Hexadecimal band decoder and relay driver - operating instructions and description

Contents

Contents 1
Introduction 1
Quick start 3
Link configuration 3
Circuit description 4
The hexadecimal band schema 6
Schematic 6

If you want to use the product without reading the entire operating instructions go to page 3

Introduction

The purpose of the Hexadecimal band decoder and relay driver is to enable you to automatically select HF or VHF/UHF antennas or any auxiliary equipment such as a linear amplifier based on the bands you selected on your Yaesu or Elecraft transceiver. This is achieved by reading the BCD output from your transceiver and determining the band in use. The term BCD is used by Yaesu to describe the four-bit binary band data (GND, BAND DATA A, BAND DATA B, BAND DATA C and BAND DATA D, Hexadecimal) output provided by your transceiver.

Based on the logic state of each of the four bits, the decoder interprets the band selected (160m through 70cm), indicated by the illumination of an LED for the band and an open collector output capable of activating a relay. The open-collector output will pull the load (antenna relay) toward ground when active. If you connect a relay to the 16 pin terminal strip you must connect one side of your relay to the RLY +Vcc terminal pin and the other to one of the band terminal pins. The three on-board relays are powered directly from the products internal 13.8v supply.

Please refer to the respective Yaesu and Elecraft operating instructions for the connector type and specific pin-outs you will need to select in order to connect from your transceiver to this product. Check your HF transceiver connector pin polarity in the transceiver operating instructions which will usually display the connectors and pins as viewed from the rear of the equipment.

The product has two modes of antenna operation,

1. From the three on-board relays marked A, B or C using the four pin Relay terminal strip.
2. Directly from the 16-pin terminal strip.

To avoid parallel relay operation, use only one of the above approaches and deactivate the on-board relays by de-soldering link 1 if you are operating your antenna relays directly from the 16-pin terminal strip.

I have attempted to provide as much flexibility in this product as practical through the use of configuration links and solder pads. Should you prefer to connect (solder) your connections to the product I have added solder pads at all the output terminals.

If required, the unit can drive antenna relays up to 28v at maximum 350mA using a separate supply connected to the relay Supply terminals.

When connected to a transceiver the unit will decode the band selected which is used to operate your antenna relays or one of the three on-board relays. The three on-board relays have single pole change over contacts, capable of switching 13.8v at the rated 350mA or from an external antenna relay supply to drive external antenna relays providing up to 28v at a maximum of 350mA.

As antennas are often multi-band, the unit includes a **band group matrix** so bands can be grouped for each antenna. Up to 14 antenna relays can be operated separately or in combination using the 16 pin terminal strip or up to three antenna relays can be activated by one of three master on-board relays.

When new there are a series of configuration links on the product which are set to the default configuration. The unit can be simply connected to your transceiver and a 13.8v power supply and once you have soldered the band group matrix as required its ready to go. Please see the Quick start section below if you wish to follow this process.

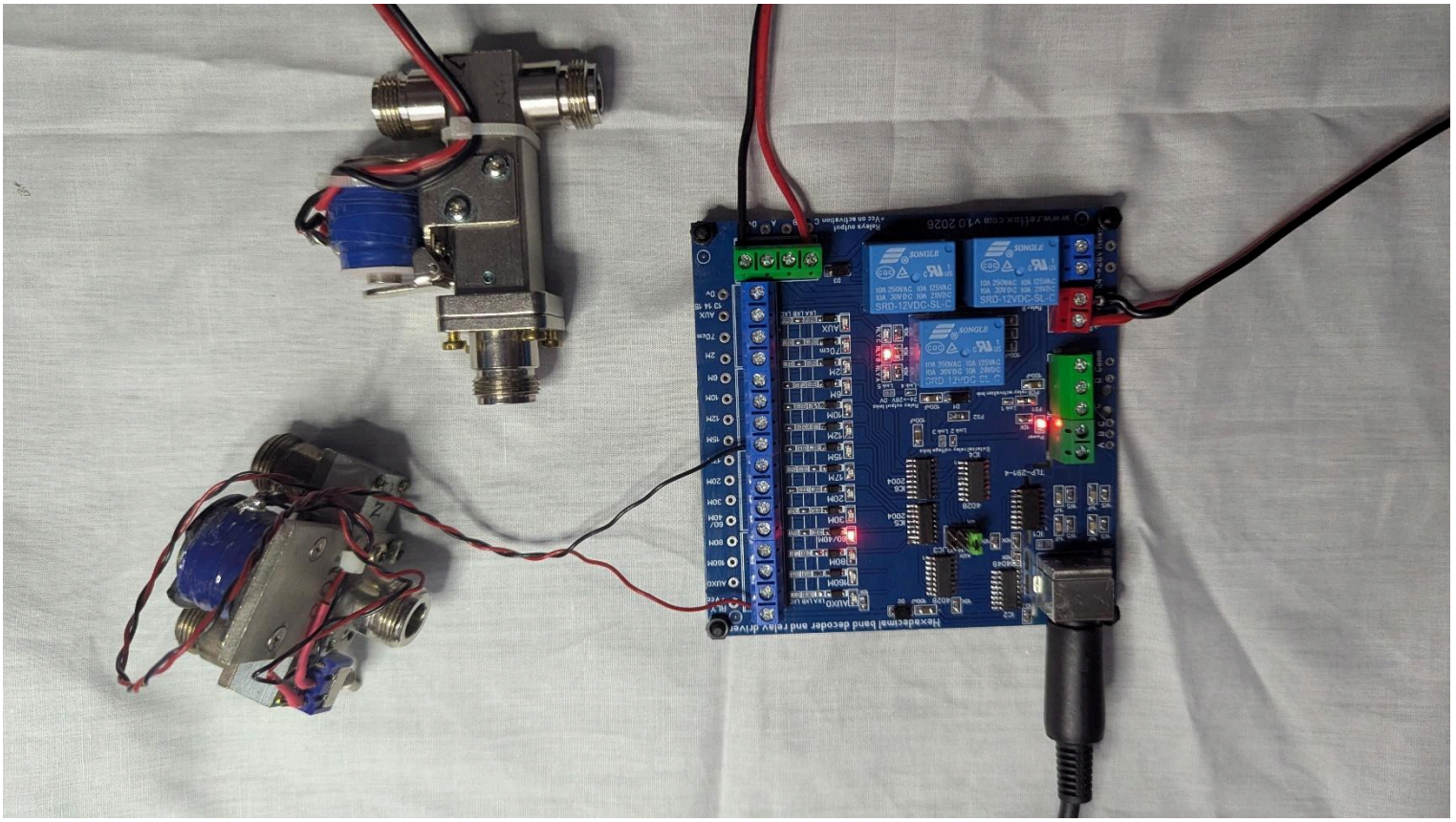
Warning! Not all soldering irons are isolated. Under no circumstances solder the PCB links or band group matrix whilst the product is activated. Remove the power before altering the pin headers or soldering the links or band group matrix.

The unit will operate between 11 and 15v DC for the purpose of this document I have used 13.8volts to indicate between 11 and 15 volts. The unit consumes 3mA in standby and 40mA when activating one of the on-board relays.

There are a number of links that can be changed on the product in order to accommodate a broad range of functions such as driving relays requiring higher voltages than the 13.8v operating voltage or providing an earth at the relay switching outputs instead of a positive voltage. Please refer to the configurations links section if you wish to make any of these changes.

The four-bit binary connection on this product employs galvanic isolation ensuring no stray voltages can damage the product input or your transceivers output port.

Both power inputs to the product are protected by 350mA re-settable fuses. Should an overload occur disconnect the supply, remove the fault condition and the fuse within the product will reset.



Quick start

If you want to use the product without reading the entire operating instructions follow this 12 step process

1. Switch off your HF transceiver.
2. Connect the four-bit binary output and Comm/GND from your HF transceiver to the product. This can be through the 6 pin mini DIN cable harness or directly to the input terminal strip marked “Common D C B A”.
3. Apply 13.8v to activate the unit. The red LED will illuminate to confirm power is present.
4. Check that the AUX0 LED is illuminated (Transceiver is switched off).
5. Switch on your transceiver and change bands ensuring that the correct LEDs illuminate correctly for each band. If this is not the case, you may have the input leads reversed or mixed?
6. Remove power from the product.
7. Connect (solder) the connections on the band group matrix (links A, B, & C) to group the bands you wish to associate with each on-board relay. **Only activate one connection on the band group matrix for each band!**
8. Power up the product and test your configuration by changing bands on your transceiver and observing the correct on-board relays operate for each band.
9. Remove power from the product (again!)
10. Connect your antenna relays to the Relays Output five pin terminal. Each external relay must be connected between the 0v terminal and one of the output terminals marked (A, B or C).
11. Apply power to the unit (for the final time) and ensure the antenna relays operate when their respective internal relays are activated.
12. Done!

Link configuration

When supplied the default link configuration this product provides a basic four-bit to hexadecimal band decode and relay driver. The product has been designed to provide as flexible solution as possible. By altering the configurations links on the PCB you can alter the functionality listed below. Please refer to figure 1 for the link positions -

1. **Link 1** - Activates the on-board relays, remove link 1 to power external relays exclusively from the 16 pin terminal strip according to the band group matrix.
2. **Links 2 and 3** - External relays can be operated at higher voltages (maximum 28v) than the 13.8v supply voltage. To do this connect your higher voltage at the separate relay supply terminals, remove link 1 & 2 and connect link 3. This applies the higher voltage to the relay driver chips.

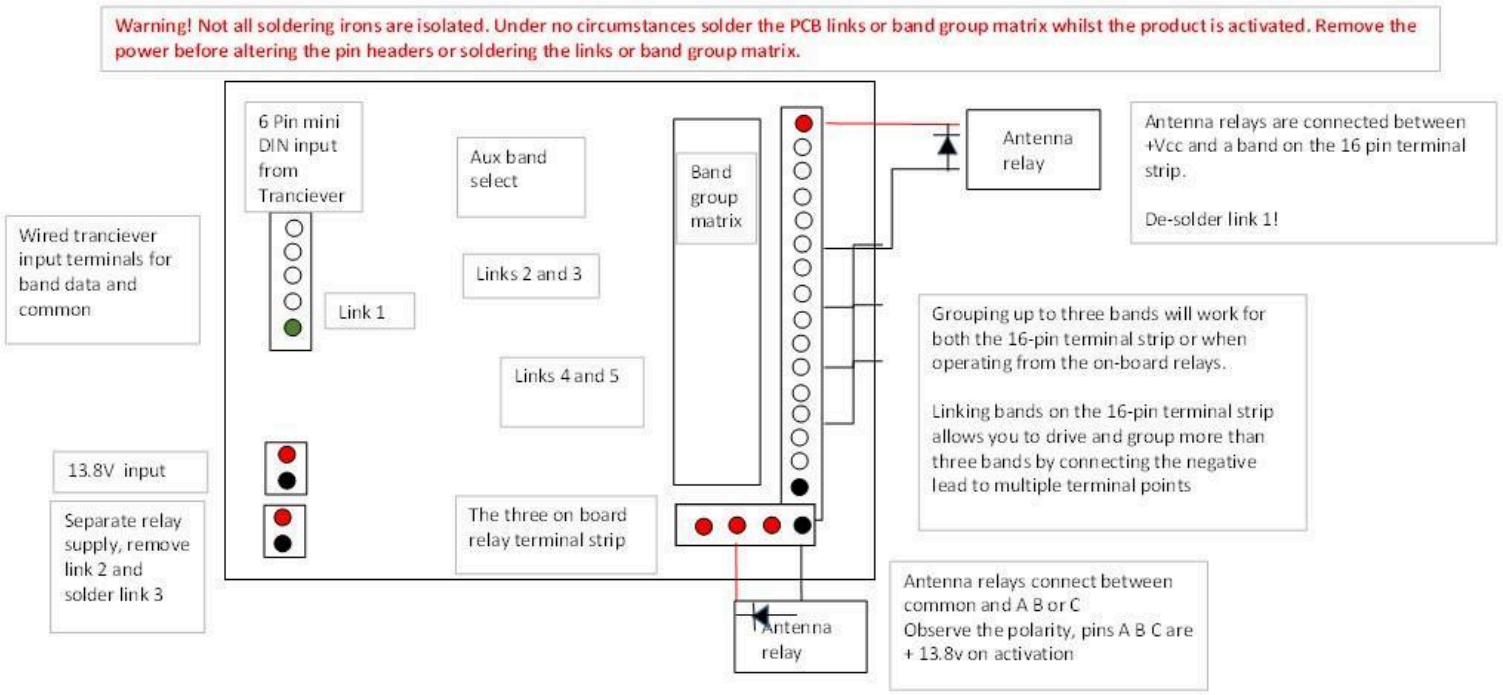
   N.B. Remember to remove link 1 if you employ a higher relay voltage. The internal relays are only rated for 12 volts.
3. **Links 4 and 5** - enable you to supply either 13.8v or 0V when the on-board relays operate.
4. **Relay A B C links on the reverse side of the product PCB -** There are three links on the reverse side of the PCB allowing you to set the internal relay contacts to ground when the on-board relays are inactive.
5. **Auxiliary headers -** There are three additional auxiliary headers marked AUX 13, 14, 15. These are set by a pin header. The header is set to AUX15 as this is the 4m band (70Mhz) on Yaesu transceivers. AUX13 operates from 30 to 499Khz; AUX14 operates from 500Khx to 1.799 Mhx

Using the 16 pin terminal strip to drive antenna relays directly

6. Connect your antenna relay between the voltage output on the terminal strip (RLY +Vcc) and one of the band terminal outputs. Check that your antenna relay operates for all the bands selected using the internal matrix. Observe the maximum current for an external antenna relay is 350ma as determined by the internal re-settable fuses! **T**
7. Linking bands on the 16-pin terminal strip (not on the matrix) allows you to drive and group more than three bands by connecting the negative lead to multiple terminal points

8. Both the on-board relays, relay outputs, and 16-pin terminal strip are protected by diodes to quench any inductive fly-back voltage generated by the on-board or your antenna relays. It is good practice to fit an additional diode (1N4001) on your antenna relay terminals to quench any fly-back voltage at source.

Figure 1



Circuit description

The unit input employs four opto-isolators, one for each of the four bit inputs in addition to decoupling capacitors across the input logic and galvanic isolation to ensure the unit is resistant to radio frequency interference. The four-bit binary signals from an HF transceiver are initially isolated by IC1 and buffered by IC2. The four bits are subsequently decoded by IC3 & 4 which performs the binary to hexadecimal decoding. The decoded signals are buffered by IC5 & IC6 in order to drive relays for antenna switching at either the 16 pin terminal strip or by activation of one of the three on-board relays through the band matrix. Each output buffer provides an open collector output at each terminal capable of sinking a maximum 500mA at 28v but limited to 350mA by internal fuses.

Hex bits 13, 14 and 15 are presented on a single terminal and can be selected using a jumper on the PCB. The default position is AUX 15 which is the 4M (70) MHz band on Yaesu transceivers. AUX 14 is activated from 500khz to 1.799 Mhz. AUX 15 is activated from 30 to 499Khz

The power LED illuminates when 13.8v supply is present. Each of the band outputs has an LED to indicate which band has been selected. If the on-board relays are not required they can be de-activated and the 16 pin output terminal strip can be used to directly drive antenna relays using the product 13.8v or at any voltage applied to the separate relay supply input.

When the unit is not connected to the transceiver, or the transceiver is switched off all four logic bits on the input are inactive and are seen by the product as logic 0, the AUX0 LED illuminates to confirm this.

The on-board matrix enables the user to select one or a combination of bands to drive one of three on-board relays (A, B or C) or any combination of external antenna relays from the 16 pin terminal strip.

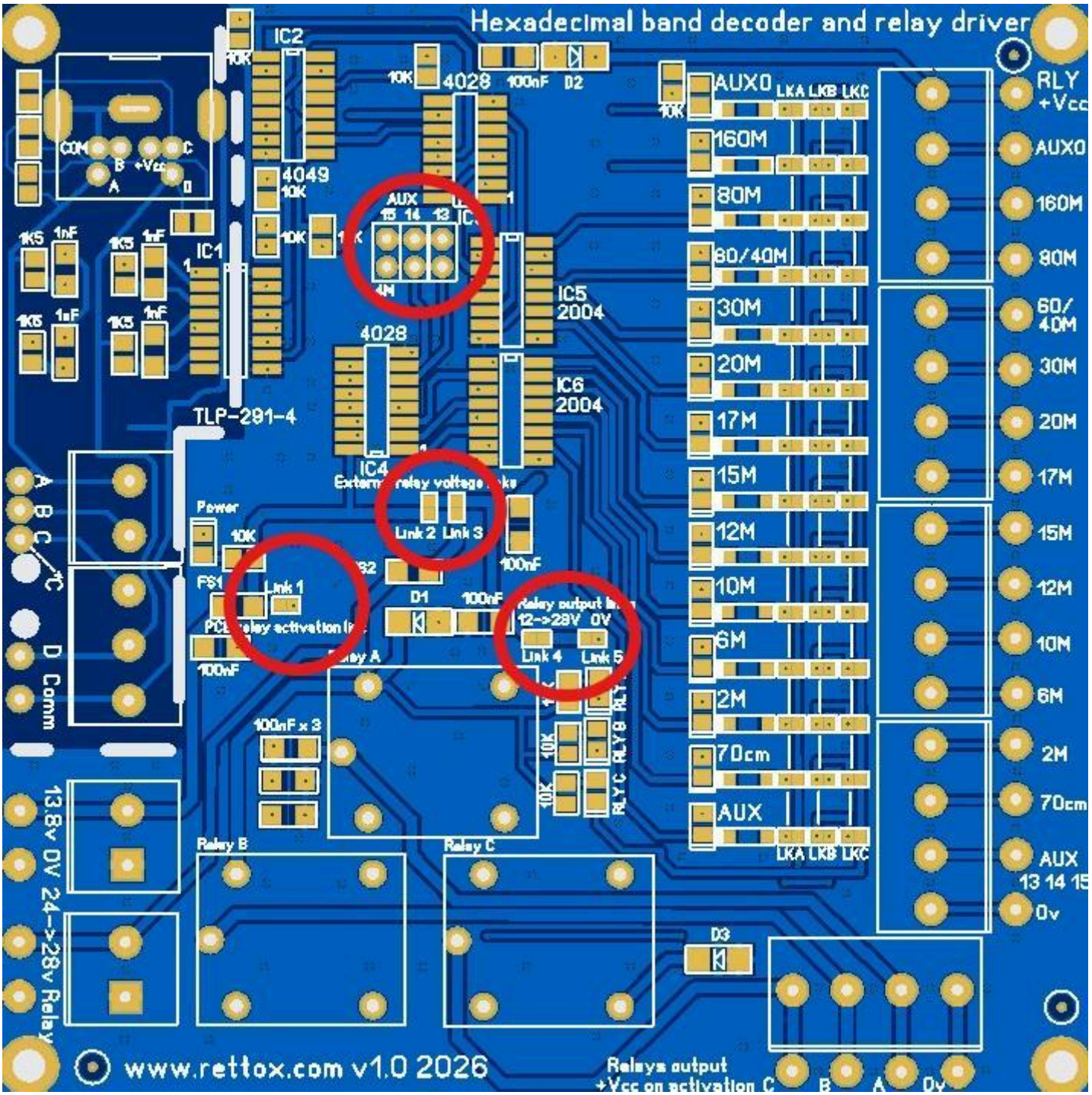
Operation of the on-board relays is indicated by the illumination of LEDs marked RLY A, RLY B and RLY C. Activation of an on-board relay will provide a voltage at the relay output terminals, enabling the user to activate up to three external antenna relays by connecting them between the 0v GND terminal and either terminal A, B, or C

N.B. Only one relay link may be activated on the band group matrix for each specific band! The three on-board relays can be associated with any combination of bands. In this way the relay outputs can be used to automatically activate an antenna relay for the specific combination of bands unique to your station.

If you connect two links on a specific band you will observe more than one of the internal relays operating at the same time, this is a fault condition and must be corrected. Visually inspect or use a multi-meter to test the on-board band group matrix and remove any unwanted links i.e. where more than one link is set for a specific band.

Figure 2

Link positions



The hexadecimal band schema

The four-bit band data output on Yaesu transceivers (called BCD) uses 5V TTL logic levels, where a logic "High" is approximately +5v and a logic "Low" is 0v. The 5v logic high is used to drive the LEDs within the opto-coupler. This product is not compatible with transceivers providing only open collector outputs however I have added the pads for four 10k pull up resistors and a voltage input. If requested I can supply an open collector input variant of this product.

When your transceiver is switched off or not connected to the product all four inputs will be interpreted by the unit as logic low so the AUX0 LED with be illuminated.

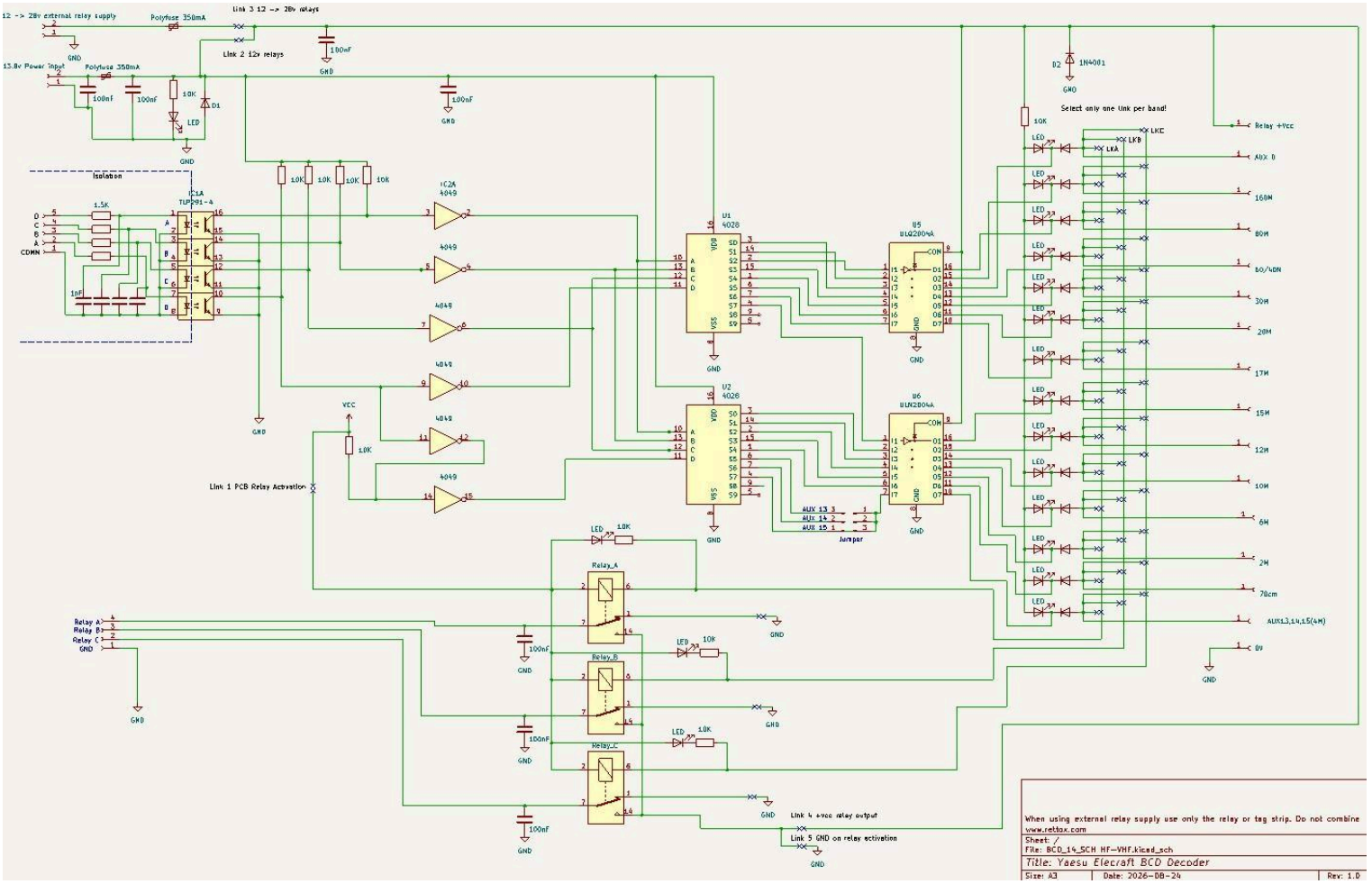
When your transceiver is powered on it will output four bits (Bit A is the least significant bit). The table below describes the schema used to map the logic to each band for this product. All low = 0 and all high = F

Band	Hex value	D	C	B	A
AUX0	0	Low	low	low	Low
160M	1	low	low	low	high
80M	2	low	low	high	Low
60/40M	3	low	low	high	high
30M	4	low	high	low	Low
20M	5	low	high	low	high
17M	6	low	high	high	Low
15M	7	low	high	high	high
12M	8	high	low	low	Low
10M	9	high	low	low	high
6M	A	high	low	high	Low
2M	B	high	low	high	High
70cm	C	high	high	low	Low
AUX13 30->499khz	D	high	high	low	High
AUX14 .5 –> 1.799Mhz	E	high	high	high	low
AUX 15 (4M)	F	high	high	high	high

N.B. there is an error in the FTX-1 User manual showing 70Cm and 30m using the same hex value. The correct values are shown in the above table.

Schematic

A full schematic is provided with the product.



All units are re-flow soldered and functionally tested to ensure they work correctly before dispatch.

Cable harnesses are available for connection to most Yaesu transceivers (FTdx-101, FTdx-10 and FTX-1, FT-991).

If you are interested in this project, or obtaining a unit for your station please contact me through my website at www.rettox.com.

73 Rex G8UBJ