



Portable Test Transmitter

Technical Manual

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September 2006***

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Table of Contents

1 — Introduction	
1.1 General.....	1-1
1.2 Specifications.....	1-1
Table 1–1. General Specifications	1-1
Table 1–2. PCM Transmitter Specifications	1-1
Table 1–2. PCM Simulator Specifications	1-2
2 — Installation	
2.1 Physical.....	2-1
2.2 Power	2-1
2.3 Connections	2-1
2.3 Software.....	2-2
3 — Operation	
3.1 General.....	3-1
3.2 Front Panel Controls	3-1
3.2.1 Keypad.....	3-2
3.2.2 RF Parameter Settings	3-2
3.2.3 PCM/PRN and INT/EXT	3-2
3.2.4 RF Output Control	3-3
3.3 Baud Rate Recovery	3-3
3.4 LS11HandHeld.exe	3-3
3.4.1 Menu Bar.....	3-3
3.4.1.1. <u>F</u> ile Menu	3-3
3.4.1.2. <u>C</u> onfig Menu	3-4
3.4.1.3 <u>L</u> oadAll.....	3-4
3.4.2 Format Name Bar.....	3-4
3.4.3 Handheld Screens	3-4
3.4.4 Simulator Page.....	3-5
3.4.5 Transmitter Tab	3-5
3.4.6 Query Tab	3-5
4 — Programming Information	
4.1 Serial Communications	4-1
4.1.1 Select Format Number	4-2
4.1.2 Set Format Name.....	4-2
4.1.3 Recall	4-2
4.1.4 Simulator Run/Halt	4-2
4.1.5 RF Parameters	4-3
4.1.6 Clock Generator	4-4
4.1.7 Mode Registers.....	4-4

4.1.8 Memory Access	4-5
Table 4-1. Frame Start Register (<i>0 T</i>)	4-5
Table 4-2. Mode Register (<i>1 T</i>)	4-6
Table 4-3. Code Register (<i>2 T</i>)	4-6
Table 4-4. Simulator Memory Map	4-8
4.1.9 Save Format	4-8
Table 4-5. Simulator Word Attributes	4-8
Table 4-6. Simulator Frame Attributes	4-8
4.1.10 Return Status	4-9
4.1.11 Configuration EEPROM	4-9
4.1.11.1 Options	4-10
Table 4-7. EEPROM[14] Options	4-10
4.1.12 Direct D/A Write.....	4-10
5 — LS11Q	
5.1 General.....	5-1
Table 5-1. LS11Q Specifications.....	5-1
5.2 LS11Q Front Panel I/O	5-1
5.3 LS11Q Operation.....	5-2
5.4 LS11Q Programming Information	5-2
5.4.1 LS11QRF Parameters.....	5-2
5.4.2 LS11Q Status Query.....	5-3

1 — Introduction

1.1 General

The Lumistar Portable Test Transmitter (herein, "Handheld," albeit it is admittedly quite a handful – it takes a chunk of lead to hold 75 watt-hours) provides a convenient sample signal for field link checkout. A flexible preprogrammed PCM simulator can modulate a low-powered wideband FM transmitter. The simulator is packaged in a convenient carrying box. The test transmitter offer's a full shift's battery operation and includes an on-board battery charger/eliminator.

The "LS11Q," as referred to herein, uses a Quasonix QSX-VST RF transmitter module to provide an SOQPSK output capability. This model has a number of differences summarized in Chapter 5.

1.2 Specifications

Form Factor	9" long x 6" wide x 7-1/2" deep with cover.
Power Dissipation	Less than 10 watts.
Battery Capacity	Greater than 12 hours when fully charged.
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. Optional: 600, 1200, 2400, 4800, 9600, 38400, 115200 baud.

RF Band	LS11: S-Band (2200-2400MHz.)
Tuning Range	200MHz max
Modulation Type	Wideband FM
Modulation Source	PCM Simulator or Front-Panel Baseband input
Output Power	-60 to +10dBm Max (<i>approximate</i>) in 5dB steps
Pre-Modulation Filter	Four selectable 4-Pole Bessel Filters, F1 points 0.5MHz, 1MHz, 2.5MHz, 5MHz. Others on special order.
FM Deviation	150kHz .. 7000kHz Peak in 10kHz increments

Table 1–2. PCM Simulator Specifications	
Format Selection	Four format definitions in non-volatile memory
Front Panel Outputs	NRZ-L and PCM Data, 0-degree clock & minor frame strobe
Output Levels	Single-ended TTL
Output Data Rate	100bps to 20Mbps (NRZ codes) 100bps to 10Mbps (all other codes)
PCM Codes	NRZ-L/M/S; Bi-Phase -L/M/S; DM-M/S; M^2 , RNRZ-L11/15, k=7 Convolutional Rate 1/2, 1/3
Word Length	Variable from 3 to 16 bits per word on a word-by-word basis
CRC Generator	CRC16/CCITT Forward/Reverse
Minor Frame Length	2 to 8,192 words per minor frame
Major Frame Length	Up to 1024 minor frames per major frame
Bit Order	MSB or LSB-first
Frame Sync Pattern	Up to 256 words (any series of 0s or 1s may be used)
Major Frame Sync	FCC (FAC), SFID
Common Words	May be a single value or selected from a group of one minor frame.
Unique Words	Seven may be programmed in any mainframe, super-commutated, or sub-commutated channel.
Test Output	32,767-bit PRN pattern
Waveform Words	Five may be programmed to appear in every frame at the same location.

2 — Installation

2.1 Physical

The LS11 is housed in a 9"x6"x7.5" ZERO case.

2.2 Power

Set the 115/230 switch on the front panel according to which continent you're on. Prime power input is a standard male IEC connector on the panel. We provide a power cord for US use.

The unit includes a battery charger that is powered whenever the unit is plugged in, regardless of the state of the power switch.

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 output is a type "N" connector.

Five BNC connectors are provided.

The external input can be selected as a modulation source. This input is terminated into 75 ohms and the expected input signal is 2V p-p for indicated deviation.

Four Test outputs are provided.

The Baseband output is a bipolar PCM output with a nominal signal level of 2V p-p terminated into 75 ohms.

The Clock and NRZL outputs are TTL levels and can be connected to a PCM decommutator or such device for test purposes. The Sync output is also TTL level. When PCM output is selected, it is asserted high during the last bit of the minor frame. When PRN output is selected, it is high for one bit period each cycle (32,767 bits) of the PRN pattern.

2.3 Software

A remote *host* application is required to set up the Handheld internal PCM simulator. 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_LS11.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 before the application will run. Launch the program by double-clicking its icon. At the top of the application window select "Config." From the dropdown select the (one) "Com Port" option.

If the Handheld is not going to be connected to COM1: use the Com Port pulldown to select the port. Then click the "Accept" button. You may close the application at this time unless you intend to use it immediately.

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 Front Panel Controls

The Handheld includes a built-in battery charger/eliminator that is active whenever AC power is available. The Handheld power switch controls the supply of battery (and charger) power to its internal circuitry.

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

```
+-----+
| LS-11 Simulator V2.01c |
| Lumistar, Inc (c)2005 |
+-----+
```

While the welcome display is up, the Handheld is retrieving the PCM format and transmitter information of record from non-volatile memory and placing it into effect. This process takes two or three seconds. Then the operational display appears:

```
+-----+
|nnnnnnnn qrrr.sM Dev=ttt|
|F:uuuuukHz-vwdBm xxx yyy|
+-----+
```

Where:

n = format name

qrrr.s = freq (500 kHz steps.) q is not a user field. It is controlled by the frequency limits of the supplied RF head.

ttt = deviation (009..700)

u = PMF select in kHz

v = output level 10dB step

w = output level 5dB step.

xxx = "PCM" or "PRN"

yyy = "INT" or "EXT"

3.2.1 Keypad

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

That means almost always, except when the Handheld is loading a new format selection from internal storage, or when the host interface receives a command to save the present new format. That process causes the blink to stop for several seconds.

Each legitimate position for the cursor is a "field." The cursor right and left arrow keys move the cursor cyclically from one field to the next. The cursor up and down arrow keys cyclically change the value of that field.

Except for the format name field, the resulting new value takes effect immediately. A change to the format name does not take effect until the cursor is moved. This will stop the cursor blink momentarily while new information is being recovered and loaded. The PCM simulator is stopped during this process.

3.2.2 RF Parameter Settings

A stored format definition has frequency, deviation, and Pre-Mod filter settings embedded in it. These settings act like "smart thumbwheels." When a new format is loaded, the settings embedded in the format definition are placed into effect. You may alter these settings, and your changes will be preserved across power cycles, until you choose a different format definition.

RF frequency settings from the host interface or recalled from stored formats are clamped within band edges. Frequencies set from the front panel are **not**. The tuning range via front panel setting is 199.5MHz starting at some frequency nn00.0MHz. It is possible to go out of band.

The output level setting is specifically NOT stored and recalled as part of the format definition. It acts more like a regular thumbwheel and changes only on command. The output level also differs in the behavior of the 5dB step. Repeated 5dB steps "carry" into the 10dB digit unless the adjustment is at the end of range.

3.2.3 PCM/PRN and INT/EXT

These display fields control the transmitter output. Selecting anything but "PCM" causes the defined PCM data to be supplanted by a cyclic pseudo-noise pattern using the same bit rate and output coding scheme. The choices are 2047 (11) and 32,767 (15) bit patterns. A "+" indicates one

error is introduced per pattern to yield a forced 4.885×10^{-4} or 3.05×10^{-5} BER.

Selecting "EXT" disconnects the PCM or PRN data from the transmitter and connects the External Modulation input to it.

3.2.4 RF Output Control

A separate toggle switch controls the RF output. When power is applied, this switch is disarmed until it is turned off. Thereafter, it is active.

When the RF switch is in the "Off" position, all RF circuitry in the Handheld is disabled.

When the RF switch is turned "On" the RF synthesizer is enabled. The RF LED indicator begins to blink. After a warm-up period, the LED stops blinking and the RF output amplifier is turned on.

3.3 Baud Rate Recovery

Serial communications may be lost from the Handheld baud rate being set incorrectly by inadvertent (or deliberate) writes to its configuration EEPROM (See Table 4–7.) If this appears to have happened, tell your software engineer to go back and read ¶4.1.11.1 again. Meanwhile, turn the power switch off. *While holding both the cursor left and right buttons down*, turn the power back on. Continue to hold the buttons until the normal operating display appears. This "three-fingered-salute" forces the baud rate to 9600 until power is cycled again.

3.4 LS11HandHeld.exe

On the host, LS11HandHeld provides a path to store PCM format and RF setup information in the Handheld for later field use. To use it meaningfully the Handheld serial port must be connected to a COM: port on the host. Then launch the program by double-clicking its icon. All normal operations of the program take place in a single window. The window has a menu bar at the top, and three display pages with selection tabs.

3.4.1 Menu Bar

The menu bar has three selections at the top.

3.4.1.1. File Menu

Clicking on **F**ile yields a dropdown with entries typical for Window Applications. The dropdown selections refer to Handheld setups saved in .ls11 files.

If a .ls11 file is currently in use by the program, its name appears in the bar at the very top of the window. File Save stores the current setup to that selected file. If no file is open, this selection will default to a File Save As.

File Save As is for use when no file is currently in use, or when you want to create a new .ls11 file or update an old one without overwriting the one in effect. Selecting this opens a regular Windows popup allowing you to choose a folder and filename. Performing this operation also makes the new file the current file.

File Recall is exactly the opposite of File Save As. Selecting this opens a regular Windows popup allowing you to choose a folder and *existing* filename. Selecting a name causes the parameters from that file to be read and makes it the current file.

Recalling a file has no effect on the Handheld itself.
--

3.4.1.2. Config Menu

Clicking on **C**onfig yields a single entry, Com Port. Selecting it pops a window where a COM: port and parameters can be selected. The default selections of 19200 baud, 8 bit characters with 1 stop and no parity should never be changed for this application, but you will need to specify which COM: port the Handheld is connected to. Click the "Accept" button to close the window.

3.4.1.3 LoadAll

Selecting LoadAll transfers the simulator and transmitter settings of the current setup to the Handheld and directs it to save them to its nonvolatile storage. Before doing this, you must select a format number and edit the format name if necessary in the format name area just below the menu bar.

3.4.2 Format Name Bar

The Handheld can store up to four different setups. This bar allows selection of a format number and a name for that format. The format number controls which format will be overwritten when a setup is written to the Handheld. You are allowed to choose an eight-character name for the format.

3.4.3 Handheld Screens

The application window has three tabs at the top. Setup pages for the PCM Simulator and RF transmitter are displayed by clicking the appropriate tab. The Query page displays display and configuration information read back from the Handheld.

3.4.4 Simulator Page

This page displays setup information for the Handheld PCM simulator. Those previously exposed to our LDPS program and its relatives will see something familiar because the Handheld simulator has capabilities similar to the LS50 simulator except its minor frame length is limited to 8,191 words.

Format definition information is displayed in several white-outlined boxes. To edit a parameter, put the cursor in the box and right-click. This yields a menu where you can select a parameter and open an edit window for it. Limits of a parameter are shown in the edit window.

I may be bold in presuming my readers are somewhat familiar with the terminology associated with PCM formats.

Clicking the Word Attributes button opens a popup where data values for common words can be entered or calculated. Also, if the format needs a few oddball-length words, they can be identified here. If you make any changes to word attributes, make sure you click "Apply" to close the window.

Click the Load Simulator button to send the setup to the Handheld.

If you changed anything on the Transmitter setup page, make sure you clicked Load Transmitter on that page before you click Load Simulator on this page! Otherwise those changes will be lost as soon as the Handheld user happens to change formats or cycle power.

3.4.5 Transmitter Tab

This page displays setup information for the Handheld RF Transmitter.

The transmitter frequency is clamped and pre-mod filter selections within the limits returned by the Handheld itself. Deviation is displayed as a number between 9 and 299, each increment being equal to 10,000 Hz of Peak Deviation .

Note there is an output level setting on this page, and you need to push the Load Transmitter button to place it in effect. This is **not** part of the format definition, but it doesn't really fit anywhere else.

3.4.6 Query Tab

When the Handheld application is launched it attempts to make contact with a Handheld on the specified COM: port. If it connects, status information is recalled from the Handheld and displayed here. If you're

playing with buttons over there, you can click the Query LS11 Info button here to refresh this display.

Format and Pre-Mod filter selection numbers on the screens are one-based, but the (raw) query data reflects zero-based numbers.

4 — Programming Information

4.1 Serial Communications

This chapter is targeted at any author developing a remote host application for the Handheld. This is a description of the data transmitted over the host interface.

Communication with the Handheld consists of exchange of short "packets." I put "packet" in quotes because the definition of packet here is unique. Each command from the host is a single packet. Once sent, the host must wait for a response before sending anything else.

Packets are strings of ASCII characters. Each transaction is initiated with a command packet from the host, and ends with receipt of a response packet from the Handheld. With one exception, a command packet consists of *zero or more* numeric parameters separated by spaces and ending with an alphabetic command character. A response packet consists of *zero or more* numeric values separated by spaces and ending with a carriage return character. Alpha characters are not case-sensitive (except for the string following "H".) All numbers in both directions are short (16-bit) hexadecimal integers. Numbers in response packets will be zero-extended to four digits. It is permissible, but not necessary, to do so in command packets. If a parameter has more than four digits, the last four are used.

When the Handheld sees a command character it stops accepting input and processes it. Any unused parameters are discarded, do not carry over to the next command. The next command may be initiated as soon as a carriage return ends the response packet.

All numbers are unsigned short hex integers. A number is a string of one or more consecutive digits. (A..F and a..f are considered to be digits.)

In the command summary following, numbers are signified as nnnn. Some commands take two parameters. A space is required to separate them. A space after the last parameter is optional. One is shown one here only for clarity.

All instances of "X" are ignored, so "0x123" is treated as 123.

Some of the commands down the list are for our factory use. They are included in this document mostly to make sure they are written down someplace.

4.1.1 Select Format Number

Four positions are available to store a setup.

n N

selects a format where n is [0..3] If you intend to store a format you must do this first.

4.1.2 Set Format Name

An eight-character name is associated with each format position, and displayed on the panel when that format is selected. When creating setups for a format,

Hzzzzzzzz

Sets the name where *zzzzzzzz* is a string of EXACTLY eight printable ASCII characters. This command may be issued sometime between "N" and "S" Avoid giving the same name to two different formats.

Character values in the range [0xA0..0xDF] are Katakana

4.1.3 Recall

To recall an existing format definition, where n is [0..3] Issue a "Y" command. This will read the stored format back from nonvolatile memory and place it into effect. This normally takes a few seconds:

n Y

4.1.4 Simulator Run/Halt

The simulator must be halted

0 R

to access memory or to store a format definition. It must be running

1 R

to generate a data stream.

4.1.5 RF Parameters

Transmitter RF parameters are set by "G" commands. A well-formed G command consists of two numeric parameters followed by an ASCII G. The actual value is the first parameter. The second parameter is an index to identify the first parameter:

nnnn 0 G

nnnn is Fc in units of 100kHz. This is rounded down to a 500kHz tuning step. The RF synthesizer is immediately retuned if currently enabled. The value becomes part of the present format definition if it is subsequently saved.

nnnn 1 G

sets FM deviation to nnnn, a number in the range [0..999] I want to say it's FM deviation in units of 10kHz but I cannot. A change takes effect immediately. The value becomes part of the present format definition if it is subsequently saved.

nnnn 2 G

nnnn in the set [0..3] selects a Pre-Mod filter. Cutoffs are NOT predetermined; their values can be gotten by a "Q" query. The value becomes part of the present format definition if it is subsequently saved.

nnnn 3 G

Set output level where nn is attenuation in units of 5dB. The value is **not** part of the present format definition. It is saved from one power cycle to the next, but is not updated if a new format is recalled. Making the value bigger *reduces* the output level. Sane values are in the range 0 (+10dBm) through 15 (<-60dBm.)

n 4 G

Enable (n=1) or disable (n=0) RF transmitter output.

This only works if the front panel RF switch is **on**. The idea was to err on the side of *not* accidentally radiating.

n 5 G

Connect the simulator output (n=0) or the External Modulation BNC to the RF transmitter input.

n 6 G

Select the PCM format or a PRN pattern as the simulator output:

n	Output
0	Defined PCM Format.
1	$2^{11}-1$ PRN Pattern.
2	$2^{11}-1$ PRN Pattern with one error/pattern.
3	$2^{15}-1$ PRN Pattern.
4	$2^{15}-1$ PRN Pattern with one error/pattern.

4.1.6 Clock Generator

The simulator clock generator is set by a "K" command. The clock rate is a long integer split into two parameters where nnnn is the LSBs of the clock rate and mmmm is the MSBs:

mmmm nnnn K

The simulator uses a Number Controlled Oscillator (NCO) to generate its output clock. Exercise the following algorithm to get the NCO operating.

1. Start with the desired output bit rate.
2. If the logical AND of 0x0C and the value (chosen according to the output code) written to the Code register (see below) is not zero, multiply the rate by 2. Otherwise multiply by 1.
3. If the RATE bit in the Code register is set, multiply the rate by 2, but if the 1/3 bit is also set, multiply the rate by 3.
4. Clamp the upper bound of the rate at 20,000,000. Neither the NCO nor the simulator are certified reliable beyond that point.
5. If the result is 262,144 or greater, the DIV field in the Mode register (Table 4–2) should be 00. Otherwise choose a DIV field and multiply the rate by the "by" factor to get larger than 262,144 if possible. Cleave the value into 16-bit halves for the command.

4.1.7 Mode Registers

The Handheld has three mode registers that must be set to complete the PCM format definition. Undefined bits in these registers must be zero.

nnnn 0 T

Writes the Frame Start register. Bit assignments are shown in Table 4–1

nnnn 1 T

Writes the Mode register. Bit assignments are shown in Table 4–2.

nnnn 2 T

Writes the Code register. Bit assignments are shown in Table 4–3.

4.1.8 Memory Access

The simulator uses two separate memories during its operation. Each minor frame word location has an attribute word associated with, and a data value to be output. The attribute table and common value tables are each 16K (16-bit) words long. There are also tables of unique, sync, and waveform values. These items are together in one 32K-word memory. There are four pages of this memory, making 128K words total. Juxtaposed with that, there are four pages of simulator frame attributes in a separate memory. Each of these pages is 1K (8-bit) words.

The Handheld presents you with a 64K word address space. The word attribute and data memory occupies locations 0..0x7FFF of that space. The frame attribute memory occupies locations 0x8000.0x83FF. The remainder of the space is unused. Two additional high-order address bits are specified by the most recent Select Format Number ("N") or Recall ("Y") command.

Table 4–1. Frame Start Register (0 T)

Bit	Mnemonic	Description
9..0	1STFRAME	Frame number of the first minor frame in the major frame.
12	SFUP	When set, causes minor frame numbers to increment in the course of the major frame.
13	FAC	When set, words with the FSP attribute are inverted during odd-numbered minor frames.
14	FCC	When set, words with the FSP attribute are inverted during the first minor frame of each major frame.
15	WDST	Always set this bit.

Writes hexadecimal nnnn to memory location aaaa. The frame attribute memory is a single byte wide, so if aaaa > 0x7FFF only the lsb's of nnnn have meaning.

aaaa 0

Reads location aaaa and sends its hexadecimal value back in a return packet. Normally this would only be needed to reverse-engineer an existing stored format.

Memory accesses with the simulator running are ignored. (Reads return 0000.)

The data/word attribute memory is mapped as shown in Table 4–4. Remember there are actually four such memories, selected by the format number.

The frame attribute memory is strictly a lookup by minor frame number. The part of the Reserved area between 0x2200 and 0x23FF is used internally as an image of the frame attribute data.

The simulator Frame Attribute Memory is loaded with frame attributes (believe it or not!) The Data and Word Attribute Memory holds both output data and word attributes.

Each minor frame word location has an associated attribute word. The attribute words are stored in data memory (See Table 4–4 for location.) The attribute word is formatted per Table 4–5.

Each minor frame in the major frame has an attribute word in the Frame Attribute memory, as shown in Table 4–6.

Data in the data areas is always right-aligned, regardless of word length or bit ordering. However, for LSB-first data, the frame sync words need to be bit-reversed to get the pattern to output properly. Also note the simulator allocates an integral number of words to the frame sync pattern, and an entire word to the SFID count, regardless of how many bits they actually use. The simulator design provides support for formats using FCC or SFID major frame correlation. There is no provision for URC formats *per se*. To simulate a URC, you will need to pre-empt enough unique words to put the URC pattern in the first minor frame.

Range	Definition
0x0000–0x1FFF	Common data values, lookup by word number mod 8192 (CWS=0.)
0x2000–0x2006	Unique word values, lookup by unique word number.
0x2007	CWS data value meaningful only if CWS=1.
0x2008–0x23FF	Reserved.
0x2400–0x27FF	Frame Sync Pattern data, lookup by word number modulo 1024.
0x2800–0x2BFF	SFID data, lookup by minor frame number.
0x2C00–0x2FFF	Waveform 1 data, lookup by minor frame number.
0x3000–0x33FF	Waveform 2 data, lookup by minor frame number.
0x3400–0x37FF	Waveform 3 data, lookup by minor frame number.
0x3800–0x3BFF	Waveform 4 data, lookup by minor frame number.
0x3C00–0x3FFF	Waveform 5 data, lookup by minor frame number.
0x4000–0x7FFF	Word attributes, lookup by word number modulo.
0x8000–0x83FF	Frame attributes.

4.1.9 Save Format

Save Format copies the RF parameters and Mode Register values into the parameter area, then copies the simulator RAM to flash memory. If the same format is selected later, the flash is read and put into effect. The save process normally takes about three or four seconds. If the simulator is not halted, the save is ignored and the command returns immediately.

S

Bit	Mnemonic	Description
6..0	WSPL <i>n</i>	If FSPL <i>n</i> (<i>n</i> =0..5) is set for the current frame, substitute contents of unique word <i>n</i> location for whatever other data would be output here.
7	CRCW	Output the CRC checkword, starting with the first bit of this word. The checkword output lasts for 16 bit periods, during which any other data otherwise defined for output is discarded.
11..8	WL	The word length in bits, less 1.
14..12	I	Data source for this word, unless overridden by CRC or unique word: 000 – Common data. 001 – Frame Sync Pattern data 010 – SFID data 011 – Waveform 1 data 100..111 – Waveform 2..5 data
15	EOF	Set to identify last word in minor frame.

Bit	Mnemonic	Description
6..0	FSPL <i>n</i>	If WSPL <i>n</i> set for the current word, substitute contents of unique word <i>n</i> location for whatever other data would be output here.
7	EOSF	Set to identify last minor frame in the major frame.

4.1.10 Return Status

Two status query commands are included. Each returns a list of hexadecimal numbers. Some things are repeated between the lists, they return different copies of data that should match. The simulator does not need to be halted to query. The "W" query was mostly written for our development use.

Q

returns numbers n1 n2 n3 ... <carriage return> These are interpreted as:

- n1 = Format Number of current format.
- n2 = Minimum allowable center frequency in MHz
- n3 = Maximum allowable center frequency in MHz (add 0.5)
- n4 = Pre-Mod Filter #0 cutoff in kHz
- n5 = Pre-Mod Filter #1 cutoff in kHz
- n6 = Pre-Mod Filter #2 cutoff in kHz
- n7 = Pre-Mod Filter #3 cutoff in kHz
- n8 = VCO Reference divider. It's 10241. You don't care.
- n9 = Center Frequency currently on screen.
- n10 = Deviation value currently on screen.
- n11 = Pre-Mod Filter selection currently on screen.
- n12 = Output level setting currently on screen.
- n13 = 0 if output is defined PCM stream, 1 if PRN pattern.
- n14 = 0 if transmitter driven from simulator, 1 if external mod input.
- n15 = 0 if front panel RF switch off, 1 if on.

W

returns numbers n1 n2 n3 ... <carriage return> These are interpreted as:

- n1 = Fc currently on screen.
- n2 = Deviation currently on screen.
- n3 = PMCO Selection currently on screen.
- n4 = Clock Rate MSBs.
- n5 = Clock Rate LSBs.
- n6 = Frame Start Register.
- n7 = Mode Register.
- n8 = Code Register.
- n9..n12 = Format name. BIG-ENDIAN (msb of n9 is first char.)

4.1.11 Configuration EEPROM

Besides the storage of formats the Handheld has another nonvolatile memory for storage of configuration and calibration data. Locations [0..13] are the values returned by a "Q" query. Location 15 is the firmware

revision number. Normally a user application would not need these commands, but locations [16..31] potentially have utility in that they hold the names of the four format definitions currently stored, in the same format as the format name returned by "W". The simulator does not need to be halted for these accesses.

aaa I

Returns value of location aaa.

nnnn aaa L

writes nnnn to location aaa.

4.1.11.1 Options

Location 14 holds option information. At this writing, the usual factory default for this location is 0x05FA, interpreted as shown in Table 4–7.

Table 4–7. EEPROM[14] Options		
Bit	Mnemonic	Description
7..0	BAUD	Sets baud rate for serial communications after the next time power is applied. The usual default value is 0xFA for 19.2k baud. Values not in the following list are nonsense: 0x40 – 600 0xF4 – 9600 0xA0 – 1200 0xFA – 19.2k 0xD0 – 2400 0xFD – 38.4k 0xE8 – 4800 0xFE – 115.2k
8..11		Reserved.
12	XMITEN	If zero, the RF switch is disarmed at power on, meaning the RF circuitry is disabled until the switch is turned off and back on. Setting this bit arms the switch.
13..15		Reserved.

4.1.12 Direct D/A Write

Two digital/analog converters are used in the Handheld. A command was needed to write deviation (m=0) and attenuation (m=1) values to them for calibration.

nnnn m V

5 — LS11Q

5.1 General

The LS11Q is based on the LS11 “Handheld” design but incorporates a Quasonix QSX-VST RF Transmitter module, which results in a number of detail differences summarized in this chapter. Items not mentioned are identical to the LS11.

Specifications not listed here are identical to the LS11. See Chapter 1.

Table 5–1. LS11Q Specifications	
Power Dissipation	Less than 25 watts.
Battery Capacity	tbd, but shorter than LS11
RF Band	S-Band (2200-2394.5MHz.)
Modulation Type	Wideband FM, SOQPSK, MHCPM
Modulation Source	PCM Simulator or Front-Panel TTL Data/Clock input
Output Power	? to +10dBm Max (<i>approximate</i>) in 5dB steps
Baseband Output Filter	Eight selectable 4-Pole Bessel Filters, F1 points 0.5MHz, 1MHz, 2MHz, 4MHz, 6MHz, 8MHz, 10MHz, 15MHz.
FM Deviation	Determined by data rate.

5.2 LS11Q Front Panel I/O

Six BNC connectors are provided.

External modulation is expected at TTL levels, and a TTL-level clock is required.

Four Test outputs are provided.

The Baseband output is a bipolar PCM output. This signal passes through the selected baseband output filter (unlike the LS11, this filter has no effect on the RF signal).

The Clock and Data outputs are TTL levels and can be connected to a PCM decommutator or such device for test purposes. For NRZ-type codes the clock is at bit rate. For Bi-Phase and Miller codes the clock is at twice bit rate.

5.3 LS11Q Operation

The LS11Q front panel operation is the same as the LS11 except as noted below. When power is applied, the LS11Q display shows a welcome banner while it is busy waking up. It looks like this:

```
+-----+
| LS-11Q Simulator V3.00c |
| Lumistar, Inc (c)2006  |
+-----+
```

The LS11Q may not recover properly from a brief power cycle. If this occurs the welcome banner will stay up. To recover, turn the power switch off for at least five seconds.

The LS11Q does not provide FM deviation control. Deviation is automatically set by the RF module. In its place, the RF transmit mode is displayed as **PCMFM**, **SOQPSK**, or **MHCPM**.

The LS11 “warm-up” period during which the RF Transmit LED blinks is eliminated. The Quasonix RF generator does not need it.

In a Baud Rate Recovery state (see ¶3.3) the RF output is disabled until power is cycled again.

5.4 LS11Q Programming Information

Most of the programming information is identical except as noted. An LS11Q can be identified by a query to the firmware revision number:

0F I

This will return a four-digit hexadecimal number in ASCII. Values in the range 0x3nnn identify an LS11Q.

5.4.1 LS11QRF Parameters

nnnn 1 G

sets the Transmitter mode, encoded as: 0: FM, 1: SOQPSK, 2: MHCPM.

nnnn 2 G

nnnn in the set [0..7] selects a Baseband Output filter. Note this is not a Pre-mod filter, it affects only the front-panel baseband output. The value becomes part of the present format definition if it is subsequently saved.

5.4.2 LS11Q Status Query

The LS11Q returns a different and longer list of parameters.

Q

returns numbers n1 n2 n3 ... <carriage return> These are interpreted as:

- n1 = Format Number of current format.
- n2 = Minimum allowable center frequency in MHz
- n3 = Maximum allowable center frequency in MHz (add 0.5)
- n4 = Baseband Output Filter #0 cutoff in kHz
- n5 = Baseband Output Filter #1 cutoff in kHz
- n6 = Baseband Output Filter #2 cutoff in kHz
- n7 = Baseband Output Filter #3 cutoff in kHz
- n8 = Baseband Output Filter #4 cutoff in kHz
- n9 = Baseband Output Filter #5 cutoff in kHz
- n10 = Baseband Output Filter #6 cutoff in kHz
- n11 = Baseband Output Filter #7 cutoff in kHz
- n12 = Center Frequency currently on screen.
- n13 = RF Transmit mode currently on screen.
- n14 = Baseband Output Filter selection currently on screen.
- n15 = Output level setting currently on screen.
- n16 = 0 if output is defined PCM stream, 1 if PRN pattern.
- n17 = 0 if transmitter driven from simulator, 1 if external mod input.
- n18 = 0 if front panel RF switch off, 1 if on.

and maybe n19 = Celsius RF transmitter temperature.