LS27B Hardware User's Manual

Dual channel Multi-Band RF Downconverter with AM and Optional FM Demodulation

Document:	USM-27B-03-001-04
Author:	B. Graber
Date:	04/10/17
Release:	Rev D

Lumistar Inc

2270 Camino Vida Roble, Suite L

Carlsbad, California 92011

(760) 431-2181

www.lumistar.net

Lumistar Inc.
2270 Camino Vida Roble, Suite L
Carlsbad, CA 92011
(760) 431-2181
(760) 431-2665 Fax
www.lumistar.net

TABLE OF CONTENTS

1 INTRODUCTION 4

1.2 MANUAL FORMAT AND CONVENTIONS 4

2 THEORY OF OPERATION 9

2.1 1ST DOWNCONVERSION 9
2.2 1ST IF BAND-PASS FILTER 9
2.3 1ST LOCAL OSCILLATOR 9
2.4 2ND DOWNCONVERSION 10
2.5 2ND LOCAL OSCILLATOR 10
2.6 2ND IF FILTER 10
2.7 DIGITAL AGC/LIMITING AMPLIFICATION/AM DEMODULATION 10
2.8 DIGITAL SIGNAL PROCESSING ENGINE (DSPE) 10
2.9 FM DEMODULATION STAGE (OPTIONAL) 11

3 INSTALLATION AND CONFIGURATION 12

3.1 PRODUCT OUTLINE DIAGRAMS 12
3.2 HARDWARE CONFIGURATION 12
3.3 STATUS LED 17
3.4 PHYSICAL INSTALLATION 17
3.5 INTERCONNECTION 19
3.6 EXTERNAL SETUP DISCRETES 27

4 COMMUNICATIONS 28

4.1 SERIAL INTERFACE OPTIONS 28

5 PROTOCOL AND MESSAGING 30

5.1 PROTOCOL 30
5.1.1 COMMAND AND STATUS MESSAGING 30
5.1.1.1 PING COMMAND MESSAGE 33
5.1.1.2 PRIMARY SETUP COMMAND/RESPONSE MESSAGE 33
5.1.1.3 SECONDARY SETUP COMMAND/RESPONSE MESSAGE 34
5.1.1.4 APPEND FLASH FILE SECTION COMMAND/STATUS MESSAGE 36
5.1.1.5 GENERAL STATUS COMMAND/RESPONSE MESSAGE 38
5.1.1.6 EEPROM PAGE READ COMMAND/STATUS MESSAGE 38

1 Introduction

1.1 General

This document is the Hardware User's Manual for the Lumistar LS27B Dual Channel Multi-band RF Downconverter. This product represents Lumistar's 3rd generation of the LS27 Series of Dual Channel RF Downconverters. In addition to the functionalities of the Lumistar LS27P3 PCI downconverter, this product also provides and optional FM demodulation stage for each input channel. Figure 1-1 contains detailed model number construction. This document applies to all model combinations indicated by this figure.

The intent of this document is to provide physical, functional, and operational information for the end user including hardware configuration, interconnection and software interfaces for the device.

The design implements a Digital Signal Processor Engine (DSPE) controlled superhetrodyne downconverter with AM demodulation and optional FM demodulation. This receiver is in the physical format and size similar to a standard 5 3/4" CD or DVD drive format. The product provides two independent and autonomous multi-band downconversion stages. Each channel provides the conversion of up to four RF pass-bands to a 70MHz Intermediate Frequency (IF) output while providing AM demodulation of the input signal. The product's standard configuration provides eight software selectable IF bandwidth filters, roughly placed at octave intervals (or as ordered by the customer), to reduce channel noise bandwidth and improve adjacent channel rejection. The product line can optionally be equipped with an FM demodulation stage and eight video filters.

Table 1-1 provides specifications for electrical, mechanical, and operational characteristics of the LS27B product. A block diagram of the product design is shown in Figure 1-2.

1.2 Manual Format and Conventions

This manual contains the following sections:

- Chapter 1 provides a brief product overview and technical specifications
- Chapter 2 provides receiver theory of operation
- Chapter 3 provides installation and configuration instructions
- Chapter 4 provides programming information

Throughout this document, several document flags will be utilized to emphasis warnings or other important data. These flags come in three different formats: Warnings, Cautions, and Information. Examples of these flags appear below.

Warning:

(Details of critical information which prevents loss of functionality)

Caution:

Details of operational or functional cautionary advisories

Information:

(Details of emphasised operational information)

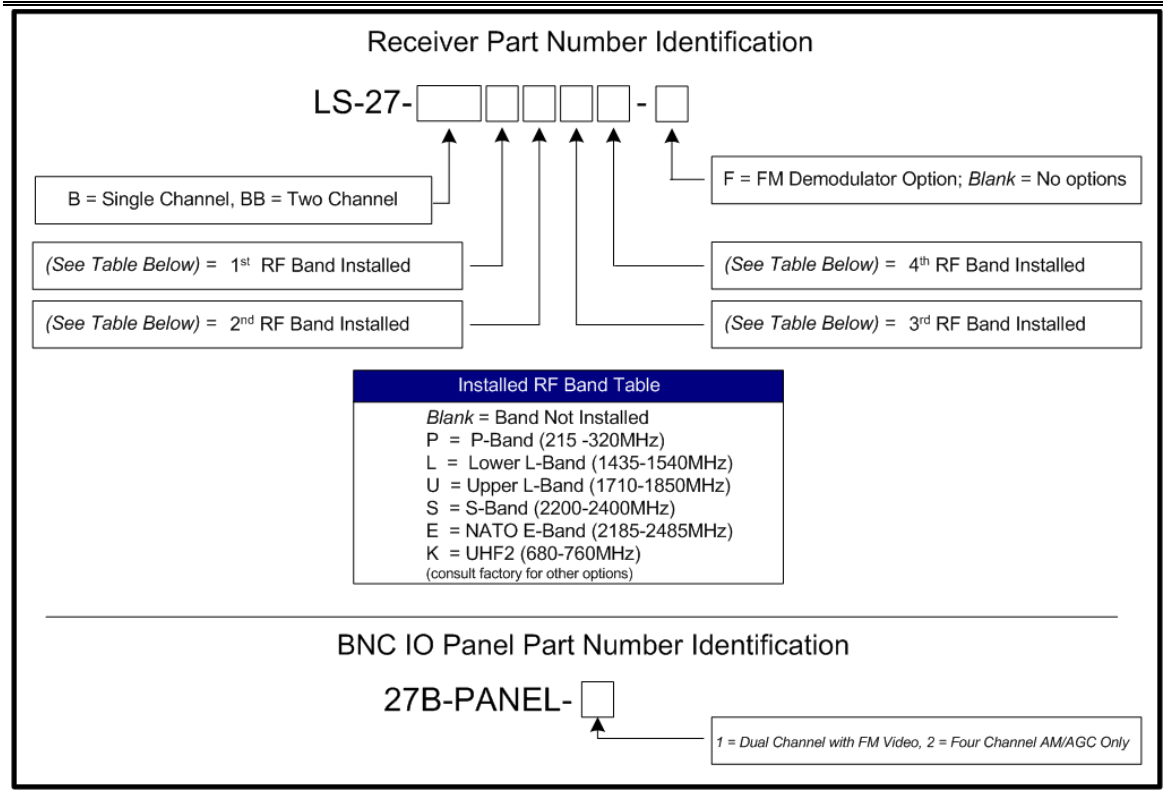


Figure 1-1 LS27B Model Number Construction Details

Category:	Specifications:	Details:
Mechanical	Envelope Dimensions	7.00"(L) x 5.75"(W) x 1.625" (H)
	Form Factor	5 3/4" CD/DVD Drive Size
	Weight	~ 30oz.
Electrical	Individual power requirements	+12VDC @ 2A (nominal); 11-36VDC input
	Total Power (both Channels)	~ 22Watts (nominal), ~26Watts (max.)
Performance		
RF Tuner	RF Input Bands	2185.5 - 2485.5 MHz (E-Band)
		2200.5 - 2399.5 MHz (S-Band)
		1710.5 - 1849.5 MHz (Upper L-Band)
		1435.5 - 1539.5 MHz (Lower L-Band)
		215.5 - 319.5 MHz (P-Band)
		Custom (Consult Factory)
	Tuner Resolution	50kHz (Typical)
	Frequency Accuracy	0.002% (Max.) 0.001% (Typical)
	RF Input AGC Range	+10dBm to –100dBm
	Input Level without Damage	+28dBm
	Receiver Input P_{1dB}	+10dBm (typical)
	Receiver Noise Figure	5dB (typical @ threshold)
	70MHz Phase Noise @ 100kHz	Less than -110dBc (typical)
	Receiver OIP_3	> +15dBm (typical)
	70MHz Output Level	-20dBm (+/- 1dBm)
	2^{nd} IF 3dB Bandwidths Available (typical)	250kHz, 500kHz, 1MHz, 2MHz, 5MHz, 10MHz, 20MHz, 40MHz (Consult factory for other values)
Demodulation	Types	AM, FM (optional)
	AM -3dB Frequency Response	50kHz (AM Low-pass Bypass Mode)
	AM Low-pass Filters	32 Software Selectable
	AM -3dB Bandwidths	50, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1K, 1.1K, 1.2K, 1.3K, 1.4K, 1.5K, 1.6K, 1.7K, 1.8K, 1.9K, 2K, 3K, 4K, 5K, 6K, 7K, 8K, 9K, 10K, 15K, 20K, 50K Hz
	FM Video Filters (typical)	125kHz, 250kHz, 500kHz, 1MHz, 2.5MHz, 4.6MHz, 10MHz, 15MHz. (Consult factory for other values)
Connectors	External Reference Input/Output	(1) SMA Jack, Female or SMB Male
	RF Signal Input	(2) SMA Jack, Female
	IF Signal Output	(2) SMA Jack, Female
	Output Connector	(1) 2x8 0.100 Shrouded Header, keyed
	DC Power Connector	(1) 1x4 0.200 Shrouded Header, keyed
	Serial Interface, DI Connector	(1) 2x10 0.100 Shrouded Header, keyed
	Ethernet Interface	(1) RJ45 (some models)
Environmental	Temperature, Operational	-40° to 85° C (Industrial)
	Temperature, Storage	-20° to 90° C
	Humidity, non-condensing	<40° C 0-90%, >40° C 0-75%

Table 1-1 Specifications for the LS27B

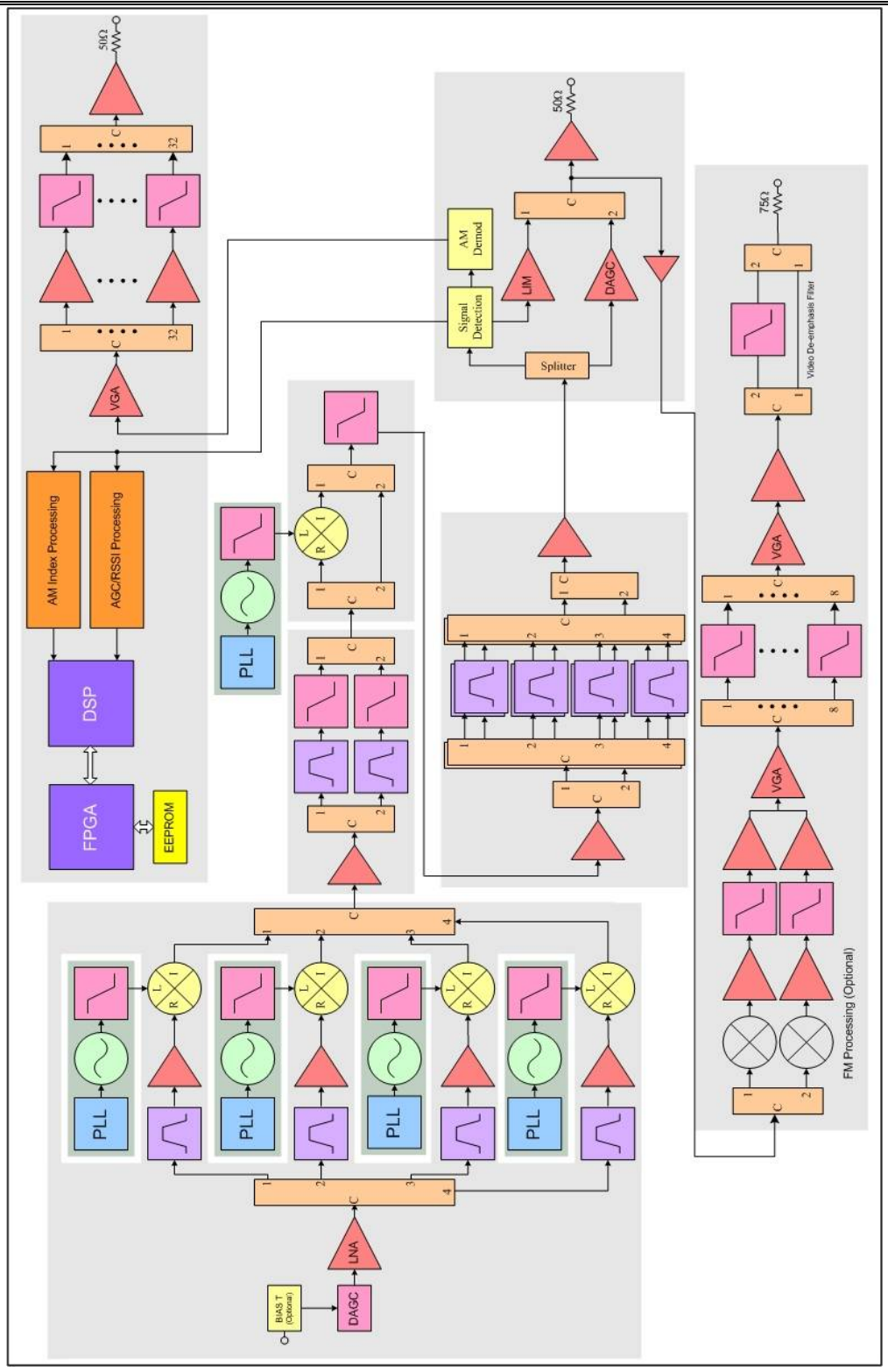


Figure 1-2 Block Diagram of LS27B Series Multi-band Receiver

2 Theory of Operation

In order to more clearly understand the operation of the receiver, this section will detail the various stages of the receiver design. These stages are as follows:

- 1st Downconversion
- 1st IF Band-pass Filter
- 1st Local Oscillator
- 2nd Downconversion
- 2nd Local Oscillator
- 2nd IF Filter
- Limiting Amplifier/AM Demodulation/Digital AGC (DAGC)
- Digital Signal Processing Engine (DSPE)
- FM Demodulation Stage (Optional)

With the exception of the DSPE, each of these sections are physically shielded and isolated from one another to facilitate the greatest EMI/RFI ingress and egress protection allowing the receiver exceptional performance.

For the following sections, refer to the block diagram of Figure 1-2.

2.1 1st Downconversion

The RF input is applied to the 1st Downconversion stage. The stage may optionally contain a bias-T which can be used to power an external LNA through the RF interface port. (Contact the factory for further details on this option.) A DAGC section is next in the signal chain for very high level signal protection and compression compensation. This is followed by a low-noise amplifier (LNA) to provide a large amount of gain while maintaining a very low noise figure enhancing the receiver's overall sensitivity. Selectable RF band-pass filters follow the LNA. The RF signal is then mixed with the first local oscillator (LO) which converted to the 1st IF frequency.

2.2 1st IF Band-pass Filter

The output of the 1st Downconversion stage is send through one of two1st IF filter paths based on the selection of high-side or low side conversion. To eliminate images and limit the overall noise bandwidth to the remaining receiver sections, a 50MHz band-pass filter is switched into the signal path.

2.3 1st Local Oscillator

In a superhetrodyne design, local oscillators (LOs) are utilized to convert high frequencies to lower, "intermediate" frequencies. The first LO is injected into the mixer of the first Downconversion stage to accomplish this task. Mixers can either utilize a sum or difference frequency component to produce IF frequencies. For example, if an RF frequency of 2,200 MHz

was to be converted to an intermediate frequency of 250MHz, a difference component of 1,950MHz could injected to the mixer or a sum frequency component of 2,450MHz could be applied. The difference component LO application is referred to a "low-side" conversion. The sum component application is referred to as "high-side" conversion. Both methods are equally valid and each has its own benefits. The LS27B design has the ability to utilize either approach and actually switch between the methods when necessary for performance reasons.

2.4 2nd Downconversion

The receiver designs contain a switchable 2nd Downconversion stage. Similar to the 1st Downconversion stage, it contains a mixer to convert the 1st IF frequency to a second IF frequency of 70MHz. If the RF frequency band is relatively low, as is the case for P-Band inputs, the on-board processor can bypass the 2nd Downconversion stage switching to a single superhetrodyne process. In either case, a low-pass filter is applied to the signal path at the output of this stage to reduce harmonics and low frequency noise from being applied to subsequent stages.

2.5 2nd Local Oscillator

The second LO is injected into the mixer of the 2nd Downconversion stage to provide the second IF frequency of 70MHz. Like the first conversion stage, the second LO utilizes low-side injection for this conversion. A low-pass filter is applied to the LO output to minimize spurious and harmonic signals from being converted in the 2nd Downconversion stage. The 2nd LO is automatically disabled for RF bands that employ a single super heterodyne process.

2.6 2nd IF Filter

From the output of the 2nd conversion stage, the resulting intermediate frequency is then applied to a group of bandpass filters to minimize noise bandwidth and improve adjacent channel rejection. The 2nd IF stage contains eight IF (SAW) filters centered at 70MHz and varying in bandwidth from 120kHz to 40MHz in approximately octave steps.

2.7 Digital AGC/Limiting Amplification/AM Demodulation

Outputs from the 2nd IF Filter Stage are routed to the final signal detection, AM demodulation, and gain stage in the receiver. The output stage combines both a limiting amplifier and digital AGC (DACG) section. Included in the design is an AM demodulation stage for antenna tracking applications. The main system gain element provides for 90 to 110dB of signal gain. Signal level detection is utilized in DAGC controls.

2.8 Digital Signal Processing Engine (DSPE)

The LS27B design contains a highly integrated digital signal processing engine (DSPE) which is utilized for linearization, filtering and control applications. This engine is composed of a digital

signal processor, FPGA resources, ADCs, DACs and localized memory used to process the signal path parameters. Each of the channels is controlled and statused as an autonomous receiver. The engine performs "real-time" tasks as well as user software interfaces.

This engine is also responsible for processing all of the serial communications to and from the unit. The LS27B comes standard with an RS232 interface and contains options for 4-wire RS422 interfaces and 10/100Mbps Ethernet.

2.9 FM Demodulation Stage (Optional)

The LS27B design may optionally contain an FM demodulation stage for each channel. The stage is split between a narrow-band and wide-band demodulator to optimize processing of each signal characteristic. The output of the FM demodulation is software switched between one of eight video filters. The output can also be switched, in addition to the video filter, thru a video de-emphasis network for true analog video signals. The unit is comes standard with NTSC de-emphasis but other formats are available. The demodulation stage has a software adjustable output level.

3 Installation and Configuration

Chapter 3 provides installation and configuration information. This chapter will familiarize the user with the layout of the device, and provide information on the proper installation and interconnection of the hardware.

3.1 Product Outline Diagrams

Figure 3-1A contains outline diagrams of the top and bottom sides of the product. Figure 3-1B contains face views of various configurations of the LS27B. Figure 3-1C shows an outline drawing of a flange mount option for the LS27B. Connector locations and switch positions are indicated. The model number, serial number, revision information and product options are denoted on the RF enclosure label.

3.2 Hardware Configuration

The receiver design contains configuration switches to control various functions. Figure 3-2 contains a diagram of the configuration switches along with the default factory positions for these switches.

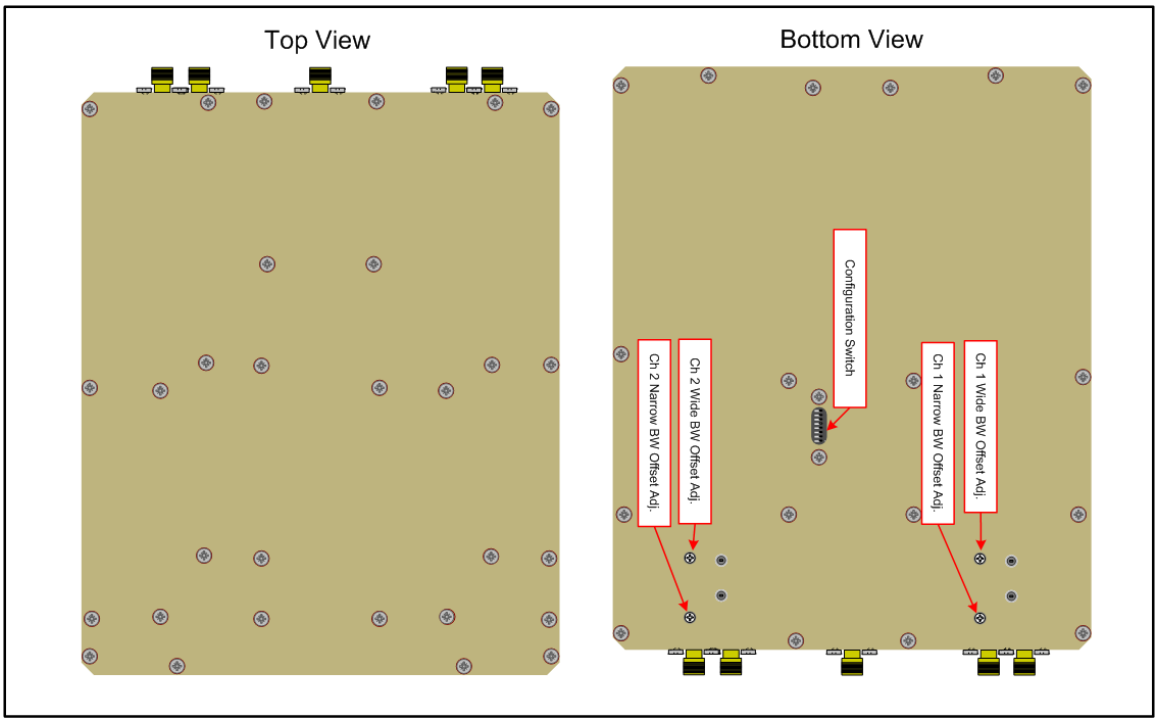


Figure 3-1A LS27B Mechanical Outline Drawing – Top and Bottom

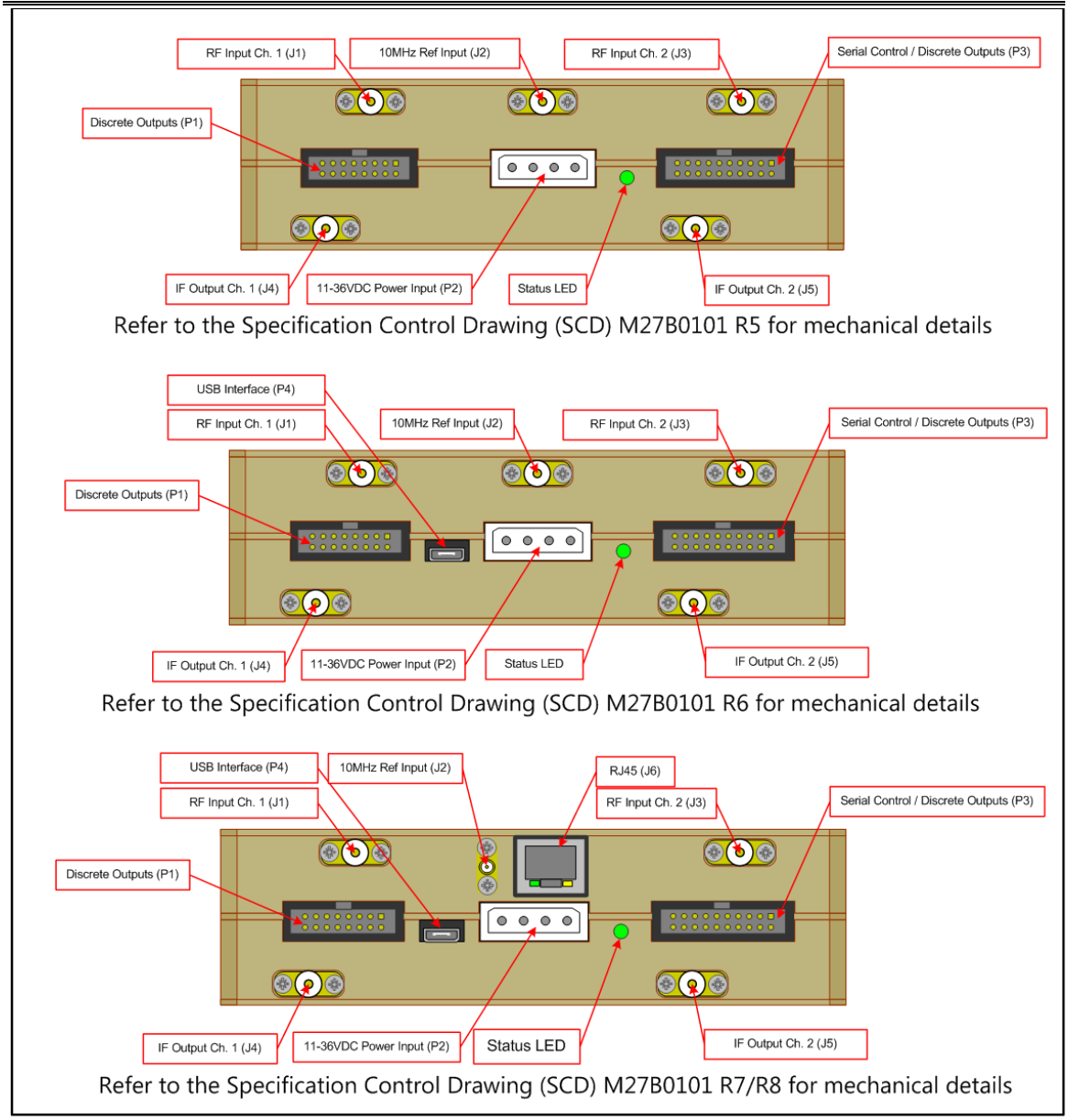


Figure 3-1B LS27B Mechanical Outline Drawing – Face Views

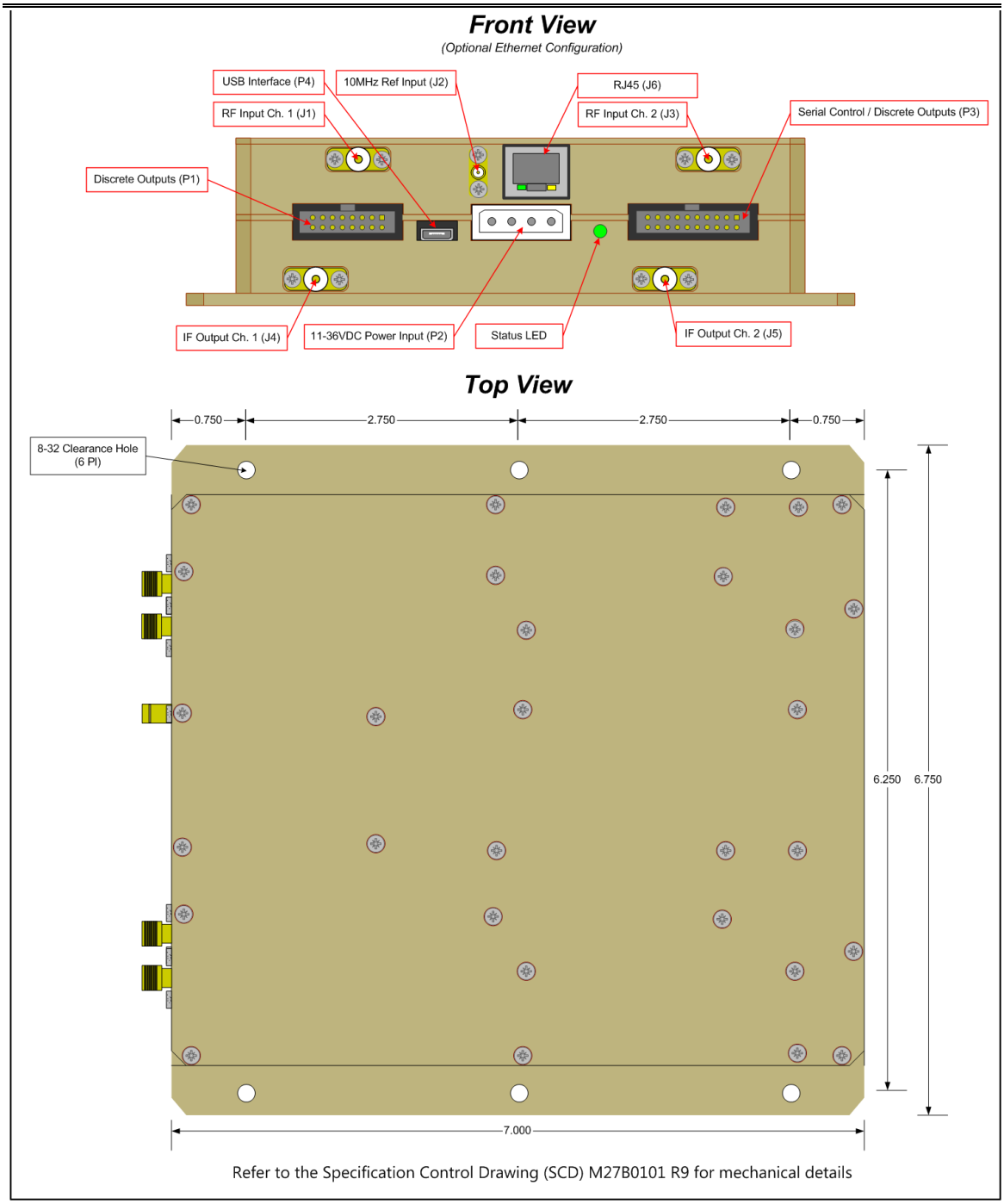
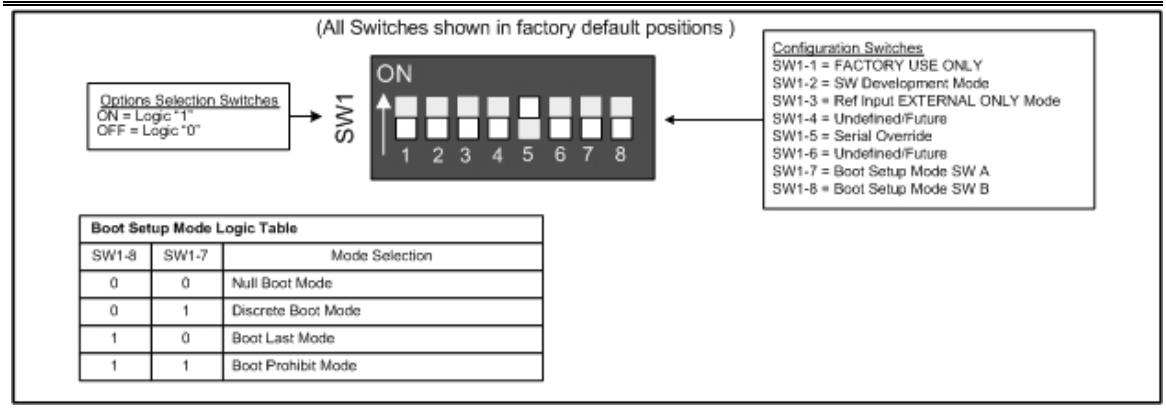


Figure 3-1C LS27B Mechanical Outline Drawing – Flange Mount Option



Boot Setup Mode Logic Table

SW1-8	SW1-7	Mode Selection
0	0	Null Boot Mode
0	1	Discrete Boot Mode
1	0	Boot Last Mode
1	1	Boot Prohibit Mode

Figure 3-2 Receiver Configuration Switch SW1

The configuration switches in Figure 3-2 have the following functions:

1.) The SW1-1 is defined as FACTORY USE and should remain in the OFF state as shown.

Warning:

SW1-1 is defined as FACTORY USE ONLY. In order to facilitate proper operation this switch MUST remain in the OFF position.

2.) The SW1-2 switch sets the LS27B to SW Development mode. When the switch is in the ON position, the serial status messages will contain dynamic data. The intent of this switch is to aid the development of user software without the necessity of having any inputs to the unit.

Warning:

If SW1-2 is in the ON position, the serial status will not reflect the actual input conditions. During normal operations, this switch MUST be in the OFF position.

3.) J2 allows for either an external reference source to be supplied to the receiver for synchronization to external RF hardware, or for the output of an on-board 10MHz reference to synchronize other external items to the unit's synthesizer reference source. SW1-3 controls the operation of the synthesizer reference clock distribution and PLL at boot-time. When SW1-3 is in the OFF position, the J2 connection is in an automatic sense mode. In this mode, at boot-time, the clock distribution system monitors for the presence of an external reference at port J2 (see Figures 3-1). If there is no external reference present at J2 (10MHz @ +4dBm) within 250msecs of boot-time, the unit will automatically switch the J2 input port to an output mode, enable on on-board 10MHz TCXO (+/- 3ppm stability minimum), and the route the

10MHz TCXO source to both the J2 output (at +2 to -2dBm @ 50 ohms) and use it to synchronize the internal synthesizers. When SW1-3 is in the ON position, the internal LS27B 10MHz reference clock will be disabled and the J2 connector will be switched to be a dedicated input. In this mode, the unit will presume the presence of an external 10MHz reference source.

Warning:
SW1-3 switch is set to ON, the reference input is in the "EXTERNAL ONLY" mode. If no external reference is supplied (10MHz @ >=4dBm), the unit will lack synthesizer synchronization which will affect the overall performance of the unit.

4.) Switch SW1-5 initiates the serial override mode. When in the ON position, the serial interface is automatically set to 57.6K BAUD for each serial communications channel. When in the OFF position, commands to alter the serial data rate can be issued.

5.) Switches SW1-7 and SW1-8 define the LS27B power-up boot configuration selection. This combination of switches allows the user to select pre-stored configuration setups by various methods. The description of these methods follows:

a. **NULL Boot Mode** – In this mode, the LS27B receivers will not tune to any stored setups that may have been previously stored in the unit's internal non-volatile memory. When commanded via one of the appropriate serial interfaces, it will tune the receiver as commanded. In this mode, storage of setup parameters are stored in internal non-volatile memory.

b. **Discrete Boot Mode –** In this mode, the LS27B receiver will be setups will be selected via the state of the external discrete lines on P3-7 thru P3-10. These discrete lines will determine a four bit number from zero to fifteen. At boot time, the LS27B will tune both receivers to the setup whose number is defined by the values of the discrete lines. Note that each receiver may still be tuned to a different frequency and setup, since each receiver has a separate list of 16 setups. Subsequent serial setup commands will override the boot setup and save that setup in non-volatile memory.

c. **Boot Last Mode –** In this mode LS27B will program the receivers with the last valid setup. Subsequent setup commands will override the boot setup and replace the setup as directed by the user.

d. **Boot Prohibit Mode** - This mode is designed for security conscious requirements. In this state the LS27B will not tune to any setup at power-up. Any serial commands will setup the receivers as usual, but no information will be retained internally in non-volatile memory. In addition, at boot time any existing setup information in any of the sixteen possible setup locations in

non-volatile memory will be deleted.

6.) Switches defined as "Undefined/Future" have no implementation and thus their state is irrelevant.

3.3 Status LED

The connector face of the LS27B contains an operational status LED. The LED is trii-color and will alternate between the colors of red, green and orange based on functional state. At power on, the LED will illuminate yellow for approximately 500 milliseconds and transition to a full red illumination until the internal boot process is complete and serial communications is initialized. This period is typically less approximately 3 seconds. During this period, the unit is not capable of receiving commands or providing serial status messages. Attempts to communicate with the unit during this period will not result in acceptance of commands of message responses.

Once communications with the unit is allowed, the status LED will flash OFF/green at an approximate 2Hz rate. Some commands may cause the alternating LED state to pause momentarily while the command completes internal processes. After completion of the internal processing of a command, the 2Hz flash rate will resume.

The only other time that the LED color will be yellow will be during an error condition that is associated with firmware programming efforts.

3.4 Physical Installation

To install the receiver in the target computer system, the following procedure should be followed:

1. Perform a normal system shutdown of the target host system and remove the primary power plug.

2. Install the receiver in an unobstructed DVD/CD drive bay or in mounting rails. PCs vary in their mechanical configurations so it may be necessary to remove additional PC hardware to properly install the unit.

3. For mounting hardware locations, reference the Specification Control Drawing for the product (Doc. Number: M27B0101).

4. It is recommended that at least four 4-40UNC mounting screws (provided) be used in the mounting of the unit. This accommodates higher vibration and shock environments. Ensure that the installation provides room for the RF and I/O connections. For units with flange mount options, no mounting screws are provided.

5. Airflow across the unit is strongly recommended to prevent long-term heat related damage. Multiple sets of mounting holes have been provided to allow for some rear fan clearances.

6. Connect the communications interface as desired. Interface to an available RS/EIA-232 or RS-422 interface via the P3 connector. If the unit contains RS-422 interface options, the RS-422 interface provisions are for a 4-wire configuration using the same command and status format as the RS-232 interface. Network interfaces are provided on some models and can be interfaced via 10/100Mbps Ethernet. Network provisions are made for communication via static IP addresses or DHCP provided addressed. Refer to the network interface documentation for the LS27B device (NetworkDevice.exe User Manual).

7. Connect the user I/O as desired via the P1 connector (refer to Figure 3-3).

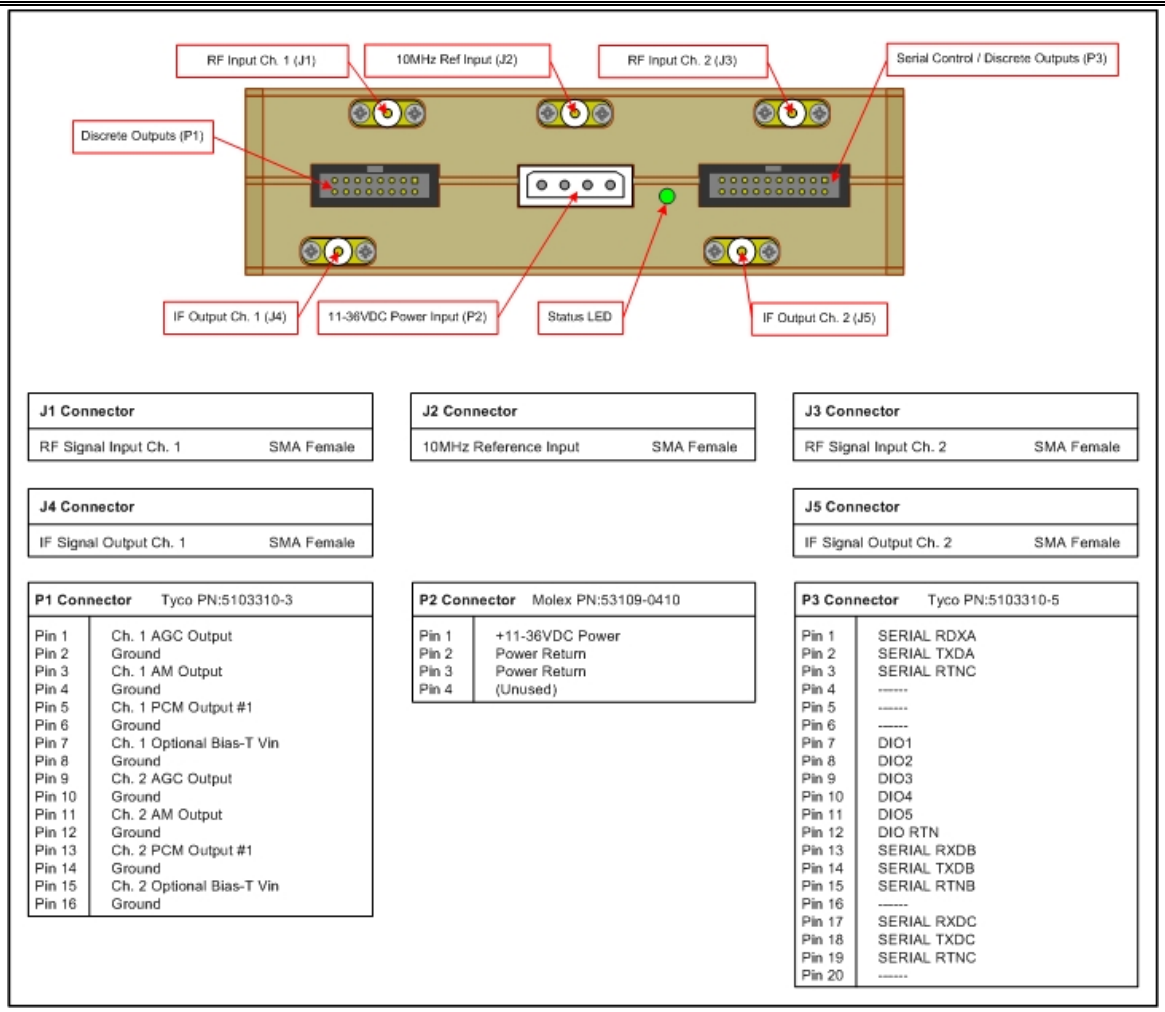
8. Connect the required RF and IF connections via the J-numbered connectors (refer to Figure 3-3).

9. Re-apply power to the unit and initiate the user software to communicate via the serial interface.

3.5 Interconnection

The receiver platforms provide multiple interface connectors. Figure 3-3A through Figure 3-3C provides interface pin-outs and mating connector information for all connectors. Lumistar can provide an optional BNC style interface panel as shown in Figure 3-4A to ease the facilitation of user interfaces. The interface can be configured is one of two formats. The primary (typical) interface is shown in configuration 1 of Figure 3-4B. A dual receiver interface can be provided as shown configuration 2 of Figure 3-4B. Pin-outs of the IO panel are shown in Figure 3-4C. An Auxilary power extension cable is provided with each delivery.

A communication harness is provided with each unit ordered based on the serial interface ordered. The harness for the RS232 serial interface is shown in Figure 3-5A. The harness for the RS-422 serial interface is shown in Figure 3-5B.



J1 Connector	
RF Signal Input Ch. 1	SMA Female

J2 Connector	
10MHz Reference Input	SMA Female

J3 Connector	
RF Signal Input Ch. 2	SMA Female

J4 Connector	
IF Signal Output Ch. 1	SMA Female

J5 Connector	
IF Signal Output Ch. 2	SMA Female

P1 Connector Tyco PN:5103310-3

Pin 1	Ch. 1 AGC Output
Pin 2	Ground
Pin 3	Ch. 1 AM Output
Pin 4	Ground
Pin 5	Ch. 1 PCM Output #1
Pin 6	Ground
Pin 7	Ch. 1 Optional Bias-T Vin
Pin 8	Ground
Pin 9	Ch. 2 AGC Output
Pin 10	Ground
Pin 11	Ch. 2 AM Output
Pin 12	Ground
Pin 13	Ch. 2 PCM Output #1
Pin 14	Ground
Pin 15	Ch. 2 Optional Bias-T Vin
Pin 16	Ground

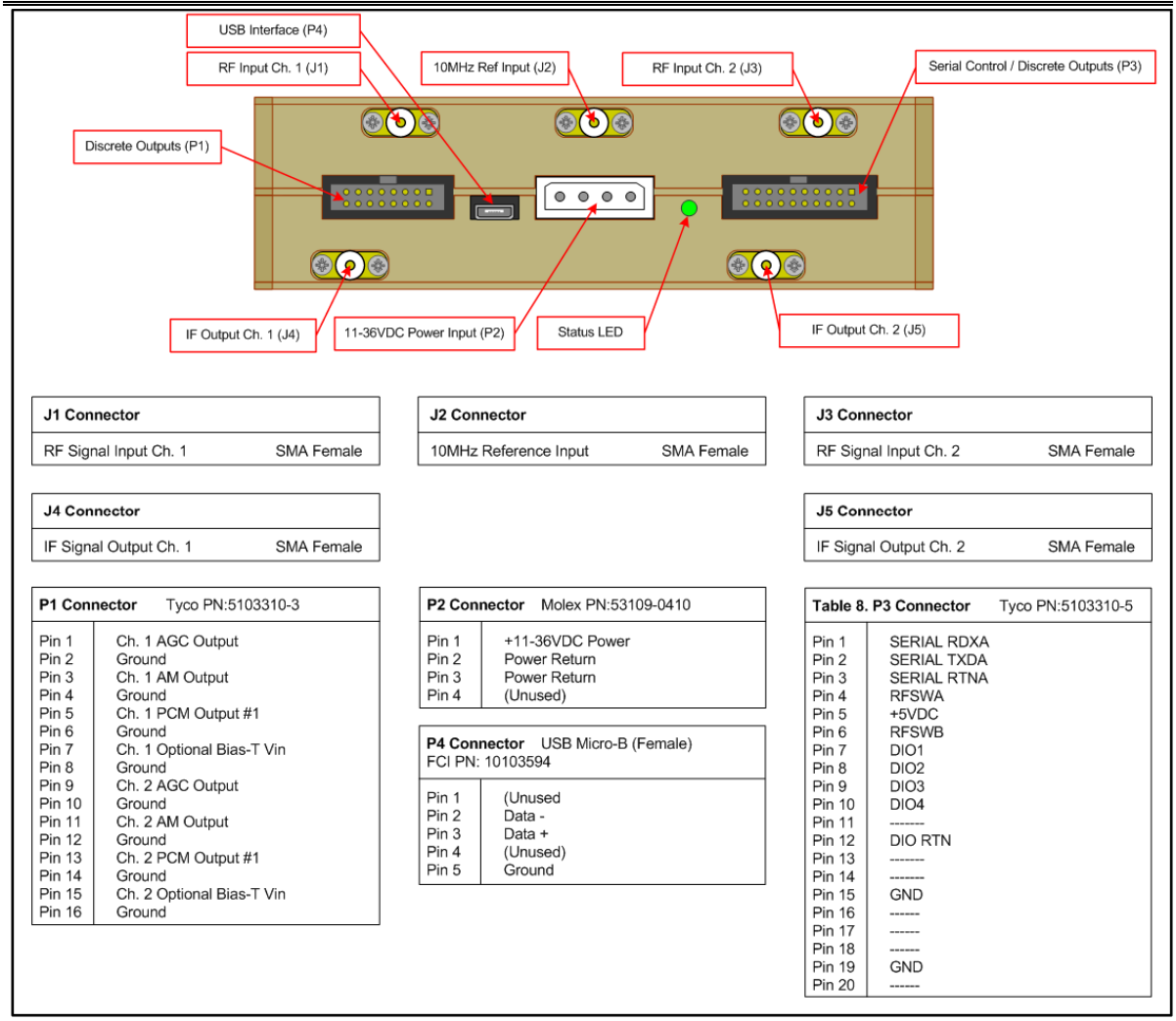
P2 Connector Molex PN:53109-0410

Pin 1	+11-36VDC Power
Pin 2	Power Return
Pin 3	Power Return
Pin 4	(Unused)

P3 Connector Tyco PN:5103310-5

Pin 1	SERIAL RDXA
Pin 2	SERIAL TXDA
Pin 3	SERIAL RTNC
Pin 4	------
Pin 5	------
Pin 6	------
Pin 7	DIO1
Pin 8	DIO2
Pin 9	DIO3
Pin 10	DIO4
Pin 11	DIO5
Pin 12	DIO RTN
Pin 13	SERIAL RXDB
Pin 14	SERIAL TXDB
Pin 15	SERIAL RTNB
Pin 16	------
Pin 17	SERIAL RXDC
Pin 18	SERIAL TXDC
Pin 19	SERIAL RTNC
Pin 20	------

Figure 3-3A LS27B Pin-outs and Connector Identification (R5)



J1 Connector	
RF Signal Input Ch. 1	SMA Female

J2 Connector	
10MHz Reference Input	SMA Female

J3 Connector	
RF Signal Input Ch. 2	SMA Female

J4 Connector	
IF Signal Output Ch. 1	SMA Female

J5 Connector	
IF Signal Output Ch. 2	SMA Female

P1 Connector Tyco PN:5103310-3

Pin 1	Ch. 1 AGC Output
Pin 2	Ground
Pin 3	Ch. 1 AM Output
Pin 4	Ground
Pin 5	Ch. 1 PCM Output #1
Pin 6	Ground
Pin 7	Ch. 1 Optional Bias-T Vin
Pin 8	Ground
Pin 9	Ch. 2 AGC Output
Pin 10	Ground
Pin 11	Ch. 2 AM Output
Pin 12	Ground
Pin 13	Ch. 2 PCM Output #1
Pin 14	Ground
Pin 15	Ch. 2 Optional Bias-T Vin
Pin 16	Ground

P2 Connector Molex PN:53109-0410

Pin 1	+11-36VDC Power
Pin 2	Power Return
Pin 3	Power Return
Pin 4	(Unused)

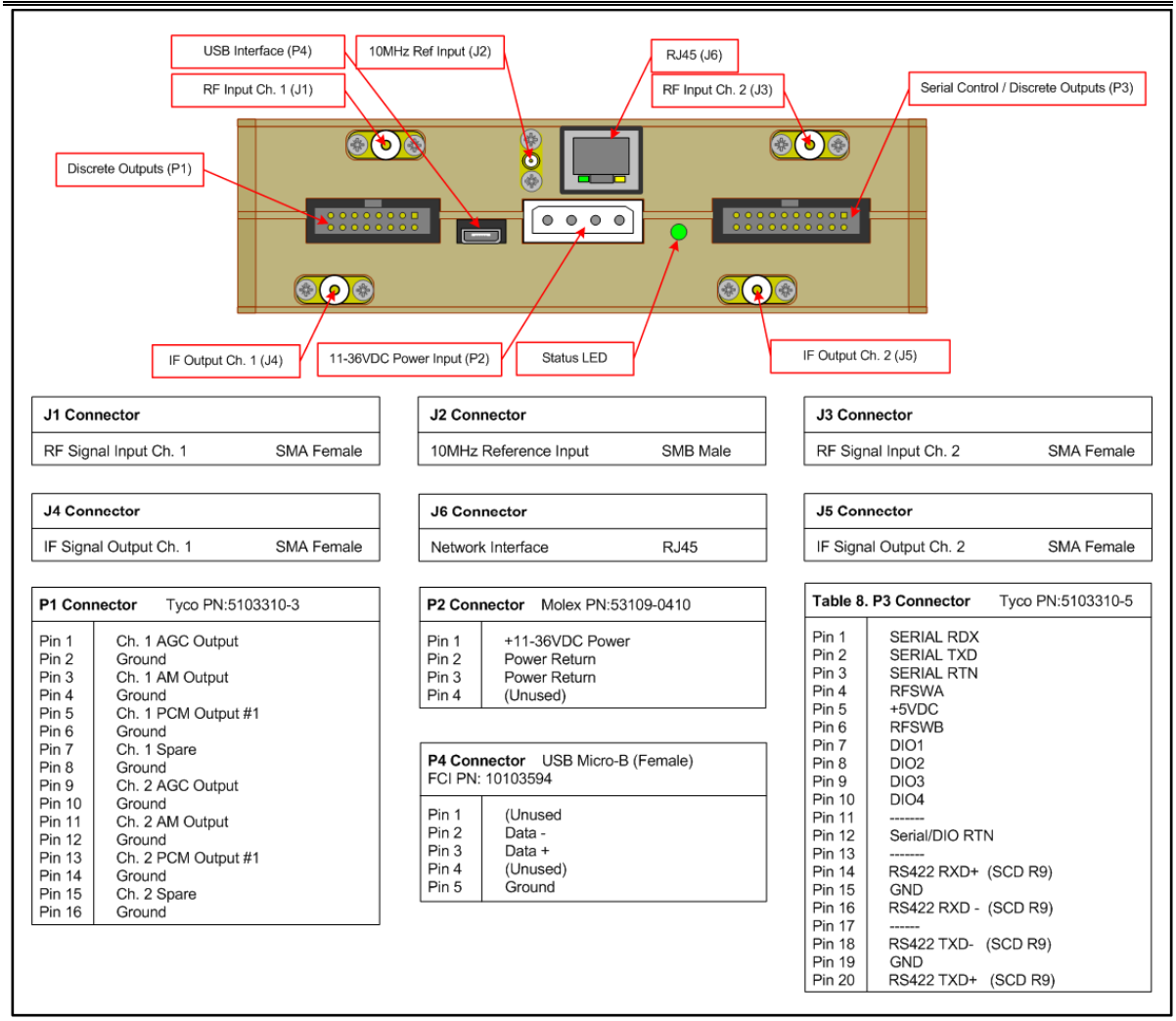
P4 Connector USB Micro-B (Female)
FCI PN: 10103594

Pin 1	(Unused
Pin 2	Data -
Pin 3	Data +
Pin 4	(Unused)
Pin 5	Ground

Table 8. P3 Connector Tyco PN:5103310-5

Pin 1	SERIAL RDXA
Pin 2	SERIAL TXDA
Pin 3	SERIAL RTNA
Pin 4	RFSWA
Pin 5	+5VDC
Pin 6	RFSWB
Pin 7	DIO1
Pin 8	DIO2
Pin 9	DIO3
Pin 10	DIO4
Pin 11	-------
Pin 12	DIO RTN
Pin 13	-------
Pin 14	-------
Pin 15	GND
Pin 16	------
Pin 17	------
Pin 18	------
Pin 19	GND
Pin 20	------

Figure 3-3B LS27B Pin-outs and Connector Identification (R6)



J1 Connector	
RF Signal Input Ch. 1	SMA Female

J2 Connector	
10MHz Reference Input	SMB Male

J3 Connector	
RF Signal Input Ch. 2	SMA Female

J4 Connector	
IF Signal Output Ch. 1	SMA Female

J6 Connector	
Network Interface	RJ45

J5 Connector	
IF Signal Output Ch. 2	SMA Female

P1 Connector Tyco PN:5103310-3

Pin 1	Ch. 1 AGC Output
Pin 2	Ground
Pin 3	Ch. 1 AM Output
Pin 4	Ground
Pin 5	Ch. 1 PCM Output #1
Pin 6	Ground
Pin 7	Ch. 1 Spare
Pin 8	Ground
Pin 9	Ch. 2 AGC Output
Pin 10	Ground
Pin 11	Ch. 2 AM Output
Pin 12	Ground
Pin 13	Ch. 2 PCM Output #1
Pin 14	Ground
Pin 15	Ch. 2 Spare
Pin 16	Ground

P2 Connector Molex PN:53109-0410

Pin 1	+11-36VDC Power
Pin 2	Power Return
Pin 3	Power Return
Pin 4	(Unused)

P4 Connector USB Micro-B (Female)
FCI PN: 10103594

Pin 1	(Unused
Pin 2	Data -
Pin 3	Data +
Pin 4	(Unused)
Pin 5	Ground

Table 8. P3 Connector Tyco PN:5103310-5

Pin 1	SERIAL RDX
Pin 2	SERIAL TXD
Pin 3	SERIAL RTN
Pin 4	RFSWA
Pin 5	+5VDC
Pin 6	RFSWB
Pin 7	DIO1
Pin 8	DIO2
Pin 9	DIO3
Pin 10	DIO4
Pin 11	-------
Pin 12	Serial/DIO RTN
Pin 13	-------
Pin 14	RS422 RXD+ (SCD R9)
Pin 15	GND
Pin 16	RS422 RXD - (SCD R9)
Pin 17	------
Pin 18	RS422 TXD- (SCD R9)
Pin 19	GND
Pin 20	RS422 TXD+ (SCD R9)

Figure 3-3C LS27B Pin-outs and Connector Identification (R7+)

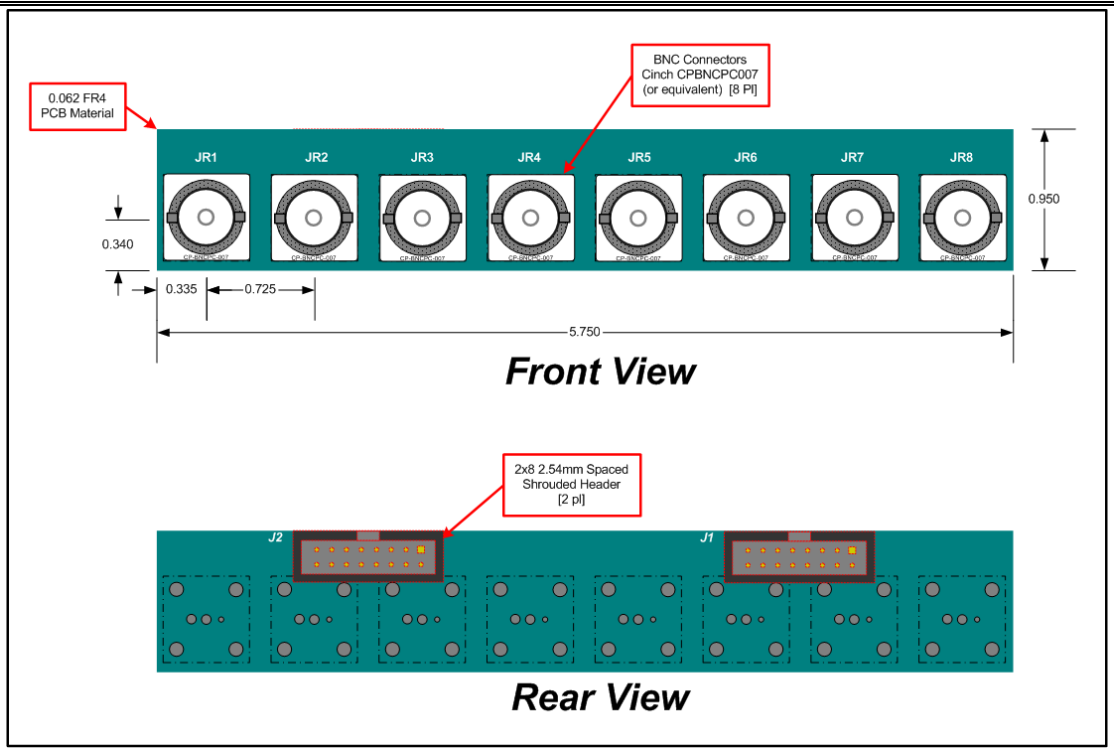


Figure 3-4A LS27B User Interface Panel

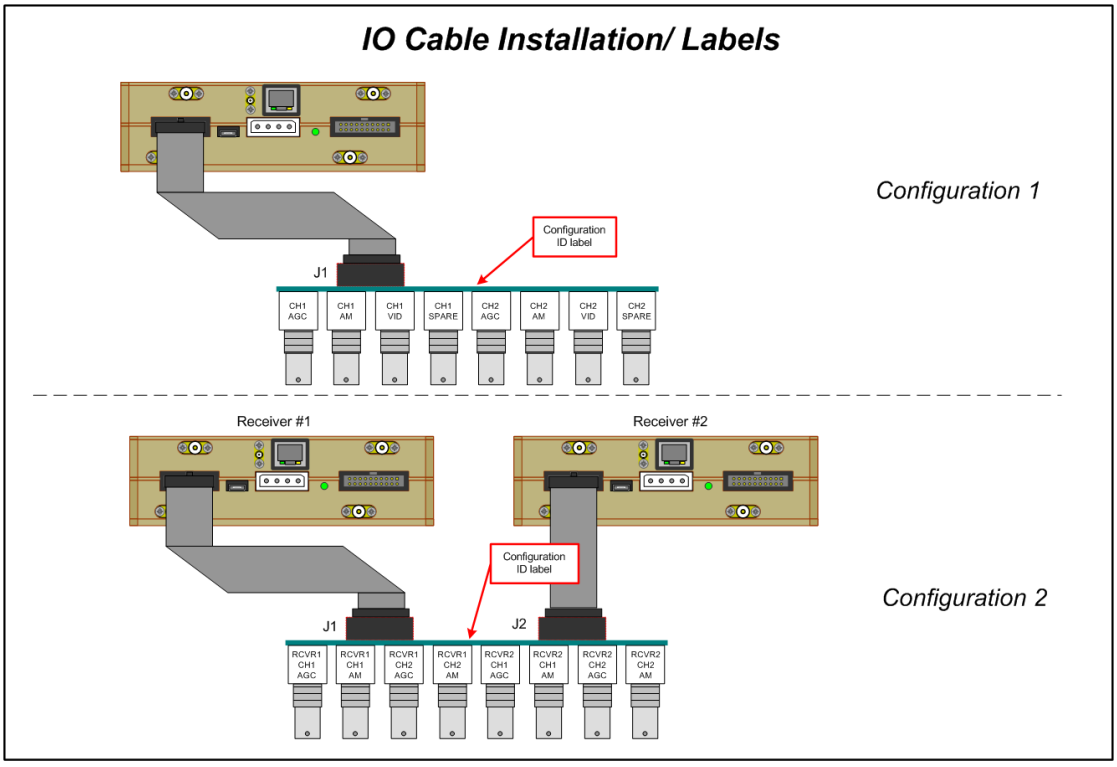


Figure 3-4B LS27B User Interface Configurations

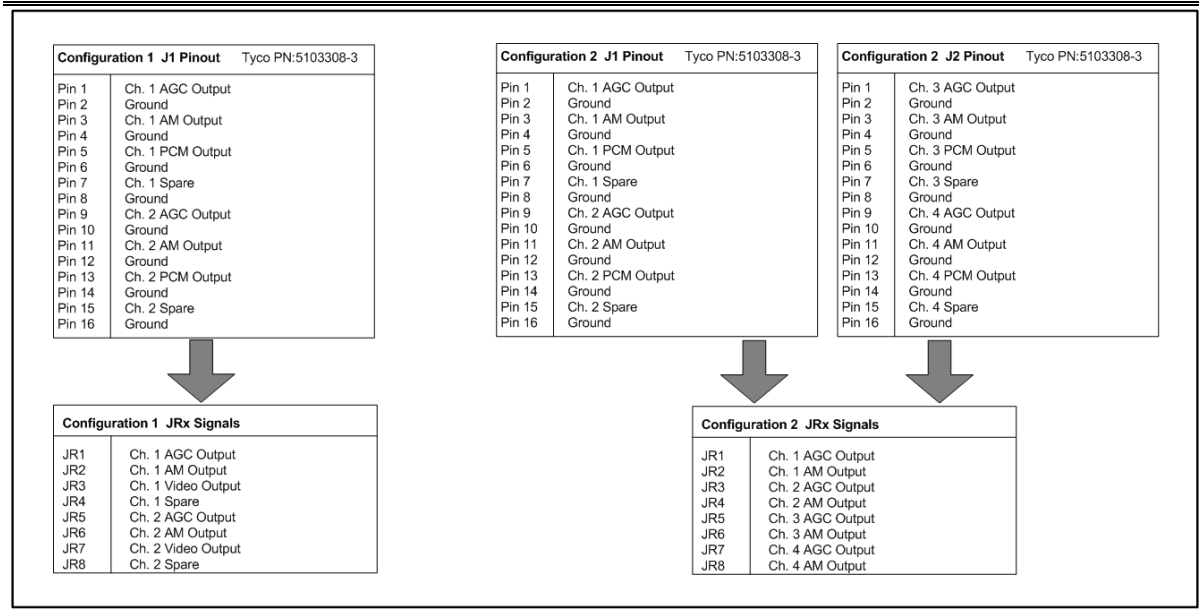


Figure 3-4C LS27B User Interface Configuration Pin-outs

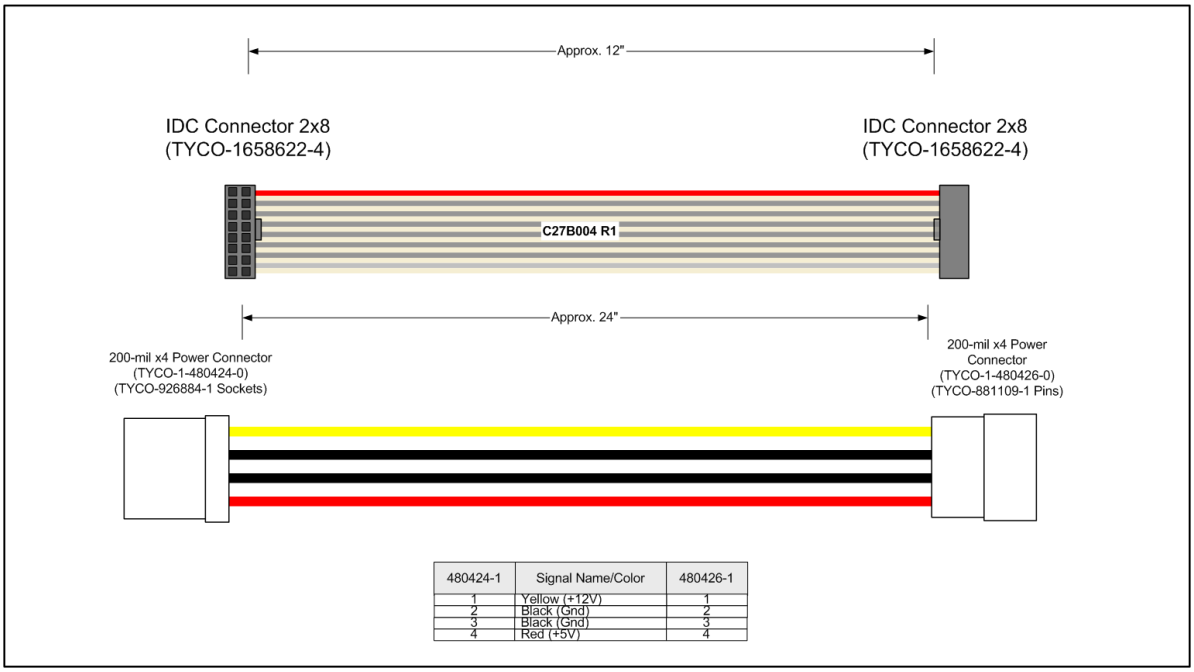


Figure 3-4D LS27B Aux Power Extension and IO IDC Ribbon cable (C27B0003/C27B0004)

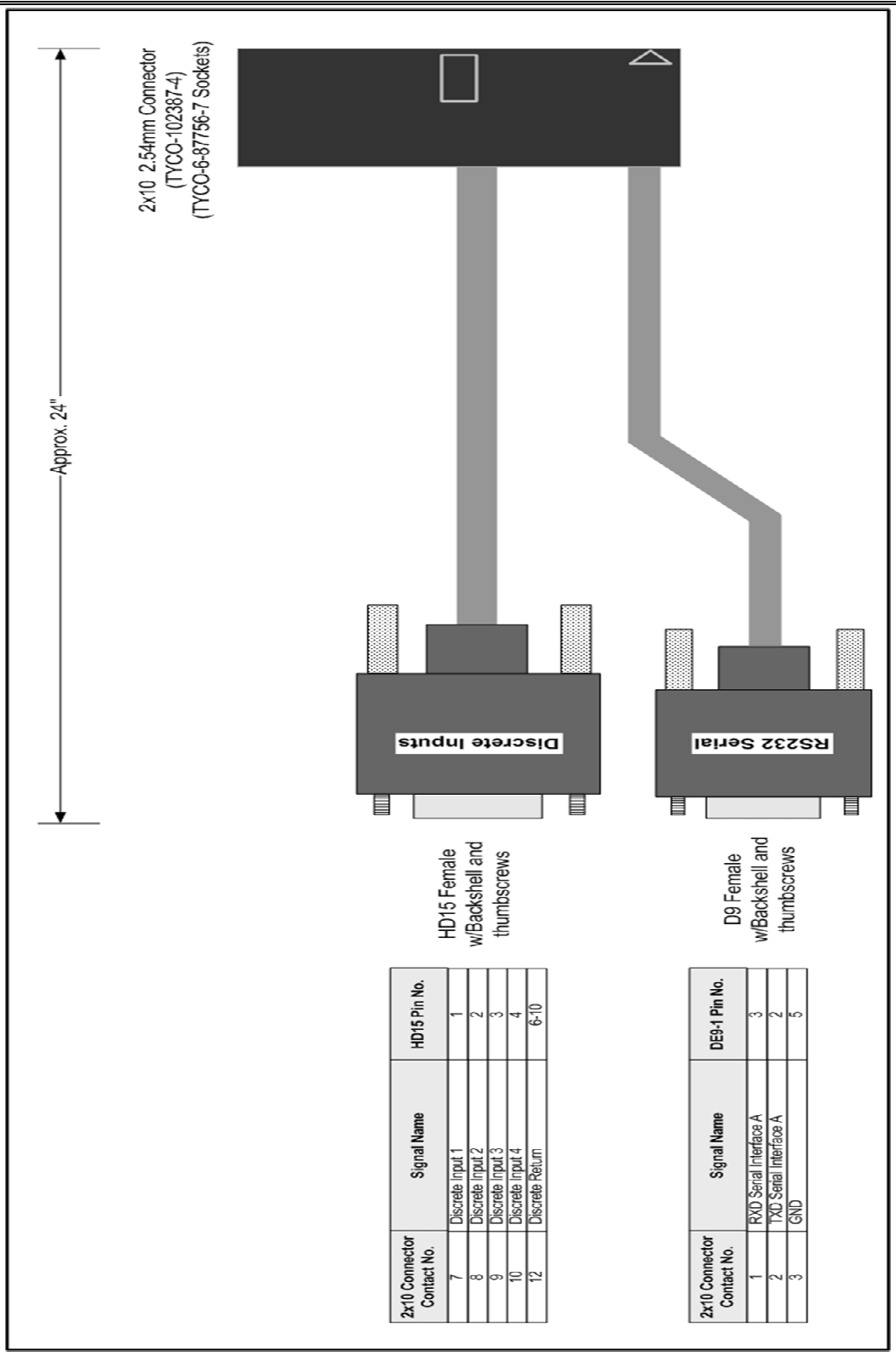
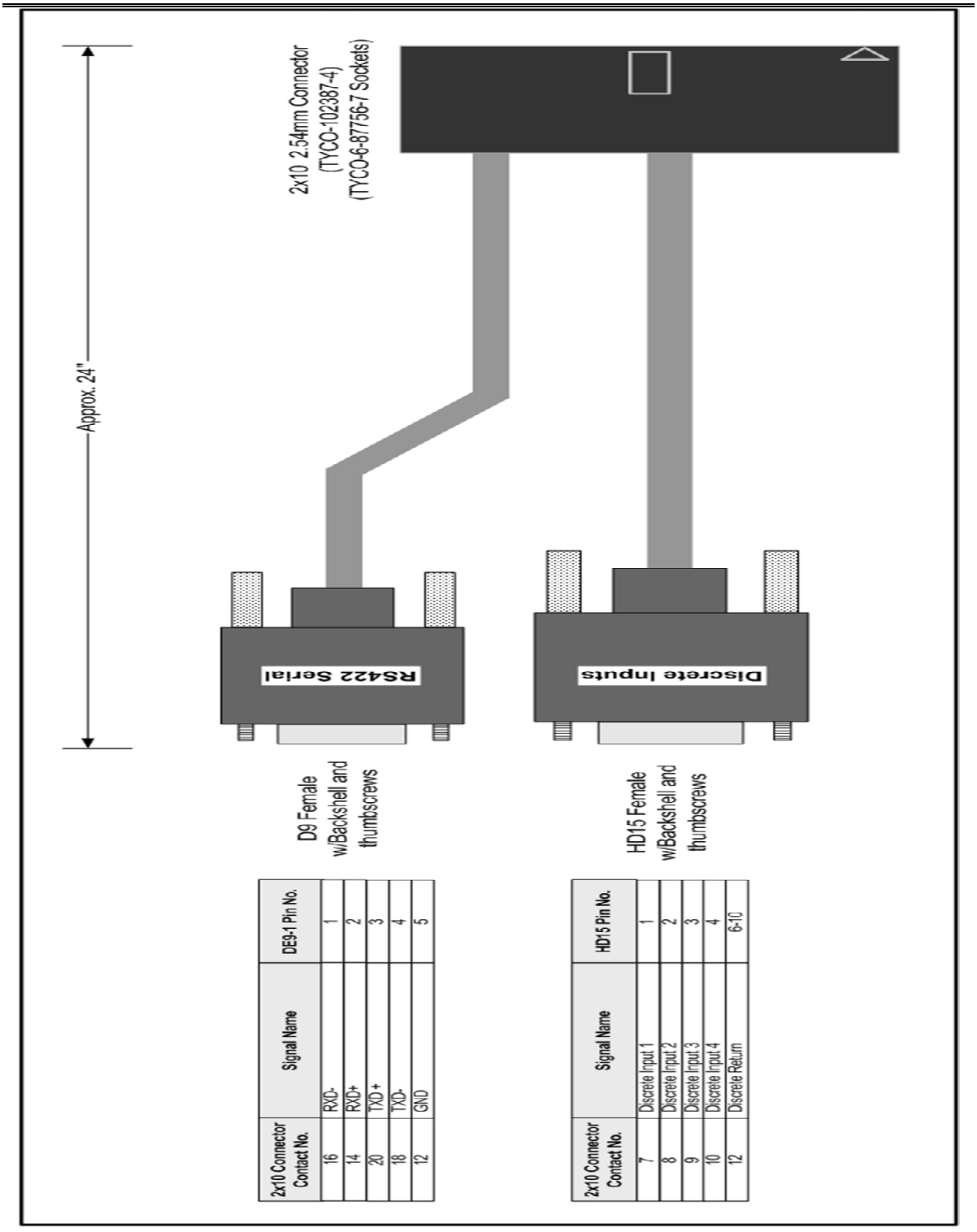


Figure 3-5A LS27B Communication RS-232 Serial Interface Cable (C27B0001)



2x10 Connector Contact No.	Signal Name	DE9-1 Pin No.
16	RXD-	1
14	RXD+	2
20	TXD +	3
18	TXD-	4
12	GND	5

2x10 Connector Contact No.	Signal Name	HD15 Pin No.
7	Discrete Input 1	1
8	Discrete Input 2	2
9	Discrete Input 3	3
10	Discrete Input 4	4
12	Discrete Return	6-10

Figure 3-5B LS27B Communication RS-422 Serial Interface Cable (C27B0002)

3.6 External Setup Discretes

As shown in Figure 3-3, connector P3 contains five discrete selection inputs (four of which are active). These bits are used to select previously stored user setups for the LS27B without the use of a serial host interface.

Each of the LS27B input channels allows the storage of up to sixteen (16) receiver setups. Using the serial interface, the user can program particular configurations for the receiver channels, and then select a corresponding storage number. The operation of these discretes is based on the boot-time mode selection switches of SW1-7 and SW1-8. (Refer to section 3.2 for the proper setting of the configuration switches to enable the use of the external setup discretes.)

The discrete inputs will function as the main controls until serial communications to the unit takes place. At that point, the discrete interfaces are ignored and control of the unit is switched to the serial interface.

Selection of the discrete (logic 1) is made by connecting the desired discrete input to P3-13 pin. If the discrete input is left disconnected, the input will be considered logic 0.

DIO 4-0 Setting	Format Selected
0000_b	Programmed Setup 0
0001_b	Programmed Setup 1
0010_b	Programmed Setup 2
0011_b	Programmed Setup 3
0100_b	Programmed Setup 4
0101_b	Programmed Setup 5
0110_b	Programmed Setup 6
0111_b	Programmed Setup 7
1000_b	Programmed Setup 8
1001_b	Programmed Setup 9
1010_b	Programmed Setup 10
1011_b	Programmed Setup 11
1100_b	Programmed Setup 12
1101_b	Programmed Setup 13
1110_b	Programmed Setup 14
1111_b	Programmed Setup 15

Table 3-1 LS27B External Discrete Setup Selection Table

4 Communications

This chapter provides communications interface information pertaining to the LS27B drive bay dual receiver.

4.1 Serial Interface Options

The LS27B is controlled and statused via one of three interface methods: an RS-232 (or optionally RS-422) asynchronous 3-wire (or 4-wire) serial interface, a USB 2.0 interface, or a 10/100Mbps Ethernet interface. The RS-232 or RS-422 interfaces are capable of being run at rates between 9.6k BAUD and 115.2k BAUD with a default rate of 57.6k BAUD. The unit is shipped with SW1-5 position in the ON position. In this position, the unit will only communicate at 57.6k BAUD. (See programming section for details on how to alter the serial communication BAUD rate.)

The host communication channel should be setup in the following configuration:

Number of bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	None

The USB interface is provided with a driver suite for Windows XP/7/8/10 operating systems. This driver will allow the USB interface to appear as a standard Windows COM port operating with the same serial interface methods as the RS-232/RS-422 interface.

The network interface method (if available) communicates via TCP/IP. This interface can either be configured to be addressed via a DHCP server or via static IP address assignments.

Information:

All serial interface methods are active simultaneously. No priority is given to one interface method versus another.

Caution:

Since all LS27B serial interfaces are active simultaneously, the last commanded state in terms of time is the one active.

5 Protocol and Messaging

This chapter provides interface protocol information for the LS27B drive bay dual channel receiver. The product is offered in single channel format in which case only the channel 1 commands will be responded to.

5.1 Protocol

The receiver protocol is active on serial interfaces in the exact same manner. Whether command and status are sent through Ethernet messages, serial messages via 3-wire/4-wire interfaces, or half-duplexed USB interfaces, the communication protocols are the same. If the receiver configuration is dual-channel, each receivers operations are autonomous.

5.1.1 Command and Status Messaging

Interface is via command-response messaging. For every command sent from the host, the receiver will respond to indicate that the command was received, at a minimum. Commands from the host are grouped in two categories: primary commands and secondary commands. Primary commands are used to control the basic tuning and setup of the receiver. Secondary commands are used to set various "lower-priority" operational modes and to obtain secondary status. Secondary host commands occasionally require that the host send two commands: a first command followed by a status request message.

All host messages require a message header of six (6) bytes. If the host command requires additional data be transferred to the host, the data will immediately follow the command header. Figure 5-1 contains a diagram of the message header for the interface protocol.

The first byte of the message header contains a device identification flag of 0x27. The second byte indicates the module address being commanded which should always be set to 0x00. Bytes 3 and 4 contain the message identification. Message identification informs the type and format of data that will follow the header, if any. Bytes 5 and 6 of the message header indicate the number of command related bytes that follow the message header.

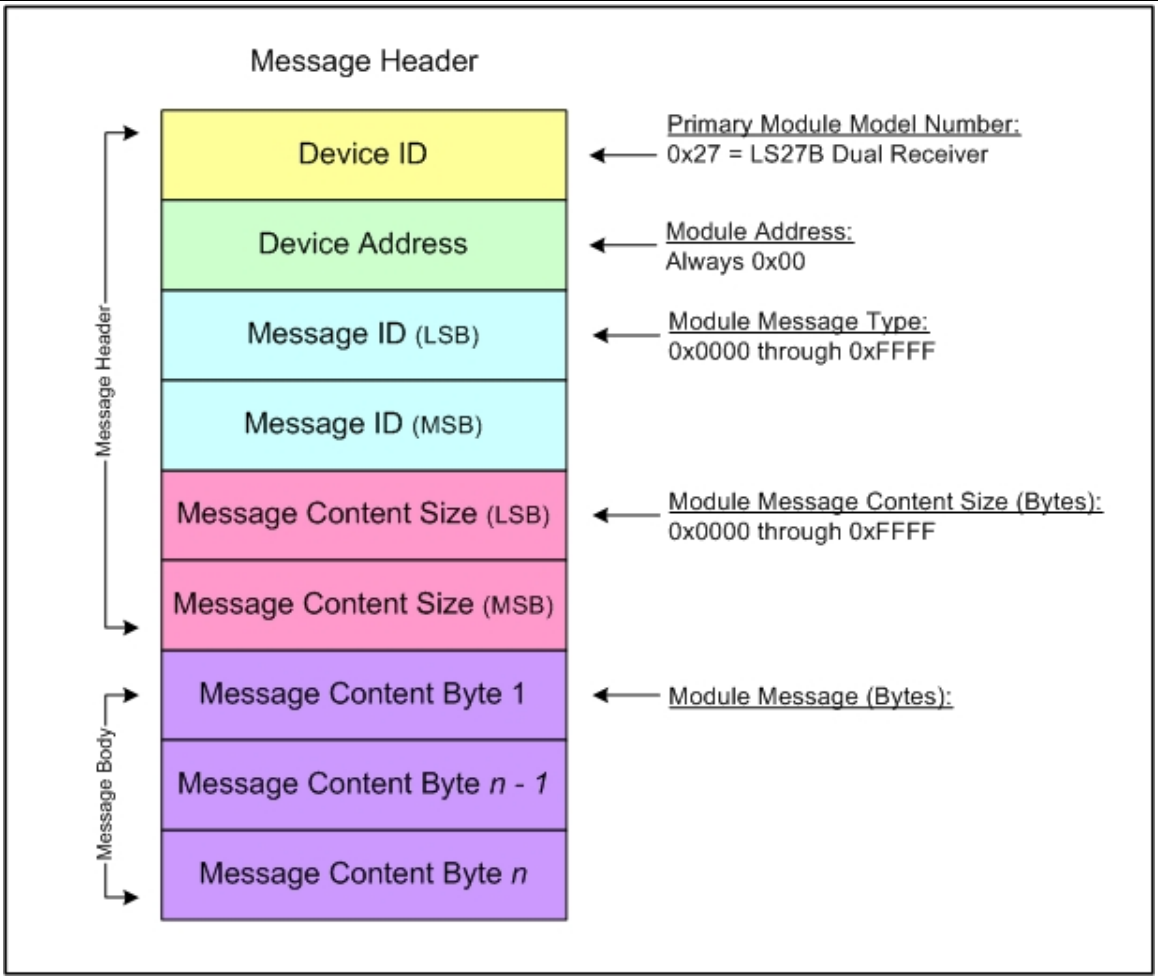


Figure 5-1 **Interface Protocol Message Format**

In response to any host command, the protocol will respond with a minimum of an echoed message header. If additional information is to be conveyed to the host, the data will immediately follow the echoed header. Figure 5-2 indicates the general configuration of the host and terminal responses.

There are six message types: a "Ping" message, a "Primary Setup" message, a "Secondary Setup" message, a "Append Flash File Section" message, a "General Status" message, and a "EEPROM Page Read" message.

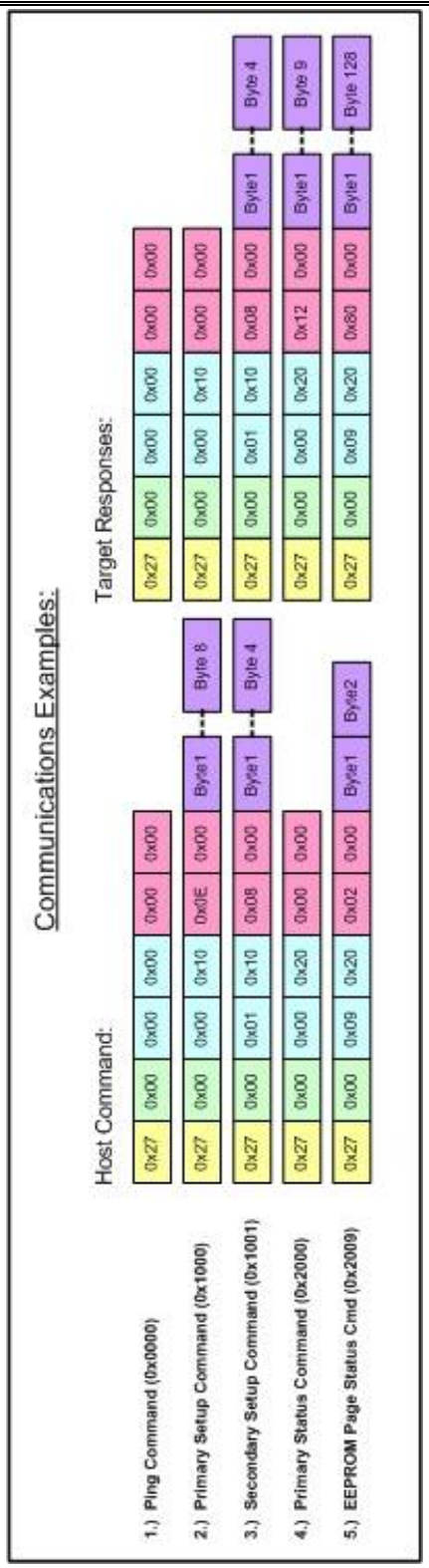


Figure 5-2 **Messaging Configurations**

5.1.1.1 PING Command Message

The "Ping" command is used as to determine the health/presence of the communications channel between the host and the receiver. In response to the "Ping" command, the receiver will echo the received message header back to the host. The message format appears in Figure 5-3.

Ping Command Content (Message ID = 0x0000)

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x00 or 0x27
1	Device Address								0x00
2	Command Op Code LSB								0x00
3	Command Op Code MSB								0x00
4	Bytes to Follow LSB								0x00
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
(none)									

Ping Command Response

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x00
3	Command Op Code MSB								0x00
4	Bytes to Follow LSB								0x00
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	Notes:
(none)									

Figure 5-3 **PING Message Command/Status Structure**

5.1.1.2 Primary Setup Command/Response Message

The "Primary Setup" message provides fundamental control information to the receiver channel. The message header is followed by eight (8) data bytes as defined in Figure 5-4. Bit definitions are also defined below.

Setup Command Content (Message ID = 0x1000)

Header Byte		D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0		Device ID								0x27
1		Device Address								0x00
2		Command Op Code LSB								0x00
3		Command Op Code MSB								0x10
4		Bytes to Follow LSB								0x08
5		Bytes to Follow MSB								0x00
Body Byte		**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0	6	-	-	POLARITY	SNUM				DCx	
1	7	INTREF	-	-	-	-	-	-	-	
2	8	LIM	-	-		FRZ	AGCTC			
3	9	-		IFBW		DEEMPHFIL	VFLT			
4	10	AMINV	-	-	AMFIL					
5	11	TUNE1 (Fc *mod* 1MHz / 10kHz)								
6	12	TUNE2 (Fc *mod* 256MHz / 1MHz)								
7	13	TUNE3 (Fc / 256MHz)								

Setup Command Response

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x00
3	Command Op Code MSB								0x10
4	Bytes to Follow LSB								0x00
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	Notes:
(none)									

Command Mnemonic	Description/Definition	Logic State/Explanation
DCx	Radio Selection Number	0=Radio 1 or Down Converter 1, 1=Radio 2 or Down Converter 2
INTREF	Internal/External Reference Clock Selection	0=Select External Reference Clock, 1=Select Internal Reference Clock
POLARITY	FM Demodulator Output Polarity	0=Normal Polarity, 1=Inverse Polarity. Not available in LS27P3 SCIA Port.
LIM	Hardware Limited Mode	0=LIM mode is off, 1=LIM mode is on.
AGCZERO	AGC Zero Mode	0=AGC Zero mode is off, 1=AGC Zero mode is on.
FRZ	AGC Freeze	0=Freeze AGC (infinite AGCTC), 1=Use selected AGCTC.
AGCTC	AGC Time Constant Selection	0=0.1 msec, 1=1 msec, 2=10 msec, 3=100 msec, 4=1 sec, 5=CustomTC1, 6=CustomTC2, 7=CustomTC3
IFBW	IFBW Filter Selection	0=Filter 1, 1=Filter 2, 2=Filter 3, 3=Filter 4, 4=Filter 5, 5=Filter 6, 6=Filter 7, 7=Filter 8
VFLT	Video Filter Selection	0=Filter 1, 1=Filter 2, 2=Filter 3, 3=Filter 4, 4=Filter 5, 5=Filter 6, 6=Filter 7, 7=Filter 8. Not available in LS27P3 SCIA Port.
DEEMPHFIL	DeEmphasis Filter Selection	0=Don't use DeEmphasis Filter, 1=Use DeEmphasis Filter. Not available in LS27P3 SCIA Port.
AMINV	AM Inverse	0=AM is normal, 1=AM is inverted.
AMFIL	AM Filter Selection	0=50, 1=100, 2=200, 3=300, 4=400, 5=500, 6=600, 7=700, 8=800, 9=900 10=1000, 11=1100, 12=1200, 13=1300, 14=1400, 15=1500, 16=1600, 17=1700, 18=1800, 19=1900, 20=2000, 21=3000, 22=4000, 23=5000, 24=6000, 25=7000, 26=8000, 27=9000, 28=10000, 29=15000, 30=20000, 31=50000
TUNE1	Receiver Tune Center Frequency Wd 1	Wd1 Receiver Center Frequency (MHz) (Fc mod 1MHz)/10kHz
TUNE2	Receiver Tune Center Frequency Wd 2	Wd2 Receiver Center Frequency (MHz) (Fc mod 256MHz)/1MHz
TUNE3	Receiver Tune Center Frequency Wd 3	Wd3 Receiver Center Frequency (MHz) Fc/256MHz
SNUM	Setup Number	Save the current setup to one of 16 possible storage locations.

Figure 5-4 **Primary Protocol Message Command/Status Structure**

5.1.1.3 Secondary Setup Command/Response Message

The "Secondary Setup" command is provides control information to the receiver channel commanded and requests that internal status from the controlled channel. The message header is followed by four (4) data bytes as defined in Figure 5-5.

Mode Command Content (Message ID = 0x1001)

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x01
3	Command Op Code MSB								0x10
4	Bytes to Follow LSB								0x04
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0 6	MODE					-	-	DCx	
1 7	CMD1								
2 8	CMD2								
3 9	CMD3								

Mode Command Response

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x01
3	Command Op Code MSB								0x10
4	Bytes to Follow LSB								0x04
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0 6	MODE					-	-	DCx	
1 7	STAT1								
2 8	STAT2								
3 9	STAT3								

Figure 5-5 **Secondary Message Command/Status Structure**

Secondary setup commands make extensive use to what are referred to as "mode commands". The mode commands allow multiple functions to be performed using the same message format. Mode commands provided are listed in Figure 5-6 and responses to mode commands in Figure 5-7. To specifically outline "Get Setup Info" (0x12) mode command, Figure 5-8 shows details of the responses.

Mode Commands:

Mode	Definition	CMD1	CMD2	CMD3
0x02	EEPROM Mode	EEPROM Sub Mode: 000pppppb = PROM Page No. 01aaaaaab = RD Offset Pg Address (LSB is returned on STAT2, MSB is returned on STAT3).	 (Unused) (Unused)	 (Unused) (Unused)
0x03	Tune Mode	Fc Mod 1MHz/10Khz	Fc MOD 256MHz/1MHz	Fc/256MHz
0x04	DAGC Control Mode	0x00 = LINEAR 0x01 = LIMITED 0x02 = COMBINER (Not implemented) 0x03 = RESERVED (Not implemented)	(Unused)	(Unused)
0x06	Read AM LPF Table	(Unused)	Table Index (0 to 31)	(Unused)
0x07	Read AM Freq Value	(Unused)	(Unused)	(Unused)
0x0B	Select AGC Out Range	(Unused)	0x00 = -4V to 0V, 0x08 = 0V to -4V, 0x01 = -2V to 0V, 0x09 = 0V to -2V, 0x02 = 0V to +2V, 0x0A = 2V to 0V, 0x03 = 0V to +4V, 0x0B = 4V to 0V, 0x04 = -2V to +2V, 0x0C = 2V to -2V, 0x05 = -4V to +4V, 0x0D = 4V to -4V, All others undefined.	(Unused)
0x0D	Program Digipot Mode	Digipot Instruction: 0x01 = Decrement Digipot 0x02 = Increment Digipot 0x03 = Set Digipot to Preset Value 0x04 = Query Digipot Setting 0x05 = Set Digipot to Default Value	 Digipot Preset Value: 0-99	Digipot Select: 0x00 = AM Gain
0x0E	Programmable AGC Out dBm Range	Lower dBm value in 2's complement format. Valid range is from -110 to 10. Granularity is 1 dBm.	Upper dBm value in 2's complement format. Valid range is from -110 to 10. Granularity is 1 dBm.	(Unused)
0x0F	Programmable AGC Out Voltage Range	Starting voltage value * 10 in 2's complement format. Valid range is from 40 (4.0 V) to -40 (-4.0 V). Granularity is 0.1 V.	Ending voltage value * 10 in 2's complement format. Valid range is from 40 (4.0 V) to -40 (-4.0 V). Granularity is 0.1 V.	(Unused)
0x10	DAC Adjust Mode	DAC Selection: 0x01 = Video Output Adjust	8 LSBs of DAC Setting	6 MSBs of DAC Setting
0x12	Get Setup Info Mode	0x00 = Get DCxCTRL124 Submode. 0x01 = Get Tune Freq Submode. 0x02 = Get DAGC Values Submode. 0x03 = Get AGC Out dBm Range. 0x04 = Get AGC Out Voltage Range. 0x05 = Get Miscellaneous Values.	(Unused)	(Unused)
0x13	DSP Flash Update Mode	DSP Flash Update SubMode: 0x00 = Append Flash Value 0xFF = Write Stored Values	 LSB of Flash Value Word (Unused)	 MSB of Flash Value Word (Unused)
0x1F	Serial Channel Control Mode	0x00 = Serial Baudrate Select Submode.	8 LSBits of (BAUD Rate/100).	3 MSBits of (BAUD Rate/100).

Figure 5-6 **Secondary Message Mode Command Definitions**

Mode Command Responses:

Mode	Functional Mode	STAT1	STAT2	STAT3
0x02	EEPROM Mode: Read	Page Offset	8 LSBs of EEPROM Read Value	8 MSBs of EEPROM Read Value
0x02	EEPROM Mode: Pg Set	Page Number	(Unused = 0)	(Unused = 0)
0x03	Tune Mode	Fc Mod 1MHz/10Khz	Fc MOD 256MHz/1MHz	Fc/256MHz
0x04	DAGC Control Mode	DAGC Control Mode Commanded	(Unused = 0)	(Unused = 0)
0x06	Read AM LPF Table	Index Value	8 LSBs of AM LPF Fc Frequency	8 MSBs of AM LPF Fc Frequency
0x07	Read AM Freq Counter	8 LSBs of AM Counter Frequency	8 Mid-SBs of AM Counter Frequency	1 MSB of AM Counter Frequency
0x0B	Select AGC Output Range	(Unused = 0)	0x00 = -4V to 0V, 0x08 = 0V to -4V, 0x01 = -2V to 0V, 0x09 = 0V to -2V, 0x02 = 0V to +2V, 0x0A = 2V to 0V, 0x03 = 0V to +4V, 0x0B = 4V to 0V, 0x04 = -2V to +2V, 0x0C = 2V to -2V, 0x05 = -4V to +4V, 0x0D = 4V to -4V, All others undefined.	(Unused = 0)
0x0D	Program Digipot Mode		Current Digipot Setting (0 – 99)	
0x0E	Programmable AGC Out dBm Range	Lower dBm value in 2's complement format.	Upper dBm value in 2's complement format.	(Unused = 0)
0x0F	Programmable AGC Out Voltage Range	Starting voltage value * 10 in 2's complement value.	Ending voltage value * 10 in 2's complement format.	(Unused = 0)
0x10	DAC Adjust Mode	DAC Selection Value	8 LSBs of the DAC Setting	6 MSBs of the DAC Setting
0x12	Get Setup Info Submodes: 0x00=Get DCxCTRL124 Submode. 0x01=Get Tune Freq Submode. 0x02=Get DAGC Values Submode. 0x03=Get AGC Out dBm Range. 0x04=Get AGC Out Voltage Range. 0x05=Get Miscellaneous Values. 0x06=Get External RSSI Correction 0x07=Get External Compression Pt.	| 7 | 6 |5|4| 3 |2|1| 0 | |LIM|AGCZERO|-|-|FRZ|-|-| - | Fc Mod 1MHz/10Khz DAGC Time Const in µsec LSB Lower dBm value in 2's comp format Start voltage value * 10 in 2's comp | - | - |-|-| VFIL |CAL| External RSSI Correction MSB External Compression Point MSB	|7|6|5|4| 3 |2| 1 | 0 | |-| IFBW|DEEMP|-|BANDOFPREF| Fc MOD 256MHz/1MHz DAGC Time Const in µsec MSB Upper dBm value in 2's comp format End voltage * 10 in 2's comp format Number of RSSI Samples MSB External RSSI Correction LSB External Compression Point LSB	| 7 |6|5|4|3|2|1|0| |AMINV|-|-| AMFLT | Fc/256MHz DAGC Control Mode (Unused = 0) (Unused = 0) Number of RSSI Samples LSB (Unused = 0) (Unused = 0)
0x13	DSP Flash Update Mode	If Submode=0x00, STAT1=0 If Submode=0xFF DSP will reboot.	If Submode=0x00, STAT2=0 If Submode=0xFF DSP will reboot.	If Submode=0x00, STAT3=0 If Submode=0xFF DSP will reboot.
0x1F	Serial Channel Control Mode	(Unused = 0)	(Unused = 0)	(Unused = 0)

Figure 5-7 **Secondary Message Mode Status Definitions**

Get Setup Info Mode Table:

Get DCxCTRL124 Values		7	6	5	4	3	2	1	0
Submode= 0x00	STAT1	LIM	AGCZERO	-		FRZ	-		
	STAT2	-	IFBW			DEEMP	-	BANDOFPREF	
	STAT3	AMINV	-		AMFIL				

Get Tune Frequency		7	6	5	4	3	2	1	0
Submode= 0x01	STAT1	Fc MOD 1MHz/10Khz							
	STAT2	Fc MOD 256MHz/1MHz							
	STAT3	Fc / 256MHz							

Get DAGC Values		7	6	5	4	3	2	1	0
Submode= 0x02	STAT1	AGCTC LSB							
	STAT2	AGCTC MSB							
	STAT3							DAGC CTRL MODE	

Get AGC Out dBm Range		7	6	5	4	3	2	1	0
Submode= 0x03	STAT1	Lower dBm Value							
	STAT2	Upper dBm Value							
	STAT3	-							

Get AGC Out Voltage Range		7	6	5	4	3	2	1	0
Submode= 0x04	STAT1	Lower Voltage Value (x10)							
	STAT2	Upper Voltage Value (x10)							
	STAT3	-							

Get Miscellaneous Values		7	6	5	4	3	2	1	0
Submode= 0x05	STAT1						VFIL		DAGC Cal Mode
	STAT2	-							
	STAT3	-							

Get External RSSI Correction		7	6	5	4	3	2	1	0
Submode= 0x06	STAT1	External RSSI Correction MSB							
	STAT2	External RSSI Correction LSB							
	STAT3	-							

Get Ext. Compression Point		7	6	5	4	3	2	1	0
Submode= 0x07	STAT1	External Compression Point MSB							
	STAT2	External Compression Point LSB							
	STAT3	-							

Figure 5-8 "**Get Setup Info" Mode Command (0x12) Response Details**

5.1.1.4 Append Flash File Section Command/Status Message

This command can be used to program the DSP with a successor flash file. This process is analogous to updating the BIOS on a personal computer. Contact Lumistar for further information and to receive the latest DSP flash file. The DSP flash file can be divided into 128 byte sections and loaded into the DSP's onboard memory with multiple 0x1020 commands. The last 0x1020 command may have a body less than 128 bytes long to accommodate the different possible lengths of the DSP flash file. In that case, the "Bytes to Follow" value in the command header section should be set to the actual number of bytes in the command body. After the last flash file section has been delivered to the DSP, send a 0x1001 Secondary Setup command with a 0x13 value in the Mode field and a 0xFF value in the CMD1 field. When the DSP receives this command it will use the reconstructed flash file that it has retained in local memory and write this file into the flash RAM. Depending on the current DSP flash file version, it may load the file and then begin blinking the LED at about 1 Hz. The LS27B will then need to be power cycled before any further commands are sent to it. More recent DSP versions will reboot after the successor file has been fully written to DSP flash RAM. Figure 5-9 defines the Append Flash File Command and Status message.

Append Flash File Section Command Content (Message ID = 0x1020)

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x20
3	Command Op Code MSB								0x10
4	Bytes to Follow LSB								0x02-0x80
5	Bytes to Follow MSB								
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0	6	Flash File Section Byte 0							
1	7	Flash File Section Byte 1							
2	8	Flash File Section Byte 2							
3	9	Flash File Section Byte 3							
4	10	Flash File Section Byte 4							
5	11	Flash File Section Byte 5							
6..121	12..127	Flash File Section Bytes 6..121							
122	128	Flash File Section Byte 122							
123	129	Flash File Section Byte 123							
124	130	Flash File Section Byte 124							
125	131	Flash File Section Byte 125							
126	132	Flash File Section Byte 126							
127	133	Flash File Section Byte 127							

Note: The length of a Flash File Section may be from 2 to 128 bytes long, and is always even. This length is placed into the Bytes to Follow LSB and MSB locations in the Header.

Append Flash File Section Command Response

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x20
3	Command Op Code MSB								0x10
4	Bytes to Follow LSB								0x00
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	Notes:
(none)									

Figure 5-9 **Append Flash File Section Command/Status Message Definitions**

5.1.1.5 General Status Command/Response Message

The General Status command is provides receiver operational status such as signal strength, deviation amounts, AM index values, and certain lock states. The message definition is shown in Figure 5-10 including discrete bit definitions.

General Status Command Content (Message ID = 0x2000)

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x00
3	Command Op Code MSB								0x20
4	Bytes to Follow LSB								0x00
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
(none)									

General Status Command Response

Header Byte		D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0		Device ID								0x27
1		Device Address								0x00
2		Command Op Code LSB								0x00
3		Command Op Code MSB								0x20
4		Bytes to Follow LSB								0x09
5		Bytes to Follow MSB								0x00
Body Byte		**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0	6	REFSTATE	PLLSYNC	-	-	ID3	ID2	ID1	ID0	
1	7	DC1RSSILO								
2	8	DC1COMPWARN	DC1ZEROSTAT	DC1LO2STAT	DC1LO1STAT	DC1RSSIHI				
3	9	-	DC1AMINDX							
4	10	-	DC1FMDEV							
5	11	DC2RSSILO								
6	12	DC2COMPWARN	DC2ZEROSTAT	DC2LO2STAT	DC2LO1STAT	DC2RSSIHI				
7	13	-	DC2AMINDX							
8	14	-	DC2FMDEV							

Response Mnemonic	Description/Definition	Logic State/Explanation
REFSTATE	Present state of the Internal/External Reference Select	1 = Internal Reference Selected, 0 = External Reference Selected
PLLSYNC	Internal Synthesizer Reference Synchronization Status	1 = PLL Synchronized, 0 = PLL Unsynchronized
DCxRSSILO	DCx Received Signal Strength (8 LSBs)	Lower 8 bits of RSSI level
DCxRSSIHI	DCx Received Signal Strength (4 MSBs)	Upper 4 bits of RSSI level
DCxCOMPWARN	DCx Compression Warning	0 = Not in compression, 1 = May be in compression.
DCxAMINDX	DCx Measured AM Index	AM Index Measurement (Range 0-127)
DCxLO1STAT	DCx LO1 Status	1 = Locked, 0 = Unlocked
DcxLO2STAT	DCx LO2 Status	1 = Locked, 0 = Unlocked
DCxFMDEV	DCx FM Deviation in Percent	Valid range is from 0% – 127%.
DCxZEROSTAT	DCx AGC Zero State	1=In AGC Zero Mode, 0=Not in AGC Zero Mode.

Figure 5-10 **General Status Command/Status Message Definitions**

5.1.1.6 EEPROM Page Read Command/Status Message

The primary receiver configuration information, used to drive software controls, is found in the first page (indexed from 0) of the receivers primary internal EEPROM. Information contained in this EEPROM includes the bandwidths installed in the receiver, associated IF and video filter bandwidths, along with various other configuration information. This information can be accessed via an EEPROM read mode command. The EEPROM Page read Message structure is shown in Figure 5-11. An example of the EEPROM contents is shown in Figure 5-12.

EEPROM Page Status Command Content (Message ID = 0x2009)

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x09
3	Command Op Code MSB								0x20
4	Bytes to Follow LSB								0x02
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0	6	-	-	-	-	-	-	-	DCx	
1	7	-	-	-	PAGE					

EEPROM Page Status Command Response

Header Byte	D7	D6	D5	D4	D3	D2	D1	D0	Notes:
0	Device ID								0x27
1	Device Address								0x00
2	Command Op Code LSB								0x09
3	Command Op Code MSB								0x20
4	Bytes to Follow LSB								0x80
5	Bytes to Follow MSB								0x00
Body Byte	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	**Notes:**
0	6	LOC0_LSB							
1	7	LOC0_MSB							
2-125	8-131	...							
126	132	LOC63_LSB							
127	133	LOC63_MSB							

Command Mnemonic	Description/Definition	Logic State/Explanation
DCx	Radio Selection Number	0=Radio 1 or Down Converter 1, 1=Radio 2 or Down Converter 2
PAGE	EEPROM Page Number Selection	0 – 31 are valid page numbers

Figure 5-11 **EEPROM Page Read Message Structure**

EEPROM Map			
Offset	**CH1**	**CH2**	**Description/ Information**
0	Signal Bandwidth Filter 0 (kHz)	Signal Bandwidth Filter 0 (kHz)	IF Filter Bandwidth (Hz) = Value x1000 Hz
1	Signal Bandwidth Filter 1 (kHz)	Signal Bandwidth Filter 1 (kHz)	
2	Signal Bandwidth Filter 2 (kHz)	Signal Bandwidth Filter 2 (kHz)	
3	Signal Bandwidth Filter 3 (kHz)	Signal Bandwidth Filter 3 (kHz)	
4	Signal Bandwidth Filter 4 (kHz)	Signal Bandwidth Filter 4 (kHz)	
5	Signal Bandwidth Filter 5 (kHz)	Signal Bandwidth Filter 5 (kHz)	
6	Signal Bandwidth Filter 6 (kHz)	Signal Bandwidth Filter 6 (kHz)	
7	Signal Bandwidth Filter 7 (kHz)	Signal Bandwidth Filter 7 (kHz)	
8	*(Unused / Spare)*	*(Unused / Spare)*	
9	*(Unused / Spare)*	*(Unused / Spare)*	
10	AGC Time Constant Count #0	AGC Time Constant Count #0	AGC Time Constant (msec) = Constant Count x 0.1msec
11	AGC Time Constant Count #1	AGC Time Constant Count #1	
12	AGC Time Constant Count #2	AGC Time Constant Count #2	
13	AGC Time Constant Count #3	AGC Time Constant Count #3	
14	AGC Time Constant Count #4	AGC Time Constant Count #4	
15	User AGC Time Constant Count #5	User AGC Time Constant Count #5	
16	User AGC Time Constant Count #6	User AGC Time Constant Count #6	
17	User AGC Time Constant Count #7	User AGC Time Constant Count #7	
18	*(Unused / Spare)*	*(Unused / Spare)*	
19	RF Band 1 Start Frequency (MHz)	RF Band 1 Start Frequency (MHz)	RF Band Edge = Value x 1MHz
20	RF Band 1 Stop Frequency (MHz)	RF Band 1 Stop Frequency (MHz)	
21	RF Band 2 Start Frequency (MHz)	RF Band 2 Start Frequency (MHz)	
22	RF Band 2 Stop Frequency (MHz)	RF Band 2 Stop Frequency (MHz)	
23	RF Band 3 Start Frequency (MHz)	RF Band 3 Start Frequency (MHz)	
24	RF Band 3 Stop Frequency (MHz)	RF Band 3 Stop Frequency (MHz)	
25	RF Band 4 Start Frequency (MHz)	RF Band 4 Start Frequency (MHz)	
26	RF Band 4 Stop Frequency (MHz)	RF Band 4 Stop Frequency (MHz)	
27	*(Unused / Spare)*	*(Unused / Spare)*	
28	*(Unused / Spare)*	*(Unused / Spare)*	
29	RF Band 1 RSSI M Scale Factor	RF Band 1 RSSI M Scale Factor	RSSI (dBm) = ((RSSI Reg Value) x (M/10000)) + (B/10)
30	RF Band 1 RSSI B Scale Factor	RF Band 1 RSSI B Scale Factor	
31	RF Band 2 RSSI M Scale Factor	RF Band 2 RSSI M Scale Factor	
32	RF Band 2 RSSI B Scale Factor	RF Band 2 RSSI B Scale Factor	
33	RF Band 3 RSSI M Scale Factor	RF Band 3 RSSI M Scale Factor	
34	RF Band 3 RSSI B Scale Factor	RF Band 3 RSSI B Scale Factor	
35	RF Band 4 RSSI M Scale Factor	RF Band 4 RSSI M Scale Factor	
36	RF Band 4 RSSI B Scale Factor	RF Band 4 RSSI B Scale Factor	
37	Signal Bandwidth Video Filter 0 (kHz)	Signal Bandwidth Video Filter 0 (kHz)	Video Filter Bandwidth (Hz) = Value x1000 Hz
38	Signal Bandwidth Video Filter 1 (kHz)	Signal Bandwidth Video Filter 1 (kHz)	
39	Signal Bandwidth Video Filter 2 (kHz)	Signal Bandwidth Video Filter 2 (kHz)	
40	Signal Bandwidth Video Filter 3 (kHz)	Signal Bandwidth Video Filter 3 (kHz)	
41	Signal Bandwidth Video Filter 4 (kHz)	Signal Bandwidth Video Filter 4 (kHz)	
42	Signal Bandwidth Video Filter 5 (kHz)	Signal Bandwidth Video Filter 5 (kHz)	
43	Signal Bandwidth Video Filter 6 (kHz)	Signal Bandwidth Video Filter 6 (kHz)	
44	Signal Bandwidth Video Filter 7 (kHz)	Signal Bandwidth Video Filter 7 (kHz)	
45	Serial Channel Baud Rate	*(Future Use)*	Serial Channel BAUD/100
46	Serial Channel Format	*(Future Use)*	No. Bits/PE/Parity/Stop Bits
47	*(Unused / Spare)*	*(Unused / Spare)*	
48	*(Unused / Spare)*	*(Unused / Spare)*	
49	DSP Firmware ID MSW	*(Unused / Spare)*	DSP Firmware Date: MSB = Month in Hex, LSB = Day in Hex
50	DSP Firmware ID LSW	*(Unused / Spare)*	DSP Firmware Date: Two Bytes = Year in Hex
51	RF/IF Hardware Port Configuration	RF/IF Hardware Port Configuration	(Future Use)
52	Board Serial Number MSW	*(Unused / Spare)*	Device Serial Number in Hex.
53	Board Serial Number LSW	*(Unused / Spare)*	
54	Ext. Ref. Input Freq. Multiplier (MHz)	*(Unused / Spare)*	External Reference Input Frequency = Multiplier x 1MHz
55	*(Unused / Spare)*	*(Unused / Spare)*	
56	Board ID ASCII Character 1	*(Unused / Spare)*	ASCII Representation Of Device ID
57	Board ID ASCII Character 2	*(Unused / Spare)*	
58	Board ID ASCII Character 3	*(Unused / Spare)*	
59	Board ID ASCII Character 4	*(Unused / Spare)*	
60	Board ID ASCII Character 5	*(Unused / Spare)*	
61	Board ID ASCII Character 6	*(Unused / Spare)*	
62	Board ID ASCII Character 7	*(Unused / Spare)*	
63	Board ID ASCII Character 8	*(Unused / Spare)*	

Figure 5-12 **EEPROM Contents**