 to request scan frame definition coordinate conversions from either longitude and latitude or scan line, pixel number cycle, and increment coordinates for the Imager and Sounder, respectively. For Super Rapid Scan Operations (SRSO), the Imager and Sounder scan frames can also be defined by a center point (in latitude and longitude, frame duration, and aspect ratio). The Message 155 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85(N-P OATS)
      NO. OF HALF-WORDS             = UP TO 968 (SEE NOTES)
      MESSAGE TYPE                  = 155
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:
    HALF-
    WORD NO. MSB                                          LSB
              0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
            |-----------------------------------------------|
         1  |               IMC SET IDENTIFIER              |
         2  |
            |-----------------------------------------------|
         3  |    NUMBER OF SCAN FRAMES IN REQUEST (J)       |
         4  |
            |-----------------------------------------------|
         5  |                     SPARE                     |
         6  |
            |-----------------------------------------------|
         7  |                   IMC STATUS                  |
         8  |
            |-----------------------------------------------|
         9  |                     YEAR                      |
            |-----------------------------------------------|
        10  |  |         DAY OF YEAR            | HR (10s)  |
            |-----------------------------------------------|
        11  | HR (1s)   |        MINUTES         | SEC (10s) |
            |-----------------------------------------------|
        12  | SEC (1s)  |              MSECS                |
            |-----------------------------------------------|
        13  |                COORDINATE TYPE                |
        14  |
            |-----------------------------------------------|
        15  |          SPACELOOK SIDE SELECTION             |
        16  |
            |-----------------------------------------------|
        17  |                SPACELOOK MODE                 |
        18  |
            |-----------------------------------------------|
        19  |              DEFAULT FRAME FLAG               |
        20  |
            |-----------------------------------------------|
        21  |             SOUNDER STEPPING MODE             |
        22  |
            |-----------------------------------------------|
        23  |       VIS SCAN START LINE NO. OR LATITUDE     |
        24  |          OR SRSO CENTER POINT LATITUDE        |
            |-----------------------------------------------|
```

Message 155 – Scan Frame Request (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
     25 |      VIS SCAN START PIXEL NO. OR LONGITUDE    |
     26 |          OR SRSO CENTER POINT LATITUDE        |
        |-----------------------------------------------|
     27 |       VIS SCAN STOP LINE NO. OR LATITUDE      |
     28 |             OR SRSO ASPECT RATIO              |
        |-----------------------------------------------|
     29 |      VIS SCAN STOP PIXEL NO. OR LONGITUDE     |
     30 |            OR SRSO FRAME DURATION             |
        |-----------------------------------------------|
     31 |                     SPARE/REPEAT COUNT        |
     32 |                                               |
        |-----------------------------------------------|
     33 |  ADDITIONAL SCAN FRAMES REPEATS WORDS 9 TO    |
 24*J+8 |        32 FOR J-1 SCANS.  SEE NOTES           |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC SET IDENTIFIER	ASCII	ANNN	N/A
NO. OF SCAN FRAMES IN MSG	I*4	1-40	N/A
IMC STATUS	I*4	0 - ENABLED 1 - DISABLED	N/A
SCAN START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366 DAY	
HOUR	BCD	0-23 HOURS	
MINUTES	BCD	0-59 MINUTES	
SECONDS	BCD	0-59 SECONDS	
MSEC	BCD	0-999 MSEC	
COORDINATE TYPE	I*4	1 - LAT/LONG 2 - SCAN LINE/PIXEL 3 - SRSO	N/A
SPACELOOK SIDE SELECTION	I*4	0 - OATS SELECTED 1 - EAST SIDE 2 - WEST SIDE	N/A
SPACELOOK MODE	I*4	0 - N/A SOUNDER 1 - FAST SPACE (9.2 SEC INTERVAL) CLAMP 2 - SLOW SPACE (36.6 SEC INTERVAL) CLAMP 3 - SCAN CLAMP	N/A
DEFAULT FRAME FLAG	I*4	0 - USED DATA PROVIDED 1 - USE DEFAULT 1 2 - USE DEFAULT 2 3 - USE DEFAULT 3	N/A
SOUNDER STEPPING MODE	I*4	-1 - N/A IMAGER 0 - NORMAL STEP MODE 1 - 0.2 SEC DWELL 2 - 0.4 SEC DWELL 3 - SKIP MODE	N/A

Message 155 – Scan Frame Request (3 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
VIS SCAN START LINE NO. OR	R*4	1-15787 (IMAGER)	LINES
		1-1582 (SOUNDER)	LINES
LATITUDE		-90 TO +90	DEG
SRSO CNTR POINT LATITUDE	R*4	-90 TO +90	DEG
VIS SCAN START PIXEL NO. OR	R*4	0-30680 (IMAGER)	PIXELS
		0-1758 (SOUNDER)	PIXELS
LONGITUDE		0-360	° WEST
SRSO CNTR POINT LONGITUDE	R*4	0-360	° WEST
VIS SCAN STOP LINE NO. OR	R*4	1-15787 (IMAGER)	LINES
		1-1582 (SOUNDER)	LINES
LATITUDE		-90 TO +90	DEG
SRSO ASPECT RATIO	R*4	0.1-10	N/A
VIS SCAN STOP PIXEL NO. OR	R*4	0-30680 (IMAGER)	PIXELS
		0-1758 (SOUNDER)	PIXELS
LONGITUDE		0-360	° WEST
SRSO FRAME DURATION	R*4	0.5-60.0	MIN
REPEAT COUNT	I*4	0-64 (IMAGER)(N-P)	N/A
	I*4	0-16 (SOUNDER)(N-P)	N/A

Notes:

1. Sounder stepping mode is ignored for the subtype Imager.
2. The IMC set identifier denotes the set in effect at the time specified in the request. See Section 4.3.2.2.1 for a description of the IMC set identifier.
3. IMC status denotes the status in effect at the time specified in the request.
4. Latitude and longitude are true geographic coordinates.
5. For SRSO, the scan frame is defined by a center point, a frame duration, and an aspect ratio. OATS determines the necessary start and stop points for the requested frame. The aspect ratio is the ratio of width(pixels) to height(lines). An aspect ratio of 1.0 generates a square frame. For example, an aspect ratio of 2.0 generates a frame twice as wide as it is high (i.e., with twice as many pixels as lines); and an aspect ratio of 0.5 generates a frame twice as high as it is wide (i.e., with twice as many lines as pixels). The actual aspect ratio may be slightly different due to overscan and swath considerations.
6. The maximum number of scan frames to convert in this message is 40, driven by the Message 55 size limitation.
7. (GOES N-P) The repeat count for the Sounder is the number of 4 scan repeats. Thus a Sounder repeat count of 16 represents a total of 64 additional scans.

Message 159 – Eclipse Predictions Request

GIMTACS/GTACS requests predictions of eclipses over a specified time span from OATS. These predictions include shadowing of the satellite by both the Earth and the Moon, with indications of entrance and exit from umbra and penumbra. The Message 159 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 159
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS
```

```
DATA BLOCK LAYOUT:
       HALF-
       WORD NO. MSB                                          LSB
                 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
              |-----------------------------------------------|
            1 |                      YEAR                     |
              |-----------------------------------------------|
            2 |  |         DAY OF YEAR            |  HR (10s)  |  SPAN
              |-----------------------------------------------|  START
            3 |  HR (1s)  |        MINUTES         |  SEC (10s) |  TIME
              |-----------------------------------------------|
            4 |  SEC (1s) |               MSECS                |
              |-----------------------------------------------|
            5 |                    DURATION                   |
            6 |
              |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SPAN START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DURATION	R*4	1-14400	MIN

Notes:

Start time and duration define the time span over which eclipse predictions are requested.

Message 160 – Sensor Intrusion Request

For GOES I-M, GIMTACS requests from OATS predictions of intrusions of the Sun and Moon into the Earth sensor FOV, into the East and West edges of the Imager and Sounder FOV, and the Sun into the CDA ground antenna's FOV (using subtype 0). For GOES N-P, GTACS requests from OATS predictions of intrusions of the Sun and Moon into the East and West edges of the Imager and Sounder FOV and of the Sun into the CDA ground antenna's FOV using Subtype 1, and the Sun into a set of predefined frames using Subtype 2. The Message 160 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 160
      MESSAGE SUBTYPE               = 0 (GOES I-M)
                                    = 1 (GOES N-P)
                                    = 2 (GOES N-P)
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|-
      1  |                     YEAR                      | |
         |-----------------------------------------------| |
      2  |  |         DAY OF YEAR            |  HR (10s) | | SPAN
         |-----------------------------------------------| | START
      3  |  HR (1s)  |        MINUTES         |  SEC (10s)| | TIME
         |-----------------------------------------------| |
      4  |  SEC (1s) |               MSECS               | |
         |-----------------------------------------------|-
      5  |                   DURATION                    |
      6  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SPAN START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DURATION	R*4	1-14400	MIN

Notes:

1. Start time and duration define the time span over which sensor intrusion predictions are requested.
2. For sensor intrusions, duration is limited to 10 days, 14,440 minutes. For frame instructions, duration is limited to 90 days, 129,600 minutes.

Message 162 – IMC Set Request (GOES N-P) (1 of 2)

GTACS sends OATS one of the Message 162 subtypes when it is ready to upload a major IMC set change. The Message 162 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 75 - 85 (Primary OATS)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 162
      MESSAGE SUBTYPE               = 1 - NORMAL SET
                                    = 2 - POST HOUSEKEEPING SET
                                    = 3 - ECLIPSE SET
                                    = 4 - POST MANEUVER SET
                                    = 5 - POST YAW FLIP SET
                                    = 6 - POST THRUSTER FLUSHING SET
                                    = 7 - POST ECLIPSE
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO. (MSB 0 … LSB 15)																
1	YEAR															
2		DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	MANEUVER WINDOW DURATION (SECONDS)															
6																

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MILLISECONDS	BCD	0-999	MSEC
MANEUVER WINDOW DURATION	R*4	0.0-6000.	SEC

Message 162 – IMC Set Request (GOES N-P) (2 of 2)

Notes:

1. This message is used by GTACS to notify OATS that it is ready to receive the specified type of IMC set.
2. Subtypes 4 or 6 will initiate generation of maneuver commands and calculation of a post-maneuver IMC set for stationkeeping, drift, or thruster flushing maneuvers. OATS must have previously commanded these maneuvers. OATS will only generate maneuver commands and calculate a post-maneuver IMC set if a commanded maneuver lies within the time window specified in the message. OATS will automatically send messages 33 and 62 when the calculation is completed.
3. Subtype 2 will initiate planning of a momentum-dumping maneuver and the post-maneuver IMC set. OATS will automatically send messages 33, 57, and 62 when the momentum-dumping maneuver planning is completed.
4. Subtype 3 will initiate calculation of an eclipse IMC set. OATS will automatically send messages 33 and 62 when the calculation is completed.
5. Subtype 5 will initiate calculation of a post-yaw-flip IMC set. OATS will automatically send messages 33 and 62 when the calculation is completed.
6. See Section 4.3.2.2.1 for the IMC set identifier format.

Message 164 – IMC, SMC, or SCC Set Enabled or Yaw-Flip State (1 of 2)

GIMTACS/GTACS sends OATS one of the Message 164 subtypes whenever it enables an IMC, SMC, or SCC coefficient set on any one satellite, or the orientation status, normal or flipped, has changed. Note that SMC and SCC options (subtypes 101 and 102) are only valid for GOES I-M. The Message 164 includes the enable time and either the IMC, SMC, or SCC set identifier or the yaw-flip status. In the case of an IMC set, GIMTACS/GTACS also sends a Message 110-6 to the SPS. The Message 164 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 32 (ALL OATS) (GOES N-P)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 164
      MESSAGE SUBTYPE               = 0 - IMC SET
                                    = 101 - SMC SET (GOES I-M)
                                    = 102 - SCC SET (GOES I-M)
                                    = 103 - YAW-FLIP STATE
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
            0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
        1 |                      YEAR                     |
          |-----------------------------------------------|
        2 |  |         DAY OF YEAR            |  HR (10s) |
          |-----------------------------------------------|
        3 |  HR (1s)  |        MINUTES         |  SEC (10s)|
          |-----------------------------------------------|
        4 |  SEC (1s) |               MSECS                |
          |-----------------------------------------------|
        5 |            IMC, SMC, or SCC SET IDENTIFIER     |
        6 |                 YAW-FLIP STATE                 |
          |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SET ENABLE TIME OF YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
IMC/SMC/SCC SET IDENTIFIER OR YAW-FLIP STATUS	ASCII	ANNN FOR IMC	N/A
		NNNA FOR SMC (GOES I-M)	N/A
		NNNC FOR SCC (GOES I-M)	N/A
		NORM FOR NORMAL	N/A
		FLIP FOR FLIP STATE	N/A

Message 164 – IMC, SMC, or SCC Set Enabled or Yaw-Flip State (2 of 2)

Notes:

1. GIMTACS/GTACS notifies OATS with this message upon enabling an IMC coefficients set on the satellite. If the IMC set type is a 3 or 4 (short span attitude adjustment), GIMTACS/GTACS implements the associated correction to the star commands at the same time. Additionally, GIMTACS/GTACS sends a start O&A message (Message 110) to the SPS.

2. When GIMTACS uploads an SMC or SCC set received from OATS, it informs OATS by using this message. The time in the SMC or SCC message is the current Universal Time Code (UTC) time when the SMC or SCC set was uploaded.

3. See Section 4.3.2.2.1 for the IMC set identifier format.

4. When transmitting the yaw-flip state, the character string ”NORM“ is sent for a spacecraft in the upright, non-flipped state, and the character string ”FLIP” is sent for a spacecraft in a flipped state.

Message 165 – IMC or MMC Status Change (1 of 2)

GIMTACS/GTACS has the ability to enable and disable IMC separately for the Imager and Sounder. Additionally, GIMTACS has the ability to enable and disable MMC separately for the Imager and Sounder. When GIMTACS/GTACS commands a status change, it notifies OATS through a Message 165. When a Message 165 indicates re-enabling of IMC for either instrument, GIMTACS/GTACS also sends OATS a Message 164 indicating which IMC set was enabled when the IMC was restored to operation. The Message 165 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 32 (ALL OATS)
      NO. OF HALF-WORDS             = 8
      MESSAGE TYPE                  = 165
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
        1  |                     YEAR                      |
           |-----------------------------------------------|
        2  |         DAY OF YEAR            |  HR (10s)    |  IMC/MMC STATUS
           |-----------------------------------------------|  CHANGE
        3  |  HR (1s)  |        MINUTES     |  SEC (10s)   |  TIME
           |-----------------------------------------------|
        4  |  SEC (1s) |               MSECS               |
           |-----------------------------------------------|
        5  |                  IMC STATUS                   |
        6  |                                               |
           |-----------------------------------------------|
        7  |                  MMC STATUS/SPARE             |
        8  |                                               |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
IMC/MMC STATUS CHANGE TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
IMC STATUS	I*4	0 - NO CHANGE 1 - ENABLED 2 - DISABLED	N/A
MMC STATUS (GOES I-M)	I*4	0 - NO CHANGE 1 - ENABLED 2 – DISABLED	N/A
SPARE (GOES N-P)	I*4	N/A	N/A

Message 165 – IMC or MMC Status Change (2 of 2)

Notes:

1. When GIMTACS/GTACS enables or disables IMC, it sends a message to OATS indicating the change. An enable message sent after IMC has been off for both instruments should be followed by an IMC set enable Message 164 so OATS knows which IMC set was enabled with restoration of the IMC operation to the instrument. It is impossible to enable different sets for the two instruments.

2. When GIMTACS enables or disables MMC, it sends a message to OATS indicating the change. An enable message sent after MMC has been off for both instruments should be followed by an MMC set enable Message 164 so OATS knows which MMC set was enabled with restoration of the MMC operations to the instrument. It is impossible to enable different sets for the two instruments.

3. See Section 4.3.2.2.1 for the IMC set identifier format.

Messages 166 & 176 – DIRA Calibration Data Response (GOES I-M)

GIMTACS provides OATS with DIRA telemetry data in response to a Message 66. The Message 66 may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS responds with a separate Message 166 for each PID, reflecting the requested subtype. When GIMTACS finishes responding with all PIDs and all subtypes, it sends a DIRA data completion Message 176 to OATS. Message 166 data block layouts and field definitions follow.

Message 166 – DIRA Calibration Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 1608 (SEE NOTES)
      MESSAGE TYPE                  = 166
      MESSAGE SUBTYPE               = 7 - ACCUMULATED DIRA PITCH, ROLL
                                          AND YAW TLM FORMAT SELECTION
                                    = 8 - DSS YAW AND PITCH, ES ROLL,
                                          ACCUMULATED DIRA PITCH, ROLL,
                                          AND YAW TLM FORMAT SELECTION
      TRACER                        = AS PROVIDED IN MSG 66
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
    HALF-
    WORD NO. MSB                                        LSB
              0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
            |-----------------------------------------------|
         1  |                     YEAR                      |
            |-----------------------------------------------|
         2  |         DAY OF YEAR            | HR (10s)     |
            |-----------------------------------------------|
         3  | HR (1s)   |        MINUTES        | SEC (10s) |
            |-----------------------------------------------|
         4  | SEC (1s)  |               MSECS               |
            |-----------------------------------------------|
         5  |   TELEMETRY PARAMETER IDENTIFICATION (PID)    |
         6  |
            |-----------------------------------------------|
         7  |     NUMBER OF DATA POINTS IN MESSAGE (N)      |
            |-----------------------------------------------|
         8  |     MESSAGE SEQUENCE NUMBER FOR THIS PID      |
            |-----------------------------------------------|
         9  |     FIRST DATA VALUE (IN ENGINEERING UNITS)   |
        10  |
            |-----------------------------------------------|
        11  |    TIME INCREMENT FROM PREVIOUS DATA POINT    |
        12  |
            |-----------------------------------------------|
        13  |    SECOND DATA VALUE (IN ENGINEERING UNITS)   |
        14  |
            |-----------------------------------------------|
        15  |  TIME OFFSETS AND DATA VALUES IN ENGINEERING  |
         :  |        UNITS FOR DATA POINTS 3-N              |
      4N+6  |-----------------------------------------------|
```

TIME OF FIRST DATA POINT IN THIS MESSAGE

Message 166 – DIRA Calibration Data Response (GOES I-M) (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
TLM PARAMETER ID (PID)	I*4	1-9999	N/A
NUMBER OF DATA POINTS	I*2	0-400	N/A
MSG SEQ NO. FOR THIS PID	I*2	1-40	N/A
ENGINEERING VALUES OF DATA	R*4	VARIOUS	VARIOUS[7]
TIME INCREMENT	R*4	0.512-300.0	SEC

Notes:

1. The tracer field should be returned exactly as found in the corresponding Message 66.
2. Message 66 generally contains multiple PIDs. Separate response messages are generated for each PID.
3. See Message 66 notes for a description of the telemetry parameters identified by the PIDs.
4. When all messages for all PIDs have been sent, a Message 176 is sent indicating completion.
5. The message length is given by $4N + 8$, where N is the number of data points in the message. The maximum length is 1608 16-bit half-words, when $N = 400$.
6. When the number of data points is zero, the message ends at half-word 8. The message is always sent, even if the number of data points is zero.
7. The units specified for engineering values are degrees for roll, pitch, and yaw. Digital Sun Sensor (DSS) pitch and yaw and Earth Sensor (ES) roll are also specified in degrees. TLM format selection is reported as a decimal integer with validation zero to seven.

Messages 167 & 177 – Trim Tab Data Response (GOES I-M)

GIMTACS sends OATS trim tab telemetry data in response to a Message 67, Subtype 1, and thruster firing history data in response to a Message 67, Subtype 2. Each of the subtypes is treated by GIMTACS as an entirely separate request with its own response and completion messages.

The trim tab telemetry data request message may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS responds with a separate Message 167 for each PID, reflecting the requested subtype. When GIMTACS is finished responding to the request (all PIDS and all telemetry subtypes), it sends OATS a Message 177.

The thruster firing history data request message is for a single time span. GIMTACS responds with a separate Message 167, Subtype 2 for the thruster firing data. The response may span several messages. When GIMTACS is finished responding to the request, it sends OATS a Message 177.

The Message 167-1 and 167-2 data block layouts and field definitions follow.

Message 167-1 – Trim Tab Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 1608 (SEE NOTES)
      MESSAGE TYPE                  = 167
      MESSAGE SUBTYPE               = 1 - PROPELLANT TANK
                                    = 4 - TRIM TAB POSITION
                                    = 5 - MAG. TORQUER
                                    = 6 - WHEEL SPEED
                                    = 9 - MAGNETOMETER
      TRACER                        = AS PROVIDED IN MSG 67
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

Message 167-1 – Trim Tab Data Response (GOES I-M) (2 of 2)

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|-
      1  |                     YEAR                      | |
         |-----------------------------------------------| |TIME OF
      2  |  |         DAY OF YEAR            |  HR (10s) | |FIRST
         |-----------------------------------------------| |DATA
      3  |  HR (1s)  |        MINUTES         |  SEC (10s)| |POINT
         |-----------------------------------------------| |IN THIS
      4  |  SEC (1s) |               MSECS               | |MESSAGE
         |-----------------------------------------------|-
      5  |   TELEMETRY PARAMETER IDENTIFICATION (PID)    |
      6  |                                               |
         |-----------------------------------------------|
      7  |        NUMBER OF DATA POINTS IN MESSAGE       |
         |-----------------------------------------------|
      8  |        MESSAGE SEQUENCE NUMBER FOR THIS PID   |
         |-----------------------------------------------|
      9  |     FIRST DATA VALUE (IN ENGINEERING UNITS)   |
     10  |                                               |
         |-----------------------------------------------|
     11  |    TIME INCREMENT FROM PREVIOUS DATA POINT    |
     12  |                                               |
         |-----------------------------------------------|
     13  |    SECOND DATA VALUE (IN ENGINEERING UNITS)   |
     14  |                                               |
         |-----------------------------------------------|
     15  |  TIME OFFSETS AND DATA VALUES IN ENGINEERING  |
      :  |        UNITS FOR DATA POINTS 3-N              |
   4N+6  |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
TLM PARAMETER ID (PID)	I*4	1-9999	N/A
NUMBER OF DATA POINTS	I*2	0-400	N/A
MSG SEQ NO. FOR THIS PID	I*2	1-40	N/A
ENGINEERING VALUES OF DATA	R*4	VARIOUS	VARIOUS
TIME INCREMENT	R*4	0.512-300.0	SEC

Notes:

1. The tracer field should be returned exactly as found in the corresponding Message 67.
2. A request message generally contains more than one PID. One or more separate response messages are then generated for each requested PID.
3. See notes for Message 67 for the description of the telemetry parameters that are identified by the PIDs.
4. Although both PIDs for trim tab positions and for each of the tank pressures are included in the data request, only one PID and its data will be returned depending on data availability and quality.
5. When all messages for all PIDs have been sent, completion is indicated by the trim tab data completion Message 177.
6. The message length is given by $4N + 8$, where N is the number of data points in the message. It has a maximum length of 1608 16-bit half-words when $N = 400$.
7. When the number of data points is zero, the message ends at half-word 8. The message is always sent, even if the number of data points is zero.

Message 167-2 – Trim Tab Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 804 (SEE NOTES)
      MESSAGE TYPE                  = 167
      MESSAGE SUBTYPE               = 2 - THRUSTER FIRING HISTORY DATA
      TRACER                        = AS PROVIDED IN MSG 67
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
    HALF-
    WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
            |-----------------------------------------------|
         1  |        NUMBER OF FIRINGS IN TIME SPAN (K)     |
         2  |                                               |
            |-----------------------------------------------|
         3  |                    SPARE                      |
         4  |                                               |
            |-----------------------------------------------|-
         5  |                    YEAR                       | |
            |-----------------------------------------------| | BURN
         6  |  |         DAY OF YEAR            |  HR (10s) | | START
            |-----------------------------------------------| |
         7  |  HR (1s)  |        MINUTES        |  SEC (10s) | | TIME
            |-----------------------------------------------| |
         8  |  SEC (1s) |              MSECS                | |
            |-----------------------------------------------|-
         9  |             FIRING SEQUENCE NUMBER            |
            |-----------------------------------------------|
        10  |          NUMBER OF THRUSTERS FIRED (N)        |
            |-----------------------------------------------|
        11  |                 BURN DURATION                 |
        12  |                                               |
            |-----------------------------------------------|
        13  |                1ST THRUSTER ID                |
            |-----------------------------------------------|
        14  |     NO. OF ON-OFF CYCLES FOR 1ST THRUSTER     |
            |-----------------------------------------------|
        15  |     TOTAL FIRING TIME FOR 1ST THRUSTER        |
        16  |                                               |
            |-----------------------------------------------|
        17  |         THRUSTER ID, TOTAL FIRING TIME        |
         :  |         & ON-OFF CYCLES FOR THE 2ND TO        |
     12+4N  |        THE N-TH THRUSTERS IN THE FIRING       |
            |-----------------------------------------------|
     13+4N  |           REPEAT FROM HALF-WORD 5 FOR         |
         :  |              THE SUBSEQUENT FIRINGS           |
  4+8K+4NK  |                  (2 THROUGH K)                |
            |-----------------------------------------------|
```

Message 167-2 – Trim Tab Data Response (GOES I-M) (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF FIRINGS	I*4	0-25	N/A
FIRING SEQUENCE NUMBER	I*2	1-25	N/A
NUMBER OF THRUSTER FIRED	I*2	1-6	N/A
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
BURN DURATION	I*4	1-2000000	MSEC
THRUSTER ID	ASCII	2A-7A, 2B-7B	N/A
TOTAL THRUSTER FIRING TIME	I*4	1-2000000	MSEC
NUMBER OF ON/OFF CYCLES	I*2	>0	N/A

Notes:

1. The number of firings is the number of wheel unloads in a day. The OATS database can handle up to 25 uncommanded firings per day. The number of wheel unloads should never exceed 25 in a single day, even during the first few days on orbit.

2. The thruster firing data for Message 167 consists solely of the uncommanded thruster firing data for wheel unloads. Thruster firing data for stationkeeping mode activities are not reported.

3. The tracer field should be returned exactly as found in the corresponding Message 67.

4. When all messages for this data subtype have been sent, completion is indicated by the trim tab data completion Message 177.

5. The message length is given by $4 + 8K + 4NK$, where K represents the number of firings and N is the number of thrusters. It has a maximum length of 804 16-bit half-words when $K = 25$ and $N = 6$.

Message 168 – Momentum Telemetry Responses (GOES N-P) (1 of 3)

GTACS transmit Message 168 to OATS approximately every 6 minutes. The data will be selected from the first half of the first valid major frame containing valid data. OATS uses the information in the message to plan the next daily momentum-dumping maneuver.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 32 (All OATS)
      NO. OF HALF-WORDS             = 122
      MESSAGE TYPE                  = 168
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	LSB 15
1	YEAR															
2		DAY OF YEAR											HR(10s)			
3	HR(1s)				MINUTES								SEC(10s)			
4	SEC(1s)				MSECS											
5	NUMBER OF LRV'S INCLUDED IN MESSAGE (k)															
6																
7	LRV #1															
8																
9	VALUE															
10																
11	REPEAT WORDS 7 THROUGH 10 FOR THE REMAINING k-1 LRV'S															
:																
6+4(k)																

Message 168 – Momentum Telemetry Responses (GOES N-P) (2 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MILLISECONDS	BCD	0-999	MSEC
NUMBER OF LRVs INCLUDED IN MESSAGE (k)	I*4	1-29	N/A
LRV	I*4	10000 - 99999	N/A
VALUE	R*4	See notes	N/A

Notes:

1. The normal telemetry variables and associated LRVs are:

Mnemoic	LRV	Validation	Units
Sn_MDX_CURRENT_MODE (S/C mode)	n0066	0-7	N/A
Sn_STR_CMDQUATREF2BDY1	n2025	-1 to +1	N/A
Sn_STR_CMDQUATREF2BDY2	n2026	-1 to +1	N/A
Sn_STR_CMDQUATREF2BDY3	n2027	-1 to +1	N/A
Sn_STR_CMDQUATREF2BDY4	n2028	-1 to +1	N/A
Sn_ROLL_MOM_IN_ECI	n2150	-200 to + 200	NMS
Sn_PITCH_MOM_IN_ECI	n2151	-200 to + 200	NMS
Sn_YAW_MOM_IN_ECI	n2152	-200 to + 200	NMS
Sn_ROLL_MOM_IN_BODY	n2068	-200 to + 200	NMS
Sn_PITCH_MOM_IN_BODY	n2069	-200 to + 200	NMS
Sn_YAW_MOM_IN_BODY	n2070	-200 to + 200	NMS
SOLAR_ARRAY_DRIVE_ANGLE	n3148	0 to 360	Deg
Sn_YAW_FLIP_FLAG	n8793	0-Inverted, 1-Normal	N/A
LPT_1_PRESSURE (fuel 1)	32010	1000 to 2000	KPa
LPT_2_PRESSURE (fuel 2)	32011	1000 to 2000	KPa
LPT_3_PRESSURE (ox 1)	32012	1000 to 2000	KPa
LPT_4_PRESSURE (ox 2)	32013	1000 to 2000	KPa
FUEL_TANK_1_TEMP_A	42060	-10 to +50	Deg C
FUEL_TANK_1_TEMP_B	42061	-10 to +50	Deg C
FUEL_TANK_1_TEMP_C	42072	-10 to +50	Deg C
FUEL_TANK_2_TEMP_A	42062	-10 to +50	Deg C
FUEL_TANK_2_TEMP_B	42063	-10 to +50	Deg C
FUEL_TANK_2_TEMP_C	42073	-10 to +50	Deg C
OX_TANK_1_TEMP_A	42064	-10 to +50	Deg C
OX_TANK_1_TEMP_B	42065	-10 to +50	Deg C
OX_TANK_1_TEMP_C	42074	-10 to +50	Deg C
OX_TANK_2_TEMP_A	42066	-10 to +50	Deg C
OX_TANK_2_TEMP_B	42067	-10 to +50	Deg C
OX_TANK_2_TEMP_C	42075	-10 to +50	Deg C

Message 168 – Momentum Telemetry Responses (GOES N-P) (3 of 3)

2. The leading digit of ACE LRVs and names in the above table, designated as “n”, will be 1 for ACE 1 and 2 for ACE 2. GTACS will only send the data for the active ACE.

3. GTACS will transmit Message 168 to OATS approximately every 6 minutes. The data will be selected from the first half of the first major frame in which all MDX_STATUS, attitude quaternion, ECI momentum, and yaw-flip are marked as valid. The Sn_STR_CMDQUATREF2BDY values will be selected from the minor frame (5) just prior to that of the ECI momentum samples (minor frame 6). For those tank pressures or temperatures that are invalid, the values should be set to –9999.

4. The listed time is the receive time associated with the beginning of the minor frame (6) of the ECI momentum sample.

Message 170 – Propulsion Subsystem Data Response (GOES N-P) (1 of 2)

GTACS sends OATS propulsion subsystem or thruster firing history telemetry data in response to a Message 70-1. The Message 70-1 may contain more than one LRV grouped by multiple requested response subtypes. However, GTACS responds with a separate Message 170 for each LRV. Each Message 170 reflects the requested subtype. When GTACS is finished responding to the request (all LRVs and all telemetry subtypes), it sends OATS a Message 180. The Message 170 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 75 - 85 (Requesting OATS)
      NO. OF HALF-WORDS             = UP TO 1606 (SEE NOTES)
      MESSAGE TYPE                  = 170
      MESSAGE SUBTYPE               = RESPONSE SUBTYPE (SEE NOTES)
      TRACER                        = AS PROVIDED IN MSG 70
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

DATA BLOCK LAYOUT:

HALF-WORD NO.	MSB 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 LSB 15	
1	YEAR	TIME OF FIRST DATA POINT IN THIS MESSAGE
2	DAY OF YEAR / HR(10s)	
3	HR(1s) / MINUTES / SEC(10s)	
4	SEC(1s) / MSECS	
5 6	TELEMETRY PARAMETER IDENTIFICATION (LRV)	
7	NUMBER OF DATA POINTS IN MESSAGE	
8	MESSAGE SEQUENCE NUMBER FOR THIS LRV	
9 10	FIRST DATA VALUE (IN ENGINEERING UNITS)	
11 12	TIME INCREMENT BETWEEN 1ST AND 2ND DATA POINT	
13 14	SECOND DATA VALUE (IN ENGINEERING UNITS)	
15 : 4N+6	TIME OFFSETS AND DATA VALUES IN ENGINEERING UNITS FOR DATA POINTS 3-N	

Message 170 – Propulsion Subsystem Data Response (GOES N-P) (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MILLISECONDS	BCD	0-999	MSEC
TLM PARAMETER ID (LRV)	I*4	10000-99999	N/A
NUMBER OF DATA POINTS	I*2	0-400	N/A
MSG SEQ NO. FOR THIS LRV	I*2	1-40	N/A
ENGINEERING VALUES OF DATA	R*4	VARIOUS	VARIOUS
TIME INCREMENT	R*4	1.024-300.0	SEC

Notes:

1. The tracer field is returned exactly as found in the corresponding Message 70.
2. Message Subtype in the header is the "response subtype" value returned for request data correlation. This value is embedded in Message 70, half-word 9.
3. A request message generally contains a number of LRVs, resulting in one or more separate response messages for each LRV.
4. See the Message 70 notes for a description of the telemetry parameters identified by the LRVs.
5. When messages have been sent for all LRVs, completion is indicated by the propulsion subsystem data completion Message 180.
6. The message length is given by 4N + 6, with a maximum length of 1606 16-bit half-words when N = 400.
7. When the number of data points is zero, the message ends at half-word 8. The message is always sent, however, even if the number of data points is zero.
8. Integer values (e.g., number of pulses) are sent as real values.

Messages 170 & 180 – Propulsion Subsystem Data Response (GOES I-M)

GIMTACS sends OATS propulsion subsystem telemetry data in response to a Message 70-1 and thruster firing history data in response to a Message 70-2. Each subtype is treated by GIMTACS as an entirely separate request with its own response and completion messages.

The Message 70-1 may contain more than one PID grouped by multiple requested response subtypes. However, GIMTACS responds with a separate Message 170 for each PID. Each Message 170 reflects the requested subtype. When GIMTACS is finished responding to the request (all PIDs and all telemetry subtypes), it sends OATS a Message 180.

The thruster firing history data request message is for a single time span. GIMTACS responds with a separate Message 170-2 for the thruster firing data. The response may span several messages. When GIMTACS is finished responding to the request, it sends OATS a Message 180. The Message 170-1 and 170-2 data block layouts and field definitions follow.

Message 170-1 – Propulsion Subsystem Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 1608 (SEE NOTES)
      MESSAGE TYPE                  = 170
      MESSAGE SUBTYPE               = 1 - PROPELLANT TANK DATA
                                    = 3 - SADA DATA
      TRACER                        = AS PROVIDED IN MSG 70
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|_
      1  |                     YEAR                      | |
         |-----------------------------------------------| |TIME OF
      2  |  |         DAY OF YEAR            |  HR (10s) | |FIRST
         |-----------------------------------------------| |DATA
      3  |  HR (1s)  |        MINUTES         |  SEC (10s)| |POINT
         |-----------------------------------------------| |IN THIS
      4  |  SEC (1s) |               MSECS               | |MESSAGE
         |-----------------------------------------------|_
      5  |   TELEMETRY PARAMETER IDENTIFICATION (PID)    |
      6  |
         |-----------------------------------------------|
      7  |        NUMBER OF DATA POINTS IN MESSAGE       |
         |-----------------------------------------------|
      8  |        MESSAGE SEQUENCE NUMBER FOR THIS PID   |
         |-----------------------------------------------|
```

Message 170-1 – Propulsion Subsystem Data Response (GOES I-M) (2 of 2)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|—
     9  |     FIRST DATA VALUE (IN ENGINEERING UNITS)   |
    10  |                                               |
        |-----------------------------------------------|
    11  |    TIME INCREMENT FROM PREVIOUS DATA POINT    |
    12  |                                               |
        |-----------------------------------------------|
    13  |    SECOND DATA VALUE (IN ENGINEERING UNITS)   |
    14  |                                               |
        |-----------------------------------------------|
    15  |  TIME OFFSETS AND DATA VALUES IN ENGINEERING  |
     :  |         UNITS FOR DATA POINTS 3-N             |
  4N+6  |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
TLM PARAMETER ID (PID)	I*4	1-9999	N/A
NUMBER OF DATA POINTS	I*2	0-400	N/A
MSG SEQ NO. FOR THIS PID	I*2	1-40	N/A
ENGINEERING VALUES OF DATA	R*4	VARIOUS	VARIOUS
TIME INCREMENT	R*4	0.512-300.0	SEC

Notes:

1. The tracer field should be returned exactly as found in the corresponding Message 70.
2. A request message generally contains multiple PIDs, resulting in separate response messages for each PID.
3. See the Message 70 notes for the telemetry parameters description identified by the PIDs.
4. Although both PIDs for each of the tank pressures are included in the data request, only one PID and its data are returned, depending on data availability and quality.
5. When messages have been sent for all PIDs, completion is indicated by the propulsion subsystem data completion Message 180.
6. The message length is given by $4N + 8$, where N is the number of data points in the message. It has a maximum length of 1608, 16-bit half-words when $N = 400$.
7. When the number of data points is zero, the message ends at half-word eight. The message is always sent, however, even if the number of data points is zero.

Message 170-2 – Propulsion Subsystem Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 324 (SEE NOTES)
      MESSAGE TYPE                  = 170
      MESSAGE SUBTYPE               = 2 - THRUSTER FIRING HISTORY DATA
      TRACER                        = AS PROVIDED IN MSG 70
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
    1-2  |          NUMBER OF FIRINGS IN TIME SPAN (K)   |
         |-----------------------------------------------|
    3-4  |                    SPARE                      |
         |-----------------------------------------------|_
      5  |                    YEAR                       | |
         |-----------------------------------------------| |  BURN
      6  |  |         DAY OF YEAR            |  HR (10s) | |  START
         |-----------------------------------------------| |
      7  |  HR (1s)  |        MINUTES         |  SEC (10s) | |  TIME
         |-----------------------------------------------| |
      8  |  SEC (1s) |               MSECS                | |
         |-----------------------------------------------|_
      9  |          FIRING SEQUENCE NUMBER               |
         |-----------------------------------------------|
     10  |          NUMBER OF THRUSTERS FIRED (N)        |
         |-----------------------------------------------|
  11-12  |                 BURN DURATION                 |
         |-----------------------------------------------|
     13  |                1ST THRUSTER ID                |
         |-----------------------------------------------|
     14  |     NO. OF ON-OFF CYCLES FOR 1ST THRUSTER     |
         |-----------------------------------------------|
  15-16  |     TOTAL FIRING TIME FOR 1ST THRUSTER        |
         |-----------------------------------------------|
     17  |THRUSTER ID, TOTAL FIRING TIME & ON-OFF CYCLES |
  12+4N  |FOR THE 2ND TO THE N-TH THRUSTERS IN THE FIRING|
         |-----------------------------------------------|
  13+4N  |  REPEAT FROM HALF-WORD 5 FOR THE SUBSEQUENT   |
         |            FIRINGS (2 THROUGH K)              |
  4+8K+  |                                               |
   4NK   |-----------------------------------------------|
```

Message 170-2 – Propulsion Subsystem Data Response (GOES I-M) (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF FIRINGS	I*4	1-10	N/A
FIRING SEQUENCE NUMBER	I*2	1-10	N/A
NUMBER OF THRUSTER FIRED	I*2	1-6	N/A
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
BURN DURATION	I*4	1-2000000	MSEC
THRUSTER ID	ASCII	2A-7A, 2B-7B	N/A
TOTAL THRUSTER FIRING TIME	I*4	1-2000000	MSEC
NUMBER OF ON/OFF CYCLES	I*2	>0	N/A

Notes:

1. Number of firings is the sequence number of the maneuver. The OATS database can handle up to 10 firings per maneuver. Under normal circumstances, the sequence number should never exceed 10 in a maneuver.

2. The Message 166 thruster firing data is solely for stationkeeping mode activities. Uncommanded thruster firing data for wheel unloads are not reported.

3. The tracer field should be returned exactly as found in the corresponding Message 70.

4. When all messages for this data subtype have been sent, completion is indicated by the propulsion subsystem data completion Message 180.

5. The message length is given by $4 + 8K + 4NK$, where K is the number of firings and N is the number of thrusters. Maximum length is 324 16-bit half-words when $K = 10$ and $N = 6$.

Message 175 – IMC Scale Factor Calibration Schedule Request

GIMTACS/GTACS sends OATS Message 175 unsolicited to request calculation of an IMC scale factor schedule of commanded scale factor offsets. OATS responds by transmitting a Message 75 to GIMTACS/GTACS containing the schedule. The Message 175 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75 - 85 (N-P Primary OATS)
      NO. OF HALF-WORDS             = 6
      MESSAGE TYPE                  = 175
      MESSAGE SUBTYPE               = 1 - IMAGER
                                    = 2 - SOUNDER
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = UNIQUE ID SUPPLIED BY GIMTACS/GTACS

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                     YEAR                      |
          |-----------------------------------------------|
      2   |         DAY OF YEAR            |  HR (10s)   |
          |-----------------------------------------------|
      3   |  HR (1s)  |        MINUTES      |  SEC (10s)  |
          |-----------------------------------------------|
      4   |  SEC (1s) |               MSECS               |
          |-----------------------------------------------|
      5   |                   DURATION                    |
      6   |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SPAN START TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
DURATION	R*4	1-180	MIN

Notes:

Start time and duration define the time span over which the IMC scale factor offset and star sightings will be commanded.

Message 176 – DIRA Calibration Data Response (GOES I-M)

GIMTACS provides OATS with DIRA telemetry data in response to a Message 66. The Message 66 may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS responds with a separate Message 166 for each PID, reflecting the requested subtype. When GIMTACS finishes responding with all PIDs and all subtypes, it sends a DIRA data completion Message 176 to OATS. Message 176 data block layouts and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = 2
      MESSAGE TYPE                  = 176
      MESSAGE SUBTYPE               = 0 - SUCCESSFUL COMPLETION
                                    = 1 - DATA DROPOUTS
                                    = 2 - PREMATURE COMPLETION
                                    = 3 - UNABLE TO FULFILL REQUEST
                                    = 4 - REQUEST PARTIALLY FULFILLED
      TRACER                        = AS PROVIDED IN MSG 66
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
         1 |      TOTAL NUMBER OF MESSAGES SENT            |
         2 |   IN RESPONSE TO THE REQUEST (TYPE 66)        |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*4	1-65535	N/A

Notes:

1. The subtypes and their definitions are as follows:

   0 Successful completion - successful completion of the telemetry data for the period of time requested.

   1 Data dropouts - minor frame dropouts detected in thruster firing data.

   2 Premature completion - telemetry data exists only for part of the requested time span.

   3 Unable to fulfill request - no telemetry data exists for the requested time span.

   4 Request partially fulfilled - data for a specific PID or PIDs does not exist in the requested time span.

2. The tracer field should be returned exactly as found in the corresponding Message 66.

3. Message 176 is sent once after all the PIDs and their possible continuations for all the response subtypes specified in the Message 66 have been sent. The total number of messages sent is for all PIDs and all subtypes requested.

4. The subtype priorities are three, four, two, one, and zero. Only one completion message is sent for a given request.

Message 177 – Trim Tab Data Response (GOES I-M) (1 of 2)

GIMTACS sends OATS trim tab telemetry data in response to a Message 67, Subtype 1, and thruster firing history data in response to a Message 67, Subtype 2. Each of the subtypes is treated by GIMTACS as an entirely separate request with its own response and completion messages.

The trim tab telemetry data request message may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS responds with a separate Message 167 for each PID, reflecting the requested subtype. When GIMTACS is finished responding to the request (all PIDS and all telemetry subtypes), it sends OATS a Message 177.

The thruster firing history data request message is for a single time span. GIMTACS responds with a separate Message 167, Subtype 2 for the thruster firing data. The response may span several messages. When GIMTACS is finished responding to the request, it sends OATS a Message 177.

The Message 177 data block layouts and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = 4
      MESSAGE TYPE                  = 177
      MESSAGE SUBTYPE               = 0 - SUCCESSFUL COMPLETION
                                    = 1 - DATA DROPOUTS
                                    = 2 - PREMATURE COMPLETION
                                    = 3 - UNABLE TO FULFILL REQUEST
                                    = 4 - REQUEST PARTIALLY FULFILLED
      TRACER                        = AS PROVIDED IN MSG 67
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
         1 |        TOTAL NUMBER OF MESSAGES SENT          |
         2 |     IN RESPONSE TO THE REQUEST (TYPE 67)      |
           |-----------------------------------------------|
         3 |           PERCENT OF TOTAL TELEMETRY          |
         4 |                FRAMES DROPPED                 |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*4	1-65535	N/A
PERCENT OF TOTAL TELEMETRY FRAMES DROPPED	I*4	0-100	PERCENT

Message 177 – Trim Tab Data Response (GOES I-M) (2 of 2)

Notes:

1. The subtypes and their definitions are as follows:

   0 Successful completion - Successful completion of the telemetry data for the period of time requested.

   1 Data dropouts - Minor frame dropouts detected in thruster firing data.

   2 Premature completion - Telemetry data exists only for part of the requested time span.

   3 Unable to fulfill request - No telemetry data exists for the requested time span.

   4 Request partially fulfilled - Data for a specific PID or PIDs does not exist in the requested time span.

2. The tracer field should be returned exactly as found in the corresponding Message 67.

3. Message 177 is sent once after a trim tab telemetry data request, Message 67-1; and, when all the PIDs and their possible continuations for all the response subtypes specified in the request message have been sent. The total number of messages sent is for all PIDs and all subtypes requested.

4. Additionally, this message is sent once after a thruster firing history data request Message 67-2, when all the continuations have been sent.

5. The subtype priorities are three, four, two, one, and zero. Only one completion message is sent for a given request.

Message 180 – Propulsion Subsystem Data Response (1 of 2)

For GOES I-M, GIMTACS sends OATS propulsion subsystem telemetry data in response to a Message 70-1 and thruster firing history data in response to a Message 70-2. Each subtype is treated by GIMTACS as an entirely separate request with its own response and completion messages.

The Message 70-1 may contain more than one PID grouped by multiple requested response subtypes. However, GIMTACS responds with a separate Message 170 for each PID. Each Message 170 reflects the requested subtype. When GIMTACS is finished responding to the request (all PIDs and all telemetry subtypes), it sends OATS a Message 180.

The thruster firing history data request message is for a single time span. GIMTACS responds with a separate Message 170-2 for the thruster firing data. The response may span several messages. When GIMTACS is finished responding to the request, it sends OATS a Message 180.

For GOES N-P, GTACS sends OATS propulsion subsystem or thruster firing history telemetry data in response to a Message 70-1. The Message 70-1 may contain more than one LRV grouped by multiple requested response subtypes. However, GTACS responds with a separate Message 170 for each LRV. Each Message 170 reflects the requested subtype. When GTACS is finished responding to the request (all LRVs and all telemetry subtypes), it sends OATS a Message 180.
The Message 180 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (I-M OATS)
                                    = 75-85 (N-P OATS)
      NO. OF HALF-WORDS             = 4
      MESSAGE TYPE                  = 180
      MESSAGE TYPE                  = 0 - SUCCESSFUL COMPLETION
                                    = 1 - DATA DROPOUTS
                                    = 2 - PREMATURE COMPLETION
                                    = 3 - UNABLE TO FULFILL REQUEST
                                    = 4 - REQUEST PARTIALLY FULFILLED
      TRACER                        = AS PROVIDED IN MSG 70
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |            NUMBER OF MESSAGES SENT            |
      2 |   IN RESPONSE TO THE REQUEST (TYPE 70)        |
        |-----------------------------------------------|
      3 |   PERCENT OF TOTAL TELEMETRY FRAMES DROPPED   |
      4 |       or TELEMETRY FRAMES SUBMITTED           |
        |-----------------------------------------------|
```

Message 180 – Propulsion Subsystem Data Response (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*4	1-65535	N/A
PERCENT OF TOTAL TELEMETRY FRAMES DROPPED	I*4	0-100 (I-M)	PERCENT
TELEMETRY FRAMES SUBMITTED	I*4	0 = NO TELEMETRY 100 = TELEMETRY	(N-P) (N-P)

Notes:

1. The subtypes and their definitions are as follows:

   0 Successful completion – successful completion of the telemetry data for the period of time requested.

   1 Data dropouts – minor frame dropouts detected in thruster firing data.

   2 Premature completion – telemetry data exists only for part of the requested time span.

   3 Unable to fulfill request – no telemetry data exists for the requested time span.

   4 Request partially fulfilled – data for a specific PID/LRV or PIDs/LRVs does not exist in the requested time span.

2. The tracer field should be returned exactly as found in the corresponding Message 70.

3. Message 180 is sent once in response to a Message 70-1, when all the PIDs/LRVs and their possible continuations for all the response subtypes specified in the request message have been sent. The total number of messages sent is for all PIDs/LRVs and all subtypes requested.

4. Additionally, for GOES I-M, this message is sent once after a thruster firing history data request Message 70-2, when all the continuation messages have been sent.

5. The subtype priorities are three, four, two, one and zero. Only one completion message is sent for a given request.

6. For GOES N-P, the telemetry frames submitted data item contains zero when no telemetry has been transferred to OATS and 100 when telemetry has been transferred.

Messages 185 & 195 – MMC Calibration Data Response (GOES I-M)

GIMTACS uses Message 185 to send OATS MMC calibration telemetry data in response to a Message 85. The Message 85 may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS sends a separate Message 185 for each PID. Each response message reflects the requested subtype. When GIMTACS has sent all the required Message 185s, all PIDs, and subtypes, it sends OATS an MMC calibration data completion Message 195. The Message 185 data block layout and field definitions follow.

Message 185 – MMC Calibration Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 1608 (SEE NOTES)
      MESSAGE TYPE                  = 185
      MESSAGE SUBTYPE               = 6 - WHEEL SPEEDS DATA
                                    = 7 - ACCUMULATED DIRA PITCH, ROLL & YAW
      TRACER                        = AS PROVIDED IN MSG 85
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
    HALF-
    WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
            |-----------------------------------------------|_
         1  |                     YEAR                      | |
            |-----------------------------------------------| |TIME OF
         2  |  |         DAY OF YEAR            |  HR (10s) | |FIRST
            |-----------------------------------------------| |DATA
         3  |  HR (1s)  |        MINUTES        |  SEC (10s) | |POINT
            |-----------------------------------------------| |IN THIS
         4  |  SEC (1s) |              MSECS                | |MESSAGE
            |-----------------------------------------------|_
         5  |   TELEMETRY PARAMETER IDENTIFICATION (PID)    |
         6  |
            |-----------------------------------------------|
         7  |     NUMBER OF DATA POINTS IN MESSAGE (N)      |
            |-----------------------------------------------|
         8  |     MESSAGE SEQUENCE NUMBER FOR THIS PID      |
            |-----------------------------------------------|
         9  |     FIRST DATA VALUE (IN ENGINEERING UNITS)   |
        10  |
            |-----------------------------------------------|
        11  |    TIME INCREMENT FROM PREVIOUS DATA POINT    |
        12  |
            |-----------------------------------------------|
        13  |    SECOND DATA VALUE (IN ENGINEERING UNITS)   |
        14  |
            |-----------------------------------------------|
        15  |  TIME OFFSETS AND DATA VALUES IN ENGINEERING  |
         .  |          UNITS FOR DATA POINTS 3-N            |
      4N+6  |-----------------------------------------------|
```

Message 185 – MMC Calibration Data Response (2 of 2)

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF DATA POINT YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
TLM PARAMETER ID (PID)	I*4	1-9999	N/A
NUMBER OF DATA POINTS	I*2	0-400	N/A
MSG SEQ NO. FOR THIS PID	I*2	1-40	N/A
ENGINEERING VALUES OF DATA	R*4	VARIOUS	VARIOUS
TIME INCREMENT	R*4	0.512-300.0	SEC

Notes:

1. The tracer field should be returned exactly as found in the corresponding Message 85.
2. Request messages generally contain a number of PIDs, resulting in a separate response message for each PID.
3. See the Message 85 notes for a description of the telemetry parameters identified by the PIDs.
4. When all messages for all PIDs have been sent, completion is indicated by the MMC calibration data completion Message 195.
5. The message length is given by $4N + 8$, where N is the number of data points in the message. It has a maximum length of 1608 16-bit half- words when $N = 400$.
6. When the number of data points equals zero, the message ends at half-word 8. The message is always sent, even if there are no data points.

Messages 187 & 197 – SMC Data Response and Completion (GOES I-M)

GIMTACS uses Message 187 to send OATS SMC telemetry data in response to a Message 87. The Message 87 may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS sends a separate Message 187 for each PID. Each response message reflects the requested subtype. Upon completion of the response, all PIDs, and all subtypes, GIMTACS sends OATS an SMC data completion Message 197. The Message 187 data block layout and field definitions follow.

Message 187 – SMC Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = UP TO 160 (SEE NOTES)
      MESSAGE TYPE                  = 187
      MESSAGE SUBTYPE               = 10 - SMC DATA
      TRACER                        = AS PROVIDED IN MSG 87
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
   1-32  |       LOCATION OF RETURNED DATA FILES         |
         |-----------------------------------------------|
  33-34  |          NUMBER OF DATA FILES (N)             |
         |-----------------------------------------------|
  35-36  |            PID OF 1ST DATA FILE               |
         |-----------------------------------------------|
  37-52  |          DATA FILE NAME FOR PID 1             |
         |                                               |
         |-----------------------------------------------|
    53   |      PID AND DATA FILE NAME FOR PIDS 2-N      |
     .   |                                               |
 34+18N  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
LOCATION OF RETURNED DATA FILES	ASCII	NONE	N/A
NUMBER OF DATA FILES	I*4	7	N/A
PID OF 1ST DATA FILE	I*4	1-9999	N/A
DATA FILE NAME FOR PID 1	ASCII	NONE	N/A
PID AND DATA FILE NAME FOR PIDS 2-N	ASCII	NONE	N/A

Message 187 – SMC Data Response (GOES I-M) (2 of 2)

Notes:

1. The tracer field should be returned exactly as found in the corresponding Message 87.
2. See the Message 87 notes for a description of the telemetry parameters identified by the PIDs.
3. The location of the returned data files includes node as well as directory information.
4. When messages for all the PIDs have been sent, completion is indicated by an SMC data completion Message 197.
5. The message length is given by 34 + 18*N*, where N is the number of PIDs. It has a maximum length of 160 16-bit half-words when *N* = 7.

Messages 188 & 198 – Thermal Snap Data Response and Completion (GOES I-M)

GIMTACS uses Message 188 to send OATS thermal snap telemetry data in response to a Message 88. The Message 88 may contain more than one PID, grouped by multiple requested response subtypes. When GIMTACS has fulfilled the request, all PIDs, and all subtypes, it sends OATS a thermal snap data completion Message 198. The Message 188 and 198 data block layout and field definitions follow.

Message 188 – Thermal Snap Data Response (GOES I-M) (1 of 2)

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = 88 (SEE NOTES)
      MESSAGE TYPE                  = 188
      MESSAGE SUBTYPE               = 11 - THERMAL DATA
      TRACER                        = AS PROVIDED IN MSG 88
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

```
DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|
   1-32  |       LOCATION OF RETURNED DATA FILES         |
         |-----------------------------------------------|
  33-34  |          NUMBER OF DATA FILES (N)             |
         |-----------------------------------------------|
  35-36  |            PID OF 1ST DATA FILE               |
         |-----------------------------------------------|
  37-52  |          DATA FILE NAME FOR PID 1             |
         |                                               |
         |-----------------------------------------------|
    53   |       PID & DATA FILE NAME FOR PIDS 2-N       |
     .   |                                               |
 34+18N  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
LOCATION OF RETURNED DATA FILES	ASCII	NONE	N/A
NUMBER OF DATA FILES	I*4	3	N/A
PID OF 1ST DATA FILE	I*4	1-9999	N/A
DATA FILE NAME FOR PID 1	ASCII	NONE	N/A
PID & DATA FILE NAME FOR PIDS 2-N	ASCII	NONE	N/A

Message 188 – Thermal Snap Data Response (GOES I-M) (2 of 2)

Notes:

1. The tracer field should be returned exactly as found in the corresponding Message 88.
2. See Message 88 notes for a description of the telemetry parameters identified by the PIDs.
3. The location of the returned data files includes node and directory information.
4. When all messages for all PIDs have been sent, completion is indicated by a thermal snap data completion Message 198.
5. The message length is given by 34 + 18*N*, where N is the number of PIDs. It has a maximum length of 88 16-bit half-words when *N* = 3.

Message 190 – Spacecraft Equipment Status (GOES I-M) (1 of 2)

GIMTACS sends OATS an unsolicited Message 190 whenever there is a change in status in any of a specified set of spacecraft equipment. OATS needs the status of various spacecraft equipment primarily, but not exclusively, for its magnetic dipole calculation. The Message 190 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 32 (ALL OATS)
      NO. OF HALF-WORDS             = 84
      MESSAGE TYPE                  = 190
      MESSAGE SUBTYPE               = 0
      TRACER                        = BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A
```

```
DATA BLOCK LAYOUT: N/A
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
         |-----------------------------------------------|—
      1  |                     YEAR                      |  |
         |-----------------------------------------------|  |  TIME OF
      2  |  |         DAY OF YEAR            |  HR (10s)|  |  EQUIPMENT
         |-----------------------------------------------|  |  STATUS
      3  |  HR (1s)  |        MINUTES         |  SEC (10s)|  |  CHANGE
         |-----------------------------------------------|  |
      4  |  SEC (1s) |               MSECS               |  |
         |-----------------------------------------------|—
   4N+1  |                 EQUIPMENT PID                 |
       .|       FOR ITEM N, WHERE N = 1,2,3,...,20       |
   4N+2  |                                               |
         |-----------------------------------------------|
   4N+3  |        EQUIPMENT STATUS (RAW TLM VALUE)       |
       .|       FOR ITEM N, WHERE N = 1,2,3,...,20       |
   4N+4  |                                               |
         |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TIME OF EQUIP STATUS CHANGE	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOURS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC
EQUIPMENT PID	I*4	1-9999	N/A
EQUIPMENT STATUS	I*4	0 OR 1	N/A

Message 190 – Spacecraft Equipment Status (GOES I-M) (2 of 2)

Notes:

1. GIMTACS sends an unsolicited Message 190 to OATS within 5 minutes of any commanded status change to any of the following spacecraft equipment:

Item	Equipment
1	Magnetometer No. 1
2	Magnetometer No. 2
3	Momentum wheel No. 1
4	Momentum wheel No. 2
5	Reaction wheel
6	Sounder electronics
7	Sounder instrument
8	Imager electronics
9	Imager instrument
10	Magnetic torquer No. 1, relay No. 1
11	Magnetic torquer No. 1, relay No. 2
12	Magnetic torquer No. 2, relay No. 1
13	Magnetic torquer No. 2, relay No. 2
14	ES 1
15	ES 2
16-20	Spares - not used

2. The message always contains the entire 20-item table. Since equipment PIDs may differ from spacecraft to spacecraft, the PIDs are stored as database items for each satellite. Also, since the equipment “on” and “off” status designation varies from one equipment to another, the statuses are maintained as database items.

Message 195 – MMC Calibration Data Completion (GOES I-M)

GIMTACS uses Message 185 to send OATS MMC calibration telemetry data in response to a Message 85. The Message 85 may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS sends a separate Message 185 for each PID. Each response message reflects the requested subtype. When GIMTACS has sent all the required Message 185s, all PIDs, and subtypes, it sends OATS an MMC calibration data completion Message 195. The Message 195 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = 2
      MESSAGE TYPE                  = 195
      MESSAGE SUBTYPE               = 0 - SUCCESSFUL COMPLETION
                                    = 1 - DATA DROPOUTS
                                    = 2 - PREMATURE COMPLETION
                                    = 3 - UNABLE TO FULFILL REQUEST
                                    = 4 - REQUEST PARTIALLY FULFILLED
      TRACER                        = AS PROVIDED IN MSG 85
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
   HALF-
   WORD NO. MSB                                          LSB
             0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
           |-----------------------------------------------|
         1 |      TOTAL NUMBER OF MESSAGES SENT            |
         2 |      IN RESPONSE TO THE MESSAGE 85            |
           |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*4	1-65535	N/A

Notes:

1. The following are subtypes and their definitions:
   - 0 Successful completion - successful completion of the telemetry data for the period of time requested.
   - 1 Data dropouts - minor frame dropouts detected in thruster firing data.
   - 2 Premature completion - telemetry data exists only for part of the requested time span.
   - 3 Unable to fulfill request - no telemetry data exists for the requested time span.
   - 4 Request partially fulfilled - data for a specific PID or PIDs does not exist in the requested time span.
2. The tracer field should be returned exactly as found in the corresponding Message 85.
3. Message 195 is sent once after all the PIDs and their possible continuations for all the response subtypes specified in the Message 85 have been sent. The total number of messages sent depends on the number of PIDs and subtypes requested.
4. The subtype priorities are three, four, two, one, and zero. Only one completion message is sent for a given request.

Message 197 – SMC Data Completion (GOES I-M)

GIMTACS uses Message 187 to send OATS SMC telemetry data in response to a Message 87. The Message 87 may contain more than one PID, grouped by multiple requested response subtypes. GIMTACS sends a separate Message 187 for each PID. Each response message reflects the requested subtype. Upon completion of the response, all PIDs, and all subtypes, GIMTACS sends OATS an SMC data completion Message 197. The Message 197 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = 2
      MESSAGE TYPE                  = 197
      MESSAGE SUBTYPE               = 0 - SUCCESSFUL COMPLETION
                                    = 1 - DATA DROPOUTS
                                    = 2 - PREMATURE COMPLETION
                                    = 3 - UNABLE TO FULFILL REQUEST
                                    = 4 - REQUEST PARTIALLY FULFILLED
      TRACER                        = AS PROVIDED IN MSG 87
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |        TOTAL NUMBER OF MESSAGES SENT          |
      2 |          IN RESPONSE TO MESSAGE 87            |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*4	1	N/A

Notes:

1. The following are subtypes and their definitions:
   - 0 Successful completion - successful completion of the telemetry data for the period of time requested.
   - 1 Data dropouts - minor frame dropouts detected in thruster firing data.
   - 2 Premature completion - telemetry data exists only for part of the requested time span.
   - 3 Unable to fulfill request - no telemetry data exists for the requested time span.
   - 4 Request partially fulfilled - data for a specific PID or PIDs does not exist in the requested time span.
2. The tracer field should be returned exactly as found in the corresponding Message 87.
3. The subtype priorities are three, four, two, one, and zero. Only one completion message is sent for a given request.
4. Message 197 is sent once after the last Message 187 is sent.

Message 198 – Thermal Snap Data Completion (GOES I-M)

GIMTACS uses Message 188 to send OATS thermal snap telemetry data in response to a Message 88. The Message 88 may contain more than one PID, grouped by multiple requested response subtypes. When GIMTACS has fulfilled the request, all PIDs, and all subtypes, it sends OATS a thermal snap data completion Message 198. The Message 198 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 41,42,43,44,45,46,47,48,49,50 (OATS)
      NO. OF HALF-WORDS             = 2
      MESSAGE TYPE                  = 198
      MESSAGE SUBTYPE               = 0 - DATA DROPOUTS
                                    = 2 - PREMATURE COMPLETION
                                    = 3 - UNABLE TO FULFILL REQUEST
                                    = 4 - REQUEST PARTIALLY FULFILLED
      TRACER                        = AS PROVIDED IN MSG 88
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = TRUE
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |      TOTAL NUMBER OF MESSAGES SENT            |
      2 |      IN RESPONSE TO THE MESSAGE 88            |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
NUMBER OF MESSAGES SENT	I*4	1	N/A

Notes:

1. The subtypes and their definitions are:
   - 0 Successful completion - successful completion of the telemetry data for the period of time requested.
   - 1 Data dropouts - minor frame dropouts detected in thruster firing data.
   - 2 Premature completion - telemetry data exists only for part of the requested time span.
   - 3 Unable to fulfill request - no telemetry data exists for the requested time span.
   - 4 Request partially fulfilled - data for a specific PID or PIDs does not exist in the requested time span.
2. The tracer field should be returned exactly as found in the corresponding data request Message 88.
3. The subtype priorities are three, four, two, one, and zero. Only one completion message is sent for a given request.
4. One Message 198 is sent after the last Message 188 is sent.

Message 199 – GTACS-OATS Text Message (GOES N-P)

GTACS uses Message 199 to send text messages to the OATS concerning command planning, contingency operations and configuration. Text messages can contain up to 65 ASCII characters. The Message 199 data block layout and field definitions are as follows:

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 13,14,15 (N-P)
      SOURCE                        = 90 - 101 (GTACS)
      DESTINATION                   = 75 - 85 (OATS)
      NO. OF HALF-WORDS             = 40
      MESSAGE TYPE                  = 199
      MESSAGE SUBTYPE               = 0
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
     HALF-     MSB                                                LSB
     WORD NO.  0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15
        1
        :                          TEXT MESSAGE
       40
```

DATA ITEM	FORMAT	VALIDATION	UNITS
TEXT MESSAGE	ASCII	N/A	N/A

Notes:

Eight-bit ASCII character pairs are formatted into half-words by placing the first character in the most significant byte (bits 0–7) and the second character in the least significant byte (bits 8–15).

Message 202 – Labeled Star Measurement (1 of 3)

Star sense sequences occur an average of once every 30 minutes on both the Imager and Sounder, in groups of three or more. The SPS extracts star sense data from the Imager and Sounder data streams, threshold-detects the data, and determines the time of occurrence of the center of peak amplitude. The SPS sends GIMTACS/GTACS a Message 2 containing instrument coordinates, duration, and detectors 1 through 8 thresholds, mean values, and number of events. Message 2 also contains four event records per detector. Each event record contains the event mean value, event duration, and the center time of the event. Star sense measurements are a consequence of command specifications contained in a Message 51 for normal star sightings or a Message 75 for IMC calibration star sightings. After each star sequence, GIMTACS/GTACS concatenates starlook identification information from the corresponding OATS Message 51 or 75 with the Message 2 star sense data from the SPS to create a Message 202 to OATS. The Message 202 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12,13,14,15 (I-P)
      SOURCE                        = 10 (GIMTACS)
                                    = 90-101 (GTACS)
      DESTINATION                   = 32 (ALL OATS)
      NO. OF HALF-WORDS             = 304
      MESSAGE TYPE                  = 202
      MESSAGE SUBTYPE               = 1 - IMAGER, NORMAL
                                    = 2 - SOUNDER, NORMAL
                                    = 3 - IMAGER, IMC CALIBRATION
                                    = 4 - SOUNDER, IMC CALIBRATION
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT:
 HALF-
 WORD NO. MSB                                          LSB
          0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
      1 |                  STAR ID                      |
      2 |-----------------------------------------------|
      3 |            NO. OF LOOKS FOR STAR              |
      4 |-----------------------------------------------|
      5 |           LOOK NO. IN CMD SEQUENCE            |
      6 |-----------------------------------------------|
      7 |                  IMC OFFSET                   |
      8 |             (FOR SUBTYPES 3 AND 4)            |-
      9 |                    YEAR                       | |
        |-----------------------------------------------| |STAR
     10 | F|         DAY OF YEAR            |  HR (10s) | |SENSE
        |-----------------------------------------------| |START
     11 |  HR (1s)  |        MINUTES         |  SEC (10s)| |TIME
        |-----------------------------------------------| |
     12 |  SEC (1s) |               MSECS                | |
        |-----------------------------------------------|-
     13 |            STAR SENSE DURATION                |
     14 |-----------------------------------------------|
```

Message 202 – Labeled Star Measurement (2 of 3)

```
HALF-
WORD NO. MSB                                          LSB
         0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
        |-----------------------------------------------|
    15  |       NO. RAW PIXELS PER INPUT SAMPLE         |
        |-----------------------------------------------|
    16  |     NO. INPUT SAMPLES PER AVERAGED SAMPLE     |
        |-----------------------------------------------|—
    17  |                  E-W CYCLES                   | |
        |-----------------------------------------------| |
    18  |                E-W INCREMENTS                 | | INSTR
        |-----------------------------------------------| | COORDS
    19  |                  N-S CYCLES                   | |
        |-----------------------------------------------| |
    20  |               N-S INCREMENTS                  | |
        |-----------------------------------------------|—
    21  |    WINDOW THRESHOLD LEVEL FOR DETECTORS 1-8   |
    28  |
        |-----------------------------------------------|
    29  |     DETECTOR MEAN VALUE FOR DETECTORS 1-8     |
    36  |
        |-----------------------------------------------|
    37  |         NO. OF EVENTS FOR DETECTORS 1-8       |
    44  |
        |-----------------------------------------------|
    45  |                  DATA LOSS                    |
        |-----------------------------------------------|
    46  |               YAW FLIP FLAG                   |
        |-----------------------------------------------|
    47  |                    SPARE                      |
    48  |
        |-----------------------------------------------|—
    49  |             EVENT MAXIMUM SIGNAL              | |EVENT
        |-----------------------------------------------| |RECORD 1
    50  |            EVENT E-W SERVO ERROR              | |
        |-----------------------------------------------| |
    51  |            EVENT N-S SERVO ERROR              | |
        |-----------------------------------------------| |
    52  |        FULL WIDTH HALF MAXIMUM (FWHM)         | |
        |-----------------------------------------------| |
    53  |         CENTER TIME OF EVENT:  YEAR           | |
        |-----------------------------------------------| |
    54  | F|             DAY OF YEAR        |   HR (10s) | |
        |-----------------------------------------------| |
    55  |  HR (1s)  |        MINUTES        |  SEC (10s) | |
        |-----------------------------------------------| |
    56  |  SEC (1s) |               MSECS                | |
        |-----------------------------------------------|—
    57  |       EVENT RECORDS 2-4 FOR DETECTOR 1        |
    80  |
        |-----------------------------------------------|
    81  |         EVENT RECORDS 1-4 FOR EACH OF         |
     .  |                 DETECTORS 2-8                 |
   304  |
        |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
F (TIME CODE FLAG)	BINARY	0 - LOCK 1 - FLYWHEEL	N/A
STAR ID (YALE CAT BS NO.)	I*4	-1, 1-9999	N/A
NO. OF LOOKS FOR STAR	I*4	1-10	N/A
LOOK NUMBER IN CMD SEQUENCE	I*4	1-10	N/A
IMC OFFSET	R*4	-0.008 TO +0.008	RAD
YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR

Message 202 – Labeled Star Measurement (3 of 3)

DATA ITEM	FORMAT	VALIDATION	UNITS
MINUTES	BCD	0-59	MIN
SECONDS	BCD	0-59	SECS
MSECS	BCD	0-999	MSECS
STAR SENSE DURATION	BINARY	1000-1200293 (I-M)	MSECS
	BINARY	1000-64000 (N-P)	MSECS
RAW PIXELS/SAMPLE	BINARY	4-4096 (I-M)	N/A
	BINARY	1-65535 (N-P)	N/A
SAMPLE/AVG/SAMPLE	BINARY	1-16	N/A
	BINARY	1-65535 (N-P)	N/A
CYCLES	BINARY	0-128	CYCLES
INCREMENTS	BINARY	0-6135 (IMAGER)	INCREMENTS
		0-2804 (SOUNDER)	
WINDOW THRESHOLD LEVEL	BINARY	0-65535 (IMAGER)	2^{-8} COUNTS
		0-65535 (SOUNDER)	2^{-4} COUNTS
DETECTOR MEAN VALUE	BINARY	0-65535 (IMAGER)	2^{-8} COUNTS
		0-65535 (SOUNDER)	2^{-4} COUNTS
NO. OF EVENTS	BINARY	0-4	N/A
FWHM	BINARY	0-65535	MSECS
SERVO ERROR	BINARY	0-1023 (IMAGER)	COUNTS
		0-8191 (SOUNDER)	
DATA LOSS	BINARY	0 = NO LOSS DETECTED	N/A
		65,535 (ALL ONES) = LOSS DETECTED	N/A
YAW FLIP FLAG	BINARY	X`00 = NORMAL	N/A
		X`3F ' FLIPPED	N/A
EVENT MAXIMUM SIGNAL	BINARY	0-65535 (IMAGER)	2^{-6} COUNTS
		0-65535 (SOUNDER)	2^{-3} COUNTS

Notes:

1. Minimum star sense duration (refer to validation range) is equal to the minimum star sense duration that can be executed by the instruments (1 second for the Imager, 4 seconds for the Sounder). The maximum star sense duration assumes the maximum number of star sense blocks are summed (1024 blocks) and the SPS buffer allocated for the storage of these samples is filled (6400 samples).
2. Raw Imager pixels are averaged in SPS hardware before being passed to SPS software. The number of raw pixels included in each input sample is denoted by half-word 15.
3. SPS software subjects the input samples provided by the instruments to a moving window averaging filter. The number of input samples enclosed by the window is denoted by half-word 16. The averaged values produced by the windowing filter are the super pixels upon which the star detection algorithm operates.
4. For a given detector, records are time ordered from earliest CDAS receive time (record one), to latest CDAS time (record four). If no data is available for an event record, the record content is null (binary 0).
5. E-W and N-S servo error data are the values computed by interpolation of the raw values at the time of each star crossing event.
6. The yaw flip flag is set to 0 for a spacecraft in its normal upright orientation and -1 (hex 3F) when it is rotated 180 degrees about the yaw axis (yaw flipped).
7. The star ID is the Yale catalog BS number value (or OATS catalog number value), ranging from 1 to 9999. Star ID -1 refers to the Moon.
8. The IMC offset is valid only for IMC calibration star measurements, as in Messages 202-3 and 202-4.
9. Data loss indicates either an Imager or Sounder data block sync loss or parity errors have occurred when ingesting the star sense data, making the star sense measurement data validity suspect.

Message 205 – Single Chord Operations Notification (GOES I-M)

GIMTACS sends OATS a Message 205 to convey the precise time when a single chord operation was commanded on or off. OATS uses the single chord start and stop times to control certain aspects of the SSAA process. The Message 205 data block layout and field definitions follow.

```
HEADER BLOCK FIELDS:
      MESSAGE SEQUENCE NO.          = 1-65535
      SATELLITE ID                  = 8,9,10,11,12 (I-M)
      SOURCE                        = 10 (GIMTACS)
      DESTINATION                   = 32 (ALL OATS)
      NO. OF HALF-WORDS             = 4
      MESSAGE TYPE                  = 205
      MESSAGE SUBTYPE               = 1 - ON
                                    = 2 - OFF
      TRACER                        = ASCII BLANKS
      MESSAGE COUNT                 = 1
      END OF MESSAGE                = 255
      ROUTING ID                    = N/A

DATA BLOCK LAYOUT: N/A
 HALF-
 WORD NO. MSB                                          LSB
           0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
          |-----------------------------------------------|
      1   |                     YEAR                      |
          |-----------------------------------------------|
      2   | F|         DAY OF YEAR            |  HR (10s) |
          |-----------------------------------------------|
      3   |  HR (1s)  |        MINUTES         |  SEC (10s)|
          |-----------------------------------------------|
      4   |  SEC (1s) |               MSECS               |
          |-----------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
SINGLE CHORD TIME YEAR	BCD	1989-2025	YEAR
DAY OF YEAR	BCD	1-366	DAY
HOUR	BCD	0-23	HOUR
MINUTE	BCD	0-59	MINUTE
SECOND	BCD	0-59	SEC
MSEC	BCD	0-999	MSEC

4.3.8 AGC-Originated Messages

AGC originated messages are listed below in the order in which their detailed descriptions are provided in this section. Message Type and Subtype appear in the lower right hand corner of these pages to assist in easy identification of the pages describing a specific message.

Type	Description	Destination
301	AGC Monitor Telemetry	GIMTACS

Message 301 – AGC Monitor Telemetry (GOES I-M)

The CDAS AGC Monitor sends GIMTACS unsolicited Message 301s. The messages contain a time stamp and the TACTS Id, the AGC receive signal strength sample value, and the Id of the antenna to which the TACTS is connected. The AGC Monitor encapsulates the Message 301s in UDP/IP packets for transmission to GIMTACS via a direct LAN connection. GOES controllers use the AGC information to predict telemetry link outages and restorals resulting from Telemetry and Command (T&C) antenna nulls during on-orbit storage, and the acquisitions of signal and losses of signal at launch support ground stations during launch and orbit raising activities. The AGC Monitor Message 301 data block layout and field definitions follow. This message has no header block.

```
HEADER BLOCK FIELDS:  N/A

DATA BLOCK LAYOUT:
HALF-
WORD NO. MSB                                                LSB
         0  1  2  3  4  5  6  7  8  9  10 11 12 13 14 15
        |-------------------------------------------------|
      1 |                   DAY OF YEAR                   |
        |-------------------------------------------------|
      2 |                   MSEC OF DAY                   |
      3 |                                                 |
        |-------------------------------------------------|
      4 |                   TACTS 1 ID                    |
        |-------------------------------------------------|
      5 |                 AGC DATA VALUE                  |
      6 |                                                 |
        |-------------------------------------------------|
      7 |               ANTENNA ID                       |
        |-------------------------------------------------|
   8-27 |              TACTS 2-6 ID                       |
        |             AGC DATA VALUES                     |
        |               ANTENNA ID                       |
        |-------------------------------------------------|
```

DATA ITEM	FORMAT	VALIDATION	UNITS
DAY OF YEAR	I*16	1-366	DAY
MSEC OF DAY	I*32	1-86400000	MSEC
TACTS ID NO.	I*16	1-6	N/A
AGC DATA VALUE	I*32	(SEE NOTES)	DB
ANTENNA ID	I*16	1-8	N/A

Notes:

1. AGC data values are multiplied by 1000, allowing the receive signal strength data to pass as binary integers instead of as real numbers. This avoids roundoff and precision issues.
2. The message length is 432 bits (27 half-words).
3. The Message 301 frequency is user selectable at AGC Monitor startup, with a default rate of one message per second.