

SECTION XXII

May 31, 1995

AUXILIARY REFERENCE INPUT (OPTION)

1-1 INTRODUCTION

1-2 This option offers the user a means of improving the hold-over performance of the GPS-XL or XL-DC when operating without GPS satellite data. When a user supplied, accurate and stable 1, 5 or 10 MHz frequency standard is connected to this input, the frequency of the internal oscillator will be locked to it when GPS satellite data is unavailable. In this way, the GPS-XL timing and frequency outputs will diverge from UTC at the rate of this Auxiliary Reference frequency rather than at the rate of the presumably much less accurate and stable internal oscillator. Since a "hitless," software switchover method is implemented, the user need not worry about timing glitches as a result of switches back and forth between the Auxiliary Reference and GPS.

1-3 This option consists of an Auxiliary Reference Input (AUX REF) connector, which is actually connected to the GPS-XL External Frequency Measurement circuitry, and software which enables using the frequency measurements to control the internal oscillator. This option may be enabled or disabled using Serial I/O Function F59, or in an XL-DC, with keypad and display, via Keypad Function F59. When this option is in place and enabled, its requirements take precedence over normal use of the External Frequency Measurement Option. Refer to Section III, Keypad and Serial I/O Function F29 for details concerning the External Frequency Measurement Option.

1-4 SPECIFICATIONS

1-5 All standard GPS-XL accuracy and stability specifications (see Section I) are valid when the GPS-XL has been operating continuously for at least 24 hours with an accurate position (error < 10 m in WGS-84) and at least four satellites are visible. Refer to the specific option section for any internal oscillator options which may also be installed in the GPS-XL or XL-DC for changes to the standard specifications which might be applicable. The addition of this option impacts the standard GPS-XL and XL-DC specifications only in the following areas:

1-6 Auxiliary Reference Input Signal Requirements:

See Sections III, of the GPS-XL or XL-DC Manual for details describing input requirements for the External Frequency Measurement Option.

1-7 Holdover Characteristics:

Initial Frequency Error: Dependent on Aux. Ref.
Drift Rate: Dependent on Aux. Ref.
Temperature Coefficient: Dependent on Aux. Ref.

2-1 INSTALLATION

2-2 This option is factory installed. Field installation is not available for this option.

3-1 OPERATION

3-2 No special operation procedures are required, other than connecting a 1, 5 or 10 MHz frequency to the Aux. Ref. input connector and informing the GPS-XL of the Auxiliary Reference Input frequency via Keypad or Serial I/O Function F59. This option may also be enabled and disabled via this function.

3-3 KEYPAD/SERIAL I/O FUNCTION F59 - AUXILIARY REFERENCE INPUT
SETUP AND CONTROL ENTRY/REQUEST (OPTION)

3-4 Function F59 allows the user to set the Auxiliary Reference input frequency and to either enable or disable internal oscillator control from frequency measurements made on that input. The user may choose either 1, 5 or 10 MHz for the input frequency. If the user enables Auxiliary Reference operation, then the internal oscillator will be steered from the frequency measurements made versus that Auxiliary Reference whenever GPS data is unavailable. *While Auxiliary Reference operation is enabled, External Frequency Measurement Option operation is supported, except that the input frequency may not be changed via Keypad or Serial I/O Function F29.* While Auxiliary Reference operation is disabled, the internal oscillator will not be steered from the frequency measurements made versus that Auxiliary Reference, even if GPS data is unavailable. Also, External Frequency Measurement Option operation is as normal while Auxiliary Reference operation is disabled.

Keypad Operation:

On the XL-DC keypad, press FUNC/ENTR followed by "59". The display will show:

Aux Ref Freq
10 MHz

Press the UP or DOWN arrow keys to select the appropriate input frequency. Press FUNC/ENTR to complete the selection. Now this display will appear:

Aux Ref or Aux Ref
DISABLED ENABLED

Press the UP or DOWN arrow keys to toggle between "DISABLED" and "ENABLED" to select the desired operating mode for this option. Press FUNC/ENTR to complete the selection.

Serial I/O Port Operation:

Send F59<CR>, this ASCII character string will be returned:

```
F59<SP><FREQ><SP><STATUS><CR><LF>
```

where:

```
F59   = ASCII characters 'F', '5' and '9'
<SP>  = ASCII space character
<FREQ> = Input frequency, either 1, 5 or 10
<STATUS> = Operating mode, either ENABLED or DISABLED
<CR>   = carriage return
<LF>   = line feed
```

To set the mode of operation of this option, send an ascii string in this format:

```
F59<SP><FREQ><SP><STATUS><CR>
```

For example, to set Auxiliary Reference operation to 5 MHz input frequency and to enable steering of the internal oscillator from measurements made on this input, send

```
Sample Entry:  F59 5 ENABLED<CR>
Response:      OK<CR><LF>
```

The Auxiliary Reference may be enabled or disabled without changing the input frequency setting by leaving out the frequency:

```
F59 ENABLED <CR>
or
F59 DISABLED <CR>
```

3-5 Changes to Operation Status Displays

3-6 With this option, the XL-DC front panel Status display will report switching of internal oscillator control from GPS to Auxiliary Reference operation. The message "Using Aux Reference" will appear where the display "No Usable Sats" or "Looking for Sats" would appear were this option not present.

3-7 In addition, operation mode status information returned by Serial I/O Function F53 will also report this optional mode of operation when it is active:

```
Sample query:  F53<CR>
Sample response:F53 TIME: USING AUX REFERENCE
```

3-8 KEYPAD/SERIAL I/O Function 73 - REQUEST/SET ALARM
STATUS/CONTROL

3-9 With this option, an additional minor alarm condition is added which indicates the absence of an Auxiliary Reference input. Refer to the Keypad and Serial I/O Function F73 topics of Section III of the GPS-XL or XL-DC Operating Manual for general use of this function.

Keypad Operation:

While scrolling through the individual alarms, using the keypad function 73, this screen will appear when this option is installed:

```
Minor Alarm:        <en>
Aux Ref:            <aux ref status>
```

where <aux ref status> may be "OK", "Fault" or "OK *". The "Fault" indication means that the Auxiliary Reference is either not present or is of the wrong frequency.

Serial I/O Port Operation:

With this option in place, an additional character is active in the minor alarm character fields (both present status and latched status). The character position pertaining to this option is position 6. Under normal operation, a '-' will appear at this position. When a fault exists, or in the latched case, has existed, a 'R' character will appear in position 6.

4-1 THEORY OF OPERATION

4-2 While GPS satellite data is available, the GPS-XL microprocessor controls its internal oscillator via a 16 bit DAC in such a way as to phase lock its output to UTC. When GPS satellite data is not available, the GPS-XL performs high resolution, heterodyne phase error multiplied, frequency offset measurements between the Auxiliary Reference input and the internal oscillator. These measurements are then used to control the internal oscillator, via the 16 bit DAC, in such a way that it is frequency locked to the Auxiliary Reference input. Since all GPS-XL outputs are coherent with the internal oscillator, they are all essentially frequency locked to the Auxiliary Reference input and will diverge from UTC at its rate.

4-3 The GPS-XL provides accurate time and frequency whenever one or more satellites are in view, with optimal performance when four or more satellites are in view. With this option, when satellite outages do occur, the GPS-XL flywheels on the Auxiliary Reference frequency, if it is present. During these periods, the

rate that the GPS-XL time and frequency outputs diverge from UTC is governed by these parameters:

- 1) The accuracy of the Auxiliary Reference frequency at the time of the outage.
- 2) The ambient temperature change during the outage period and the temperature coefficient of the Auxiliary Reference frequency.
- 3) The inherent drift or ageing rate of the Auxiliary Reference frequency as a function of time. For instance, all quartz and Rubidium oscillators exhibit this drift.

Should the Auxiliary Reference input not be present, then the GPS-XL will flywheel on its internal oscillator in the same manner as it would if the Auxiliary Reference Option were not implemented or if it were disabled.

5-1 MAINTENANCE

5-2 There is no maintenance required for this option.