

### USB Cables Interface for the FLEX-6000

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## Overview

### USB Cables Overview

The USB Cables feature provides a means to control external devices such as amplifiers, antenna controllers, and tuners via USB to Serial cables connected to the USB ports on the back panel of the radio. Signals generated by SmartSDR appear on the cable in a form acceptable to the external device. The two USB ports of the radio can be used and a USB can be used if more than two cables are needed.

This feature is limited to FTDI USB to Serial cables which contain embedded circuitry that translates the USB signals and protocol to one of several serial port protocols. In some cases, data flow is bidirectional with a wide selection of speeds and signaling levels.

FlexRadio carries two FTDI cables that can be used to interface with many devices:

- FTDI USB to Serial Cable DB9M (UT232R-200). This is referred to as “FTDI USB to Serial Cable” in the remainder of this document. For most configurations, only Pins 2, 3, and 5 will be required.

DB9M Pin No.	Name
1	DCD
2	<b>RXDATA</b>
3	<b>TXDATA</b>
4	DTR
5	<b>GND</b>
6	DSR
7	RTS
8	CTS
9	RI

- FTDI C232HM (C232HM-EDHSL-0). This cable has an output of 10 pins that can be used for interfacing to other devices. This cable is referred to as “FTDI C232HM” in the remainder of this document.

Pin	Name
1 (Red)	VCC
2 (Orange)	BIT 1
3 (Yellow)	BIT 2
4 (Green)	BIT 3
5 (Brown)	BIT 4
6 (Grey)	BIT 5
7 (Purple)	BIT 6
8 (White)	BIT 7
9 (Blue)	BIT 8
10 (Black)	GND

The serial cable that is used to interface with external devices will vary for each device. One of the above cables may be sufficient for operation in many cases, while for other devices a proprietary cable or custom-made cable may also be needed. Several cable requirements for commonly used devices are provided in this document. If your device supports a CAT serial protocol or BCD data and is not listed in this document, please refer to the manufacturer’s manual and cable datasheets to identify the cable requirements.

Three main types of cables are supported, CAT, BIT and BCD, described below. In addition, a preconfigured cable type is provided for Down East Microwave 2 and 4-meter Low Drive Power Amplifiers: See <http://www.downeastmicrowave.com/product-p/2mldpa.htm> for more information.

While FlexRadio does not carry stock on USB hubs, users have verified that this hub works well: [https://www.amazon.com/gp/product/B00DZS7DLS/ref=od\\_aui\\_detailpages00?ie=UTF8&psc=1](https://www.amazon.com/gp/product/B00DZS7DLS/ref=od_aui_detailpages00?ie=UTF8&psc=1).

## Cable management

USB Cables are managed through the USB Cables window found in the **Settings -> USB Cables** menu. Using the **USB Cables** window, cables can be selected, activated and deactivated, modified, logged and removed. The fields in the window are:

- **Name** – The name given to the USB Cable. Newly installed cables get a default name. The name can be changed with the Edit command.
- **Serial Number** – The serial number of the USB Cable, read from the FTDI chip embedded in the cable.
- **Type** – The type of the USB Cable. This field is modified using the **Edit** command and must be one of the following:
  - CAT
  - Bit
  - BCD
  - LDPA
  - DSTAR
- **Enabled** – Enables or disables a USB Cable.

The **Edit**, **Log** and **Remove** buttons perform a function on a selected cable. Clicking **Edit** opens a window that allows the user to edit the settings of the selected cable. Clicking **Log** opens a window that enables logging for a cable. Logging allows the user to see and monitor all traffic going across the cable. For BIT and BCD cables the log indicates the bits written out to a cable as a single hexadecimal number. Clicking **Remove** removes the cable from SmartSDR management. Note that cables can be removed only when they are unplugged.

## CAT Cables

CAT cables are serial data communication cables on which a small subset of the CAT command set is implemented. Most of the functions implemented on these cables are frequency reporting functions. Each defined cable has a source device in the radio associated with it which supplies the frequency information communicated across the cable.

The sources are:

- **TX Slice** - The cable will report the frequency of the slice receiver that holds the Transmit Indicator.
- **Active Slice** - The cable will report the frequency of the active slice receiver (the slice that has the yellow cursor).
- **TX Panadapter** - The cable will report the center frequency of the panadapter that contains the transmit slice
- **Specific Slice** - The cable will report the frequency of the specified slice (A, B, C, D, E, F, G, H)
- **RX Antenna** - The cable will report the frequency of the specified receive antenna (ANT1, ANT2, XVTR, RXA, RXB). *Note: If multiple slices are on the same RX Antenna then the frequency of the last tuned slice will be reported.*

- **TX Antenna** - The cable will report the frequency of the specified transmit antenna (ANT1, ANT2, XVTR). [Note: This frequency is only changed/reported when the TX Slice is connected to the specified antenna.](#)

The **Advanced** menu provides configuration for link speed, number of data bits, parity, stop bits and flow control.

The CAT commands supported on CAT cables are:

- **FA** and **ZZFA**: Report the 'source' frequency, **Get/Read Only**
- **FB** and **ZZFB**: Report the 'source' frequency, **Get/Read Only**. FA and FB report the same information.
- **FR**: reports which slice is the receiver (0 or 1) which corresponds to the slice that is NOT the transmitter
- **FT**: report or set the transmit slice
- **SP**: report the status of split or enter split mode
- **SB**: report the status of a “sub-band receiver.” This command will report SB0 in the case where only a single SCU is in use or 1 when more than one SCU is in use
- **IF** and **ZZIF**: Report the 'source' frequency as well as mode and other parameters, **Get/Read Only**
- **AI** and **ZZAI**: Set 'auto-report' enabled/disabled
  - If auto-report is FALSE, then the external device must poll by sending a command through the USB Cable. If auto-report is TRUE, then anytime the 'source' frequency changes it is automatically sent on the CAT cable
- **PC**: Used to set and get the current power level

## BIT Cables

BIT cables provide a means to map the tuned frequency of the radio to a set of individual signals/wires at the end of the cable. These cables are designed to control external devices when the radio is tuned to specific bands or frequency ranges, and for external keying or sequencing that is triggered when the transmitter becomes active.

The signal that appears on each bit/pin of a BIT cable is configured by use of the controls in the USB Cables menu:

- **Pin** – Enables/disables each pin/bit individually
- **Polarity** - Controls whether the pin/bit is high or low when triggered
- **Source** - Determines which source is used as the frequency check for this bit/pin. The sources are the same as for the **CAT** cables, listed above.
- **Trigger** - Determines the band/frequency range that the source must be within for this bit/pin to be active.
- **PTT** - When set, the pin/bit will become active only when the radio is in transmit and the source frequency is within the output band/frequency range. Individual pin/bit PTT and TX Delays can be set and will be used by the radio when keyed.

## BCD Cables

BCD cables provide a means to map the tuned frequency of the radio to a 4 or 5-bit Binary Coded Decimal output representing specific bands.

The BCD signal that appears on the cable is configured by use of the controls in the USB Cables menu:

- **Source** - Determines which source is used as the frequency check. The sources are the same as for the CAT cables, listed above
- **Type** – Specifies which of several available BCD mappings are generated by the cable:
  - HF\_BCD - Yaesu/Elecraft BCD band output
  - VHF\_BCD - Like HF\_BCD but for VHF and higher bands
  - HF\_VHF\_BCD - Combined HF and VHF output

The full set of BCD Band Outputs can be seen on the following pages.

## BCD Cable: BCD Output Bit Pattern

BCD Output					
Band	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
160	0	0	0	0	1
80	0	0	0	1	0
60	0	0	0	0	0
40	0	0	0	1	1
30	0	0	1	0	0
20	0	0	1	0	1
17	0	0	1	1	0
15	0	0	1	1	1
12	0	1	0	0	0
10	0	1	0	0	1
6	0	1	0	1	0
2	0	1	0	1	1
432	0	1	1	0	0



## BCD Cable: VHF VBCD Output Bit Pattern

VHF VBCD Output					
Band	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
6	0	0	0	0	1
2	0	0	0	1	0
222	0	0	0	1	1
432	0	0	1	0	0
902	0	0	1	0	1
1296	0	0	1	1	0
2304	0	0	1	1	1
3456	0	1	0	0	0
5760	0	1	0	0	1
10368	0	1	0	1	0
24048	0	1	0	1	1
47088	0	1	1	0	0
4	0	1	1	0	1

## BCD Cable: HF + VHF Output Bit Pattern

HF + VHF Output					
Band	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
160	0	0	0	0	1
80	0	0	0	1	0
60	0	0	0	0	0
40	0	0	0	1	1
30	0	0	1	0	0
20	0	0	1	0	1
17	0	0	1	1	0
15	0	0	1	1	1
12	0	1	0	0	0
10	0	1	0	0	1
6	1	0	0	0	1
2	1	0	0	1	0
222	1	0	0	1	1
432	1	0	1	0	0
902	1	0	1	0	1
1296	1	0	1	1	0
2304	1	0	1	1	1
3456	1	1	0	0	0
5760	1	1	0	0	1
10368	1	1	0	1	0
24048	1	1	0	1	1
47088	1	1	1	0	0
4	1	1	1	0	1

## LDPA Cables

Control cables for Low Drive Power Amplifiers for the 2 and 4 meter bands produced by Down East Microwave Inc. are supported by the LDPA option in the **USB Cables** menu. The functions supported by the amplifiers are determined by the manufacturer, so the options for this type of cable are limited to selecting the model of the amplifier and turning the pre-amplifier on and off. As with all USB cables, the entire cable can be enabled or disabled.



# Device Configurations

## SteppIR

The USB Cable feature can provide frequency information to the Steppir SDA 100 controller. When the SDA 100 is configured in AUTOTRACK mode, antenna tuning will be re-optimized every 50 kHz and will follow the radio to any frequency within the range of the antenna. For more information about the AUTOTRACK mode of the SDA 100, please refer to the SDA 100 manual at [www.steppir.com](http://www.steppir.com).

Note that only frequency tracking capabilities are provided with this feature. Non-CAT SteppIR commands are not supported at this time. The S12 cable can be obtained from SteppIR. Alternatively, a custom-made cable that shorts pins 7 and 9 together on the SDA100 side and crosses pins 2 and 3 will also work.

### Required Cables:

- FTDI USB to Serial Cable
- SteppIR S12 Cable

### Device Setup:

- Set the SDA 100 to 9600 Baud.
- Set the Transceiver Mode on the SDA 100 to Kenwood.
- Plug the FTDI USB to Serial cable into a USB port on the FLEX-6000 radio.
- Plug one end of the SteppIR S12 cable into the 9-pin end of the USB to Serial cable and plug the other end of the S12 cable into the DATA IN port of the SDA 100.

### SmartSDR Setup:

- Ensure that SmartSDR has set the baud rate of the cable to 9600. This is the default.
- Go to the USB Cables window in SmartSDR. The USB Cable should be recognized and appear on the list. Ensure that the cable type is set to CAT, and set the source to the trigger of your choice [see USB CAT Cables section in SmartSDR Software manual for more details].

## KAT500 Antenna Tuner

The Elecraft KAT500 can be directly connected to the FLEX-6000 to interpret frequency changes. To correctly respond to the FA-CAT command, the KAT500 requires Firmware version 1.36 or later.

Required Cable:

- Elecraft KXUSB

Device Setup:

- Plug the KXUSB cable into a USB port on the FLEX-6000 radio.
- Plug the other end of the KXUSB interface cable into the PC DATA jack on the KAT500

SmartSDR Setup:

- Set the Cable Type to "CAT"
- Set Auto-report to "Enabled"

## KPA500 Amplifier

The KPA500 amplifier can interface with the FLEX-6000 to track bands and frequency. Note that other controls (such as STBY, OPER) are not supported.

Required Cables:

- FTDI USB to Serial Cable
- Null Modem Cable (Pins 2 and 3 crossed, pin 5 straight through)

Device Setup:

- Connect the FTDI USB to Serial Cable to the Null Modem cable, and connect the Null Modem cable to the "RS232 (XVCR)" port on the back panel of the KPA500
- Set the baud rate in the "RS232 X" menu entry. All speeds (4800-38400) should work. Set this value to 9600 to match the default value of the FLEX-6000.
- Go to the "RADIO" menu and set the option to "SERIAL"
- Go to the "SER POLL" menu and set polling to "ON"

SmartSDR Setup:

- Set the Cable Type to "CAT"

## ACOM 600S

The FLEX-6000 can control an ACOM 600S using one of two methods:

### CAT control

Using this method, the FLEX-6000 exchanges CAT commands with the amplifier using a Serial Port cable and a custom cable.

#### Required Cables:

- FTDI USB to DB9M Serial Cable
- Custom DB9F to DE15M cable, wired as described below

The CAT port on the back panel of the ACOM 600S is a DE15 female connector. The connection from the FTDI USB to DB9M Serial Cable to the DE15M port on the 600S should be made in accordance to the “CAT 5V TTL Interface” or “CAT RS232 Interface” specification for the 600S amplifier, which depends on the voltage of the FTDI cable being used. Set the com port parameters in the amplifier and in SmartSDR to 9600 baud, No parity, 8 bit, and 1 stop bit.

600S DE15M CAT Port (TTL)	600S DE15M CAT Port (RS232)	FTDI DB9M
Pin 4 (TX TTL)	Pin 3 (TX RS232)	Pin 2 (RxD)
Pin 1 (RX TTL)	Pin 2 (RX RS232)	Pin 3 (TxD)
Pin 5 (Ground)	Pin 5 (Ground)	Pin 5 (Ground)

- Additional details can be found in the ACOM 600S documentation, available on-line.

#### Device Setup:

- Set the ACOM CAT/AUX settings to RS232 or TTL depending on the type of the Serial Cable.

#### SmartSDR Setup:

- Set the Cable Type to “CAT”

### BCD Band Data control

Using this method, the FLEX-6000 sends band data to the amplifier over a BCD cable connected to the 600S CAT/AUX back-panel socket.

#### Required Cable:

- FTDI C232HM (MPSSE) or similar
- The connector on the back of the ACOM 600S is a 15 pin D-SUB female socket. A custom connection will be needed on the end of the C232HM cable using a 15 pin D-SUB male connector. Connect the wires of the C232HM as follows:

ACOM 600S Pin	CS232HM wire
5 – Ground	Black
7 – Data 0	Orange
8 – Data 1	Yellow
9 – Data 2	Green

10 – Data 3	Brown
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- Additional details can be found in the ACOM 600S documentation, available on-line.

Device Setup:

- Set the ACOM CAT/AUX settings to BCD.

SmartSDR Setup:

- Set the Cable Type to “BCD”
- Set the BCD type to “HF\_BCD”



## ACOM 2000a

The FLEX-6000 works with the ACOM 2000a with the new style RTU.

Required Cables:

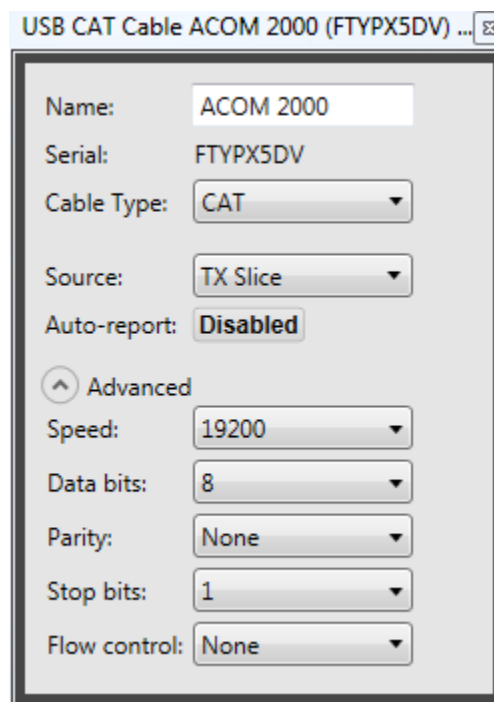
- FTDI USB to Serial Cable
- Custom DE15 Cable (See ACOM 2000a manual)

Device Setup:

- Set the mode to Kenwood

SmartSDR Setup:

- Set the Cable Type to “CAT”
- Set the serial port speed to 19200 baud



## SPE Amplifiers (2K-FA, 1.3K-FA, 1K-FA)

SPE amplifiers can be interfaced with the FLEX-6000 series and communicate via CAT commands or Band Data. The CAT interface is recommended and is shown below.

Required Cables:

- FTDI USB to Serial Cable
- Custom DB9F to DE15M cable

The CAT port on the back panel of the SPE amplifiers is a DE15 male connector. Make sure to use this CAT port and not the AUX port on the back panel of the amplifier. The connection from the DB9M FTDI USB to serial cable to the DE15M CAT port on the SPE should be made in accordance to the “CAT 5V TTL Interface” or “CAT RS232 Interface” specification for the SPE amplifier, which depends on the voltage of the FTDI cable being used. Set the SPE amplifier mode to FLEX CAT. Set the com port parameters to 9600 baud, No parity, 8 bit, and 1 stop bit. Also, set SPE Amps drive power per band and power level to ensure that the amp is not overdriven.

<b>SPE DE15M CAT Port (TTL)</b>	<b>FTDI</b>
Pin 3 (TX TTL)	RxD
Pin 4 (GND)	GND
PIN 10 (RX TTL)	TxD

<b>SPE DE15M CAT Port (RS232)</b>	<b>DB9M</b>
PIN 9 (TX)	Pin 2 (RxD)
Pin 4 (GND)	Pin 5 (GND)
Pin 1 (RX 232)	Pin 3 (TxD)

SmartSDR Setup:

- Set the Cable Type to “CAT”

## Palstar AT-Auto Tuner / Kessler Engineering AT-Auto Tuner

Note: This section does not describe the **Palstar HF-Auto** auto tuner. The **AT-Auto** auto tuner, previously manufactured by Palstar is now manufactured by Kessler Engineering.

Required Cable:

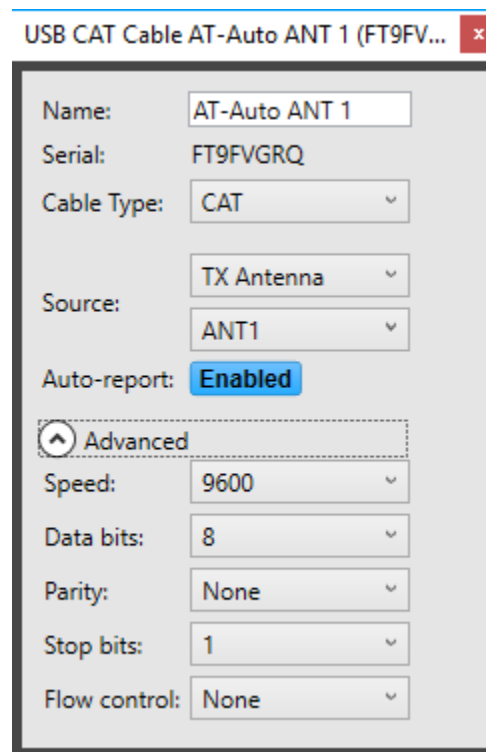
- FTDI USB to Serial Cable

Device Setup:

- Plug the serial cable into the “RS-232 DATA INPUT” port on the tuner
- Set the AT Auto CAT menu to Kenwood, no external tuner

SmartSDR Setup:

- Set the Cable Type to “CAT”
- Set Auto-report to “Enabled”



USB CAT Cable AT-Auto ANT 1 (FT9FV... x

Name: AT-Auto ANT 1

Serial: FT9FVGRQ

Cable Type: CAT

Source: TX Antenna

ANT1

Auto-report: Enabled

Advanced

Speed: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

## Array Solutions BandMaster III

Required Cable:

- FTDI C232HM (MPSSE)

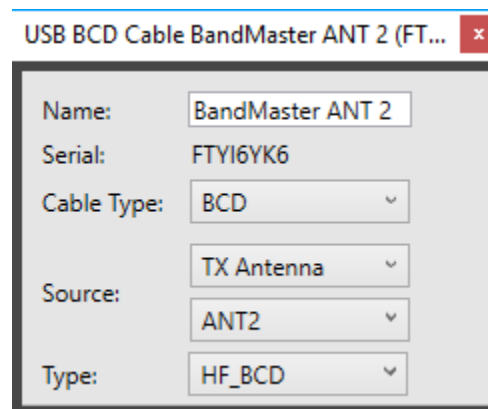
Device Setup:

- Connect the C232HM cable to the Bandmaster in the following way

Bandmaster	C232HM MPSSE Cable
Pin 1 (Band Data A)	Pin 2 (Orange)
Pin 6 (Band Data B)	Pin 3 (Yellow)
Pin 8 (Band Data C)	Pin 4 (Green)
Pin 4 (Band Data D)	Pin 5 (Brown)
Pin 5 (Ground)	Pin 10 (Black)

SmartSDR Setup:

- Set the Cable Type to “BCD”
- Set the BCD type to “HF\_BCD”



## DEMI LDPA

The 2m/4m DEMI LDPA is supported on the FLEX-6000 with a pre-configured cable type that is designed to work out of the box (<http://www.downtownmicrowave.com/product-p/2mldpa.htm>)

Required Cable:

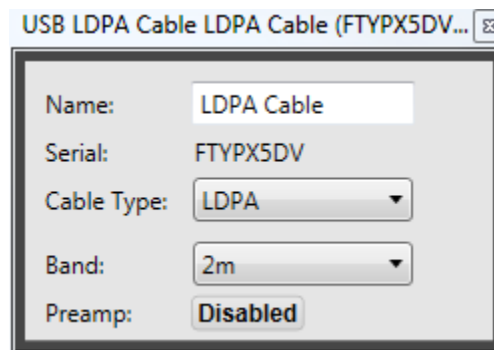
- “Remote Option” USB cable provided by Down East Microwave

Device Setup:

- None

SmartSDR Setup:

- Make sure the Cable Type is set as “LDPA”
- Select the correct band for the cable (2m or 4m)



## Transverters

The USB interface can be used to key transverters using the BIT cable type. You will be able to key your transverter only when the specified band or frequency range is being used by the selected source.

Required Cables:

- FTDI C232HM (MPSSE)

SmartSDR Setup:

- Make sure the Cable Type is set to “BIT”
- Each wire on the C232HM cable can be set to key the transverter by setting the PTT to “PTT On” for the given pin
- In the following example the first three wires on the C232HM have been mapped to key different bands. The orange wire is 2m, yellow wire is 222, and the green wire is 902.

USB Bit Cable Transverter PTT (FTYPX5DV) Edit

Name:  Serial Number: FTYPX5DV Cable Type:

Pin	Polarity	Source	Trigger	PTT, Delay (ms)
0: <input type="checkbox"/> Enabled	<input type="checkbox"/> Active Low	<input type="text" value="TX Slice"/>	Band <input type="text" value="2"/>	<input type="button" value="PTT On"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>
1: <input type="checkbox"/> Enabled	<input type="checkbox"/> Active Low	<input type="text" value="TX Slice"/>	Band <input type="text" value="222"/>	<input type="button" value="PTT On"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>
2: <input type="checkbox"/> Enabled	<input type="checkbox"/> Active Low	<input type="text" value="TX Slice"/>	Band <input type="text" value="902"/>	<input type="button" value="PTT On"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>
3: <input type="checkbox"/> Disabled	<input type="checkbox"/> Active High	<input type="text" value="TX Slice"/>	Band <input type="text" value="20"/>	<input type="button" value="PTT Off"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>
4: <input type="checkbox"/> Disabled	<input type="checkbox"/> Active High	<input type="text" value="TX Slice"/>	Band <input type="text" value="20"/>	<input type="button" value="PTT Off"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>
5: <input type="checkbox"/> Disabled	<input type="checkbox"/> Active High	<input type="text" value="TX Slice"/>	Band <input type="text" value="20"/>	<input type="button" value="PTT Off"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>
6: <input type="checkbox"/> Disabled	<input type="checkbox"/> Active High	<input type="text" value="TX Slice"/>	Band <input type="text" value="20"/>	<input type="button" value="PTT Off"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="260"/>
7: <input type="checkbox"/> Disabled	<input type="checkbox"/> Active High	<input type="text" value="TX Slice"/>	Band <input type="text" value="20"/>	<input type="button" value="PTT Off"/> PTT: <input type="text" value="0"/> TX: <input type="text" value="0"/>

## Hilberling HPA-8000B Amplifier

The HILBERLING HPA-8000B amplifier can be interfaced with the FLEX-6000 series via CAT commands. The CAT interface calls for a FTDI USB-RS232 adapter and for a cable from the adapter to the DB25 connectors J3/J4 called REMOTE TRX 1/TRX 2 at the rear of HPA-8000B.

### Required Cables:

- FTDI USB to Serial Cable
- Custom DB9M to DB25F cable (A DB25 to DB9 adapter will not work)

The CAT ports on the back panel of the HPA-8000B amplifiers are DB25 female connectors. The connection between the DB9M FTDI USB to RS232 adapter to the DB25F port on the HPA-8000B should be in accordance with the HPA-8000B manual, page 13.

HPA-8000B	FTDI DB9M
Pin 12 (RS232 TX)	Pin 2 (RxD)
Pin 24 (RS232 RX)	Pin 3 (TxD)
Pin 13 (GND)	Pin 5 (GND)

### Device Setup:

- Select “FlexRadio and Model: FLEX-6000” in the Transceiver Setup Menu CAT-Type
- Select power level per your needs
- Select Baud Rate 19200.

### SmartSDR Setup:

- Set the Cable Type to CAT

USB CAT Cable HPA-8000B (AH02ELIV) ...

Name: HPA-8000B  
Serial: AH02ELIV  
Cable Type: CAT  
Source: TX Slice  
Auto-report: Disabled

Advanced

Speed: 19200  
Data bits: 8  
Parity: None  
Stop bits: 1  
Flow control: None