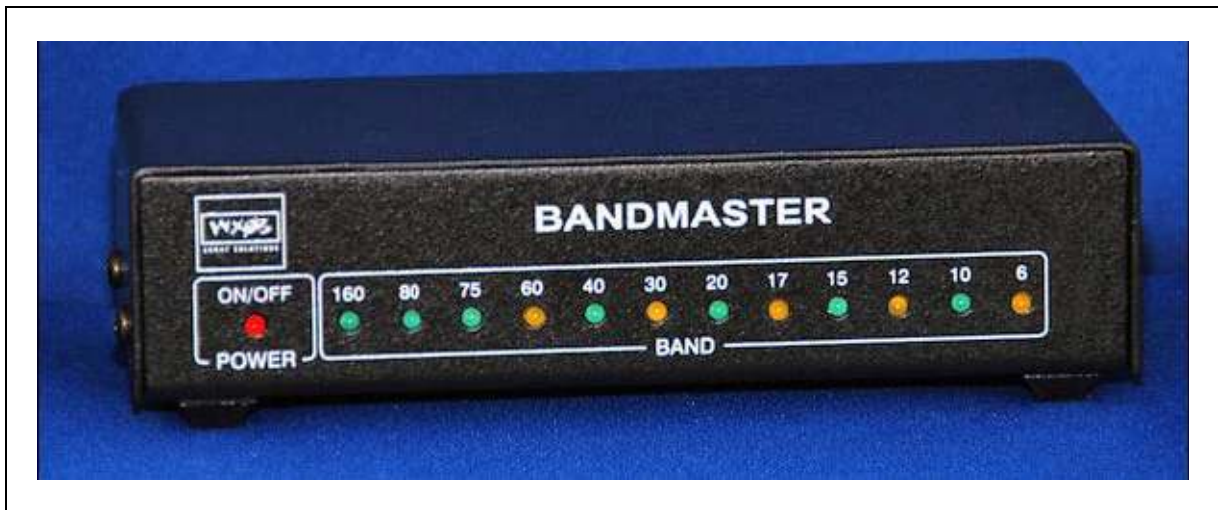




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Bandmaster Universal Band Decoder



Version 1.9.8

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Change log

Version 1.5	29 th dec 2007
Version 1.6	30 th dec 2007
Version 1.7	31 st dec 2007
Version 1.8	1 st jan 2008
Version 1.9.1	2 nd jan 2008
Version 1.9.1	2 nd jan 2008
Version 1.9.2	3 rd jan 2008 pre-released
Version 1.9.3	4 th jan 2008, changed tables, added PTT/CW section, added table/figure reference.
Version 1.9.4	5 th jan 2008, added change log, correction in PTT/CW section, added specifications, added connection figures.
Version 1.9.5	6 th jan 2008, English corrections Image framing Adjustment of headers
Version 1.9.6	jan 2008, Added release level to page 1 edited specifications
Version 1.9.7	15 th jan 2008, Minor corrections in text
Version 1.9.8	19 th jan 2008, Clarified ICOM band voltage support will be a later date.

Introduction

The **Bandmaster** band decoder is a highly integrated unit that not only decodes band information using **ICOM** "Band selector voltages" (note 1) or **YAESU** "band data" (note 2), but it can sense frequency information for all bands from 160M through 6M, including 160M, separate 80M and 75M, 60M, WARC bands and 6M by monitoring **CAT** (note 3) data going to and from the radio. The **Bandmaster** also contains all circuitry for level conversion thus eliminating the need for a separate **CAT** radio interface (note 4).

The **Bandmaster** supports radios from **ICOM**, **KENWOOD**, **YAESU** as well as other radios like the **K2** or **TENTEC ORION** using **CAT** protocols from these manufacturers (note 5). You can even use the decoder as a stand-alone unit where it will monitor the **CAT** commands, **YAESU** "band data" (note 2) or **ICOM** "band selector voltage" (note 1) from the radio and automatically switch to the band being used at that time by the radio and this without any computers attached to the **Bandmaster** or the radio! Finally, it can be connected to your computer and used with your favorite logging/control program as your **CAT** interface or level converter, thus replacing your existing converter (note 3) and antenna selector. Further more, the **Bandmaster** can be used to remotely trigger your PTT on your radio or send CW.

Using the **Bandmaster** configuration software you will also have the ability to set the frequency limits for each band and setting remotely the **ICOM CI-V** address, thus providing even a great deal more flexibility. The **Bandmaster** gives you two separate outputs for each band, one of these outputs is switched to ground when activated and the other is switched to a "Common" pin, this "Common" pin may be connected to ground or any voltage source you desire.

Note 1: ICOM Band Selector voltages is not supported in the present version.

Note 2: **YAESU** BCD Band Data information does not support, 75M and 60M.

Note 3: **CAT** = Computer Aided Tuning, **CAT** is used to control your radio via computer based logging/control or satellite control softwares.

Note 4: **ICOM** CT-17 or **YAESU** FIF-232 or the **KENWOOD** IF10a/IF-232C.

Note 5: The **K2** which uses **KENWOOD** protocol and some of the **TENTEC** which emulates an **ICOM** IC-735.

1 Physical description

The **Bandmaster** is a fairly simple device. The front panel has a power LED and 12 LEDs indicating what band is selected by the **Bandmaster**. The back of the **Bandmaster** has four connectors (figure 1) used for the various connections;

- J1 (DB9 Male) radio connector is used to connect the **Bandmaster** to your radio (**ICOM CI-V**, RS-232c, TTL, **YAESU** BCD, **ICOM** band selector voltage (note 1), etc...).
- J6 (DB9 Female) is used to connect the **Bandmaster** to your PC via an RS-232c serial (COM) port.
- J7 Power connector on you right, this is a standard jack and will support 11 to 16 Volts DC.
- And J8 (DB25 Female) is used to connect to Bandmaster to the devices to be controlled.



Figure 1; Front and rear view

Note 1: Icom Band Selector Voltage is not supported in present version.

2 Bandmaster hardware configuration

In this section we will look at the different ways of configuring the **Bandmaster's** hardware. The **Bandmaster** hardware configuration is done using a series of jumper blocks on the left side of the circuit board to select and configure;

- The Radio type (J4).
- The **CAT** addresses (J9).
- The Connection speed (J5).
- The interface voltage levels (J2) used by the **CAT** interface on the J1 connector.
- J3 on the left side of the PCB is used to put the **Bandmaster** in programming mode.
- And there are also two switches in the lower left side of the PCB. S1 is used in advanced programming of the device and S2 is a hardware reset.

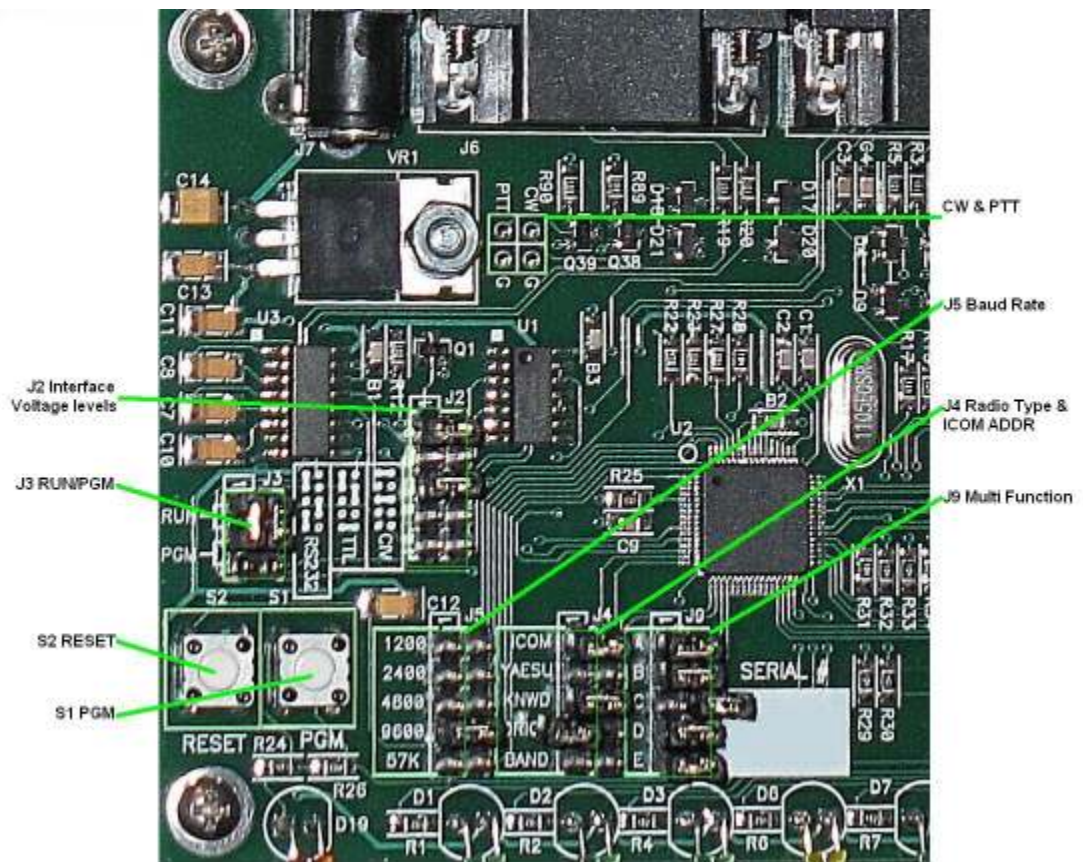


Figure 2: Jumper location

2.1 Radio type configuration

To select the type of radio attached to the **Bandmaster**, simply set J4 to the type of radio (**ICOM**, **YAESU**, **KENWOOD** or **ORION**) being attached to J1 on the back of the **Bandmaster**.

2.1.1 ICOM

ICOM radios can control the **Bandmaster** in two different ways, first via **CAT** commands by monitoring the **ICOM CI-V** radio control protocol for frequency band changes and second via the **ICOM "Band Selector Voltages"** (Note 1).

By far the best way to use the **Bandmaster** with an **ICOM** radio is via the **ICOM CI-V** interface. The **CI-V** protocol was introduced as a standard control protocol by **ICOM** in the early 80s and is still in use today in there top of the line radios. **ICOM CI-V** can be used to control multiple radios remotely via a simple TTL connection using a mono 1/8" jack. One of the many strength of the **ICOM CI-V** protocol is the fact that it is backward compatible between all **ICOM** radios since its introduction and the fact that multiple radios and computers can be attached to a **CI-V** buss like an **ICOM CT-17**.

Note 1: Icom Band Selector Voltage is not supported in present version.

2.1.1.1 ICOM CI-V

To configure the **Bandmaster** with an **ICOM** radio using the **CI-V** interface, place a jumper in the "radio type & ICOM addr" jumper block (J4) over the pair of pins next to the **ICOM** label and if you wish to hardwire the **CI-V** address you must place jumpers over the appropriate positions in the "multi function" (J9) and "radio type & ICOM addr" (J4) jumper blocks as per figure 3. They should add up to the **CI-V** address of the **ICOM** radio you want to monitor. For example, if your radio uses the address 53H, you must place jumpers on the 40, 10, 02 and 01 pin pairs.

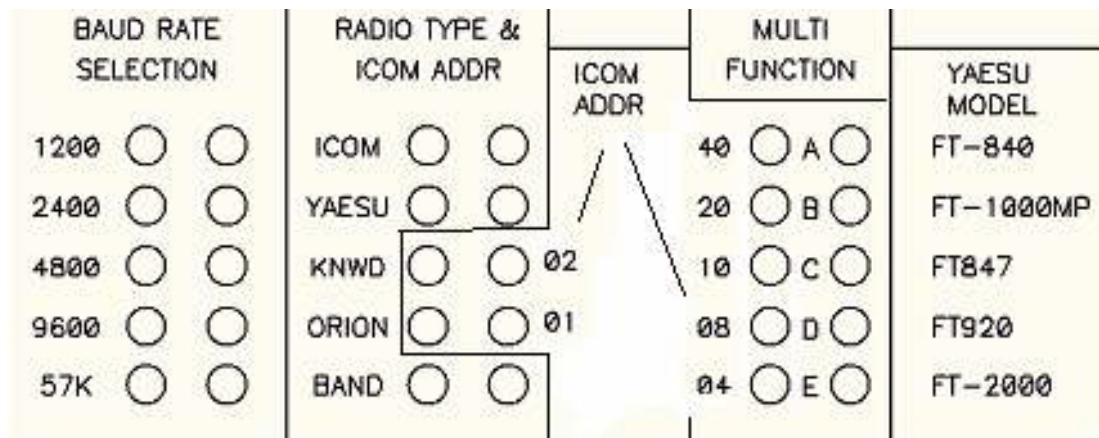


Figure 3; Jumper settings for J5 (Baud Rate), J4 (Radio Type) and J9 (Multi Function)

Note: The 40, 20, 10, 08, & 04 are on the "multi function" jumper block (J9). The 02 and 01 are on the "radio type & ICOM addr" jumper block (J4) at positions **KENWOOD** and **ORION** Respectively.

Do not install any address jumpers if you wish to set the address using the **Bandmaster** Configuration software, this sets the address to 00h which tells the band decoder firmware to use the value set with the **Bandmaster** configuration software.

Note: Make certain to set **CI-V** transceive option in your radio to **OFF** when using **ICOM CI-V**. Check your **ICOM** radio reference manual to see if your radio has this option and to make certain it is **OFF**.

2.1.1.2 ICOM Band Selector Voltage (Note 1)

To configure the **Bandmaster** with an **ICOM** radio using "**Band Selector Voltage**", place a jumper in the "**radio type & ICOM addr**" jumper block (J4) over the pair of pins next to the **ICOM** label and the **BAND**.

Note : ICOM Band Selector voltages is limited to 80M, 40M, 30M, 20M, 15M and 10M

Note 1: Icom Band Selector Voltage is not supported in present version.

2.1.2 KENWOOD

To configure the **Bandmaster** with a **KENWOOD** radio, place a jumper in the "**radio type & ICOM addr**" jumper block (J4) over the pair of pins next to the **KNWD** label.

2.1.3 YAESU

Just like with **ICOM**, **YAESU** offers on some models two ways of connecting the **Bandmaster** decoder;

- Band data can be decoded from the **CAT** commands.
- Or band data can be acquired from the "**Band Data outputs**" connector on most models (see section 3.2.4).

2.1.3.1 YAESU CAT

To configure the **Bandmaster** to monitor **CAT** commands sent to or from a **YAESU** radio, place a jumper in the "**radio type & ICOM addr**" jumper block (J4) over the pair of pins next to the **YAESU** label. Then place a jumper over the pair of pins on the "**multi function**" block (A-E) for your radio model.

Note: The YAESU CAT option will work with most logging programs but is not guaranteed to work with all software. This is due to limitations of the YAESU protocol.

2.1.3.2 YAESU BCD Band Data

To configure the **Bandmaster** to monitor **YAESU** BCD band data, Place a jumper in the "**radio type & ICOM addr**" jumper block (J4) over the pair of pins next to the **YAESU** label. Do not place any jumpers on this header to use the Band Data information from the radio.

2.1.4 ORION

To configure the **Bandmaster** with an **ORION** Place a jumper in the "**radio type & ICOM addr**" jumper block (J4) over the pair of pins next to the **ORION** label.

2.2 Baud Rate

The Baud Rate header is used to set the baud rate required for your radio when using **CAT**, this is also the same baud rate that will be used by the computers RS232c serial (COM) port to communicate with both the radio and/or the **Bandmaster**. The standard for **ICOM** and **KENWOOD** radios is 9600 while most **YAESU** radios use 4800. The **TENTEC ORION** uses 57K. Place a jumper over the pair of pins for the desired baud rate in J5.

Note: In most radios these can be changed in the radio configuration, please verify using your radio reference manuals the actual setting in the radio being controlled.

2.3 Interface type

Before plugging the **CAT** cable to your radio you must set the jumpers to configure the interface to match the voltage levels required by your radio.

The three options are standard **RS-232c**, **TTL** and **ICOM CI-V**. Refer to your radio reference manual to determine the proper interface type.

- **ICOM** radios use **CI-V**.
- Most radios that have a DB-9 type **CAT** connector can assumed to be RS-232c
- While most of those that have the data on non-standard connector are most likely TTL level, such as the **YAESU** FT-840, FT-890, etc.

*Note: improperly setting these jumpers could damage you radio or the **Bandmaster**. Do not assume any settings, **VERIFY** in your radio reference manual how your radio is set.*

Use the chart in figure 4 or the labeling on the board to set the jumpers on J2 in the correct positions.

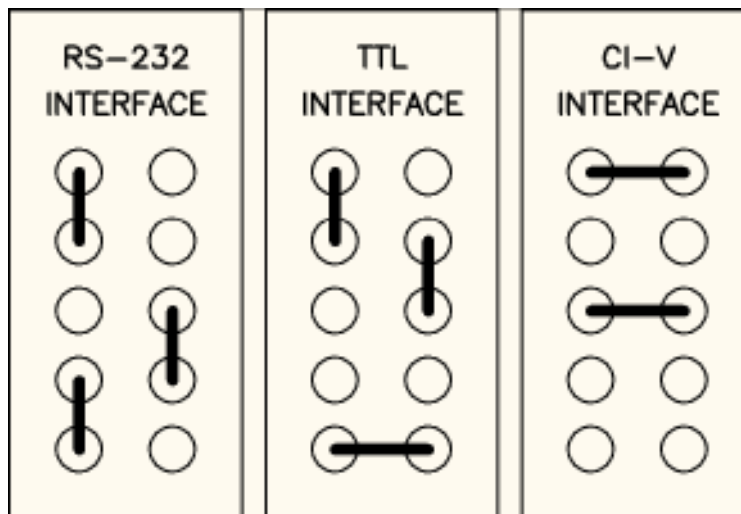


Figure 4; Interface voltage levels (J2)

3 Connections and cable configurations

Using the **Bandmaster** via the **CAT** interface by far gives you the most out of your **Bandmaster**. But if for different reasons you can not, the **Bandmaster** gives you the flexibility of monitoring either **ICOM "band selection Voltages"** or **YAESU BCD "band data"** from the radio. In this section we will look at different ways of connecting your **Bandmaster** and how to make the cables to connect your radio to the **Bandmaster**.

3.1 Computer interface (J6)

A computer is not required for operation of the **Bandmaster**, but the **Bandmaster** being compatible with most logging/control software hooking the **Bandmaster** to a computer increases its flexibility. To do so, simply connect a straight-through DB-9 male/DB-9 female cable (do not use a "null-modem" cable), between the **Bandmaster** RS232c connector (J6) and an RS232c serial (COM) port on your computer. Next simply configure your logging software for your radio setting via the RS232c serial (COM) port used by the **Bandmaster** and connect your radio to the radio connector (J1) of the **Bandmaster** (see section 3.2). Other than making certain that the Computer, **Bandmaster** and radio are all running at the same baud rate, there are no special settings required as the **Bandmaster** is transparent to the logging/control software.

Note : if you run out of RS232c serial (COM) ports on your computer you can look at using a USB to RS232c Serial (COM) port, these are fairly low cost and easy to add to your computer.

3.2 Radio interface (J1)

The J1 connector on the back of the **Bandmaster** is used to interface the **Bandmaster** to the radio, thus giving the possibility of the **Bandmaster** to be automatically controlled by the radio. J1 is also used as the output of the computer radio interface toward the radio when using the **Bandmaster** as your computer interface.

J1 gives the user the possibility of hooking up all the radios supported by the **Bandmaster** via the selection of the proper pin configuration.

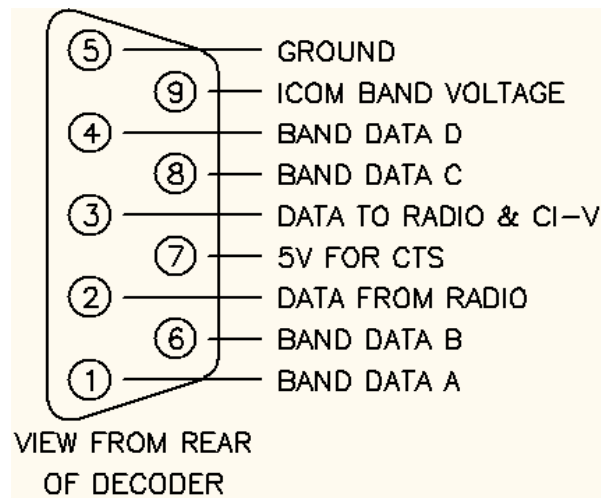


Figure 5; J1 pinout configuration

3.2.1 ICOM

ICOM radios can be connected in two (2) different ways to the **Bandmaster**;

- **ICOM CI-V Protocol**
- Or "**Band Selector Voltages**"

3.2.1.1 ICOM CI-V (J1)

To make an **ICOM CI-V** connection on **Bandmaster J1**, simply connect the ground of a mono 1/8" plug to pin 5 and the center conductor (TIP) to pin 3.

When the **Bandmaster** is connected to an **ICOM** radio via a **CI-V** connection it can replace the **ICOM** CT-17, since the **Bandmaster** J6 RS-232c connector can be used as an interface to the computer. The **Bandmaster** then monitors all **CI-V** commands from the radio or the computer for frequency or band data changes, once it spots a band change via one of these commands the **Bandmaster** reacts by matching the band selection on the **Bandmaster** to the settings on the radio.

The **Bandmaster** can be used autonomously with out any computer attached to the radio, when this is the case the **CI-V** radio interface still sends out commands indicating the frequency and band change, these are monitored by the **Bandmaster** that reacts accordingly.

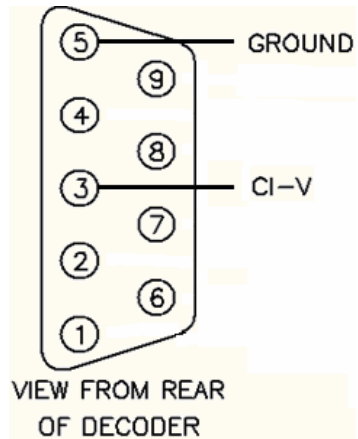


Figure 6; J1 ICOM CI-V pinout

One of the added advantages of **ICOM CI-V** interfacing versus **ICOM** band voltage decoding is the fact that with **CI-V** you will be able to properly switch to 160m, 75m, 60m, WARC bands (17m and 12m) and 6m band. The **ICOM** band select voltage does not give you these possibilities.

3.2.1.2 ICOM band select voltage (J1) (Note 1)

ICOM also offers on the back of most radios since the early 80s, a pair of accessory connectors (Acc(1) and Acc(2)) where you can interface many devices (RTTY, phone patch, linear amplifiers, antenna tuners, etc...). On pin 4 of the Acc(2) connector (See figure 8) you will find a "**Band voltage output**" also known as "**Band Select Voltage**" this is a 0.0 to 8.0Volt DC reference voltage that changes according to what band the radio is on (See table 1).

If you want to connect the **Bandmaster** to an **ICOM** radio via the "**Band Select Voltage**" simply connect pin 4 of a 7 Pin Male DIN connector to Pin 9 of the **Bandmaster J1** connector and Pin 2 of the 7 Pin Male DIN connector to pin 5 of the **Bandmaster J1** connector.

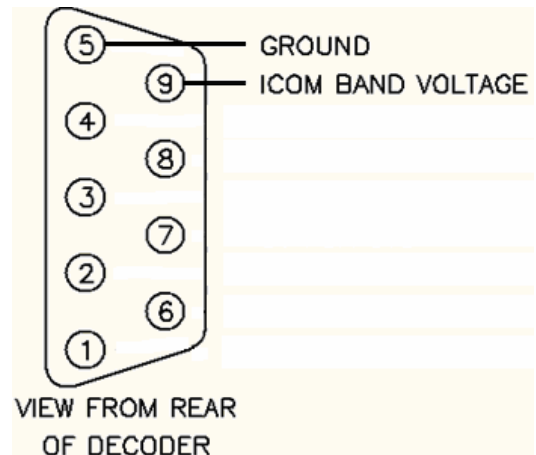


Figure 7; J1 ICOM Band selector voltage pinout, Icom Band Selector Voltage is not supported in present version.

Note 1: Icom Band Selector Voltage is not supported in present version.


ACC (2)	PIN No.	NAME	DESCRIPTION	SPECIFICATIONS
 Rear panel view	1	8 V	Regulated 8 V output.	Output voltage : 8 V \pm 0.3 V Output current : Less than 10 mA
	2	GND		Same as ACC(1) pin 2.
	3	SEND		Same as ACC(1) pin 3.
	4	BAND	Band voltage output. (Varies with amateur band)	Output voltage : 0 to 8.0 V
	5	ALC		Same as ACC (1) pin 8.
	6	TRV	Activates [XVERT] input/output when "HIGH" voltage is applied.	Input impedance : More than 10 k Ω Input voltage : 2 to 13.8 V
	7	13.8 V		Same as ACC(1) pin 7.

Figure 8; ICOM ACC (2) connector configuration. (Icom Band Selector Voltage is not supported in present version.)

Band	Band Control Voltage
160M	7.0 – 8.0V
80M/75M	6.0 – 6.5V
40M	5.0 – 5.5V
20M	4.0 – 4.5V
17M/15M	3.0 – 3.5V
12M/10M	2.0 – 2.5V
30M	0 – 1.2V

Table 1; ICOM band voltages
(Icom Band Selector Voltage is not supported in present version.)

3.2.2 RS-232c connections (J1)

Manufacturers using direct RS232c DB9 connections can be attached to the **Bandmaster** via the J1 connector and a specially design cable.

Note: The pin out of the connector at the radio end may vary, check your radio reference manual for proper hook up.

Bandmaster J1 pin out	DB9 radio pin out
Pin 2 Send Data	Pin 2 Receive Data
Pin 3 Receive Data	Pin 3 Send Data
Pin 5 CTS	Pin 6 DSR
Pin 7 Ground	Pin 5 Ground

Table 2: RS232 cable configuration for J1

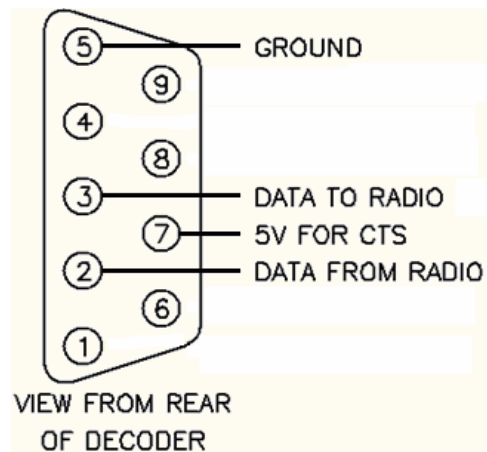


Figure 9; J1 RS232c pinout

3.2.3 TTL connection (J1)

The **Bandmaster** pins used on J1 for the TTL output compatible with manufacturers using TTL interfaces are;

Bandmaster J1 pin out
Pin 2 Send Data
Pin 3 Receive Data
Pin 5 CTS (Optional)
Pin 7 Ground

Table 3: TTL connections on J1

These should be wired according to your radio. Again the radio connection may change according to your radio! Please refer to your reference manual before attaching the **Bandmaster** to prevent any damage to the radio or the **Bandmaster**.

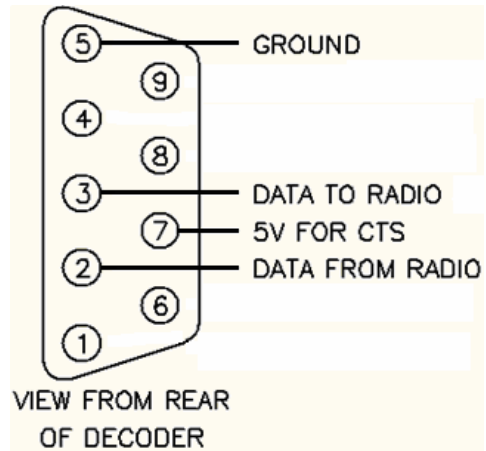


Figure 10; J1 TTL pinout

3.2.4 YAESU BCD band selector (J1)

YAESU also offers on some radios a BCD connection to push band selection information from the radio toward external devices. The **Bandmaster** can, via the J1 connector and a specially design cable, decode this information. The pins used on J1 for this are;

Bandmaster J1 pin out
Pin 1 Band Data A
Pin 6 Band Data B
Pin 8 Band Data C
Pin 4 Band Data D
Pin 5 Ground

Table 4: YAESU BCD input connections on J1

Table 5 below shows the **YAESU** band data selection in BCD mode. Note that in this mode 75M and 60M are not supported.

Band	Band Data
160M	0001
80/75	0010
40M	0011
30M	0100
20M	0101
17M	0110
15M	0111
12M	1000
10M	1001
6M	1010

Table 5; YAESU BCD band selection.

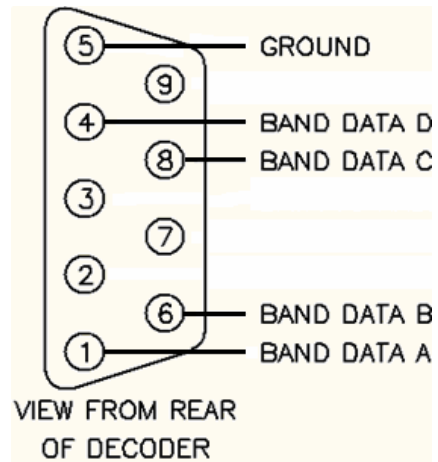


Figure 11; J1 Yaesu Band Data pinout

3.3 Bandmaster Output (J8)

The **Bandmaster** J8 connector is a Female DB25, where pins 1 through 12 are used for Outputs A (160M to 6M) and pins 14 through 25 are used for Output B (160M to 6M) and pin 13 is used as the COMMON for Output B. The output A switches to ground when activated and the B outputs switches to the COMMON (pin 13) when activated. The COMMON (Pin 13) may be connected to ground or any voltage source you desire. The pinout of J8 is shown in figure 12. The connector is shown looking at the rear panel of the unit.

Connections to multi-Band antenna can be addressed using a simple diode matrix combining the different bands for that selection.

Example: an 80/40 dipole on the Output A side can be selected on a remote relay box by attaching one diodes cathode to the 80M-A (pin 2) and second diode cathode to the 75M-A (pin 3) and a third diode cathode to the 40M-A (pin 5) output of J8 on the **Bandmaster** and the other ends on the 3 diodes (anodes) are attached together to the selected relay.

(Polarity, choice of the diodes and connections would be according to voltage and usage of outputs A or B on the **Bandmaster**.)

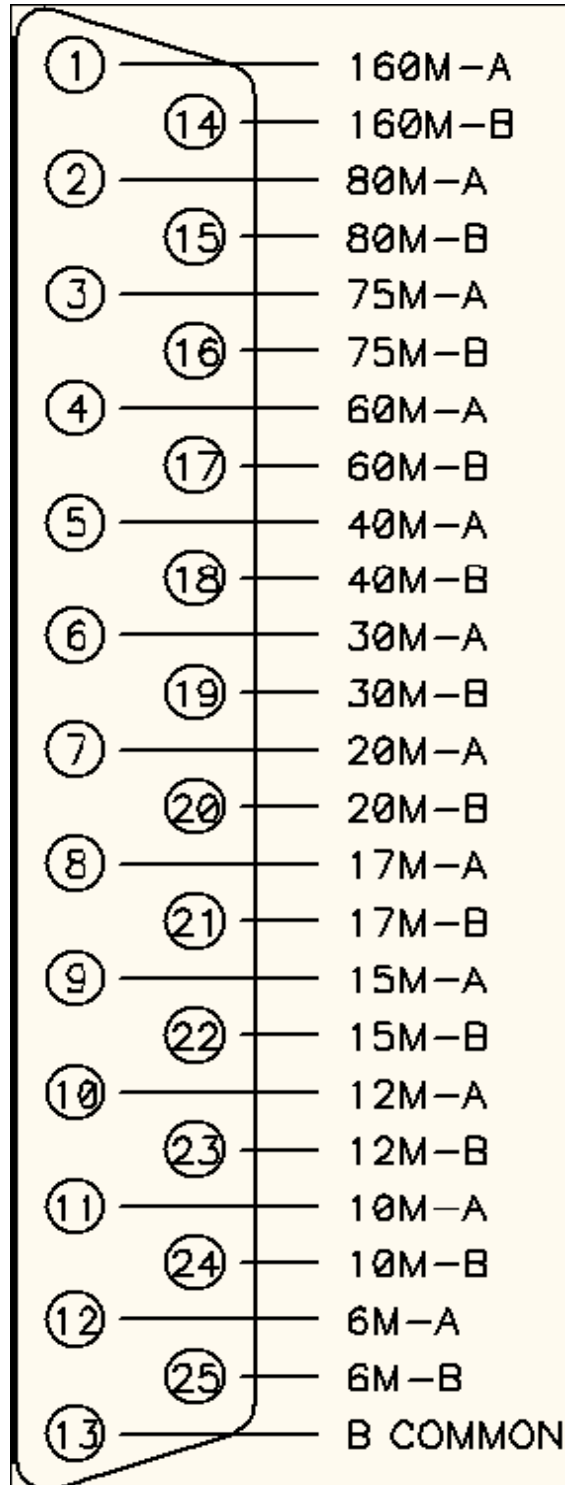


Figure 12: J8 pinout

3.4 PTT and CW operations via the Bandmaster

The **Bandmaster** as the possibility to remotely control your station further by offering the user the possibility to trigger the PTT or send CW via the J6 connection to your computer. It has become a standard for most logging/control softwares to give the possibility to the user to trigger the PTT and CW via the RTS and DTR control wire of the RS232c connection to the computer.

The **Bandmaster** design was made with this in mind, you will find in upper left corner of the PCB near J6 and pair of solder points identified as PTT and CW. These are respectively linked to RTS and DTR via a transistor circuit that will dropped them respectively to ground when triggered. By soldering a cable to each you can easily add separate jacks in the back of the **Bandmaster** to connect your rig's PTT and CW.

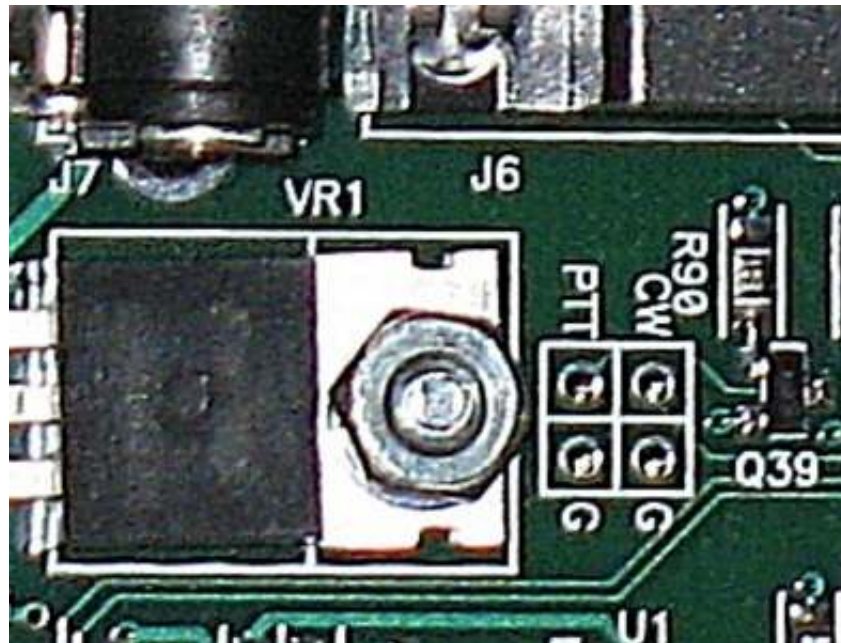


Figure 13; CW and PTT connections

Next simply configure your software to trigger the PTT via RTS and CW via DTR. These settings are specific to each application, please refer to your applications reference manual for proper configuration settings.

4 Hooking up your Bandmaster

- Verify your radio configuration as per your manufacturer's reference manual.
- Configure your jumpers in the **Bandmaster** according to your radio as per section 2.
- Make our cables specific to your radio as per section 3 or custom made cables can be purchased from **ARRAY SOLUTION**.
- Connect your **Bandmaster** to your radio using J1 (DB9M) according to the connection option you selected in section 3.2.
- Connect your **Bandmaster** to your computer using J6 (DB9F) using a regular M/F DB9 cable (optional).
- Connect **Bandmaster** to the device(s) to be controlled (antenna switch, BPF, Sixpack, etc...) via the J8 (DB25F).
- Connect the 12 Volt DC power to the back of the **Bandmaster**.
- And you are done.

5 Operations

Once your radio is cabled correctly, apply power to the **Bandmaster**. As you switch bands on your radio or logging/control software, the **Bandmaster** will switch to your band of choice within 2.5 to 5 seconds. This delay ignores transients and false signals from the radio which can cause unwanted problems.

If using computer logging/control programs, the application should be configured to the computer RS-232c serial (COM) port where the **Bandmaster** is connected. The Logging/control programs will use the **Bandmaster** as the **CAT** level converter interface thus making the **Bandmaster** transparent to the application.

*Note: you **can not** run the **Bandmaster** configuration application at the same time as a logging/control program because you can not have two applications grabbing the same serial port. Thus make certain your **Bandmaster** configuration application is closed before running any other application using your **Bandmaster**.*

6 Bandmaster Configuration Software

The **Bandmaster** also includes a software utility that can be used to customize the band segments and set the **ICOM CI-V** address.

Before using the software utility you must place the Band Master in the programming mode. This is done by unplugging the power cable, removing the cover, remove the Baud Rate jumper (J5) and move the two RUN/PGM jumpers (J3) to the PGM position and then reapplying power. Run the software utility and select the proper COM port. You may now customize the band segments by clicking on the band you wish to change. If you wish to use the utility to set the **ICOM CI-V** address you must first remove all jumpers related to **ICOM CI-V** addressing, essentially setting the address to 0. This will tell the Band Master to use the remotely programmed address instead of the jumper address. Set the **CI-V** address by clicking on Address (Hex).

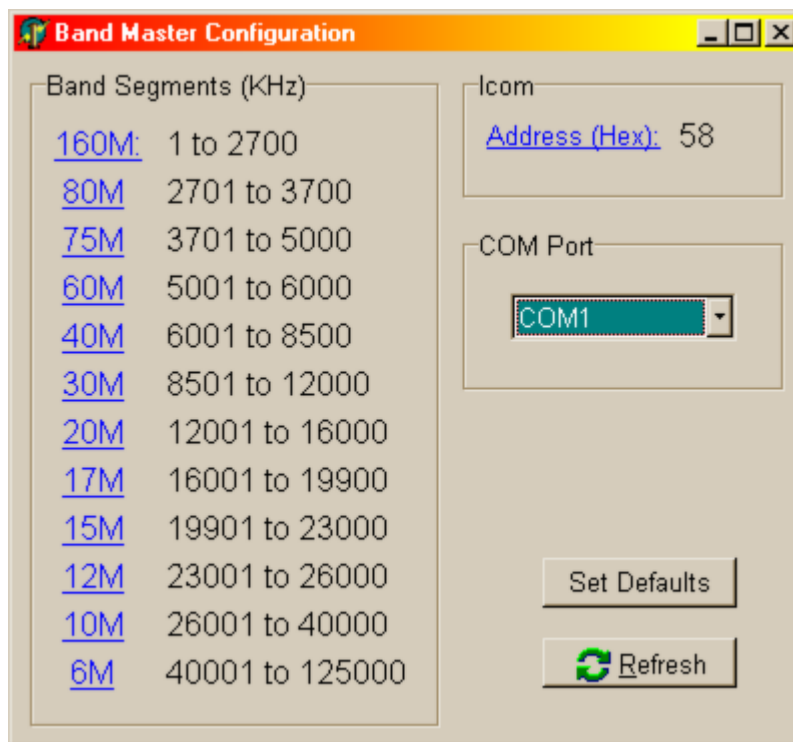


Figure 14; **Bandmaster** configuration application.

After programming is complete restore the **Bandmaster** to the run mode. Do this by removing power, moving the two RUN/PGM jumpers J3 to the RUN position, reinstall the Baud Rate jumper (J5) for the desired baud rate, reinstall the cover and reapply power.

*Note: you can not run the **Bandmaster** configuration application at the same time as a logging/control program because you can not have two applications grabbing the same serial port. Thus make certain your **Bandmaster** configuration application is closed before running any other application using your **Bandmaster**.*

Specifications

Dimensions.....	Very small box 1.5"H X 6.5"W X 3.5"D
Enclosure.....	All metal case, RFI immune - CE and FCC compliant
J7 Operating voltages.....	+11 to +16 Volts DC
J7 polarity.....	Center positive
J8 Maximum current on contacts.....	Max 3 Amps
J8 Number of contacts per bands.....	2 per bands : 1 to ground and one to a common
Numbers of bands.....	12 bands
Bands covered.....	160M, 80M, 75M, 60M, 40M, 30M, 20M, 17M, 15M, 12M, 10M, 6M
Band selection support.....	CAT, ICOM CI-V and Yaesu BCD Band Data
CAT protocol support.....	ICOM CI-V, Kenwood and Yaesu CAT
ICOM Band Voltage support	Icom Band Selector Voltage is not supported in present version.
Yaesu Band data support.....	Yaesu BCD Band Data (See table 5)
Supported manufacturers.....	Elecraft, ICOM, Kenwood, Tentec, Yaesu (Note 1)

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Note 1: Not all manufacturers radio models are supported, verify according to manufacturers documentation.