

FLEX-6400 / FLEX-6600 HARDWARE REFERENCE

Version **2.1.30**

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1 INTRODUCTION

1.1 WELCOME

Thank you for purchasing the FLEX-6400/FLEX-6600 direct sampling software defined radio (SDR) from FlexRadio Systems. The FLEX-6400 and FLEX-6600 are top performing HF/6m transceivers that make use of the latest SDR technology using direct digital sampling at the RF input for exceptional performance and distortion free reception. Direct sampling technology eliminates analog mixing and amplification to minimize spurious output and in-band intermodulation distortion to ensure ultra-clean RF transmission.

The FLEX-6400 and FLEX-6600 along with the SmartSDR software “ecosystem” represents the ultimate operating experience for amateur radio operators.

1.2 MANUAL LAYOUT

The **FLEX-6400/FLEX-6600 Hardware Reference Manual** is designed as a guide for use while installing, configuring, and integrating your FLEX-6400/FLEX-6600 into your amateur radio station. This manual expands on the **FLEX-6400/FLEX-6600 Quick Start Guide** regarding connection details and hardware configuration including basic connectivity information for interfacing with the more common types of third-party hardware. It is designed for use in conjunction with the **SmartSDR Software User’s Guide**. References to the **SmartSDR Software User’s Guide** will be provided to assist you.

Throughout this manual, important references will be highlighted for your information and safety. The following symbols and styles will be used:

! – WARNING: THIS MEANS THAT THERE IS A POTENTIAL SAFETY HAZARD IF THE RADIO IS CONFIGURED OR OPERATED IMPROPERLY. PAY SPECIAL ATTENTION TO ALL “!” WARNINGS.

Δ – CAUTION: This is a precautionary statement to acknowledge there is a risk to damaging your radio or operating it in an unintended manner. Pay special attention to the “Δ” symbol to get the most from your FLEX-6400/FLEX-6600.

I – Information: Important information will be highlighted with the “i” symbol. Read these notes for helpful hints and details about your FLEX-6400/FLEX-6600.

1.3 NOTICES TO THE USER

IMPORTANT NOTICE - READ BEFORE OPERATING THIS UNIT

WARNING!

This radio has been configured to operate in your country according to your nation's regulations. It will operate on frequencies which are not allowed for public use. You are required to have a valid amateur radio license of an appropriate class from your government to have the privileges to operate on amateur radio frequencies.

Except those actions which have been described in the **FLEX-6400/FLEX-6600 Quick Start Guide**, **FLEX-6400/FLEX-6600 Hardware Reference Manual**, and **SmartSDR Software User's Guide**, no other manipulations to the radio are allowed. The unit must only be opened and/or serviced by a qualified technician. Unauthorized repairs may damage the radio and void the manufacturer's warranty.

Please study the **FLEX-6400/FLEX-6600 Quick Start Guide** and the **FLEX-6400/FLEX-6600 Hardware Reference Manual** and **SmartSDR Software User's Guide** prior to operating the unit. These documents contain important information for safe operation.

For any questions due to misunderstanding, translation errors and alike, please refer to the **FLEX-6400/FLEX-6600 Hardware Reference Manual** and **SmartSDR Software User's Guide** first.

Radio frequency energy (RF) from transmitters can interact with some electronic devices, such as cardiac pacemakers and defibrillators. Please refer to the implanted pacemaker or defibrillator manufacturer's instructions with respect to precautions to be taken in the vicinity of an amateur radio transmitter. If any interaction or interference with a pacemaker or implanted defibrillator is suspected, STOP transmitting immediately.

2 WARRANTY INFORMATION

FLEX-6400 / FLEX-6600 Signature Series 2-Year Limited Hardware Warranty

This Limited Warranty is effective as of the date of first purchase by the consumer. Original equipment hardware warranties and manufacturer support for FlexRadio Systems products applies only to the original purchaser and are not transferable unless a Warranty Transfer agreement is purchased from FlexRadio Systems. Before sending in your product for service, it is recommended that you query the FlexRadio Community to make sure your issue is not easily resolved. If you still have an issue, submit a request for support via the FlexRadio HelpDesk. Once you are assigned an incident or ticket number, one of our Technical Support Engineers will determine if the issue your product is experiencing requires service or repair and will either issue you an RMA (Return Material Authorization) number for service in Austin, TX or refer you to another authorized Service Center. Any product returned for service that is out of warranty or has had its warranty voided is subject to a one (1) hour diagnostic bench charge. This charge will be applied to any work performed.

What is Covered:

During the first thirty (30) days after the date of shipment, FlexRadio Systems will fully repair or replace a defective product at their discretion. For the remaining two (2) years after the date of shipment, FlexRadio Systems will replace defective parts free of charge (post-paid) for transceiver components only. Any replacement hardware parts will be warranted for the remainder of the original warranty period or ninety (90) calendar days from the date of installation or repair, whichever is longer. FlexRadio Systems will also correct any failure caused by defective parts and materials. You must send the unit at your expense to FlexRadio Systems. FlexRadio Systems will pay return shipping to the country of purchase.

What is Not Covered:

This Limited Warranty as it pertains to the transceiver or radio components does not cover repair or damage caused by (1) misuse, negligence or user modifications; (2) any performance or operational malfunctions involving non-FlexRadio Systems accessory equipment; (3) connection to improper or unstable voltage supply; (4) improper execution of hardware calibration or test routines; (5) the incorrect installation of any and all cables connected to the radio by the user; (6) the use of third-party software applications or hardware that directly or indirectly controls radio functions and/or operating state by utilizing a communication or control protocol, such as, but not limited to CAT or I2C commands or (7) random acts of nature such as flood, fire, water, weather related storm, lightning or electrostatic discharge damage.

Limitation of Incidental or Consequential Damages:

This warranty does not extend to non-FlexRadio Systems equipment or components used in conjunction with our products. Any such repair or replacement is the responsibility of the customer. FlexRadio Systems shall not be liable or responsible for reimbursement for any special, indirect, incidental or consequential damages, including but not limited to any loss of business or profits, loss of property, loss of revenue, loss of use, loss of data, inconvenience or cost of unauthorized service.

3 IMPORTANT NOTICE – READ BEFORE OPERATING THIS UNIT

3.1 PRECAUTIONS

! – THIS UNIT IS NOT A TOY. IT MUST NOT BE HANDLED BY CHILDREN NOR PLACED/OPERATED WITHIN REACH OF CHILDREN.

! – DO NOT LEAVE PACKING MATERIAL FOR THIS UNIT UNATTENDED. IT MAY BE HARMFUL TO CHILDREN IF MISUSED.

! – THIS UNIT CONTAINS SMALL PARTS THAT COULD BE A CHOKING HAZARD TO SMALL CHILDREN. DO NOT LEAVE ACCESSORIES UNATTENDED.

! – DO NOT OPERATE THIS UNIT IN POTENTIALLY EXPLOSIVE ENVIRONMENTS.

! – NEVER ATTEMPT TO INSERT WIRES OR ANY TOOLS INTO THE INTERIOR OF THIS UNIT DURING OPERATION. THIS MAY CAUSE FIRE OR ELECTRIC SHOCK.

! – THIS UNIT MUST ONLY BE OPERATED WITH THE ELECTRICAL POWER DESCRIBED IN THE FLEX-6400/FLEX-6600 QUICK START GUIDE. NEVER CONNECT THE +13.8VDC POWER CONNECTOR DIRECTLY TO AN AC OUTLET. THIS MAY CAUSE A FIRE, INJURY, OR ELECTRICAL SHOCK.

! – NEVER CONNECT OR DISCONNECT ANTENNAS WHILE IN TRANSMIT MODE. THIS MAY CAUSE ELECTRICAL SHOCK OR RF BURNS TO YOUR SKIN AND DAMAGE TO THE UNIT.

! – THIS UNIT GENERATES RADIO FREQUENCY (RF) ENERGY. USE CAUTION AND OBSERVE PROPER SAFETY PRACTICES REGARDING YOUR SYSTEM CONFIGURATION. WHEN ATTACHED TO AN ANTENNA, THIS RADIO IS CAPABLE OF GENERATING RF ELECTROMAGNETIC FIELDS WHICH REQUIRE EVALUATION ACCORDING TO YOUR NATIONAL LAW TO PROVIDE ANY NECESSARY ISOLATION OR PROTECTION REQUIRED, WITH RESPECT TO HUMAN EXPOSURE!

Δ - This unit must only be opened and/or serviced by a qualified technician. Opening the unit may void the manufacturer's warranty

Δ - Do not operate this unit in areas of extreme humidity.

Δ - Avoid operating this radio in direct sunlight or other areas of extreme heat, excessive vibration, or mechanical force.

Δ - When using earphones, use caution when adjusting the volume to prevent any harm to your hearing.

Δ - If this unit is intended for use in commercial applications, special safety regulations and cautions may apply to prevent accidents.

Δ - If any defect, abnormal result, or other observations occur that are not covered by the [Quick Start Guide](#); immediately cease operation and contact the manufacturer or local distributor for operational advice or repair of the unit.

I- *No other physical modification of this radio is allowed. Any other use or modification (including software changes that affect operational characteristics) will void the manufacturer's warranty.*

I- *Ensure proper ventilation around the radio; this includes 2" clearance on the sides and back.*

I- *If you operate this unit in conjunction with a linear amplifier, always make sure your output power is below the maximum input limits of the amplifier. Consult your amplifier owner's manual for proper connection and operation.*

3.2 LEGAL NOTICES

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4 SPECIFICATIONS

4.1 GENERAL

Specification	FLEX-6400	FLEX-6600
Frequency Range (Transmitter)		
Rated Output Power @ 100W nominal	160m - 6m (Amateur bands only by country) MARS optional	160m - 6m (Amateur bands only by country) MARS optional
Transverter (XVTR) IF Output Port	100 KHz - 54 MHz	100 KHz – 54 MHz
Frequency Range (Receiver)		
Low Band (First Nyquist Zone)	30 kHz – 54 MHz	30 KHz to 54 MHz
High Band (Second Nyquist Zone)	NA	NA
Emission Modes*	A1A (CW), A3E(AM), J3E (SSB), F3E (FM)	A1A (CW), A3E(AM), J3E (SSB), F3E (FM)
Frequency Stability		
Standard	0.5ppm TCXO	0.5 ppm TCXO
With GPSDO Option (GPS Locked)	5x10 ⁻¹² over 24 Hours	5x10 ⁻¹² over 24 Hours
Antenna Impedance - Unbalanced	50 Ohms	50 Ohms
Antenna Tuner Load Range - Unbalanced	8.3 - 300 Ohms (80m – 10m) 6.7 - 150 Ohms (160m and 6m)	8.3 - 300 Ohms (80m – 10m) 6.7 - 150 Ohms (160m and 6m)
Standard Supply Voltage	+13.8 VDC +/- 15%	+13.8 VDC +/- 15%
Supply Current (Receive/Transmit)	1.7A Receive Typ., 23A Transmit Max.	2A Receive Typ., 23A Transmit Max.
Operating Temperature Range	0 to +50C, +32 to +122F	0 to +50C, +32 to +122F
Dimensions		
With Feet	7" (17.8 cm) H, 14" (35.5 cm) W, 12" (30.5 cm) D	7" (17.8 cm) H, 14" (35.5 cm) W, 12" (30.5 cm) D
Weight	10.5 lbs., 4.8 kgs	11.1 lbs, 5.0 kgs

* - Other modes may be available through the addition of third-party waveform plug-ins.

4.2 TRANSMITTER

Specification	FLEX-6400	FLEX-6600
Transmitter Architecture	Direct Digital Up Conversion	Direct Digital Up Conversion
TX DAC Resolution	16-bit	16-bit
TX DAC Sampling Rate	122.88 Msps	245.76 Msps
Output Power CW/SSB/RTTY/FM (AM) at 13.8 VDC (nominal)	100W (25W)	100W (25W)
XVTR Port Power Output	0 dBm Typ., +10 dBm Max.	0 dBm Typ., +10 dBm Max.
Modulation	DSP Generation	DSP Generation
Spurious Emissions	HF: -55 dBc, 6m: -65 dBc	HF: -55 dBc, 6m: -65 dBc
Carrier Suppression	-80 dBc below peak output	-80 dBc below peak output
Unwanted Sideband Suppression	-80 dBc below peak output	-80 dBc below peak output
Transmit Frequency Response	Default 100-2900 Hz (Variable 50-10 kHz)	Default 100-2900 Hz (Variable 50-10 kHz)
Microphone Impedance	600 Ohms Nominal, 200-10k Ohm	600 Ohms Nominal, 200-10k Ohm

4.3 RECEIVER

Specification	FLEX-6400	FLEX-6600
Receiver Architecture	Direct Down Conversion	Direct Down Conversion
Spectral Capture Units	1	2
Maximum Slice Receivers	2	4
Maximum Spectral Displays (Panadapters)	2	4
ADC Resolution	16-bit	16-bit
ADC Sampling Rate	122.88 Msps	245.76 Msps
Reciprocal Mixing Dynamic Range	1 KHz 110 dB, 2 KHz 116 dB	1 KHz 110 dB, 2 KHz 116 dB
Amateur Band Preselectors	3 rd order	7 th order contest bands, 3 rd order other bands
Spurious and Image Rejection Ratio	>80 dB	>100 dB
External Powered Speaker Output Impedance/Level	10 kOhm / 2.6Vpp max.	10 kOhm / 2.6Vpp max.
Headphone Output	16 Ohm Minimum Load @ 21 mW	16 Ohm Minimum Load @ 21 mW

5 UNPACKING AND INSPECTION

5.1 UNBOXING

FLEX-6400/FLEX-6600 radios are double packed to protect your investment. To remove the radio, carefully cut the tape on one end of the outer carton and open the end flaps to expose the inner carton. Remove the inner carton by placing one hand on the inner carton while using the other hand to invert the outer box so the open end is facing down. Carefully place the inner carton on a flat surface then remove the outer carton by pulling up on the sides. Use caution not to let the inner carton slip out and fall.

Position the inner carton so the FLEX-6400/FLEX-6600 label is facing up. Carefully cut the tape and open the flaps exposing your radio. Remove the upper packing foam and set it aside.

I - Be sure to keep the carton and all packing material in case you ever need to ship your FLEX-6400/FLEX-6600.

5.2 VISUAL INSPECTION

5.2.1 General

Note the orientation of the radio in the packing foam. It is important that the front of the radio be properly aligned to prevent damage if further shipment is required. Remove the radio from the foam and the poly bag. Retain this bag if further shipment is required.

! - WARNING: POLY BAGS CAN BE A SUFFOCATION HAZARD. DO NOT LEAVE THIS BAG UNATTENDED AROUND SMALL CHILDREN!

Δ – CAUTION: THE POLY BAG IS VERY IMPORTANT TO PROTECT YOUR RADIO'S FINISH SHOULD YOU EVER NEED TO SHIP IT. DO NOT SHIP THE RADIO IN THE PACKING FOAM WITHOUT FIRST PLACING IT IN THE INCLUDED POLY BAG.

5.2.2 Radio

Inspect your FLEX-6400/FLEX-6600 radio for any physical damage due to rough shipment. Remove the protective cover from the front display.

5.2.3 Included Accessories

- One (1) FLEX-6400 or FLEX-6600 Transceiver
- One (1) FHM-2 Electret Hand Microphone
- One (1) 6 ft. (1.8m) CAT 5 Ethernet cable
- One (1) DC power cord with Anderson Powerpole™ connectors
- One (1) SmartSDR for Windows installation and documentation CD

- One (1) **FLEX-6400/FLEX-6600 Quick Start Guide**

5.2.4 Additional Items Not Included but Required

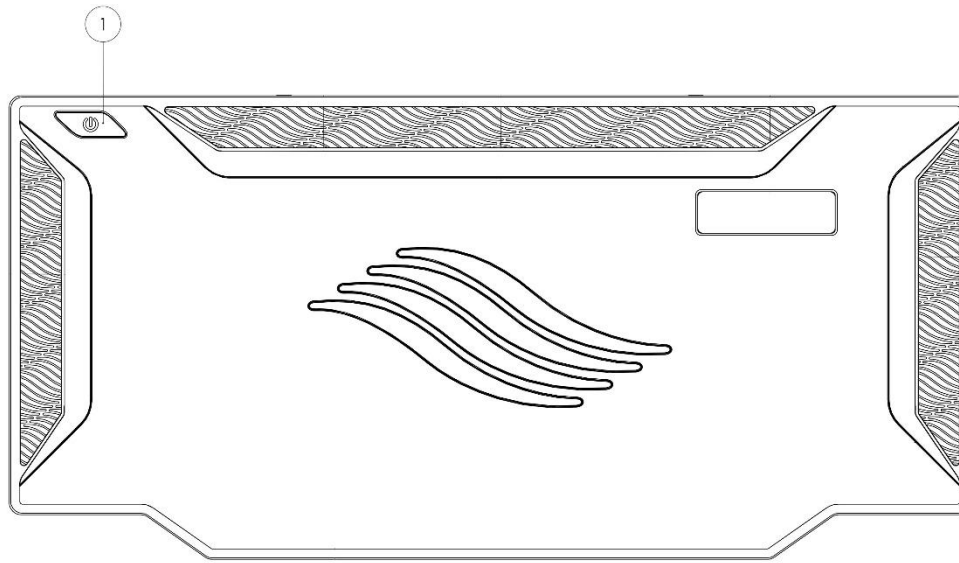
In addition to the supplied accessories, software and cables supplied with the FLEX-6400/FLEX-6600, you will need to provide the following:

- An HF-Antenna or dummy load.
- An RF ground (if possible).
- Powered stereo speakers (computer type) or stereo headphones.
- A stabilized 13.8V DC power supply, capable of 25A or greater continuous duty.
- A Personal Computer (PC) running Windows 7 or above. Both 32 and 64-bit operating systems are supported (64-bit recommended).
- A 100/1000BaseT Ethernet Access – either an open port on your computer or on your local area network (LAN) Ethernet switch.

5.3 REPORTING DAMAGE

Please report any missing items or shipping damage to FlexRadio or your Distributor immediately. It is helpful to take digital pictures of the damage to assist in resolving the issue with the shipper. See the [CONTACT US](#) web page FlexRadio contact information. You can always open a HelpDesk Ticket at <https://helpdesk.flexradio.com>

6 FRONT PANEL CONTROLS AND CONNECTIONS



The front panel of the 6400/6600 contains only the Power button ^① and the radio's backlights. The Power button is used to turn the radio on and off and is illuminated with a number of colors to indicate the radio's operational state:

- FLASHING GREEN: Radio is starting or shutting down
- SOLID GREEN: Radio is in receive mode
- FLASHING RED: See **Error Conditions** below
- SOLID BRIGHT RED: Transmitting on PA
- SOLID DIM RED: Transmit engaged, but transmit interlocks are not ready. Refer to the SmartSDR documentation for description of the transmit interlocks.
- SOLID ORANGE: Transmitting on XVTR port with low power
- SOLID PURPLE: Radio is performing a software update
- FLASHING WHITE: Radio is performing a reset to factory defaults
- OFF: Radio is off

When the optional GPS Disciplined Oscillator is installed:

- SOLID AMBER: Radio is off, GPSDO is powered for stability
- FLASHING YELLOW: GPSDO is warming up
- SOLID YELLOW: GPSDO is "holdover" mode (has lost satellites)
- SHORT FLASH BLUE: GPSDO is locking
- LONG FLASH BLUE: GPSDO is in "hold phase" mode
- SOLID BLUE: GPSDO is locked

The power control is a “soft power control” that performs multiple functions depending on the state of the radio. If the radio is powered off, momentarily pressing and releasing the button will start the radio software. The radio takes approximately sixty seconds to become fully functional.

Momentarily pressing and releasing the button when the radio is running will start an orderly shutdown of the radio software. When the button is pressed, the button will slowly flash green. At the conclusion of the shutdown, the button will either turn off or turn solid amber if a GPSDO is installed. A full shutdown can take up to 10 seconds. It is advisable to allow the radio to shut down in this way. During a shutdown, the radio will save its settings, so ending the shutdown early by removing power from the radio may cause a loss of settings.

Avoid removing power from the radio when it is performing a software update (power button is solid purple). Doing so may result in the radio becoming unresponsive.

Holding the power button down for 4+ seconds while the radio is running will trigger an immediate shutdown. This skips the database writing procedure, so any changes will not be saved. This is not a recommended shutdown procedure for regular use.

Reset Procedure

With the radio powered off, press and hold down the power button for approximately 5 seconds until the Power LED flashes white, then release the power button. The radio will start and will set all of its internal settings to their default values.

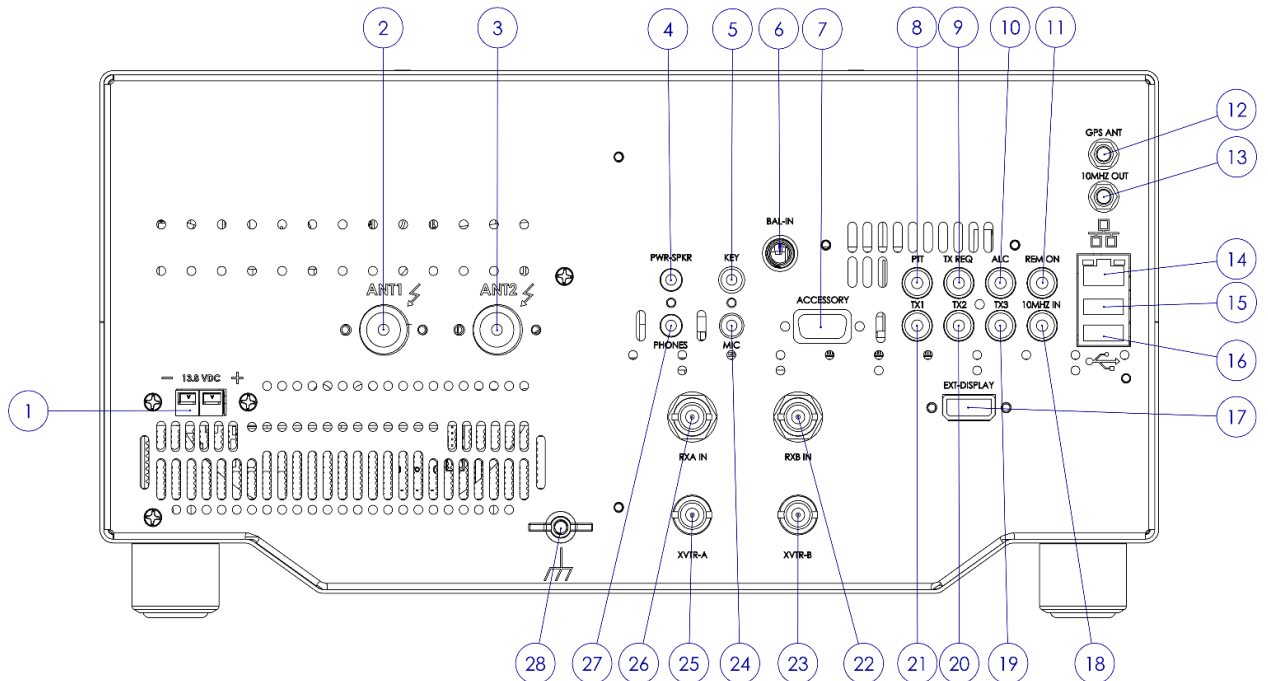
Error Conditions

Certain hardware and software error conditions cause the radio to stop operating and display an error code by flashing the Power button light as follows:

- One red flash: Fan malfunction
- Two red flashes: Software crash
- Three red flashes: Boot failure
- Four red flashes: Input power over voltage
- Five red flashes: CPU overcurrent
- Six red flashes: Input power under voltage

In the case of a software crash, the error code repeats for about 15 seconds, then the radio will reboot. In the other cases, the error code repeats until the Power button is pressed, then the radio shuts down. An additional press of the Power button is needed to restart the radio.

7 REAR PANEL CONNECTIONS



7.1 DC POWER INPUT



The FLEX-6400/FLEX-6600 is designed to operate from a 13.8 volt nominal DC supply capable of supplying 25 amps of continuous current to the radio.

! – This unit must only be operated with the electrical power described in this manual. NEVER CONNECT THE +13.8VDC POWER CONNECTOR DIRECTLY TO AN AC OUTLET. This may cause a fire, injury, or electrical shock.

Δ – The FLEX-6400/FLEX-6600 requires 13.8 VDC @ 25 amps measured at the radio in order to transmit maximum wattage. Multiple power cable connections between the power supply and the FLEX-6400/FLEX-6600, a poorly regulated power supply, undersized power cable and very long power cable lengths will result in a voltage drop, especially under load. Any voltage deviation from 13.8 VDC will result in lower power output that the 100W nominal specification.

I - For best results, select a linear or switching power supply that is well regulated and free of internally generated radio frequency noise. “Birdies” generated by a poorly filtered supply can often appear as signals in the SmartSDR Panadapter display.

The Anderson Powerpole™ connector contains 45 Amp pins to minimize voltage drop during transmit. The **RED** connection should be connected to the positive (+) lead of the power source. The **BLACK** connection should be connected to the negative (-) lead of the power source.

I - If you choose to use your own Powerpole cabling, be sure to properly size the wire and the Powerpole connector to minimize voltage drop during transmit. Excessive voltage drop can cause lower transmit power output levels.

7.1.1 Fused Internally at 30 Amps

The power input has a protective 30 Amp automotive “blade type” fuse inside the radio case. In the event you ever need to replace the internal fuse, remove the top cover and locate the fuse in the rear corner of the PA board just inside the case adjacent to the Anderson Powerpole connector.

! – NEVER USE A FUSE WITH A CURRENT RATING HIGHER THAN 30 AMPS! FAILURE TO PROPERLY USE THIS SAFETY DEVICE COULD RESULT IN DAMAGE TO YOUR RADIO, POWER SUPPLY, OR CREATE A FIRE RISK.

7.2 TRANSCEIVER ANTENNA PORTS [1,2]

Transceiver antenna ports are SO-239 50 ohm connectors. Refer to SmartSDR documentation for explanation on how to select which port is active.

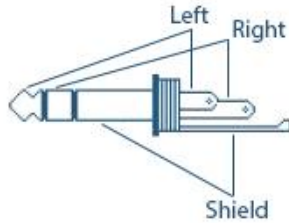
! - WARNING: THE FLEX-6400/FLEX-6600 ARE CAPABLE OF GENERATING RF POWER LEVELS OF 100 WATTS. HIGH RF LEVELS WILL CAUSE SEVERE RF BURNS. NEVER TOUCH THE TRANSCEIVER ANTENNA PORT, AN EXPOSED COAXIAL CABLE END, OR A CONNECTED ANTENNA WHILE THE RADIO IS IN THE TRANSMIT MODE.

! – NEVER CONNECT OR DISCONNECT ANTENNAS WHILE IN TRANSMIT MODE. THIS MAY CAUSE ELECTRICAL SHOCK OR RF BURNS TO YOUR SKIN AND DAMAGE TO THE UNIT.

! – THIS UNIT GENERATES RADIO FREQUENCY (RF) ENERGY. USE CAUTION AND OBSERVE PROPER SAFETY PRACTICES REGARDING YOUR SYSTEM CONFIGURATION. WHEN ATTACHED TO AN ANTENNA, THIS RADIO IS CAPABLE OF GENERATING RF ELECTROMAGNETIC FIELDS WHICH REQUIRE EVALUATION ACCORDING TO YOUR NATIONAL LAW TO PROVIDE ANY NECESSARY ISOLATION OR PROTECTION REQUIRED, WITH RESPECT TO HUMAN EXPOSURE!

7.3 POWERED SPEAKERS 4

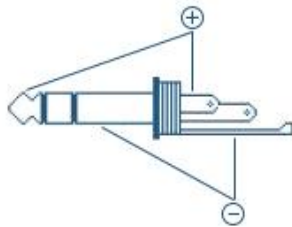
The **PWR SPKR** connector accepts a 1/8-inch (3.5mm) stereo (TRS) plug and provides stereo line level output for amplified PC speakers. **CAUTION: Do not use a mono (TS) plug as this will short-circuit the right channel signal to ground.**



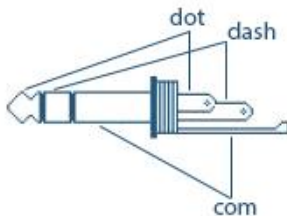
7.4 CW KEY/PADDLE JACK 5

For CW operation, the 1/8 inch (3.5mm) TRS **KEY** connector accepts a TRS plug for operating a keyer with paddles or a straight key.

When Connecting a CW straight key, a TRS plug must be used for proper connectivity to the radio. Connect the key to the Tip and Sleeve, leave the Ring unconnected.



When connecting a CW paddle and using the internal electronic keyer, connect the Dot to the Tip, the Dash to the Ring and the paddle common to the Sleeve.



7.5 BALANCED AUDIO INPUT (FLEX-6600 ONLY)

6

This is a balanced audio input for the radio and will produce the highest quality audio transmission. It can be used as a microphone level input, or a line level input. It accepts a ¼" (6.3mm) TRS Phone Plug.

TRS Connector		
Cont act	Description	Connector
Tip	Positive phase for balanced mono signals or mic (+)	
Ring	Negative phase for balanced mono signals or mic (-)	
Sleeve	Ground or shield connection	

To prevent ground loops and RF ingress into the microphone circuit, the MIC (-) wire should be connected to the Ring and NOT to the Sleeve, the chassis ground. The circuit is wired as a true differential input and can thus be used with balanced microphone or line input.

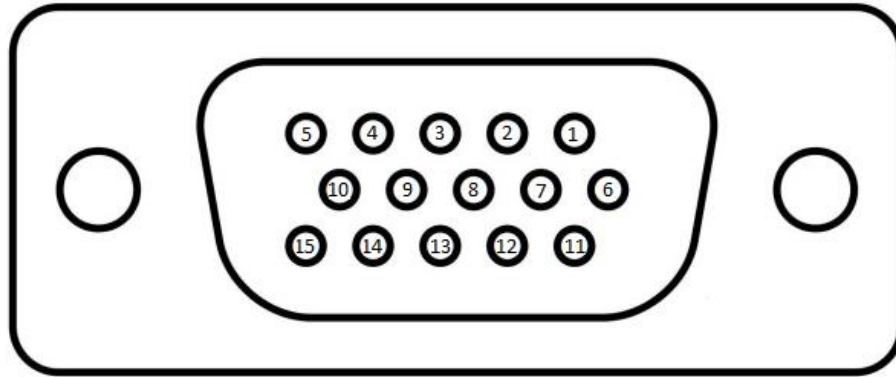
7.5.1 MIC vs. LINE Use

The balanced input currently supports microphone level audio input only. The microphone level is suitable for a dynamic microphone. The balanced input does not have any DC bias capability. If your microphone requires bias power (5VDC) or phantom power (48VDC), an external power supply is required. Line level inputs (-10 dBV) should be attached to the Accessory connector (see section 7.6.1).

7.5.2 Line Level

There are a number of different definitions of "line level". The audio input device in the FLEX-6400/FLEX-6600 series radios is designed for a "consumer line level" specification. This is defined as -10 dBV. If you plan to use "professional line level" devices to feed your radio, you will need to reduce the output level so that it does not exceed the -10 dBV level (-8 dBu). The hardware input will clip around 0 dBm (~-2.2dBV).

7.6 ACCESSORY CONNECTOR 7



Rear Panel View: FLEX-6400/6400M/6600/6600M

The accessory connector is a high-density HD-15 female connector. There are a number of inputs and outputs on this connector.

! - This is the same type of connector used by VGA monitors. Do not connect to VGA monitors.

Δ – All Accessory inputs are 3.3VDC MAX Input

7.6.1 Pin 1: Line In

This audio line input can be used to feed consumer level (-10dBV) audio into the transmitter. Refer to the SmartSDR documentation for information describing how to enable this input, and what configurations are available.

7.6.2 Pin 2: Line1 Out

This audio line output is a buffered output of the **POWERED SPEAKERS** left channel.

7.6.3 Pin 3: Line2 Out

This audio line output is a buffered output of the **POWERED SPEAKERS** right channel.

7.6.4 Pin 4: KEY In

This input is a keying input for CW. Refer to the SmartSDR documentation for information describing how to enable this input, and what configurations are available. Pin 4 is keyed to GROUND.

7.6.5 Pin 5, Pin 6, Pin 7, Pin 8 and Pin 10: GROUND

These pins are all connected to chassis ground.

7.6.6 Pin 9: +5VDC

This pin is a +5VDC output for use by external equipment. This pin is capable of sourcing up to 500mA of current. A thermally resetting fuse will protect the radio from damage.

I - This pin is protected by a thermally protected fuse. If an over-current occurs, the fuse will open and remain open until the overload is removed.

7.6.7 Pin 11: Accessory TX

This pin is a buffered PTT output identical to the three RCA connectors TX1, TX2, and TX3. Refer to the SmartSDR documentation for information on how to configure this output.

7.6.8 Pin 12: SDA I/O

This pin is the data signal for an I2C serial communication channel. It is to be used with external equipment. Refer to the SmartSDR documentation for more information.

7.6.9 Pin 13: Accessory TX REQ

This pin is an additional transmitter interlock signal input. Refer to the SmartSDR documentation for information on how to configure this input.

7.6.10 Pin 14: PTT in

This pin is a Push-To-Talk input. Ground Pin 14 to engage transmit.

7.6.11 Pin 15: SCL I/O

This pin is the clock signal for an I2C serial communication channel. It is to be used with external equipment. Refer to the SmartSDR documentation for more information.

7.7 PTT INPUT 8

This RCA connector is provided for an external Push-To-Talk signal. Ground the center pin of this RCA to engage PTT. (Note: 3.3VDC Max. Input.)

7.8 TX REQUEST INPUT (INTERLOCK) 9

This RCA connector is provided to receive an interlock signal from external amplifiers, or other external equipment. When enabled it will prevent the FLEX-6400/FLEX-6600 from

going to transmit. The TX Request Input can be enabled with a 3.3V to 5V logic signal (when in Active High mode) or connecting to ground (when in Active Low mode). The circuit is a 74LVC14 CMOS Schmidt trigger logic input with a 2.7k pullup to +3.3V. The IC is 5V tolerant, so you can drive it with TTL levels as well. It can also be driven with an open collector transistor or open drain MOSFET. Grounding the center pin of this connector will prevent transmit from engaging (when in Active Low). Refer to the SmartSDR documentation for information about how the interlock system works and how to determine what is preventing transmit. The SmartSDR for Windows Software User's Guide also includes details on how to interlock two radios from simultaneous transmit for a Multi/2 operation.

7.9 EXTERNAL AMPLIFIER ALC INPUT 10

This RCA connector is provided to receive an ALC signal from an external amplifier. The shell is ground, and the pin is a negative going DC voltage, zero to -4 Volts.

! – VOLTAGES BELOW -4VDC MAY DAMAGE THE ALC INPUT.

Δ – Please note this input is provided as a safety measure for external amplifiers. It is NOT meant to be used in regular operation as an active power control input or to modify the “attack” of an external amplifier. Almost all modern HF amplifier manufacturers discourage the use of ALC in normal operation. In fact, many amplifiers do not have ALC implemented. The [SmartSDR Software User's Guide](#) describes the recommended method for setting the power level on an external amplifier on a per-band basis.

7.10 REMOTE POWER ON INPUT 11

This RCA connector is provided for remote power-on functionality. When the Remote Power ON feature is enabled, shorting this input to ground will activate the radio - opening this connector will disable power on the radio. Refer to the SmartSDR documentation for information on how to configure this input. (Note: 3.3VDC Max Input.)

7.11 GPS ANTENNA INPUT (W/GPSDO OPTION) 12

If the radio is equipped with the optional GPSDO, this female SMA connector is for connecting the included GPS antenna. The GPSDO provides DC bias for the antenna preamp. It can work with antennas that require either 3.3 Volt or 5 Volt DC bias.

7.12 10MHZ REFERENCE OUTPUT (W/GPSDO OPTION) 13

If the radio has the optional GPSDO, the 10 MHz reference output is a buffered 3.3V p-p output of the 10 MHz oscillator in the GPSDO. The signal can be used to provide a reference signal for external equipment. The connector is a female SMA.

Δ – CAUTION: USE CARE IN ATTACHING OR REMOVING SMA CONNECTORS. BEST PRACTICE IS TO HOLD THE COAX WITH ONE HAND WHILE TWISTING THE SMA CONNECTOR SHELL WITH THE OTHER. ONCE THE MALE AND FEMALE CONNECTORS MATE, TURN UNTIL SNUG BUT DO NOT OVER TIGHTEN!

7.13 ETHERNET CONNECTOR 14

This is the network connection for the radio. It is an auto-sensing 100 megabit or 1 gigabit Ethernet port. It auto-senses polarity as well, so if you are using a direct connection to your PC, you do not need a crossover cable. Refer to the SmartSDR documentation for information as to the network configuration options.

7.14 USB 2.0 PORTS 15 16

The USB 2.0 ports are used for SmartSDR specific functions only. Do not connect unqualified USB devices to the FLEX-6400/FLEX-6600. Refer to the SmartSDR documentation for information about how these work.

7.15 EXTERNAL DISPLAY 17

External displays are not supported on FLEX-6400 and FLEX-6600 models.

7.16 10 MHZ INPUT 18

The external reference clock input is used to synchronize the radio's master oscillator. Requires a 1.0v p-p minimum to 3.3v p-p maximum (4dBm min - +15dBm max), sine or square wave signal.

7.16.1 Radio Oscillator Startup

The radio can use the external 10MHz reference, the optional GPSDO reference, the internal TCXO reference, or choose among them automatically. When set to automatic mode, the radio prioritizes the reference signals in External, GPSDO and TCXO order. In automatic mode, the radio watches for the appearance or disappearance of reference signals and chooses the highest priority available signal. In manual mode, the radio uses the selected input whether a signal is present or not. See the SmartSDR documentation for more details.

7.17 TX RELAY OUTPUTS [1,2,3] 19 20 21

TX1, TX2 and TX3 are outputs for keying external equipment such as amplifiers, external T/R switches, etc. They are isolated individual outputs. Refer to the SmartSDR documentation for an explanation on how to configure the timing for each output.

Δ – The TX Relay outputs are designed to handle signaling levels of up to +40 VDC @ 140 mA maximum. Some amplifiers do not have circuits to prevent keying voltage transients and older amplifiers may exceed the maximum voltage level resulting in damage to the radio if directly connected. Verify the voltage/current on your external device before connecting to TX Relay 1-3. FlexRadio highly recommends the use of a buffer/isolator box between the radio and the external device as a best operating practice regardless of the keying voltage.

7.18 RX-B RF INPUT (FLEX-6600 ONLY) 22

This female BNC connector is a direct feed to the input of the second Spectral Capture Unit (SCU-B) in the radio. This port is for use as a RECEIVE ONLY input to the RXB SCU. Refer to the SmartSDR documentation for information describing how to select this input, and how it can be used.

7.19 XVTR-B TRANSVERTER PORT (FLEX-6600 ONLY) 23

This female BNC connector is a receiver input and low-level exciter output for use with Transverters. Refer to the SmartSDR documentation for information regarding using the FLEX-6400/FLEX-6600 with external transverters. The FLEX-6400 has one transverter port and the FLEX-6600 includes two transverter ports.

I - The XVTR port can also be used as an auxiliary receive antenna connection when not being used for transverter operation.

7.20 MICROPHONE JACK 24

The **MIC** connector accepts a 1/8-inch (3.5mm) stereo (TRS) plug and provides a pseudo-balanced microphone input. Pseudo-balanced means that the mic (+) and mic (-) lines are balanced all the way to the input of the A/D converter, where the mic (-) line is DC grounded. The connector may be used with dynamic or electret microphone elements. A software enabled 3V bias voltage through a 2.1k Ohm source impedance may be applied to the Mic (+) line for electret microphones.

Note: The PTT signal is not accepted by this connector.

TRS Connector		
Contact	Description	Connector
Tip	Positive phase or mic (+)	
Ring	Negative phase or mic (-)	
Sleeve	Ground or shield connection	

7.21 XVTR-A TRANSVERTER PORT (25)

This female BNC connector is a receiver input and low-level exciter output for use with Transverters. Refer to the SmartSDR documentation for information regarding using the FLEX-6400/FLEX-6600 with external transverters. The FLEX-6400 has one transverter port and the FLEX-6600 includes two transverter ports.

I - The XVTR port can also be used as an auxiliary receive antenna connection when not being used for transverter operation.

7.22 RX IN/RX-A RF INPUT (26)

This female BNC connector is a direct feed to the input of the first Spectral Capture Unit (SCU-A) in the radio. This port is for use as a RECEIVE ONLY input to the RXA SCU. Refer to the SmartSDR documentation for information describing how to select this input, and how it can be used.

7.23 HEADPHONE JACK

The PHONES connector accepts headphones with a standard 1/8-inch (3.5mm) stereo (TRS) plug. Recommended ratings for headphones are 25mW into 16-ohm load or 13mW into a 32-ohm load. **CAUTION: Do not use a mono (TS) plug as this will short-circuit the right channel signal to ground.**

WARNING! NEVER operate the transceiver with headphones or other audio accessories at high volume levels. Discontinue use immediately if you experience any ringing in your ears.

7.24 CHASSIS GROUND

This is a thumbscrew for attaching an earth ground to the chassis of the radio. Grounding is the most important safety enhancement you can make to your shack. Always ground the FLEX-6400/FLEX-6600 to your station RF ground using high quality wiring with the

length being as short as possible. Braided wire is considered the best for ground applications. Your station ground should be a common point where all grounds come together. You will likely be using a PC and a DC power source so be sure to ground these devices together as well.

8 INSTALLATION

8.1 SAFETY

Since your FLEX-6400/FLEX-6600 will likely be connected to many different antenna and external interface conditions, safety is an important factor in your station setup. In addition to grounding mentioned earlier, proper Electro-Static Discharge (ESD) and lightning protection should be employed. It is outside the scope of this manual to go into details regarding proper ESD protection. Please follow good amateur practice to protect yourself and your investment.

8.2 RADIO PLACEMENT

Proper placement of your FLEX-6400/FLEX-6600 is important for maximum reliability. For proper ventilation, place your radio on a hard surface in a dry area with at least 1" of clearance on each side of the radio to allow for optimal fan operation and 2" behind the radio for cabling clearance. An optional 19" rack mount kit is available for mounting.

8.3 ENVIRONMENTAL CONSIDERATIONS

This radio is designed for indoor operation in a clean dust free environment. Try to avoid areas of wide temperature extremes. This includes placing the sides of the radio too close to the hot exhaust of an external amplifier. Should the temperature inside the radio become too high, the fans will automatically increase to a higher speed. (Note this can happen after long periods of transmit.)

Δ - Do not operate this unit in areas of extreme humidity.

Δ - Avoid operating this radio in direct sunlight or other areas of extreme heat, excessive vibration, or mechanical force.

8.4 CONNECTING TO A PC

8.4.1 Ethernet Cabling Requirements

The FLEX-6400/FLEX-6600 is designed to use CAT5e or CAT6 Unshielded Twisted Pair (UTP) network cabling. If you need to make a network connection that is longer than the included cable, be sure to use high-quality cable. Note that the Ethernet specification requires the cable to be less than 100 meters in length before a repeater or switch is required. You should avoid the use of Shielded Twisted Pair (STP) type Ethernet cables. The shield can provide a noise return path that can adversely affect receiver performance.

Δ – As mentioned earlier, proper Electro-Static Discharge (ESD) and lightning protection should be employed. It is outside the scope of this manual to go into details regarding proper ESD protection. However, it's important to note that this radio could be

connected to a potential ESD threat that you aren't used to: the Ethernet connection. Many times, adjacent ESD and lightning can enter a shack over the power, cable, or telephone lines. The ESD will then "jump" your Internet modem device and travel throughout the house on the Ethernet cable. A small investment in a 100Mbit Ethernet Surge/Lightning Suppressor could save your expensive FLEX-6400/FLEX-6600 from damage.

8.4.2 Direct PC Connection (Link-Local)

The simplest method to connect your PC to your FLEX-6400/FLEX-6600 is using a Link-Local connection. Simply plug the included Ethernet cable into the FLEX-6400/FLEX-6600 and then directly into the network connection on your PC, Microsoft Windows™ will recognize your radio and establish a local only connection. When the radio is activated, it will begin to broadcast its presence on the Link-Local connection. Note that in Link-Local mode, your radio will not be connected to or available to any other network connections on your PC.

I - It is not necessary to use a "crossover" Ethernet cable to establish a Link-Local connection with the FLEX-6400/FLEX-6600. The Ethernet interface on the radio has a smart sensing feature that will detect a Link-Local connection and make the proper adjustments internally.

8.4.3 Connecting via a Local Network

The most versatile method to connect your PC to your FLEX-6400/FLEX-6600 is to connect your radio to your existing local area network (LAN). Using the included Ethernet cable (or another appropriate cable), plug one end into the FLEX-6400/FLEX-6600 Ethernet port and the other end into your existing Ethernet switch or home router. With this LAN connection, your radio will automatically receive a network IP address and begin broadcasting its presence with the radio is activated. The advantage of the LAN connection is that all PCs on your LAN can have access to the radio.

8.4.3.1 Network Configuration Considerations

There are several points to consider when connecting your FLEX-6400/FLEX-6600 radio to your LAN:

- Your LAN must be configured to supply a network address to the radio. This is known as Dynamic Host Control Protocol (DHCP). Most LANs do this by default. If you can simply plug multiple PCs into your LAN to connect to the internet, your LAN is very likely set up to serve DHCP to the radio. Once you have connected the radio over the LAN via DHCP, you may assign a static IP address. Refer to the *SmartSDR Software User Guide* for more details.
- Even though the FLEX-6400/FLEX-6600 is capable of operating in Gigabit, 100Mbit, and 10Mbit LAN environments, FlexRadio highly recommends a minimum

100Mbit LAN environment. **Note that you can easily overload a 10Mbit LAN or LAN component with FLEX-6400/FLEX-6600 running multiple panadapters and receivers.**

8.4.4 Installing SmartSDR

SmartSDR is the operating software that runs along with your FLEX-6400/FLEX-6600 to provide the human interface to your radio. Please refer to the **FLEX-6400/FLEX-6600 Quick Start Guide** and **SmartSDR Software User's Guide** for information regarding installation, configuration, and operation of your radio with this software.

9 FHM-X MICROPHONES

The FLEX-6400/FLEX-6600 includes the FHM-2 condenser microphone with coiled cable to support rear panel connection.

9.1 FHM-2 SPECIFICATIONS

Element Type: Condenser

Impedance: 2.2k ohm $\pm$ 5% @ 1 kHz

Sensitivity: -38 dB $\pm$ 2dB @ 1 kHz

Frequency Response: Full range (75-12k Hz @ -3 dB, flat)

The FHM-2 is a high output condenser microphone that requires a bias voltage to function properly.

9.2 CONNECTING THE FHM-2 MICROPHONE

The microphone connects to the Microphone and Push to Talk inputs on the back panel of the FLEX-6400 or FLEX-6600. Insert the 1/8" (3.5mm) TRS plug into the MIC input (see section **7.20, Microphone Jack**) and the RCA plug into the PTT input (see section **7.7, PTT Input**). This microphone requires a DC bias to operate, so be sure to enable the bias in the radio software. See the [SmartSDR Software User's Guide](#) for more details.

9.3 BEST PRACTICES

To achieve the optimal fidelity from the FHM-2 microphone the following best practices are recommended. *NOTE: Up, Down, and Fast buttons on the FHM-2 are not supported on the FLEX-6400/FLEX-6600 models.*

Keep the microphone 1-2 inches away from your mouth: All microphones including the FHM-2 experience the proximity effect in which lower frequencies become more pronounced as the microphone is brought closer to the mouth, providing a higher fidelity frequency response.

Cross talk the microphone: Unfortunately talking close to the microphone also amplifies other sounds that can result in picking up breathing noises (low rumble) and plosive sounds from certain words. To minimize the effect, speak across the front of the microphone and not directly into it. This is known as "cross talking" the microphone.

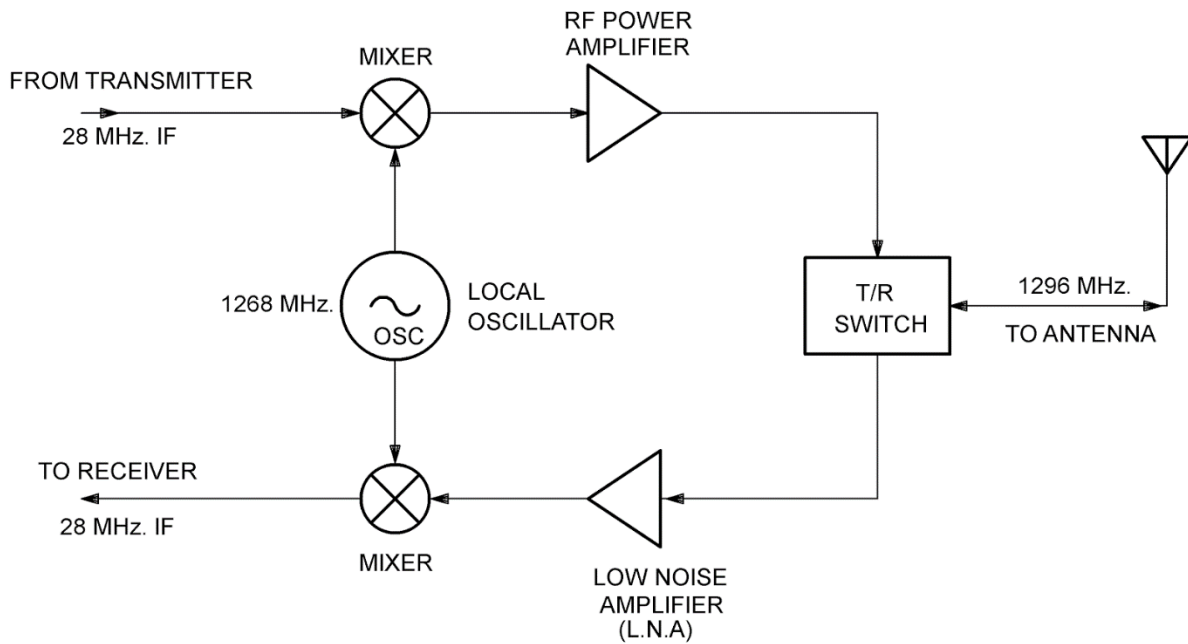
Setting the Equalizer (EQ): Everybody has unique voice characteristics which preclude one person's EQ settings being optimal for someone else. In addition, microphones have different characteristics reproducing human speech. Therefore, to optimize your voice transmissions, you should set the EQ to match your voice and the microphone you are using. The best way to achieve an optimal EQ setting for your voice and microphone is to listen to your actual transmission over the air using a 2nd receiver. If one is not available,

you can record your voice and listen to the recording to set the EQ. This is covered in detail in the **SmartSDR Software Users Guide**.

10 TRANSVERTER SETUP

Transverters allow both reception and transmission on frequencies not available in your base FLEX-6400/FLEX-6600 radio. The transverter translates RF at one frequency to another for both transmit and receive. Generally, the transverters will have an RF side that is in the VHF or microwave region and an IF side in the HF or low VHF side. An example transverter block diagram is shown below:

EXAMPLE TRANSVERTER APPLICATION



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This transverter converts from 10m RF signals (28MHz) to 1296MHz RF signals and back. The transverter shown in the picture has three RF connectors:

RX IF - the 10m receive port

TX IF - the 10m transmit port

RF - the RF input and output that goes to an antenna

This type of transverter is known as a “Split IF” transverter since the IF side of the transverter utilizes both a receiver and a transmitter port. The other type of transverter is a “Common IF” transverter where a relay internal to the transverter is used to switch a single IF port between receive and transmit. Both the FLEX-6400 and FLEX-6600 are capable of either Common IF or Split IF operation.

10.1 TRANSMIT POWER CONSIDERATIONS

The default transverter output is 0 dBm (1.0 mW). The FLEX-6400/FLEX-6600 can produce an output on the XVTR port up to +15dBm for frequencies below 54MHz. If your transverter requires a higher-level input, it is recommended that you either modify the transverter for a lower power input or provide an amplifier to amplify the transmit signal before passing to the transverter.

10.2 RF CONNECTIONS - COMMON IF

For a common IF configuration, the Common IF port of the transverter should be connected to the XVTR port on your FLEX-6400/FLEX-6600. This will be the only RF connection between the transverter and the radio.

10.3 RF CONNECTIONS - SPLIT IF

For split IF transverters, the TX IF of your transverter should be connected to the XVTR port on the FLEX-6400/FLEX-6600. The RX IF port should be connected to either RX-A or RX-B (FLEX-6600 only).

While it is technically feasible to use the ANT1 or ANT2 ports for receive, this is not recommended since these ports can produce high-power RF at any time that could damage your transverter.

10.4 PTT CONNECTIONS

The radio will need to provide a PTT signal to place the transverter into transmit mode. Most transverters will have a grounded-PTT input. This should be connected to a FLEX-6400/FLEX-6600 TX1, TX2 or TX3 output to cause the transverter to transmit. Depending on the design of the transverter, a weak pull-up may be required.

10.5 SEQUENCERS

In some transverter applications, notably those that include a split RF output, preamplifiers and/or power amplifiers, a sequencer may be used. The specific details of connecting and configuring a sequencer are beyond the scope of this document, but the TX1, TX2 or TX3 output from the radio are generally used as an input to the sequencer to allow it to properly switch and enable/disable each component in your lash-up.

10.6 MULTIPLE TRANSVERTERS

At this time, no band data is provided by the radio and this may provide an effective limit of one transverter at a time. FlexRadio anticipates adding band data in a later release of SmartSDR that would assist remote switching hardware in selecting between multiple transverters.

11 DIGITAL MODE SETUP (SOUND CARD INTERFACE)

There are two options for operating digital modes with the FLEX-6400/FLEX-6600 SDRs. The *preferred* method does not use a physical sound card connection; it uses DAX (Digital Audio eXchange) where the audio is streamed digitally between the radio and client software over the Ethernet connection via the IP/UDP protocol. This method eliminates unnecessary analog to digital and digital to analog conversions which degrades signal to noise ratio (SNR) performance.

You may also operate digital modes in essentially the same manner as most analog/DSP radios where analog audio from the speakers and to the microphone input is interfaced with a PC sound card. The following procedure can be used for operating digital modes with the FLEX-6400/FLEX-6600 interfaced to a sound card.

This procedure assumes that you have a working knowledge of operating digital modes with your favorite sound card based digital mode program and will not delve into the details of configuring specific third-party digital mode programs. Connecting the FLEX-6400/FLEX-6600 to a PC sound card

There are several audio inputs and outputs on the FLEX-6400/FLEX-6600 that can be used for connecting the radio hardware to a PC sound card. Please refer to the **SmartSDR Software User's Guide** for a detailed description on configuring and enabling digital modes.

The basic audio schematic is used to connect a FLEX-6400/FLEX-6600 to a PC sound card:

- PC Sound Card Mic / Line In <---> FLEX-6400/FLEX-6600 Audio Output
- PC Sound Card Line Out / Speaker Out <---> FLEX-6400/FLEX-6600 Audio Input

FLEX-6400/FLEX-6600 Inputs:

- Rear panel microphone connector [MIC] (1/8" TRS)
- Rear Balanced Input [BAL] (1/4" TRS connector) - FLEX-6600 only
- Rear Accessory input [ACC] (15-pin D-sub connector)

FLEX-6400/FLEX-6600 Outputs:

- Rear panel headphone [PHONES] connector (1/8" TRS connector)
- Rear Powered Speaker connector [PWR SPKR] (1/8" TRS connector)
- Rear Accessory output (15-pin D-sub connector)

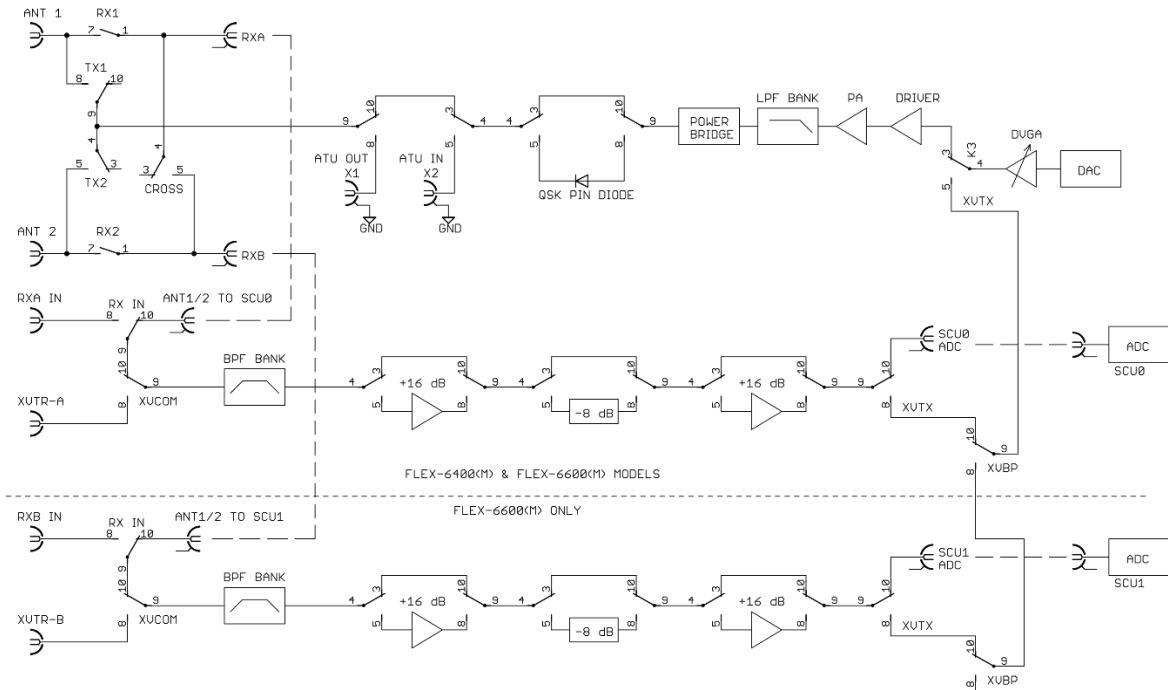
The audio input and output you choose is mostly a matter of your operating preferences. For example, if you also operate phone modes, you may not want to constantly disconnect your microphone and speakers to facilitate the connection to the PC sound

card, so you may want to use the Accessory connector for both the audio input and output. In the following example, the left channel audio output on the Accessory connector is used to facilitate both the input and output audio connections to the PC sound card.

When connecting the FLEX-6400/FLEX-6600 to a PC sound card, connect one of the FLEX-6400/FLEX-6600 inputs to the LINE OUT on the sound card and one of the FLEX-6400/FLEX-6600 outputs to the MIC or LINE IN on the sound card.

12 ANTENNA CONSIDERATIONS

The FLEX-6400/FLEX-6600 Series radios incorporate a unique smart antenna switching matrix to simplify connections from your radio to your station antennas. The following is the signal flow diagram for the FLEX-6400 and FLEX-6600 transceivers:



- ANT1 and ANT2 can be used for transceiver operation. RXA (and RXB on FLEX-6600) are for receive only but can be paired with ANT1 or ANT2 for split antenna operation. The XVTR ports can be used for transverter operation or as an additional receive antenna port.
- For very high-speed CW above 60WPM (QRQ mode), separate receive and transmit antennas should be used to remove any switching delays. The transmit antenna must be connected to ANT-A or ANT-B and the receive antenna must be connected directly to RXA or RXB.

Consult the [SmartSDR Software User's Guide](#) for a complete description of the operation and configuration of the FLEX-6400/FLEX-6600 antenna matrix system.

12.1 ANTENNA SELECTION

The unique ability of the FLEX-6400/FLEX-6600 to receive continuously over a very wide bandwidth opens up a new paradigm in amateur transceiver operation. This also changes how you might consider the proper antenna for your station operation. First, it's

important to note that almost EVERY properly installed antenna will work adequately as a broadband receive antenna; even single band Yagi antennas work quite well across the amateur bands. Start by experimenting with your existing antennas to see how well they work!

For added performance across a wider frequency range, consider adding a broadband receive antenna such as a beverage, long wire, log-periodic, traditional or shielded loop, or multi-band dipole, yagi, or vertical. Using the antenna matrix, you can receive over a wide range, and then use your tuned narrowband antennas for transmitting. Consult the **SmartSDR Software User's Guide** for antenna configuration.

13 ANTENNA TUNER UNIT (ATU)

The FLEX-6400/FLEX-6600 automatic antenna tuner unit (ATU) is an antenna matching network designed to present a 50 ohm, low SWR load to the power amplifier (PA) for efficient RF power transfer on non-resonant antenna systems.

The FLEX-6600 has an integrated ATU as a standard feature whereas the ATU for the FLEX-6400 is a user installable option.

13.1 SPECIFICATIONS

Network Type: L Network

Antenna Connection: Unbalanced (coax)

Frequency Range: 1.8 to 54 MHz

VSWR Range: 8.3 - 300 Ohms (80m – 10m)

6.7 - 150 Ohms (160m and 6m)

Tune Power: 10W / 2W on 6m (automatically set by software)

Δ – It is not recommended to attempt repeated tuning of antennas with the ATU connected to antenna systems that exceed the maximum VSWR on a frequency of interest. Some antenna systems, such as physically short multiband antennas may exhibit a very narrow range of resonance (a high Q antenna) in addition to being very reactive. The FLEX-6400/FLEX-6600 ATU is not designed to tune these types of antenna systems. An external antenna tuner that is designed to handle a wider VSWR range is recommended for these types of antennas.

14 OPTIONAL GPS DISCIPLINED OSCILLATOR (GPSDO) SETUP

14.1 GPSDO INTRODUCTION

The FLEX-6400 and FLEX-6600 have the ability to attain extremely precise frequency control through the use of an optional Global Positioning System Disciplined Oscillator (GPSDO) module. After satellite acquisition and synchronization, the GPSDO is capable of maintaining frequency accuracy to $<5.0 \times 10^{-12}$ in a stable temperature environment.

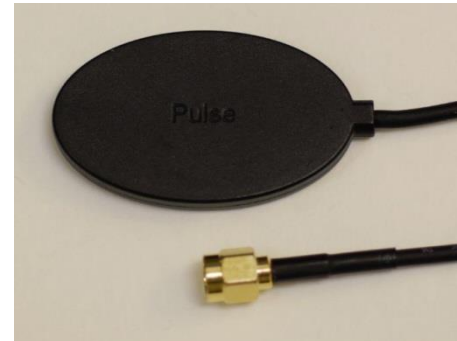
14.2 GPS ANTENNA PLACEMENT

In order for the GPSDO to function properly, the indoor GPS receiver antenna must be positioned so it has an unobstructed view of the sky in order to receive timing information from the GPS satellite constellation. While the best location for a GPS antenna is outside in the clear, most of the time simply placing the indoor antenna in a window will suffice. In general, the better the view of the sky (south in the northern hemisphere and north in the southern hemisphere), the quicker the GPS will lock to a high accuracy level. Some experimenting may be required to find the optimal location.

I - The included low-profile GPS antenna is not waterproof; it is not suitable for outdoor use.

I - The included low-profile GPS antenna may be marked with the word "PULSE". This is actually the BOTTOM of the antenna and should be placed down and away from the sky. An included adhesive tape strip is available for permanently affixing the GPS antenna to a window sill or outside location.

Δ – CAUTION: USE CARE IN ATTACHING OR REMOVING SMA CONNECTORS. BEST PRACTICE IS TO HOLD THE COAX WITH ONE HAND WHILE TWISTING THE SMA CONNECTOR SHELL WITH THE OTHER. ONCE THE MALE AND FEMALE CONNECTORS MATE, TURN UNTIL SNUG BUT DO NOT OVER TIGHTEN!



14.3 GPSDO LOCK SEQUENCE AND STATUS INDICATORS

Please consult the [SmartSDR Software User's Guide](#) for a complete description of the on-screen displays and software setup of the GPSDO.

Upon FLEX-6400/FLEX-6600 initialization, the radio will sense a GPSDO module is installed and switch from the default oscillator to the GPSDO reference output signal. The MULTIFUNCTION STATUS INDICATOR (MSI) will illuminate FLASHING YELLOW to indicate the GPSDO is in "warm up" mode.

Once satellites are acquired and the synchronization process has begun, the MSI will change to a SHORT FLASHING BLUE to indicate “locking” mode.

Upon reaching full “locked” mode, the MSI will go to SOLID BLUE. Once locked, the GPSDO may re-synchronize occasionally due to satellite changes. A LONG FLASHING BLUE will indicate this “hold phase”.

If GPS satellites are no longer visible, the GPSDO will enter “holdover” mode and the MSI will indicate SOLID YELLOW. The radio will continue to be completely functional, but the frequency accuracy could diminish to $\pm 2 \times 10^{-8}$ over time. The GPSDO is configured to remain “powered” even when the radio is off. This maintains frequency accuracy of the GPSDO. The MSI shows SOLID AMBER.

I - Initial GPS acquisition and synchronization can take up to 1 hour depending upon antenna placement and your location on Earth. This is normal, and the radio is fully functional during this process.

I - GPSDO self-installation is possible and is covered in a separate installation manual included with the GPSDO OPTION KIT.

15 CALIBRATION

The FLEX-6400/FLEX-6600 is extensively calibrated, aligned and tested as part of the manufacturing and quality assurance processes. In general, there are a limited number of hardware calibrations that can be performed by the user, but the ones available are listed below.

15.1 FREQUENCY CALIBRATION

The FLEX-6400/FLEX-6600 incorporates high-quality low phase noise TCXO for frequency accuracy and stability. However, oscillators undergo a slow gradual change of frequency with time, known as aging and may require periodic frequency calibration using a known frequency standard.

The FLEX-6400/FLEX-6600 *without* an installed GPSDO can be calibrated by the user utilizing the automated routine provided in the SmartSDR for Windows client software. Before running this calibration routine, allow for the radio to temperature stabilize for at least 30 minutes before calibrating the frequency. The calibration routine will temporarily use Slice A and ANT-1 to receive over the air signals from a known frequency source, such as WWV or CHU. Also, refrain from frequency calibrating the radio in extremely high, low or fluctuating ambient temperatures as this will introduce error into the calibration process. Please refer to the [SmartSDR Software User's Guide](#) for detailed frequency calibration instructions.

16 KEY CONTACTS

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16.2 OUTSIDE OF THE USA

Please contact your local distributor. See www.flexradio.com/distributors.

www.flexradio.com