

SECTION XII ADVANCED PERFORMANCE IEEE-488 INTERFACE OPTION

SECTION XII-I - GENERAL INFORMATION

1-1 INTRODUCTION

1-2 The Advanced Performance IEEE-488 Interface Option provides the user with an IEEE-488 communication port which is compatible electrically and mechanically with the IEEE-488 standard 488-1978. Data is sent and received using strings of ASCII coded characters.

There are two types of IEEE-488 interface options for the Truetime Mark III product line, the standard and a higher speed version. This manual describes the higher speed Advanced performance Interface.

The Advanced Performance IEEE Option also has a hardware "trig in" input with 1 microsecond resolution.

1-3 through 1-10 reserved.

1-11 IEEE-488 INTERFACE SPECIFICATIONS

1-12 Capability

Source Handshake:	SH1, full capability
Acceptor Handshake:	AH1, full capability
Talker:	T8, basic talker, serial poll, unaddress if MLA.
Listener:	L4, basic listener, unaddress if MTA
Service Request:	SR1, full capability
Remote Local:	RL0, no capability
Parallel Poll:	PP2, local configuration
Device Clear:	DC1, full capability
Device Trigger:	DT1, full capability
Controller:	C0, no capability
Driver Electronics:	E1, open collector

1-13 Environmental

Operating Temperature:	0°C to +50°C (+32°F to +122°F)
Storage Temperature:	-55°C to +85°C (-67°F to +185°F)
Humidity:	95%, non-condensing

1-14 IEEE Connector

Type: 24-Pin IEEE-488/ANSI MC1.1 Ribbon
 Mate: Not supplied.
 Pinout: See Table 12-1

"Trig in" connector

Type: BNC
 Mate: Not supplied.
 Electrical: LSTTL level, arrival time of positive edge is recorded to 1 microsecond resolution.

TABLE 12-1
 IEEE-488 CONNECTOR PINOUT

Pin #	Description
1	DI01 data line
2	DI02 data line
3	DI03 data line
4	DI04 data line
5	EOI general bus management line
6	DAV interface handshake line
7	NRFD interface handshake line
8	NDAC interface handshake line
9	IFC general bus management line
10	SRQ general bus management line
11	ATN general bus management line
12	Shield earth ground
13	DI05 data line
14	DI06 data line
15	DI07 data line
16	DI08 data line
17	REN general bus management line
18	Signal common
19	Signal common
20	Signal common
21	Signal common
22	Signal common
23	Signal common
24	Signal common

1-15 Transfer speed

The interface is able to transfer the 20-byte time string in 1.5 milliseconds.

SECTION XII-II - INSTALLATION

2-1 INTRODUCTION

2-2 No installation is required when the IEEE-488 Interface Option is purchased at the same time as the receiver. It is factory-installed. The following installation instructions apply only to an option acquired after the initial purchase of the receiver.

2-3 through 2-10 reserved.

2-11 FIELD INSTALLATION

2-12 Supplied with the IEEE-488 Interface Option are the following items:

1. Assembly 86-386
2. Mounting hardware

2-13 **Warning:** Only a qualified technician should attempt installation of this option. Dangerous voltages are present which can cause electric shock that could result in severe injury or even death. Disconnect all power before disassembling the unit!

2-14 The only equipment required for installation is a phillips screwdriver.

2-15 If the receiver is rack mounted, first remove it from the rack as described in Section II of this manual. Installation requires connecting the 86-386 Assembly into an empty option slot.

2-16 Remove the top lid and retain the screws. Remove the cover plate of an empty option slot and save the four screws. Slide the option assembly into the guides on the side rails of the slot and firmly press the assembly connector into the Bus Backplane Assembly connector. Secure the option to the chassis with the previously saved screws. Replace the lid and secure with the previously saved screws. Remount the receiver in the rack if desired.

It should be noted that older clocks may not have the needed software support for the Advanced Performance IEEE Option. To find out if your unit will support this option, use keypad function 18 to find out the version of system software installed. If the display responds with the message "function not implemented", your unit lacks the proper version of software for this option. Consult TrueTime customer Service if a software update is needed.

SECTION XII-III - OPERATION

3-1 INTRODUCTION

3-2 The IEEE-488 connection, data format and functions are explained in the following sections.

3-3 through 3-10 reserved.

3-11 IEEE-488 CONNECTION

3-11.1 The 24-pin ANSI MC1.1 microribbon receptacle connector (Ansley 609-2407 or equivalent) mounted on the rear panel and labeled "IEEE-488" is a parallel, bi-directional data port. This output is compatible electrically, mechanically and functionally with the ANSI/IEEE standard 488-1978. A copy of the this standard is available from The Institute of Electrical and Electronics Engineers, Inc. This reference is the industry-accepted standard for this interface.

3-11.2 Data is sent and received using ASCII coded characters. The mating connector is a 24-pin microribbon plug connector). Table 12-1 shows the pin assignment.

3-11.3 The default IEEE-488 port address is 05. Use Keypad Function 30 to change this address. Refer to "KEYPAD FUNCTION 30 - IEEE-488 ADDRESS" in Section III of this manual. Keypad Function 30 will also display the address currently selected. The default on subsequent power-ups will be the address in use just before the previous power-down.

3-12 through 3-20 reserved.

3-21 IEEE-488 FUNCTION LIST

3-21.1 Most of the functions available via the front panel keypad and the RS-232 Interface are also available via the IEEE-488 Interface. Some IEEE-488 functions have no keypad or RS-232 counterpart. Some functions operate differently depending upon the model of the host receiver as indicated in the paragraphs describing that function. Some functions are not implemented in some model receivers. Table 12-2 indicates which functions are available for each model receiver.

3-21.2 It should be noted that this option does not support the Time Interval/Event Timing option or the "emulation mode", function f16, that was offered with earlier IEEE-488 interfaces.

**TABLE 12-2
IEEE-488 FUNCTION LIST**

COMMAND	FUNCTION	GPS-DC	GPS-FPC	468-DC	OM-DC
F01	Time Zone Select	X	X	X	X
F02	12/24 Hour Format Select	X	X	X	X
F03	Time/Date Entry	X	X	X	X
F05	Time Quality Enable/Setup	X	X	X	X
F06	Keypad Lock Enable	X	X	X	X
F07	External Oscillator Enable	X			
F07	Oscillator Request			X	
F09	Time On Request Enable	X	X	X	X
F13	Worst-case Time Error Request	X	X	X	X
F14	Time Base Frequency Stability Entry	X		X	X
F15	Esclusive Use Enable	X	X	X	X
F17	Slow Code Setup	X	X	X	X
F18	Software Version Request	X	X	X	X
F28	Time Interval/Event Timeing	X			
F29	Frequency Measurement	X			
F50	Antenna Position Entry/Request	X	X		
F50	Receiver Position Entry/Request			X	X
F51	Cable Delay Entry/Request	X	X		
F52	Leap Seconds Entry				X
F53	Operational Mode Select	X	X		
F53	Satellite Position Request			X	
F53	Leap Seconds Update Enable				X
F55	Altitude Units Select	X			
F65	Satellite Select	X	X	X	
F65	Station Enable				X
F66	Daylight Savings Enable	X	X	X	X
F71	Oscillator Statistics Request	X	X		
F79	Warm Start	X	X		

3-22 ADDRESS SELECTION

3-22.1 Use keypad function 30 to request or enter the address to be used by the IEEE-488 interface. The initial out-of-the-box default is 05. The default on subsequent power-ups is the last value used before power-down.

Press "FUNC/ENTR", then "3" "0". The display will show:

```
ieee-488 address
  05
```

Press the right or left arrow keys to position the cursor beneath the digit that you wish to change. Press the up or down arrow keys to scroll through the possible choices. Alternately, numbers may be directly entered using the keypad. The cursor will automatically advance to the next position. When the display shows the desired address, press "FUNC/ENTR" to enter the data. The acceptable range of addresses is 0 to 31.

3-23 through 3-30 reserved.

3-31 GENERAL INPUT AND OUTPUT FORMAT

3-31.1 Data may be sent to or requested from the IEEE-488 port by using various function commands and ASCII character strings. In general those functions which request status or data fit the form

```
F<FUNC><CR>
```

where

F	is the ASCII character F or f.
<FUNC>	is a two-digit function number.
<CR>	is the ASCII character for carriage return (Hex 0D)

The format for both data input and data output strings is

```
F<FUNC>[<SEP><FIELD>]<LT>
```

where

F	is the ASCII character F or f.
<FUNC>	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<FIELD>	is a data entry or request.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.
[]	encloses a phrase that is repeated as often as necessary.

3-31.2 Output strings from the IEEE-488 port are kept to fixed lengths whenever possible. This means that numeric values will often contain many leading blanks. Numeric values are right justified so that the least significant digit is always in the same position in the string. Quantities that can be positive or negative will have a sign even if positive. This is done to simplify the task of programming computer systems that receive the data. The formats of the output strings are designed so that it is possible to request the state of a function and save the response string. Later that string can be sent to the unit to restore the original state of that function. The Bus management "EOI" is asserted with the line feed character.

3-31.3 Input strings sent to the unit may be of variable length but less than 32 characters which is the size of the input buffer. The number of separators between fields may be varied. Numeric values may be entered with or without leading zeros. Where a sign is allowed, it may be omitted for positive quantities. String fields (such as "on" or "off") may be entered in upper or lower case, as can the "F" that starts all IEEE-488 commands. All commands may be ended with a carriage return alone or by a carriage return line feed combination. Some fields of some commands are optional, and may be replaced by a semicolon. If a field is so replaced, the corresponding value will be left unchanged.

3-31.4 Incorrect entry may result in an error message as described under "IEEE-488 ERROR MESSAGES " at the end of this Section. Correct entries are acknowledged with OK<CR><LF>.

3-32 through 3-40 reserved.

3-41 EXCLUSIVE USE

3-41.1 To facilitate remote operation, the unit has the ability to grant "exclusive use" to the IEEE-488 port or the RS-232 port via keypad function 15. The front panel keypad cannot be granted exclusive use. At most, one port at a time can have exclusive use until sent a command to release it or until the unit loses power. At power-on or when exclusive use is off, any port or the front panel has free access. When a port has exclusive use, the front panel keypad and all other ports cannot change any of the setup parameters. They can, however, request the current parameters.

Example:

If the RS-232 port has exclusive use and "FUNC/ENTR" "0" "1" is pressed on the keypad, the current time zone will be displayed. If "FUNC/ENTER" is pressed, attempting to set the time zone, an error message displays and the time zone displays again. To exit the function use the "TIME", "STATUS", or "POSITION" button.

Example:

If the IEEE-488 port has exclusive use and "F02<CR>" is sent to the RS-232 port, the port will respond with the current setting of the 12/24 hour mode. However, if "F02 12<CR>" is sent to the RS-232 port which is an attempt to change the 12/24 hour mode, the message:

ERROR 04 EXCLUSIVE USE<CR><LF>

will be returned, indicating that the RS-232 port is not currently allowed to change this item.

3-42 through 3-50 reserved.

3-51 IEEE-488 FUNCTION DESCRIPTIONS

3-52 IEEE-488 FUNCTION F01 - TIME ZONE SELECT

3-52.1 Use IEEE-488 function F01 to select or determine the time zone offset. To request the offset send F01<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F01<SEP><SIGN><HH>:<MM><LT>

where

F	is the ASCII character F.
01	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<SIGN>	is + for positive offsets or - for negative offsets.
<HH>	is the one or two-digit hours offset from +12 to -12 hours.
:	is the ASCII character for a colon.
<MM>	is the two-digit minutes offset.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F01<CR>
Response: -8:30<CR><LF>

3-52.2 To set the time zone offset send a character string with the format above to the IEEE-488 port.

Sample entry: F01 10:00<CR>
Response: OK<CR><LF>

3-53 through 3-60 reserved.

3-61 IEEE-488 FUNCTION F02 - 12/24 HOUR FORMAT SELECT

3-61.1 Use IEEE-488 function F02 to request or set the time display format. To determine the format send F02<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F02<SEP><HH><LT>

where

F	is the ASCII character F.
02	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<HH>	is 12 or 24.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F02<CR>
Response: F02 12<CR><LF>

3-61.2 To set time format send a character string with the format above to the IEEE-488 port.

Sample entry: F02 24<CR>
Response: OK<CR><LF>

3-62 through 3-70 reserved.

3-71 IEEE-488 FUNCTION F03 - TIME/DATE ENTRY

3-71.1 Use IEEE-488 function F03 to enter or request time and date. To request time and date send F03<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F03<SEP><TYPE><SEP><mm>/<dd>/<yy><SEP><HH>:<MM>:<SS><LT>

where

F	is the ASCII character F.
03	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<TYPE>	is either LOCAL or UTC.
<mm>	is the one- or two-digit month.
/	is the ASCII character slash.
<dd>	is the one- or two-digit day.
<yy>	is the two-digit year.
<HH>	is the one- or two-digit hours.
:	is the ASCII character for a colon.
<MM>	is the two-digit minutes.
<SS>	is the two-digit seconds.
<LT>	is the line terminator, either a carriage return and line fee for output strings or a carriage return only for input strings.

Sample request: F03<CR>
Response: F03 UTC 01/07/91 02:48:29<CR><LF>

Sample request: F03 LOCAL<CR>
Response: F03 LOCAL 01/07/91 7:48:29<CR><LF>

Sample request: F03 UTC<CR>
Response: F03 UTC 01/07/91 2:48:29<CR><LF>

3-71.2 To set the time zone offset send a character string with the format above to the IEEE-488 port. Either the date mm/dd/yy or the time HH:MM:SS may be omitted if they are replaced with a semicolon (;). Only valid dates are acceptable. Time must be entered in 24 hour format, e.g., 15 hours for 3 p.m.. This function is intended only to get or set the approximate time for use before the clock has locked to a satellite or station.

Sample entry: F03 LOCAL 10/3/03 20:07:04<CR>
Response: OK<CR><LF>

Sample entry: F03 ;; 3:06:48<CR>
Response: OK<CR><LF>

3-72 through 3-80 reserved.

3-81 IEEE-488 FUNCTION F05 - TIME QUALITY ENABLE/SETUP

3-81.1 Use function F05 to enable or disable the time quality indicators or to set the four worst-case-error thresholds. The front-panel numeric display, the RS-232 output string and the IEEE-488 output string indicate the time quality. Refer to NUMERIC DISPLAY in Section III of this manual for a complete description of the display's time quality indications. Refer to "RS-232 FUNCTION F08 - CONTINUOUS TIME ONCE PER SECOND" for a description of the time quality indication in the IEEE-488 time output string. As shipped the time quality indicators are enabled and set to the thresholds shown in Table 12-3.

TABLE 12-3
TIME QUALITY THRESHOLDS

THRESHOLD	GPS-DC	GPS-FPC	468-DC	OM-DC
First	1000 ns	10000 ns	500000ns	1000000ns
Second	10000 ns	100000 ns	1000000ns	10000000ns
Third	100000 ns	1000000 ns	10000000ns	100000000ns
Fourth	1000000 ns	10000000 ns	100000000ns	500000000ns

The unit will retain the values in use at power-down and will use them for subsequent power-ups.

3-81.2 To determine if the indicators are enabled and what the thresholds are, send F05<CR> to the IEEE-488 port. The port will respond with the ASCII character string

```
F05<SEP><STATE><SEP><FLAG><SEP><FLAG><SEP><FLAG><SEP><FLAG><LT>
```

where

F is the ASCII character F.
05 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<STATE> is ON or OFF.
<FLAG> is one error threshold in nanoseconds, 1 to 11 digits with or without leading zeros.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F05<CR>
Response: F05 ON 00000000100 00000001000 00000010000 00000020000

3-81.3 To enable, disable or set the thresholds of the time quality indicators send a character string with the format above to the IEEE-488 port. Any threshold value may be omitted and left unchanged if it is replaced with a semicolon (;). The range of acceptable threshold values is 4000000000 ns to 00000000010 ns. Values smaller than the specified accuracy of the clock are of no use.

Sample entry: F05,OFF,10,,,70 ,00001000000<TAB>2000000<CR>
Response: OK<CR><LF>

Sample entry: F05 ON 100 1000 ; 2000
Response: OK<CR><LF>

Note that although leading zeros are not required for data entry they will be included in any data response.

3-82 through 3-90 reserved.

3-91 IEEE-488 FUNCTION F06 - KEYPAD LOCKOUT ENABLE

3-91.1 Use IEEE-488 function F06 to enable or disable the keypad lockout feature. As shipped the keypad lockout is disabled. The state of the keypad lockout on subsequent power-ups will be the same as it was on the previous power-down. To determine if the keypad lockout is enabled send F06<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F06<SEP><STATE><LT>

where

F	is the ASCII character F.
06	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<STATE>	is ON or OFF.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F06<CR>
Response: F06 OFF<CR><LF>

3-91.2 To enable or disable the keypad lockout send a character string with the format above to the IEEE-488 port.

Sample entry: F06,ON<CR>
Response: OK<CR><LF>

3-92 through 3-100 reserved.

3-101 IEEE-488 FUNCTION F07 - GPS-DC OSCILLATOR SELECT

3-101.1 **For GPS-DC receivers only.** Use IEEE-488 function F07 to select the standard or external oscillator or request the input frequency. As shipped the standard oscillator is selected. The oscillator used on subsequent power-ups will be the same as it was on the previous power-down. The frequency of the external oscillator is reported by but cannot be changed by this function. To determine which oscillator is in use send F07<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F07<SEP><STATE><SEP><FREQ><LT>

where

F	is the ASCII character F.
07	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<STATE>	is ON or OFF.
<FREQ>	is the detected input frequency 1,5, or 10MHz or the string NO INPUT.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F07<CR>
Response: F07 ON 10MHz<CR><LF>

Sample request: F07 5MHz<CR>
Response: F07 1MHz<CR>

3-101.2 To enable or disable the external oscillator send a character string with the format above to the IEEE-488 port.

Sample entry: F07 OFF<CR>
Response: OK<CR><LF>

3-102 through 3-110 reserved.

3-111 IEEE-488 FUNCTION F07 - 468-DC OSCILLATOR REQUEST

3-111.1 **For 468-DC receivers only.** Use IEEE-488 function F07 to request oscillator used as the reference during periods of unlock, either the standard, internal or external oscillator. Selection of the oscillator is automatic. Send F07<CR> to the IEEE-488 port and the port will respond with the ASCII character string

F07<SEP><OSCIL><LT>

where

F	is the ASCII character F.
07	is the function number.
<OSCIL>	is STANDARD, INTERNAL or EXTERNAL.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F07<CR>
Response: F07 STANDARD<CR><LF>

3-112 through 3-120 reserved.

3-121 IEEE-488 FUNCTION F07 - EXTERNAL OSCILLATOR ENABLE

3-121.1 **For OM-DC receivers only.** Use IEEE-488 function F07 to enable or disable the external oscillator. As shipped the external oscillator is disabled. The state of the external oscillator on subsequent power-ups will be the same as it was on the previous power-down. The receiver automatically detects the frequency of the external oscillator; it cannot be changed by this function. To determine if the external oscillator is enabled, send F07<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F07<SEP><STATE><LT>

where

F	is the ASCII character F.
07	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<STATE>	is ON or OFF.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F07<CR>
Response: F07 ON<CR><LF>

To enable or disable the external oscillator send a character string with the format above to the IEEE-488 port.

Sample entry: F07 OFF<CR>
Response: OK<CR><LF>

3-122 through 3-130 reserved.

3-131 IEEE-488 FUNCTION F09 - TIME ON REQUEST

3-131.1 When the IEEE-488 port receives the command string F09<CR> it awaits a request for time-of-year. Thereafter, when the port receives a solitary upper-case ASCII character "T" or a Group-Execute-Trigger command, it immediately saves the current time (with a resolution of 1 ms) in a buffer, then outputs the contents of that buffer to the port. The port will continue to respond with time-of-day each time it receives a "T" or a Group-Execute-Trigger command until this function is canceled by sending a control-C character (HEX 03) to the port. All other input will be ignored until then. The output string format is

<SOH>DDD:HH:MM:SS.mmmQ<CR><LF>

where

<SOH>	is the ASCII start-of-header character (HEX 01).
<CR>	is the ASCII carriage return character (HEX 0D).
<LF>	is the ASCII Line Feed character (HEX 0A).
DDD	is the day-of-year.
HH	is the hours.
MM	is the minutes.
SS	is the seconds.
.	is the ASCII period character.
mmm	is the milliseconds.
:	is the ASCII colon character.
Q	is a time quality character.

The time quality character may be a

SPACE	which indicates a worst-case error less than threshold 1.
.	which indicates a worst-case error greater than or equal to threshold 1.
*	which indicates a worst-case error greater than or equal to threshold 2.
#	which indicates a worst-case error greater than or equal to threshold 3.
?	which indicates a worst-case error greater than or equal to threshold 4.

The time quality character prior to satellite signal acquisition will be "?". Refer to "RS-232 FUNCTION F13 - WORST-CASE-TIME ERROR REQUEST" for an explanation of worst-case error. Until it receives a control-C the port will ignore all other input.

Sample entry: F09<CR>
Second entry: T
Response: <SOH>128:20:30:04.342*<CR><LF>

If the port receives the character "P" (upper or lower case) it will respond with the arrival time of the latest "trig in" pulse with microsecond resolution, and re-enables the receipt of another pulse. The format of this output is the same as that for the Group Execute Trigger or the "T" output with 3 more digits of resolution:

Sample entry: F09<CR>
Second entry: P
Response: <SOH>128:20:30:04.342754*<CR><LF>

See section 3-360 for a full description of the use of the "trig in" input.

3-132 through 3-140 reserved.

3-141 IEEE-488 FUNCTION F13 - WORST-CASE TIME ERROR REQUEST

3-141.1 Use IEEE-488 function F13 to request the estimated worst-case time error. Refer to RS-232 FUNCTION 13 - WORST-CASE TIME ERROR in Section III for an explanation of worst-case time error. Time error begins to accumulate when the receiver loses contact with the transmitted signal. The receiver calculates the worst-case time error based on the stability of the time base in use, either the internal or external oscillator, and the time elapsed since loss of lock. The IEEE-488 port will report this calculated error when it receives the string F13<CR>. The port will respond with the ASCII character string

F13<SEP><ERROR><CR><LF>

where

F	is the ASCII character F.
13	is the function number.
<SEP>	Is one or more separator characters; either space, comma or tab.
<ERROR>	is the calculated worst-case error in seconds.
<CR>	is a carriage return character.
<LF>	is a line feed character.

Sample request: F13<CR>
Response: F13 02.000000000<CR><LF>

3-141.2 When the unit is turned on, and has yet to obtain accurate time, an error of 40.000000000 seconds will be reported. This over-range indication means that the time error is unknown. If the unit loses lock, time error will stop accumulating when it reaches this value.

3-142 through 3-150 reserved.

3-151 IEEE-488 FUNCTION F14 - TIME BASE STABILITY ENTRY

3-151.1 **For GPS-DC receivers only.** Use IEEE-488 function F14 to set or determine the external oscillator stability. If tracking satellites the GPS-DC Mark III will calculate the stability of the external oscillator in a few minutes and replace any entered value with the calculated value. The out-of-the-box default for external oscillator stability is 1.0e-7 for GPS-DC Mark III receivers. The value on subsequent power-ups will be the same as it was on the previous power-down. To request the present value send F14<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F14<SEP><MULT>E<EXP><LT>

where

F	is the ASCII character F.
14	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<MULT>	is a multiplier between 1 and 10. In input strings it can be a single digit or a digit followed by a decimal point and up to 5 digits. In output strings it will be a digit followed by a decimal point and 5 digits.
E	is the ASCII character E representing "exponent".
<EXP>	is a negative two-digit exponent from -05 to -14.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

The error is expressed in exponential form, i.e., 1E-7 means 1.0×10^{-7} sec/sec.

Sample request: F14<CR>
Response: F14 2.00000E-07<CR><LF>

3-151.2 To enter the external oscillator stability send a character string with the format above to the IEEE-488 port.

Sample entry: F14<TAB>1E-09<CR>
Response: OK<CR><LF>

3-152 through 3-160 reserved.

3-161 IEEE-488 FUNCTION F14 - TIME BASE FREQUENCY/STABILITY ENTRY

3-161.1 **For 468-DC receivers only.** Use IEEE-488 function F14 to determine the frequency and stability of the reference oscillators. To request the present values sent F14 to the IEEE-488 port. The port will respond with the continuous ASCII character string

F14<SEP><STDSTAB><SEP><INTFREQ><SEP>
<INTSTAB><SEP><EXTFREQ><SEP><EXTSTAB><LT>

where

F is the ASCII character F.
14 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<STDSTAB> is the stability of the standard oscillator in the format <MULT>E<EXP>.
<MULT> is a one- or two-digit multiplier from 1.0 to 9.0.
E is the ASCII character E representing "exponent".
<EXP> is a negative two-digit exponent from -05 to -14.
<INTFREQ> is the two-digit frequency of the internal oscillator in MHz.
<INTSTAB> is the stability of the internal oscillator in the format <MULT>E<EXP>.
<EXTFREQ> is the two-digit frequency of the external oscillator in MHz.
<EXTSTAB> is the stability of the external oscillator in the format <MULT>E<EXP>.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

The stability is expressed in exponential form, i.e., 1E-7 means 1.0×10^{-7} sec/sec.

Sample request: F14<CR>
Response: F14 1.0E-08 05 1.0E-09 10 1.0E-10<CR><LF>

3-161.2 To enter the oscillator stabilities and frequencies send a character string with the format above to the IEEE-488 port. The negative sign cannot be omitted. Any stability or frequency value may be omitted if it is replaced with a semicolon (;).

Sample entry: F14 1E-09 01 ; 05 3.8E-13<CR>
Response: OK<CR><LF>

3-162 through 3-170 reserved.

3-171 IEEE-488 FUNCTION F14-EXTERNAL OSCILLATOR STABILITY ENTRY

3-171.1 **For OM-DC receivers only.** Use IEEE-488 function F14 to set or determine the external oscillator stability. The out-of-the-box default for external oscillator stability is 1.0e-7. The value on subsequent power-ups will be the same as it was on the previous power-down. To request the present value send F14<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F14<SEP><MULT>E<EXP><LT>

where

F is the ASCII character F.
14 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<MULT> is a one-digit multiplier from 1 to 4.
E is the ASCII character E representing "exponent".
<EXP> is a negative two-digit exponent from -05 to -14.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

The value is expressed in exponential form, i.e., 1e-7 means 1.0×10^{-7} sec/sec.

Sample request: F14<CR>
Response: F14 2e-14<CR><LF>

To enter the external oscillator stability send a character string with the format above to the IEEE-488 port.

Sample entry: F14<TAB>1E-09<CR>
Response: OK<CR><LF>

3-172 IEEE-488 FUNCTION F15 - EXCLUSIVE USE ENABLE

3-172.1 At times it is advisable to prevent entry of data via the front panel or the RS-232 port. When the exclusive use function is enabled via the IEEE-488 port, data entries may be made only via the IEEE-488 port. If the IEEE-488 port has exclusive use, the front panel display and the RS-232 Port will respond only to requests for data but not to commands to enter data. Use IEEE-488 function F15 to enable or disable or request the state of the exclusive use function. As shipped the exclusive use function is disabled. The state of the exclusive use function on subsequent power-ups will be off. To enable or disable this function send a string of the form

F15<SEP><STATE><CR>

where

F	is the ASCII character F.
15	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<STATE>	is OFF if no port has exclusive use, OTHER if some other port has exclusive use, SELF if the IEEE-488 port has exclusive use or ON if requesting exclusive use for the IEEE-488 port.
<CR>	is a carriage return character.

The state will change or, if another port has exclusive use, the port will respond with the string

ERROR04 EXCLUSIVE USE<CR><LF>

Sample entry: F15 ON<CR>
Response: OK<CR><LF>

Sample entry: F15 ON<CR>
Response: ERROR 04 EXCLUSIVE USE

Sample request: F15<CR>
Response: F15 OTHER<CR><LF>

3-173 reserved

3-174 IEEE-488 FUNCTION F17 - SLOW CODE SETUP (OPTION)

3-174.1 Use IEEE-488 function F17 to request or set the pulse widths of the optional slow code output.

3-174.2 This output provides one pulse per minute, primarily for placing timing marks on drum recorders. The once per minute, once per hour and once per day pulses can each be set to a different length, or the same length with this function. The lengths can range from 0 to 59 seconds, whole numbers only. A length of 0 means that the pulse is absent.

3-174.3 Each pulse edge is aligned to within a few nanoseconds of the clock's 1 pps pulse, with the rising edge at the start of a minute.

3-174.4 To determine the current pulse widths, F17<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F17<SEP><MIN><HR><DAY><LT>

where

F	is the ASCII character F.
17	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<MIN>	is the length in seconds of the once per minute pulse.
<HR>	is the length in seconds of the once per hour pulse.
<DAY>	is the length in seconds of the once per day pulse .
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F17<CR>
Response: F17 02 04 06<CR><LF>

To set pulse lengths of the slow code output, send a character string with the format above to the IEEE-488 port.

Sample entry: F17 1 2 03<CR>
Response: OK<CR><LF>

3-174.5 This will set the once per minute pulse to 1 second width, the once per hour pulse to 2 seconds, and the once per day pulse to 3 seconds.

3-174.6 When shipped, the unit is set to have pulse widths of 2, 4, and 6 seconds for the minute, hour, and day pulses respectively. The widths will be retained when the unit is not powered.

3-175 IEEE-488 FUNCTION F18 - SOFTWARE VERSION REQUEST

3-175.1 Use IEEE-488 function F18 to obtain information about the current version of the software installed in the unit.

Send the string :

F18<CR>

3-175.2 The unit will respond with a string no longer than 80 characters.

example:

TRUETIME Mk III sys ver 018 GPS-XL v1.034 182-6098v001<CR><LF>

3-175.3 This string indicates that the system software is version 018, and the clock-specific software is version 182-6098v001.

176 through 180 reserved

3-181 IEEE-488 FUNCTION F28 - TIME INTERVAL/EVENT TIMING (OPTION)

3-181.1 Refer to manual section 3-398 for specifications on the Time Interval/Event Timing Input.

3-181.2 Use IEEE-488 I/O Function F28 to perform time interval or event time measurements. There are 3 basic command formats, as follows;

- 1.) F28<SEP><FORMAT><SEP><MODE><CR> is used to begin or alter the measurement process,
- 2.) F28<CR> is used to request current status,
- 3.) F28<SEP><CMD><CR> is used to obtain the next measurement or to terminate the function. Each of these command formats are discussed in detail below.

3-181.3 Syntax:

F	is the ASCII character F.
28	is the function number.
<SEP>	is one or more optional separator characters; either space, comma or tab.
<FORMAT>	is either 'TI' for Time Interval (sub-seconds only) or 'ET' for Event Timing which includes day of year through subseconds.
<MODE>	Capture Buffer operation when Full. 'S' indicates the measurement process is Suspended when the buffer is full, 'O' indicates the oldest data in the buffer is Overwritten, and the measurement process continues.
<CMD>	'M' returns the next measurement in the buffer. 'N' returns the next measurement but also appends the number of measurements remaining in the buffer. 'OFF' terminates the function and discards the remaining measurements (the data is still retrievable via the RS-232 port).
<CR>	is the carriage return character.

3-181.4 BEGINNING THE MEASUREMENT PROCESS

3-181.5 To begin the measurement process and clear the buffer or to change current operational settings without disturbing the buffer, a command of the following form is sent to the IEEE-488 port:

F28<SEP><FORMAT><SEP><MODE><CR>

If another rear panel port, e.g. the User serial port, is using F28, the response message will be: ERROR 04 EXCLUSIVE USE. Otherwise, the IEEE-488 port takes exclusive use and clears the TI/ET capture buffer.

3-181.6 During normal IEEE-488 F28 operation, Front Panel Keypad F28, if invoked, can be used to monitor data sent to the IEEE-488 port. When the IEEE-488 bus terminates F28 operation via F28 OFF<CR>, the Keypad F28 function will take control and rapidly scroll through the remaining data, purging the buffer.

3-181.7 'FORMAT' defines the data format and can be 'ET' or 'TI'. If 'FORMAT' is the 'ET' setting, measurements will be returned with the following format:

<DAY>:<HOUR>:<MIN>:<SEC>.<NSEC><CR><LF>

where

<DAY> is the 3-digit day of year.
: the ASCII colon character.
<HOUR> the 2-digit hours.
<MIN> the 2-digit minutes.
<SEC> the 2-digit seconds.
. the ASCII decimal point character.
<NSEC> the 9-digit subsecond string.
<CR> the carriage return character.
<LF> the line feed character.

If 'FORMAT' is the 'TI' Time Interval setting, measurements will be returned with the following format: .NSEC<CR><LF>

'NSEC' ranges from .000000000 to .999999999, representing time into the current second the external event was detected. Note that all events are stored in the buffer in full Event Timing format, allowing captured data to be displayed in either format.

3-181.8 Sample Command: F28 ET O<CR>

When next interrogated, the IEEE-488 port will respond with the measurement status string:
F28 EVENT TIMING, OVERWRITE OLDEST, 0 MEAS RDY<CR><LF>

3-181.9 Sample Command: F28 TI S<CR>

When next interrogated, the IEEE-488 port will respond with the measurement status string:
F28 TIME INTERVAL, STOP WHEN FULL, 25 MEAS RDY<CR><LF>

3-181.10 REQUESTING F28 STATUS

3-181.11 By sending the function number without arguments, the measurement status string will be returned with the next interrogation:

3-181.12 Sample Command: F28<CR>

When next interrogated, the IEEE-488 port will respond with a typical message :
F28 EVENT TIMING, STOP WHEN FULL, 53 MEAS RDY<CR><LF>

Or, if the function is off:

F28 OFF<CR><LF>

3-181.13 OBTAINING MEASUREMENTS

3-181.14 Measurements may be requested using one of two commands. The 'M' command returns the next measurement in the buffer using the selected data format. The 'N' command returns the next measurement in the buffer using the selected data format AND appends the number of measurements remaining in the buffer.

3-181.15 F28 M<CR> When next interrogated, the next measurement in the buffer will be returned using the format specified.

3-181.16 Sample Command: F28 M<CR><LF>

Response: 318:19:50.283548915<CR><LF>

if the Event Time format is selected, or,

.283548915<CR><LF>

if the Time Interval format is selected.

3-181.17 F28 N<CR> appends the number of measurements remaining in the buffer.

3-181.18 Sample Command: F28 N<CR><LF>

When next interrogated, the IEEE-488 port will respond with the next measurement:
318:19:50.283548915 15 MEAS RDY<CR><LF>

if the Event Time format is selected, or,

.283548915 15 MEAS RDY<CR><LF>

if the Time Interval format is selected.

3-181.19 If no measurements are ready (empty buffer), the response is:

F28 NO VALID MEASUREMENT YET<CR><LF>

3-181.20 TERMINATING F28, IEEE-488 TI/ET

3-181.21 F28 OFF<CR> , when sent, terminates the TI/ET process and releases F28 TI/ET hardware and buffer for use by other ports. Any data remaining in the buffer is inaccessible to the IEEE-488 F28 function. If the Keypad F28 function was monitoring IEEE-488 operation, it will purge the buffer of remaining data. The RS-232 User Port F28 TI/ET function still has access to data remaining in the buffer (if not purged by Keypad F28), and will begin dumping the data upon entry into that function.

182 through 185 reserved

3-186 IEEE-488 FUNCTION F29 - EXTERNAL FREQUENCY MEASUREMENT (OPTION)

3-186.1 Refer to section 3-400 for information concerning the External Frequency Measurement input. Use IEEE-488 I/O function F29 to set the measurement mode, input frequency and measurement interval parameters and view current settings and measurement data.

3-186.2 This function provides the capability to measure the frequency of an externally applied 1, 5 or 10 MHz signal very accurately with respect to the disciplined GPS-XL oscillator. The resolution of the measurements is 6 parts in 10^{11} divided by the Measurement Interval. The range of fractional frequency offset from the nominal input frequency which may be measured is +/- 500 PPM. The Measurement Interval may be specified in integer seconds over the range of 1 to 100,000 seconds.

3-186.3 Function 29 offers three modes of operation:

OFF	--	No measurements are reported in this mode.
QUERY	--	Measurements are reported only when requested in this mode.
PERIODIC	--	Measurements are continuously taken at the specified interval and written to a buffer which retains the last 10 measurements. Function F29 remains in this mode until commanded into the OFF or QUERY mode.

3-186.4 The measurement technique uses a heterodyne phase error multiplier approach to achieve high resolution at short sample periods. An important feature of this implementation is that "zero dead time" frequency measurements are performed. In essence the position in

GPS-XL internal time of a zero crossing of the externally applied frequency being measured is recorded, or "timestamped", once per measurement interval with 60 picosecond resolution. (In the QUERY mode of operation, the reception of the measurement request string causes a timestamp to be performed, rather than at a fixed repetitive rate as in the PERIODIC mode of operation). In addition, the number of zero crossings between successive timestamps is also recorded.

3-186.5 When it is time to perform a measurement, either because the selected interval in PERIODIC mode has elapsed or a QUERY mode measurement request has been received, the previous measurement timestamp is subtracted from the current one and the difference is divided by the number of zero crossings between these two timestamps. This result is the average period of the external frequency being measured over the interval. The reciprocal of this period is then compared to the nominal frequency to determine the fractional frequency offset. The timestamp reported with the resulting measurement is the ending timestamp of the two phase readings used to make the measurement. Since this ending timestamp is now the beginning timestamp for the next measurement, there is no "dead time" present in the measurements.

3-186.6 The reported timestamp resolution is sufficient to allow integrating the fractional frequency offset measurements to fully recover the relative phase of the external frequency source being measured versus the disciplined GPS-XL internal or external oscillator.

3-186.7 INTERROGATE CURRENT F29 MODE AND STATUS

3-186.8 To view the current settings, send a character string of the form:

F29<CR> or
F29<CR><LF>

where

F	is the ASCII character "F"
29	is the function number
<CR>	is the Carriage Return character
<LF>	is the linefeed character.

3-186.9 When next interrogated, the IEEE-488 port will respond with one of the following messages:

OFF mode response message:
F29 OFF<CR><LF>

QUERY mode response message:
F29 QUERY <FREQ><CR><LF>
e.g. F29 QUERY 10 MHZ <CR><LF>

PERIODIC mode response message:
F29 PERIODIC <FREQ> <INTERVAL> <# MEAS RDY><CR><LF>
e.g. F29 PERIODIC 10 MHZ 60 SEC 5 MEAS RDY<CR><LF>

where:

<SEP> is a separator character, either space, comma or tab.

<MODE> is either OFF, QUERY or PERIODIC.
 <FREQ> is the input frequency in MHz, either 1, 5 or 10. This field is not sent if the mode is OFF.
 <INTERVAL> is the measurement interval in seconds, a decimal integer in the range of 1 to 100000. This field is not sent if the mode is OFF or QUERY.
 <# MEAS RDY> is the number of measurements completed and stored in the Periodic buffer.

3-186.10 SET NEW F29 MODE

3-186.11 To configure function F29, send a string conforming to one of the following formats:

3-186.12 Set OFF MODE to terminate the Frequency Measurement process:
 F29<SEP><OFF><CR>

The <FREQ> and <INTERVAL> fields are excluded from the command. When commanded to the OFF mode, any data in the periodic measurements buffer will be lost. When next interrogated, the IEEE-488 port will respond with:
 OK<CR><LF>

3-186.13 Set QUERY MODE to initialize the Frequency Measurement Function for subsequent frequency measurements on demand:

F29<SEP><QUERY><SEP><FREQ><CR>

The <INTERVAL> field is excluded. When commanded to the QUERY mode, any data remaining in the periodic measurements buffer will be discarded.

When next interrogated, the IEEE-488 port will respond with:

F29<SEP><TIMESTAMP><SEP><MODE><SEP><FREQ><CR><LF>

where:

<TIMESTAMP> is dayofyear:hours:minutes:seconds.subseconds in this fixed field format:

ddd:hh:mm:ss.nnnnnnnnn

This timestamp is the initial phase timestamp which will be used to compute the first fractional frequency offset measurement which will follow either from a QUERY or PERIODIC update.

3-186.14 Set PERIODIC MODE to initialize the Frequency Measurement function and begin periodic frequency measurements:

F29<SEP><PERIODIC><SEP><FREQ><SEP><INTERVAL><CR>

3-186.15 In the PERIODIC mode of operation, measurements are performed each INTERVAL seconds. The result of each periodic measurement is stored in the periodic measurement buffer. When full, the oldest measurement is discarded to create room for the latest measurement. To avoid data loss, the periodic measurement buffer should never be allowed to fill. The buffer holds a maximum of 10 measurements.

The Periodic mode is suitable for long term automated observation of the performance of an external frequency standard or for the calibration of free running timebase oscillators.

3-186.16 MEASUREMENT RETRIEVAL

3-186.17 To retrieve a measurement while in the QUERY or PERIODIC mode, send the following string:

```
F29<SEP><F><CR>
```

where:

<F> is the ASCII character "F".

3-186.18 In the QUERY mode, the frequency measurement value returned is the one performed upon receipt of the measurement retrieval command. The measurement interval is the time in integer seconds between receptions of the above string. This mode is useful in matching the data rate of some other process which is concurrently being logged and is not necessarily periodic or synchronized with the GPS-XL.

3-186.19 In the PERIODIC mode, the frequency measurement value returned is the oldest measurement in the periodic measurements buffer. After returning the oldest value, the buffer read pointer is incremented. If the periodic measurements buffer is empty, an empty message is returned as discussed below. To determine the number of measurements contained in the buffer, send the "F29" command, as discussed under the "INTERROGATE CURRENT F29 MODE AND STATUS" paragraph above.

3-186.20 The measurement returned in either the QUERY or PERIODIC modes is in the following format:

```
F29<SEP><TIMESTAMP><SEP><FFO><CR><LF>
```

where

<FFO> is fractional frequency offset of the input frequency relative to its nominal frequency in this fixed field scientific notation format:
sX.XXXXXXXXXXXEsXX

3-186.21 If, under PERIODIC MODE, the periodic measurements buffer is empty, the following message is returned:

```
F29 NO VALID MEASUREMENT YET<CR><LF>
```

This is a sample measurement returned either from PERIODIC mode or on request from QUERY mode:

```
F29 123:21:37:56.000894320 -2.89345678245E-04<CR><LF>
```

3-187 through 3-207 reserved

3-208 IEEE-488 FUNCTION F50 - ANTENNA POSITION ENTRY/REQUEST

3-208.1 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F56 to enter or request the antenna position. The out-of-the-box default for position is that of the TRUETIME factory in Santa Rosa, California. The position on subsequent power-ups will be the same as it was on the previous power-down. To determine the present position send F50<CR> to the IEEE-488 port. The port will respond with the continuous ASCII character string

```
F50<SEP><SIGN><SEP><DEG>D<MIN>M<SEC>S<SEP>
<SIGN><SEP><DEG>D<MIN>M<SEC>S<SEP><SIGN><ALT>
<UNITS>pdop<PDOP><LT>
```

where

F	is the ASCII character F.
50	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<SIGN>	is N or S for latitude; E or W for longitude; or + or - for longitude, latitude or altitude or no character for altitude. A negative sign means a south latitude or a west longitude.
<DEG>	is the two-digit degrees for latitude or the three-digit degrees for longitude.
D	is the ASCII character D or d. Always d in output strings.
<MIN>	is the two-digit minutes.
M	is the ASCII character M or m or '. Always ' in output strings.
<SEC>	is the two-digit seconds.
S	is the ASCII character S or s or ". Always " in output strings.
<ALT>	is the altitude in feet or meters.
<UNITS>	is the units of altitude, either a M or m for meters or F or f for feet depending on the units selected with keypad function F55, RS-232 function F55 or IEEE-488 function F55.
pdop	is the ASCII string pdop.
<PDOP>	is the 3- or 4-digit value of the position dilution of precision.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F50<CR>
 Response: F50 N 38d23'54.8" W 122d42'53.9" 41m pdop 2.49m<CR><LF>

3-208.2 To enter a position send a character string with the format above to the IEEE-488 port. Longitude, latitude, altitude or pdop may be omitted in the string provided they are replaced with a semicolon (;) character. The altitude units may be feet or meters.

Sample entry: F50 - 02d30'03.1" + 14d23m40s -10m<CR>
 Response: OK<CR><LF>

Sample entry: F50 N 10D20M51.3S W 150D40MO3.OS +1000M<CR>
 Response: OK<CR><LF>

3-209 IEEE-488 FUNCTION F50 - RECEIVER POSITION ENTRY/REQUEST

3-209.1 **For 468-DC receivers only.** Use IEEE-488 function F50 to request or enter the receiver position. To request the position presently used send F50<CR> to the IEEE-488 port. The port will respond with the continuous ASCII character string

```
F50<SEP><SIGN><SEP><DEG>D<MIN>M<SEC>S<SEP>
<SIGN><SEP><DEG>D<MIN>M<SEC>S<LT>
```

where

F	is the ASCII character F.
50	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<SIGN>	is N or S for latitude; E or W for longitude; or + or - for longitude, latitude or altitude or no character for altitude. - corresponds to S or W.
<DEG>	is the two-digit degrees for latitude or the three-digit degrees for longitude.
D	is the ASCII character D or d. It is always d in output strings.
<MIN>	is the two-digit minutes.
M	is the ASCII character M or m or '. It is always ' in output strings.
<SEC>	is the two-digit seconds.
S	is the ASCII character S or s or ". It is always " in output strings.
<LT>	is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F50<CR>
Response: F50 N 80d34'56.1" E 123d14'23.5"<CR><LF>

To achieve the specified time accuracy the position must be entered to within 1 minute of latitude and longitude. To enter a new position send a character string with the format above to the IEEE-488 port.

Sample entry: F50 S 80D 35M 50.0s +100d 15m 20.0S<CR>
Response: OK<CR><LF>

3-210 IEEE-488 FUNCTION F50 - RECEIVER POSITION ENTRY/REQUEST

3-210.1 **For OM-DC receivers only.** Use IEEE-488 function F50 to request or enter the receiver position. The out-of-the-box default is the position of the TrueTime factory in Santa Rosa, California, U.S.A. The default for subsequent power-ups is the position in use at the previous power-down. To request the position presently used send F50<CR> to the IEEE-488 port. The port will respond with the continuous ASCII character string

```
F50<SEP><SIGN><SEP><DEG>D<MIN>M<SEC>S<SEP>
<SIGN><SEP><DEG>D<MIN>M<SEC>S<LT>
```

where

F is the ASCII character F.
50 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<SIGN> is N or S for latitude; E or W for longitude; or + or - for longitude, latitude or altitude or no character for altitude. - corresponds to S or W.
<DEG> is the two-digit degrees for latitude or the three-digit degrees for longitude.
D is the ASCII character D or d. It is always d in output strings.
<MIN> is the two-digit minutes.
M is the ASCII character M or m or '. It is always ' in output strings.
<SEC> is the two-digit seconds.
S is the ASCII character S or s or ". It is always " in output strings.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F50<CR>
Response: F50 N 80d34'56" E 123d14'23"<CR><LF>

3-210.2 To achieve the specified time accuracy, the position must be entered to within 0.5 degrees of latitude and longitude. To enter a new position, send a character string with the format above to the IEEE-488 port.

Sample entry: F50 S 80D 35M 50s +100d 15m 20S<CR>
Response: OK<CR><LF>
Result: The position is now S 80d 35' 50.0" and E 100d 15' 20.0".

3-211 through 3-220 reserved.

3-221 IEEE-488 FUNCTION F51 - CABLE DELAY ENTRY

3-221.1 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F51 to enter or request the cable delay. The out-of-the-box default is 50ns. The value on subsequent power-ups will be the same as it was on the previous power-down. To determine the present value send F51<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F51<SEP><DELAY>ns<LT>

where

F is the ASCII character F.
51 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<DELAY> is the 1 to 10 digit delay from +02000000000 ns to -02000000000 ns.
ns is the optional two-character units, nanoseconds.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F51<CR>
Response: F51 200ns<CR><LF>

3-221.2 To enter the cable delay send a character starting with the format above to the IEEE-488 port.

Sample entry: F51<TAB>1025NS<CR>
Response: OK<CR><LF>

Sample entry: F51,10000000000ns<CR>
Response: OK<CR><LF>

3-222 through 3-230 reserved.

3-231 IEEE-488 FUNCTION F52 - LEAP SECOND ENTRY

3-231.2 **For OM-DC receivers only.** Use IEEE-488 function F52 to enter the current number of leap seconds. Due to variations in the earth's rotation, "leap seconds" must be added to or subtracted from extracted Omega time to get true UTC-USNO time. Therefore, the user must enter the current number of leap seconds. The OM-DC Mark III will thereafter automatically correct Omega time to UTC-USNO. The addition or subtraction of a leap second may occur as often as twice per year. If a correction must be made, it is always done on June 30 or December 31. The U. S. Naval Observatory announces leap seconds in advance. The user may write

U.S. Naval Observatory,
Washington, D.C., 20392-5100

for the current number of leap seconds. All those who have filled out and returned the "USER REGISTRATION" card in the front of this manual, will receive notification in advance of leap second changes. Also, users may call TrueTime's Customer Service Department for the current number of leap seconds.

3-231.3 The out-of-the-box default is number of leap seconds in effect at the time of shipment. The default on subsequent power-ups will be the value in use at the previous power-down (unless leap second occurs while the unit is without power). To enter the current number of leap seconds send an ASCII character string of the form

F52<SEP><SIGN><LEAPSEC><CR>

where

F	is the ASCII character F.
52	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<SIGN>	is + or -.
<LEAPSEC>	is the total number of leap seconds in effect.
<LT>	is the line terminator, a carriage return and a line feed.

Sample Entry: F52 +18<CR>
Response: OK<CR><LF>

3-232 through 3-240 reserved.

3-241 IEEE-488 FUNCTION F53 - OPERATIONAL MODE SELECT

3-241.2 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F53 to select the operational mode, either AUTO, SURVEY, TIME or MANUAL. Refer to "OPERATIONAL MODES" in Section III for an explanation of the operational modes. The power-up default is the mode in use at the previous power-down. To request the present mode send F53<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F53<SEP><MODE><LT>

where

F is the ASCII character F.
53 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<MODE> is AUTO, SURVEY, TIME, or MANUAL.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F53<CR>
Response: F53 SURVEY<CR><LF>

3-241.3 To enter an operational mode send a character string with the format above to the IEEE-488 port.

Sample request: F53<TAB>TIME<CR>
Response: OK<CR><LF>

Sample entry: F53,AUTO<CR>
Response: OK<CR><LF>

3-242 through 3-250 reserved.

3-251 IEEE-488 FUNCTION F53 - SATELLITE POSITION REQUEST

3-251.1 **For 468-DC receivers only.** Use IEEE-488 function F53 to request the position of the satellite whose signal is presently being decoded. The power-up default is all zeros. To request the present satellite position send F53<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F53<SEP><SIGN><LAT><SEP><LONG><SEP><SIGN><ALT><LT>

where

F is the ASCII character F.
53 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<SIGN> is + or -.
<LAT> is the latitude in degrees.
<LONG> is the longitude in degrees.

<ALT> is the altitude (radius) error in microseconds.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F53<CR>

Response: F53 +9.0028 122.0123 +010.6<CR><LF>

3-252 through 3-260 reserved.

3-261 IEEE-488 FUNCTION F53 - LEAP SECOND UPDATE ENABLE

3-261.1 **For OM-DC receivers only.** Use IEEE-488 function F53 to enable the automatic adjustment of the number of leap seconds at the appropriate time. The out-of-the-box default is 0. The default on subsequent power-ups will be the value in effect at the previous power-down (unless leap second update occurred while the unit was without power).

3-261.2 If this function is enabled, the OM-DC Mark III will automatically adjust the second count at the appropriate time even if power is lost as long as there is battery power for the real-time clock. If the leap second is positive, the time will increment to 23:59:60 after 23:59:59 on June 30 or December 31. That is, the last minute of June 30 or December 31 will contain 61 seconds. If the leap second is negative, the time will not count second 23:59:59 but skip to 00:00:00 after 23:59:58. That is, the last minute of June 30 or December 31 will contain only 59 seconds. Leap seconds are always referenced to UTC so the local time of leap second adjustment will depend upon the time zone that was last selected with function 01. To enable the automatic leap-second update send an ASCII character string of the form

F53<SEP><LEAPSEC><CR>

where

F	is the ASCII character F.
53	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<LEAPSEC>	is the change in the total number of leap seconds in effect, either 0, +1 or -1.
<CR>	is the a carriage return character.

Sample Entry: F53 +1<CR>
Response: OK<CR><LF>
Result: The number of leap seconds will increase by one and the time will adjust at the appropriate time.

3-262 through 3-270 reserved.

3-271 IEEE-488 FUNCTION F55 - ALTITUDE UNITS SELECT

3-271.1 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F55 to select the units of the altitude, either feet or meters. The out-of-the-box default is meters. The units upon subsequent power-ups will be the same as they were on the previous power-down. To request the units presently in use, send F55<CR> to the IEEE-488 port. The port will respond with the ASCII character string.

F55<SEP><UNITS><LT>

where

F is the ASCII character F.
55 is the function number.
<SEP> is one or more separator characters: either space, comma or tab.
<UNITS> is FEET or METERS.
<LT> is the line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F55<CR>
Response: F55 FEET<CR><LF>

3-271.2 To enter units send a character string with the format above to the IEEE-488 port.

Sample request: F55<TAB>METERS<CR>
Response: OK<CR><LF>

Sample request: F55,FEET<CR>
Response: OK<CR><LF>

3-272 through 3-281 reserved.

3-282 IEEE-488 FUNCTION F65 - SATELLITE SELECT

3-282.1 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F65 to select specific satellites for the receiver to track or deselect satellites, i.e instruct the receiver to ignore certain satellites. Send the string of the form

F65<SEP><REQUEST>[<SEP>NN]<CR>

or

F65<SEP><REQUEST>ALL<CR>

where

F is the ASCII character F.
65 is the function number.
<REQUEST> is either SELECT or DESELECT
<SEP> is one or more separator characters: either space, comma or tab.
NN is a two-digit satellite number.
ALL is the ASCII character string ALL.
[] encloses a phrase that is repeated as often as necessary.
<CR> is a carriage return character.

The IEEE-488 port will respond with an OK.

Sample entry: F65 SELECT 02 18 13<CR>
Response: OK<CR><LF>

Sample entry: F65<TAB> SELECT ALL<CR>
Response: OK<CR><LF>

Sample entry: F65 DESELECT 01 08<CR>
Response: F65 OK<CR><LF>

3-283 IEEE-488 FUNCTION F65 - SATELLITE SELECT

3-283.1 **For 468-DC receivers only.** Use IEEE-488 function F65 to select a specific satellite for the receiver to acquire. Send the string of the form

F65<SEP><SAT><CR>

where

F	is the ASCII character F.
65	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<SAT>	is either AUTO, EAST or WEST.
<CR>	is a carriage return character.

The IEEE-488 port will respond with an OK.

Sample entry: F65 EAST<CR>
Response: OK<CR><LF>

3-384 IEEE-488 FUNCTION F65 - STATION ENABLE

3-284.1 **For OM-DC receivers only.** Use IEEE-488 function F65 to select which station signals the OM-DC Mark III will lock to. The initial out-of-the-box default is "ENABLE" for all stations, that is, the receiver will attempt to lock to any Omega station with a readable signal. The default upon subsequent power-ups will be the selections in use just prior to the previous power-down. The receiver will lock only to stations that are enabled and skip those stations that are disabled. Use this function to disable reception of stations that are experiencing trouble or are off the air for routine maintenance. A schedule of routine maintenance and information concerning current status of Omega may be obtained from

Commanding Officer
Omega Navigation System Center
7323 Telegraph Road
Alexandria, VA 22310-3998

or by calling the Center at (703) 866-3801 or (703) 866-3800.

3-284.2 To alter a station's status send a string of the form

F65<SEP><STATUS><SEP><LIST><CR>

where

F	is the ASCII character F.
65	is the function number.
<SEP>	is one or more separator characters: either space, comma or tab.
<STATUS>	is the ASCII string SELECT or DESELECT.
<LIST>	is a list of the letters assigned to the stations to be selected or deselected.
<CR>	is a carriage return character.

Sample Entry: F65 SELECT C<CR>
Response: OK<CR>
Result: Hawaii station selected. All other stations deselected.

Sample Entry: F65 DESELECT ABE<CR>
Response: OK<CR>
Result: Norway, Liberia and La Reunion stations are deselected. All other stations selected.

3-284.3 To request the stations selected send F65<CR> to the port. The port will respond with a string in the form above.

Sample Entry: F65<CR>
Response: F65 SELECT ABD<CR><LF>

3-285 through 3-310 reserved.

3-311 IEEE-488 FUNCTION F66 - DAYLIGHT SAVINGS ENABLE

3-311.1 **For 468-DC receivers only.** Use IEEE-488 function F66 to enable or disable the automatic or manual daylight savings time adjustment. The initial out-of-the-box default is "Auto" meaning that the time will automatically convert to or from daylight savings time at 2:00:00 AM on the appropriate day as indicated by GOES transmissions. The default upon subsequent power-ups will be the selection in use just prior to the previous power-down.

3-311.2 To request the present status of the daylight savings enable, send F66<CR> to the IEEE-488 port. The port will respond with the ASCII character string

F66 OFF<CR><LF>

if the DST adjustment is disabled, or the string

F66 AUTO<CR><LF>

if automatic mode is use, or if manual mode is in effect, the string:

F66 MANUAL <IN HOUR><SEP><IN WEEK><SEP><IN DAY><SEP>
<IN MONTH><SEP><OUT HOUR><SEP><OUT WEEK><SEP><OUT DAY>
<SEP><OUT MONTH><LT>

where

<IN HOUR>	is the time to enter DST in 24-hour format.
<SEP>	is one or more separator characters, either space, comma or tab characters. For output strings this will be a single space character.
<IN WEEK>	is which week to enter DST, 1, 2, 3, 4 or 0 (for last).
<IN DAY>	is the day of week to enter DST, 1 through 7 where Sunday is 1.
<IN MONTH>	is the month to enter DST, 1 through 12 where 1 is January.
<OUT HOUR>	is the hour to exit DST, in 24 hour format.
<OUT WEEK>	is which week to exit DST, 1, 2, 3, 4 or 0 (for last).
<OUT DAY>	is the day in to exit DST, 1 through 7 where Sunday is 1.
<OUT MONTH>	is the month to exit DST, 1 through 12 where 1 is January
<LT>	is a line terminator, a carriage return and line feed for output strings, only a carriage return for input strings.

Sample request: F66<CR>
Response: F66 OFF<CR><LF>
Meaning: DST is disabled.

Sample Request: F66<CR>
Response: F66 MANUAL 02 1 1 04 02 0 1 10
Meaning: Manual settings are in effect. The entry time is 02 a.m. on the first Sunday of April and the exit time is 02 a.m. on the last Sunday in October.

To disable Daylight Saving Time send the string:

F66 OFF<CR>

To enable automatic Daylight Saving Time adjustment, send the string:

F66 AUTO<CR><LF>

To enable manual Daylight Saving Time adjustment and set the DST entry and exit times send an ASCII character string with the format described under manual mode above to the serial port. If desired, any item may be replaced with a semicolon, which will leave its value unchanged. If any of the items in an input string are invalid, an error message will be returned. Refer to the end of this section for an explanation of error messages.

Sample Entry: F66 MANUAL 4 2 2 3 13 4 6 11<CR>
Response: OK<CR><LF>
Meaning: DST will now be entered 04 a.m. on the 2nd Monday in March and exit DST at 01 p.m. on the 4th Friday in November.

Sample Entry: F66 MANUAL ; 0 ; ; ; ; ;<CR>
Response: OK<CR><LF>
Meaning: DST will now be entered on the last week of the month. All other parameters remain unchanged.

Sample request: F66<CR>
Response: F66 AUTO<CR><LF>

3-311.3 To alter the state of the daylight savings enable send a character string with the format above to the IEEE-488 port.

Sample request: F66<TAB>Off<CR>
Response: OK<CR><LF>

Sample request: F66,Auto<CR>
Response: OK<CR><LF>

3-312 IEEE-488 FUNCTION F66 - DAYLIGHT SAVINGS ENABLE

3-312.1 **For OM-DC, GPS-DC, and GPS-FPC receivers only.** Use IEEE-488 function F66 to enable or disable the automatic Daylight Savings Time (DST) adjustment or set the entry or exit times for DST. The initial out-of-the-box default is "OFF" meaning that time unadjusted for DST will display. The defaults upon subsequent power-ups will be the selection and parameters in use just prior to the previous power-down.

3-312.2 To request the present status of the daylight savings enable, send F66<CR> to the IEEE-488 port. The port will respond with the ASCII character string F66 OFF<CR><LF> if the DST adjustment is disabled or if not, the continuous string

F66 MANUAL <IN HOUR><SEP><IN WEEK><SEP><IN DAY><SEP>
 <IN MONTH><SEP><OUT HOUR><SEP><OUT WEEK><SEP><OUT DAY>
 <SEP><OUT MONTH><LT>

where

<IN HOUR>	is the time to enter DST in 24-hour format.
<SEP>	is one or more separator characters, either space, comma or tab characters. For output strings this will be a single space character.
<IN WEEK>	is which week to enter DST, 1, 2, 3, 4 or 0 (for last).
<IN DAY>	is the day of week to enter DST, 1 through 7 where Sunday is 1.
<IN MONTH>	is the month to enter DST, 1 through 12 where 1 is January.
<OUT HOUR>	is the hour to exit DST, in 24 hour format.
<OUT WEEK>	is which week to exit DST, 1, 2, 3, 4 or 0 (for last).
<OUT DAY>	is the day in to exit DST, 1 through 7 where Sunday is 1.
<OUT MONTH>	is the month to exit DST, 1 through 12 where 1 is January
<LT>	is a line terminator, a carriage return and line feed for output strings, only a carriage return for input strings.

Sample request: F66<CR>
 Response: F66 OFF<CR><LF>
 Meaning: DST is disabled.

Sample Request: F66<CR>
 Response: F66 MANUAL 02 1 1 04 02 0 1 10
 Meaning: Manual settings are in effect. The entry time is 02 a.m. on the first Sunday of April and the exit time is 02 a.m. on the last Sunday in October.

3-312.3 To disable the DST adjustment the string F66<SEP>OFF<CR> to the serial port.

Sample entry: F66<TAB>Off<CR>
 Response: OK<CR><LF>
 Result: DST is disabled.
 Sample entry: F66,OFF<CR>
 Response: OK<CR><LF>
 Result: DST is disabled.

3-312.4 To enable the DST adjustment and set the DST entry and exit times send an ASCII character string with the long format above to the serial port. If desired, any item may be replaced with a semicolon, which will leave its value unchanged. If any of the items in an input string are invalid, an error message will be returned. Refer to the end of this section for an explanation of error messages.

Sample Entry: F66 MANUAL 4 2 2 3 13 4 6 11<CR>
 Response: OK<CR><LF>
 Meaning: DST will now be entered 04 a.m. on the 2nd Monday in March and exit DST at 01 p.m. on the 4th Friday in November.

Response: Sample Entry: F66 MANUAL ; 0 ; ; ; ; ; <CR>
OK<CR><LF>
Meaning: DST will now be entered on the last week of the month. All other parameters remain unchanged.

3-313 through 3-330 reserved.

3-331 IEEE-488 FUNCTION F71 - OSCILLATOR STATISTICS REQUEST

3-331.1 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F71 to request the time base frequency offset and the short term drift rate of the time base. Refer to keypad Function 71 - OSCILLATOR STATISTICS REQUEST for an explanation of these values. Send the string F71<CR> to the IEEE-488 port and it will respond with the continuous string

F71<SEP>offset=<SEP><SIGN><MULT>E<SIGN><EXP>
drift=<SEP><SIGN><MULT>E<SIGN><EXP><CR><LF>

where

F is the ASCII character F.
71 is the function number.
<SEP> is one or more spaces.
<MULT> is a multiplier, one digit followed by a decimal point and three digits.
E is the ASCII character E for exponent.
<SIGN> is - for negative or + for positive.
<EXP> is the 2-digit exponent.
<CR> is a carriage return character.
<LF> is a line feed character.

Sample request: F71<CR>
Response: F71 offset= -3.091E-10 drift= -1.139E-12<CR><LF>

3-332 through 3-340 reserved.

3-341 IEEE-488 FUNCTION F79 - WARM START

3-341.1 **For GPS-DC and GPS-FPC receivers only.** Use IEEE-488 function F79 to initiate a warm start. Send the string F79<CR> and the IEEE-488 port will respond by initiating a warm start.

Sample: F79<CR>
Response: OK<CR><LF>

3-342 through 3-350 reserved.

3-351 IEEE-488 EMULATION COMMANDS

3-351.1 The advanced performance IEEE option does not support the emulation of the the IEEE-488 commands of the older Mark I and Mark II receivers.

3-351.2 SRQ HANDLING

3-351.3 When the interface is not in "F09" mode, it will assert the Service Request when it receives a Group Execute Trigger command (GET command) or a pulse is detected in the "trig in" input. The arrival time of each event will be stored, and can be retrieved by entering "F09" mode. It should be noted that if a single "T" character is sent before retrieving the time for

the GET command, the time of the GET command will be lost. The time for the "trig in" pulse will be retained until a single "P" character is sent. Refer to paragraph 3-131 for a description of "F09" mode.

3-351.4 Obtaining the time of either the GET command or the "trig in" pulse will not cause SRQ to be released. SRQ will only be released by means of a serial poll.

3-351.5 When the interface is subjected to a serial poll, its response byte will be as follows:

Bit 0: set if the time of a GET command is waiting.

Bit 1: set if the time of a "trig in" pulse is waiting.

Bit 6: always set.

All other bits will be clear.

3-351.6 These bits will also report the current status of the above events if the interface is serially polled without SRQ being asserted.

3-351.7 Bit 0 of the response byte will be cleared as soon as the "f09" command is given. It will not wait until the port transmits the data for the latest GET command.

3-351.8 Bit 1 of the response byte will be cleared as soon as the port receives a "P" when in "f09" mode. It will not wait until the port transmits the data for the latest trig in pulse.

3-351.9 "TRIG IN" INPUT

3-351.10 This input allows the arrival time of incoming pulses to be recorded. The rising edge of any pulse is time-tagged by hardware registers, and any following pulse is ignored until the currently waiting pulse time is requested.

3-351.11 If no trig in pulse has been received since the last trig pulse arrival time has been requested, the interface will return the string:

<SOH>000:00:00:00.000000<CR><LF>

in response to a "P" input.

3-351.12 The arrival time of a pulse is stored in a separate area from the "T" or Group Execute Trigger time areas, so that those events will never cause pulse times to be lost.

3-351.13 If the interface is not in "f09" mode, an incoming pulse will cause the Service Request line to be asserted. If it is in "f09" mode, no Service Request will occur.

3-351.14 It should be noted that 1 microsecond resolution of the "trig in" input should not be taken to imply equivalent time accuracy. If this option is used in, say, a 468-DC, **relative** times between pulses may be had to ± 1 microsecond accuracy, but the clock's absolute accuracy to NIST time is not nearly as good, and the times for the pulse capture will reflect this. If this option is used in a clock that has better than 1 microsecond accuracy to UTC, such as a GPS-DC, then pulses may be timed with absolute accuracy to the provided resolution.

3-351.15 Also, even the accuracy of relative times of pulse arrivals may be degraded if the pulses are widely separated in time and the clock is relying in its internal time base because it is not locked to its time source(eg. GPS satellites).

3-351.16 The data from the "trig in" input is not available on any port other than the IEEE-488 port on the ieee option board.

3-351.17 ON-BOARD SWITCH POSITIONS

3-351.18 S1 position 1 must be off. The other positions of S1 do not matter, unless two 86-386 boards are installed in the same unit. In that case, position 2 of one board must be off, and the other on.

3-352 through 3-380 reserved.

3-381 IEEE-488 ERROR MESSAGES

3-381.1 The IEEE-488 port will respond with the message "ERROR 01 VALUE OUT OF RANGE" if the input string was in the correct format but contained a value, probably numeric, that was out of the range of acceptable values. Refer to the paragraphs explaining the function in use for the correct range of values.

Sample entry: F01 13:00<CR>
Response: ERROR 01 VALUE OUT OF RANGE<CR><LF>

3-381.2 The IEEE-488 port will respond with the message "ERROR 02 SYNTAX" if it receives a string in an incorrect format. Refer to "GENERAL INPUT AND OUTPUT FORMAT" in Section III.

Sample entry: F03 LOCAD<CR>
Response: ERROR 02 SYNTAX<CR><LF>

3-381.3 The IEEE-488 port will respond with the message "ERROR 03 BAD/MISSING FIELD" if the input string lacks a required field. Refer to the paragraph in this section explaining the function in use.

Sample entry: F14 1E<CR>
Response: ERROR 03 BAD/MISSING FIELD<CR><LF>

3-381.4 The IEEE-488 port will respond with the message "ERROR 04 EXCLUSIVE USE" if another port has exclusive use and if the string sent is a request to enter data. Refer to "IEEE-488 FUNCTION F15 - EXCLUSIVE USE ENABLE" in this section for an explanation of the exclusive use function.

Sample entry: F53 AUTO<CR>
Response: ERROR 04 EXCLUSIVE USE<CR><LF>

3-381.5 The IEEE-488 port will respond with the message "ERROR 05 NO SUCH FUNCTION" if the function number requested is not implemented.

Sample entry: F40<CR>
Response: ERROR 05 NO SUCH FUNCTION<CR><LF>