



**LS-26-PR**

***Portable Receiver***

***Technical Manual***

**U26PR01  
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# 1 — Introduction

## 1.1 General

The Lumistar LS-026PR Portable FM Receiver/Digital Bit Synchronizer provides a complete S-Band FM receiver and 20Mbps digital bit synchronizer in a hand-carry enclosure. The FM receiver section of the design is capable of tuning, frequencies from 2200.5 MHz to 2399.5MHz in 500kHz steps. The received FM signal is filtered and demodulated and the resulting PCM stream is routed to the Digital Bit Synchronizer section of the design. The demodulator section of the FM receiver is capable of demodulating an 8MHz RF input resulting in a maximum NRZL PCM data rate of 16Mbps.

The digital bit synchronizer decodes the receiver PCM transmissions providing correlated clock and data recovery. The digital bit synchronizer also provides a user programmable PCM output format, which may be used for tape storage or as a means of providing PCM format translation.

## 1.2 Specifications

| <b>Table 1–1. General Specifications</b> |   |
|--|---|
| Form Factor                              | 9" long x 6" wide x 7-1/2" deep with cover.             |
| Power Dissipation                        | ???   |
| Temperature (Operating)                  | 0 to 50 °C  |
| Temperature (Non-Operating)              | -25 to +70 °C   |
| Host Interface                           | RS-232 19200 baud, 8-bit, 1 stop, ASCII without parity. |

| <b>Table 1–2. Receiver Specifications</b> |  |
|---|--|
| RF Band                                   | S-Band. 2200-2399.95MHz, 50kHz tuning steps. |
| Tuning Range                              | 200MHz max                                   |
| Safe Maximum Input                        | +27dBm                                       |
| Nominal AGC Range                         | 75dBm  |
| VSWR                                      | 2:1 max.; 1.5:1 typical                      |
| Frequency Accuracy                        | 0.002 PPM typical                            |
| Noise Figure                              | 10dB max. ; 6dB typical                      |
| RF Input/70MHz Output (Z)                 | 50 ohms                                      |
| FM Demodulator BW                         | 8MHz Max. (16MHz NRZL data)                  |

**Table 1–3. PCM Bit Synchronizer Specifications**

|                              |   |
|------------------------------|---|
| Input Impedance (Test Input) | ~500Ω   |
| Input and Output PCM Codes   | NRZ-L, NRZ-M, NRZ-S, BiΦ-L, BiΦ-M BiΦ-S, DM-M, DM-S, M <sup>2</sup> M, M <sup>2</sup> S, RZ, RNRZ(2 <sup>11</sup> -1, 2 <sup>15</sup> -1) |
| Bit Rate                     | 50-16Mbps NRZ Codes; 50-8Mbps others  |
| Signal Amplitude             | 0.1V to 10V p-p   |
| Loop Bandwidth (LBW)         | 0.01 to 2% (data rate dependent)  |
| Acquisition Range            | +/- (4 x LBW Setting)   |
| Tracking Range               | +/- (10 x LBW Setting)  |
| Mean Acquisition Time        | 100-150 bits  |

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## **2 — Installation**

### **2.1 Physical**

The Portable Receiver is housed in a 9" x 6" x 7.5" ZERO case.

### **2.2 Power**

Prime power input is a standard male IEC connector on the panel. We provide a power cord for US use. (Nominal) 115 or 230Volt power may be applied. The power switch is included with the input connector.

### **2.3 Connections**

All I/O connections are through the front panel.

The host interface is a female DE09 connector pin-compatible with 9-pin Personal Computer serial interfaces.

The RF input is a type "SMA" connector.

A 70MHz IF testpoint is provided on an "SMA" connector.

Five BNC connectors are provided.

Rcvr PCM Out is the baseband output signal from the receiver FM demodulator.

BSync PCM In is a test input. This provides a baseband input to the PCM Bit Synchronizer when the Bit Synchronizer Test parameter is set to "Ext." Otherwise this input is ignored and the Bit Synchronizer input is in the image of the signal at the Rcvr PCM Out testpoint.

BSync NRZL and BSync CLK are TTL-compatible Bit Synchronizer outputs.

BSync PCM Out is a baseband level representation of the Bit Synchronizer output. It may be NRZL or any of a variety of PCM codes.

A 15-pin subminiature "D" type connector provides a number of auxiliary signals for special purposes. Its pinout is shown in Table 2-1.

**Table 2–1. Auxiliary I/O Connector**

| Pin   | Signal  |
|-------|---|
| 1     | LINKGOOD. This signal reflects an output from the Bit Synchronizer BER Test not normally used for Portable Receiver applications. |
| 2     | CLK2+. High side of Bit Synchronizer RS422 clock output, paired with pin 12.  |
| 3     | NRZL2+. High side of Bit Synchronizer RS422 NRZL output, paired with pin 13.  |
| 4     | TAPE+. High side of Bit Synchronizer RS422 PCM output, paired with pin 14.  |
| 5     | PRBSOUT. Output from the Bit Synchronizer BER Test data generator.  |
| 6..10 | Ground  |
| 11    | AMFIL. Output of the Receiver AM demodulator. This signal is low-pass filtered with a 3dB cutoff at approximately 60kHz.          |
| 12    | CLK2-. RS422 output paired with pin 2.  |
| 13    | NRZL2-. RS422 output paired with pin 3.   |
| 14    | TAPE-. RS422 output paired with pin 4.  |
| 15    | DACRSSI.  |

## 2.4 Controls and Indicators

The Portable Receiver panel has 2 24-character by 2-line LCD display and keypad with four “arrow” keys for local control. Usage is discussed in Chapter 3.

A 70dB rotary step attenuator is connected in series with the RF Input for strong-signal environments.

Neither local nor remote operating software can read the setting of this attenuator.

Two green LED indicators show the status of the Bit Synchronizer Signal Present and Lock detectors.

In practice, the “Thres” indicator is always on. We’re working on that.

## 2.5 Software

A remote *host* application is used to set up the Portable Receiver stored formats. We provide an application for PC-Compatibles with Microsoft Windows 98/2K/XP and one free serial communications port.

The host application would normally be distributed as a monolithic Setup\_LS26V5.exe on CD-ROM. Installation consists of inserting the CD, browsing to that program (if it does not autorun) and executing it. For most users the installation defaults will be satisfactory, just click through them. It will create a folder for the application and a screen icon for it. The computer where the application is installed is now referred to as the “host.”

One configuration setting *may* need to be made. If the Portable Receiver is not connected to COM1, launch the program by double-clicking its icon. At the top of the application window select "Config." Use the Com Port pulldown to select the port. Then click the "Accept" button. You will need to close the application and restart it before it will run properly.

|  |
|--|
| The Portable Receiver must be connected and powered on before launching the host application, regardless of anything you read anywhere else. |
|--|

## 3 — Operation

### 3.1 General

Two user interfaces are associated with the Handheld. Aside from its own front panel display and controls, there is also a host interface, which implies a software application running as a Windows 98/2K/XP task.

### 3.2 Local Operation

When power is applied, the display shows a welcome banner while it is busy waking up. It looks like this:

```
+-----+
| LS-26 Receiver V1.00c |
| Lumistar      (c)2005 |
+-----+
```

**Preliminary.** In the following discussion, please mentally append the sentence, "At least, that was the *plan*." in the white space after each paragraph. Thank You.

#### 3.2.1 Status Display

While the welcome display is up, format specifications of record are retrieved from non-volatile memory and placed into effect. This process takes a few seconds. Then the operational display appears:

```
+-----+
|nn: -qq.rdBm D:tt% A:uu%|
|vvvvvvvvbps >wwwww?Err|
+-----+
```

Where:

**nn** = format number (0..31.) If the Portable Receiver is in local control, the number is followed by a (:) colon. If the receiver is in remote control, it is followed by an (=) equal. In remote control the Receiver and Bit Synchronizer setups may be reviewed but not changed locally. Nor can the format number be changed.

**qq.r** = input signal strength, not counting the rotary attenuator setting.

**tt** = FM Deviation, normalized to (0..99%)

**uu** = AM Modulation Index normalized to (0..99%)

**vvvvvvvv** = PCM Bit Synchronizer measured clock rate.

**>** visible if the Bit Synchronizer BER error counter overflowed.

**wwwwwww** = BER Error Count during the last one-second sample.

**?** visible if BER Tester lost synchronization during the last sample.

If the BER tester was out of sync at the end of the last sample, or if the BER Test Mode is set to “Off,” the BER Error Count is not displayed.

### **3.2.2 Keypad**

A keypad with four arrow keys manipulates the display. The display cursor position is indicated by an underscore. Whenever not busy processing input, the cursor character winks continuously.

When the Status Display is active:

- Up arrow and down arrow keys have no effect.
- Right arrow key selects the Receiver Setup display.
- Left arrow key selects the Bit Synchronizer Setup display.

When either Setup Display is active:

- Up arrow and down arrow keys cyclically change the value of the cursor character or field.
- Right arrow and left arrow keys move the cursor. The movement is not cyclic; moving the cursor off the top left or lower right corner restores the Status Display.

On the respective setup displays, changing a parameter has no effect until the status display is restored, with two exceptions:

If the format number field is changed, the new format is immediately retrieved from nonvolatile storage and placed into effect.

Changing the Bit Synchronizer Test Mode takes effect immediately.

### **3.2.3 Format Numbers**

Thirty-two setups are held in non-volatile memory. When powered off, the Portable Receiver remembers which format number was in effect; this is restored at power-on.

Formats are divided into two groups; Format 0, and Formats (1..31) distinguished by the latter being “pristine,” meaning they are read-only from local control. You may retrieve any of them from either Setup Display but you cannot store one back.

A format includes both Receiver and Bit Synchronizer parameters.

If you use a setup display to access a new format, and return to the Status display without modifying it, the selected format number value will be retained. Whenever you modify a format locally, when you return to the Status display, the format number is changed to 0. Then the resulting new setup is saved, and placed into effect.

### 3.2.4 Receiver Setup Display

A data entry cursor is shown as a blinking character. Right/left arrow moves the cursor, but moving the cursor right from the VF: field, or left from 10's of format number returns to the status display screen. Up/down arrow changes that one digit or field value cyclically, except in the format number field the digits interact with each other to keep the displayed value in the [0..31] range.

A change to anything but the format number does not take effect until you return to the status display screen. Nor is it remembered if you power down while this screen is displayed.

```
+-----+
|nn: ffff.ffMHz TC:1aaams|
|IF:jjjjjkHz VF:vvvvvkHz|
+-----+
```

**nn** = Format Number. As on the status display. If a remote host has been connected and sent any sort of setup command, the prompt character following changes from ":" to "=" to show the screen is now read-only. Otherwise you can up/down arrow to change the format number. The selected format will be retrieved and the display updated.

**ffff.ff** = RF center frequency in MHz, in 50kHz steps. You cannot get to the first digit, it is fixed in the set [1, 2]. The second digit is limited to the set [2, 3] or [4, 5]. The last digit is limited to the set [0, 5].

**1aaa** = AGC Time Constant: Choose from the set of 1, 10, 100, or 1000ms.

IF Bandwidth: Choose from the four selections. These are selections that were made when the receiver is built.

A setting of less than 10MHz results in the cursor resting on a blank.

Video or Post-Detect Cutoff filter: Choose from the four selections. These are selections that were made when the receiver is built.

A setting of less than 10MHz results in the cursor resting on a blank.

Right arrow from this field switches to the status display screen.

If you have changed any receiver setup parameter on this screen, when you leave the screen the receiver is tuned, the format number is changed to 00, and the setup is then saved as format 0. Both the Receiver and Bit Synchronizer setup are so affected.

### 3.2.5 Bit Synchronizer Setup Display

This display works rather like the Receiver setup described above. screen, and the format number field works exactly the same way. The other fields work "similarly."

```
+-----+
|nn: #####bps  LW:xxx%|
|IN:yyyy  OUT:zzzz  TST:mmm|
+-----+
```

**#####** = Bit Rate up to 20Mbps. The screen will allow you to set 29.999999Mbps but that's illegal.

**xxx** = Choose one of the eight standard LS40 loopwidth selections.

**yyyy** = PCM input code. The standard set of NRZ, Bi-Phase, Miller, RNRZ11, RNRZ15 are available. The extended RNRZ codes can be selected remotely but will not be displayed properly here.

**zzzz** = Tape output PCM code. Available selections are the same as the PCM input code.

**TST**: Loopback Test Control. "Off" disables loopback testing for normal operation.

"Ext" causes a test pattern (a 32767-bit pseudorandom pattern) to appear at the loopback test output. Its PCM output code is the same as the selected PCM input code. If approximately this pattern is presented at the front panel BSync PCM In BNC, loopback sync status is achieved and BER measurements can be taken.

|  |
|--|
| The Bit Synchronizer input is disconnected from the Receiver in this mode. |
|--|

"Int" causes this same test pattern to be internally looped into the Bit Synchronizer for confidence testing.

This field works differently from other setup parameters. A change takes effect immediately, without leaving the screen. Right arrow from this field switches to the status display screen.

If you have changed any Bit Synchronizer setup parameter on this screen except TST:, when you leave the screen the Bit Synchronizer is tuned, the format number is changed to 00, and the setup is then saved as format 0. Both the receiver and Bit Synchronizer setup are so affected.

### **3.4 LS26V5.exe**

LS26V5.exe is a Microsoft *Windows* application used to control the Portable Receiver. This program is very similar to the one used with the LS26 Airborne Receiver, so much so that it can be used with either type of hardware. Consequently, the Operating section of the Lumistar *LS-26-SB5 Quick-Start Guide* is applicable and may be taken as an extension to this document. I would insert it here except