



BAND DECODER-I FOR ICOM RADIOS

Quick Start

1. Connect your transceiver Band Data outputs to the Band Decoder input J1.
2. Connect a source of 12 Vdc to the Band Data power connector with the provided 5.5/2.5 mm OD/ID coaxial plug.
3. Connect the external relays, such as the Top Ten Devices Six Way Relay Box, to output connector J2.
4. Program the outputs by installing wire jumpers or diodes on the internal programming header, as required by your antenna farm. (Note that a prefabricated jumper plug is already installed in your decoder's programming header at the factory. If Figure 2a suits your needs, the decoder needs no further programming.)

You're in business! (Details on all the above steps are provided in the following paragraphs.)

If you intend to connect the Band Decoder to an IC-775DSP, you will need to make a simple modification to the decoder. See the instructions below.

Contacting Top Ten

You may write to us at the following address:

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A telephone answering machine may be found at (610) 935-2684. All messages are answered promptly.

We are also available on the Internet. With the proliferation of Internet Services Providers, e-mail addresses may be changed frequently. As of February 6, 1999, the following were in effect:

N3RD: n3rd@ix.netcom.com
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Check our latest magazine ads for current e-mail addresses.

Overview

The Band Decoder continuously follows your Icom transceiver's band changes, and provides a separate NPN transistor switch to ground for seven of the nine bands your rig can operate on. (Due to the way Icom encodes the band voltage, 20 and 17 meters are combined, as are 15 and 12 meters.) By connecting external antenna relays to the Decoder's output, automatic antenna selection is possible, relieving the operator of this task.

Light emitting diodes (LEDs) on the front of the decoder indicate the band in use. A seven position manual bandswitch is provided to override the input signals or to manually select antennas if the rig is not available for some reason.

The basic Band Decoder provides NPN outputs, which switch the negative side of the external relays to ground. External relays which require a source of 12 Vdc to operate rather than a switch to ground can also be controlled. In this case, the Band Decoder must be fitted with the *Source Driver Modification* described later in this manual.

Circuit Description

The schematic of the Band Decoder is shown in Figure 1. The schematic represents a decoder which has been fitted with the *Source Driver Modification*, which will be described later.

All components except the input/output connectors and bandswitch are mounted either on the decoder board or source driver (SD) printed circuit boards.

The decoder accepts a stepped analog voltage from the transceiver, which is decoded by the LM3914A into a one-of-seven output. The following table describes how the various input voltages are decoded:

Band MHz	Input Voltage
10	0.0 to 1.0 Volts
28 or 24	2.0 to 3.0 Volts
21 or 18	3.0 to 4.0 Volts
14	4.0 to 5.0 Volts
7	5.0 to 6.0 Volts
3.5	6.0 to 7.0 Volts
1.8	7.0 to 8.0 Volts

The U1 outputs are low when the band is selected. These six outputs are routed to U2, which inverts them to being high when the particular band is selected. The outputs from U2 are then routed to U3, which contains seven N-channel Darlington pair transistor switches. When their input goes high, their output switches to

ground. All unselected outputs float at 12-13.8 Vdc, depending upon the actual power supply voltage.

When the transceiver is on the 10 MHz band, the band voltage goes to zero. A decoding gate (U4) is provided to detect this condition, and provides an output to the seventh U3 transistor switch. When the rig is on 10 MHz, all the LEDs will be off.

The following table shows which U3 output pin is low for each band in use:

Band In Use	U3 Pin Low
160m	11
80m	12
40m	13
30m	10
20m	14
17m	14
15m	15
12m	15
10m	16

The seven outputs from U3 are taken to the programming header, designated as U5. This is where you install either wire jumpers or diodes to program the outputs for your particular antenna farm. The header is removable to allow easy wiring or rewiring. (TIP: Put the header in a loose socket when soldering the wires or diodes. This will prevent the pins on the header from wandering when the soldering pencil heats the connection.)

Several examples of how to install diodes and wire jumpers for typical antenna configurations are shown in Figures 2a-e. The outputs from the programming header are routed to output connector J2 for connection to the external antenna relays.

The manual bandswitch has seven positions, an AUTO and positions for the normal contesting bands 160 through 10 meters. In AUTO, the base of Q3 is grounded, turning Q3 off. When the switch is rotated off of AUTO, Q3 base goes high, turning on Q3, which shorts the U1 input line to ground, which effectively disables the decoder function. The bandswitch provides the switch to ground for the six contesting bands, simulating the outputs from the decoder IC U1. The LEDs will follow the position of the bandswitch.

The Band Decoder requires a 12 Vdc nominal supply. The power connection can either be made at the 2.5 mm coaxial connector on the rear panel or via input connection J1 Pin 7. Diodes CR1 and CR2 isolate these two sources to prevent circulating currents in case voltage is applied to both inputs simultaneously.



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Source Driver Modification

When installed, Source Driver IC U6 provides a 12 Vdc nominal source to energize external relays. This may be useful to control remote relays from Ameritron and DX Engineering. The inputs to U6 behave just like a normal relay coil being switched to ground. This means that programming for the source driven outputs is done on U5 in exactly the same manner as if the relays were actually being switched directly by U3. However, if for any reason programming diodes need to be placed externally of the band decoder enclosure, then they must "point to" the source driven relays.

Modifications Required for Use With IC-775DSP

Some of the new IC-775DSP radios put out band voltages that are too low for the Band Decoder to properly decode. We are trying to resolve this problem with Icom as it affects other Icom products that use the band voltage as well.

Your new decoder should operate properly with most of the Icom radios. If you experience a problem with an incorrect band being selected, you may change the threshold voltages in the decoder in the following manner. Remove the Band Decoder cover and locate R1 on the circuit board. You will notice a second resistor has been "piggy backed" with R1. Carefully cut one of the leads of the piggy back resistor (20K) and lift the resistor slightly to disconnect it. If you cut the lead half way up, it can be resoldered later if necessary.

This change in resistor value will lower the threshold voltages such that the decoder will work properly with the 775.

Input Cable Considerations

A cable must be made to bring the band voltage and reference ground from the rig to the decoder. These signals are available at the Accessory Jack on the rear of the radio.

If desired, the radio can supply power to the Band Decoder and relays. In this case, an additional wire needs to be included in the cable. Be aware that this power supply line is generally not fused, and damage could result to the radio from a short circuit in the external circuitry. For this reason, **Top Ten Devices does not recommend using the transceiver as the source of power for the decoder and relays or other external devices.**

Typical Applications

Several typical installations are shown in Figures 2a-2e. These few examples are shown to illustrate the necessary cabling and programming for fairly typical configurations. There are countless other variations.



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In applying your Band Decoder in your automatic antenna selection configuration, you should be aware of the following considerations:

1. The source of power for the decoder and relays can either be from the radio or an external supply. Top Ten recommends that an external supply be used. Use the provided 5.5/2.5 mm OD/ID coaxial plug.
2. The decoder can be "programmed" to select various combinations of antennas. A programming header is provided inside the decoder for conveniently locating diodes or wire jumpers. However, programming may be done externally as well, and in fact may be required (see Figure 2d).
3. The Top Ten Devices band decoders provide individual band outputs for use in **automatically** activating external antenna relays and other devices. By making antenna selection automatic, the operator is relieved of this chore, and can focus his attentions on working the contest or chasing that rare DX station. However, to truly relieve the operator of any worry, it must be assured that there is no way for the automatic controls to select an antenna which is not resonant. Several simple examples will illustrate the point.

The simplest configuration to imagine is one with a single monoband antenna for each band, as shown in Figure 2a. Wired as shown there is no way possible for the system to select an improper antenna.

However, to complicate the example, let us assume that a 5 band trapped vertical antenna is being used as the primary antenna on 80 meters, but the operator would like to be able to access this antenna as a back up for the 10-40 meter bands. The operator might be tempted to place a manual coaxial switch in the line to select the 5 band vertical vs. the balance of the station antennas. The problem with this approach is that if the op forgets to return the switch to its normal position before a QSY to 160 meters, he may inadvertently apply 160 meter power to the vertical and damage one of the traps. This hybrid of partly automatic and partly manual antenna selection is consequently somewhat dangerous, since the operator will quickly become accustomed to the automatic controls and may forget about the manual switch.

In this latter case, by eliminating the manual coax switch and application of programming diodes and external manual control switches, **it is possible** to allow manual access to the 5 band vertical while on 10, 15, 20, 40, or 80 meters while preventing its access on 160 meters. While this may appear to be considerably more complicated than just inserting a manual coaxial switch, and it is, Top Ten recommends that the extra effort be made to properly configure the station for fully automatic selection of a resonant antenna.

Regardless of how complicated the station antenna farm is, it is definitely possible to implement a switching scheme which will positively assure that a resonant antenna is received when you switch bands. It is hoped that the fundamental



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concepts regarding "programming the decoder outputs" described elsewhere and shown in the various examples will provide the necessary knowledge to allow the operator to tackle the more challenging configurations. Discussion of these scenarios is beyond the scope of this manual.

4. Antenna relays and bandpass filters, such as those available from Dunestar and ICE, can be switched simultaneously by a single decoder, as is shown in Figure 2d. The only limitation is that the total current that U3 is required to sink not exceed 500 mA, which represents over 10 standard Top Ten antenna relays. If the Source Driver modification is fitted, total U6 current must not exceed 400 mA. Be careful that your relays are really rated at 12 Vdc nominal and are wired appropriately (sink versus source).

5. ALWAYS test your circuit with a continuity checker first, prior to application of any RF power. Most DVMs have a "bell" which can be conveniently used to verify that the proper relays pick up on the various bands. NEVER use RF power to check out your relays.

Limited Warrantee

Top Ten Devices warrants this unit to be free from defects in parts and workmanship for a period of one year. The unit will be either repaired or replaced, at our discretion. The only cost will be the cost of return shipping. If repairs are required during the warrantee period for other than manufacturing or parts defects, an estimate of the repair cost will be provided prior to repair.

Top Ten Devices is not responsible for any consequential damages to other equipment or personnel injury as a result of using this product, or any of the suggested uses.

If the terms of the above Warrantee and Limitation of Liability are not acceptable, please return the unit to Top Ten Devices for a full refund.

Specifications

Power Supply Voltage	+12 to +15 volts dc
Current required (no relays).....	10 mA
Output current capability	
Sink driver (U3-ULN2004A)	500 mA
Source driver (U6-UDN2580A)	400 mA
Output open circuit voltage	
Sink driver (U3-ULN2003A)	50 V max
Source driver (U6-UDN2580A)	25 V max