Convert the TenTec Orion Individual Band Output Controls to BCD (or ICOM Band Voltage)

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Introduction

More ham stations are using automatic control for the selection of filters, antennas, feedlines, and automatic bandswitching of modern amplifiers and automatic antenna tuners. There have been a few standard interfaces adopted for automatic control, the most popular being the BCD (binary coded decimal) interface that is output by Yaesu (ABCD) and Elecraft (0123) transceivers. The BCD interface maps 160-6 meters sequentially as shown in Table 1:

Table 1 – BCD Interface

Band	BCD Code	Band	BCD Code
160M	0001	17M	0110
80M	0010	15M	0111
*60M	0000	12M	1000
40M	0011	10M	1001
30M	0100	6M	1010
20M	0101		

*60 meters is recognized as 0000 by several remote control devices.

TenTec Orion Interface Problem and Solution

The popular TenTec Orion I/II transceivers provide a band data interface consisting of open-collector outputs that saturate for each individual band. These outputs do not interface easily with many automatic band-switching amplifiers and autotuners. So how can we convert the Orion's individual active low band outputs to the more universal BCD interface?

This turns out to be a fairly easy task using the readily available 74HC147 10-to-4 line priority encoder. The 74HC147 accepts data from nine active low inputs (A0 to A8) and provides a 4-bit binary representation on the four active low outputs (Y0 to Y3). The BCD coding scheme requires the BCD outputs to be active high, so a separate inverter is necessary on the 74HC147 active low BCD outputs.

The 74HC147 decoding works perfectly with the individual low 160-10M band data outputs of the Orion, EXCEPT for 60 meters. I.e., there are only nine discrete inputs on the 74HC147, but there are 10 outputs from the Orion when using 60 meters. Additionally, the 60 meter output doesn't correspond with the normal BCD coding scheme. Because the 74HC147 provides the full 10-to-4 line encoding by forcing all four outputs high when all nine data inputs are high, we can recognize 60 meters without having to use the Orion 60 meter band data output. When 60 meters is selected, all other Orion band outputs are high. So if we simply ignore the 60 meter output, we can assume 60 meters is selected when all other outputs are high. Figure 1 shows a simplified block diagram of the solution, and Table 2 shows the logic table. Note that the 1Y/A output is the least significant bit, and 4Y/D is the most significant bit.

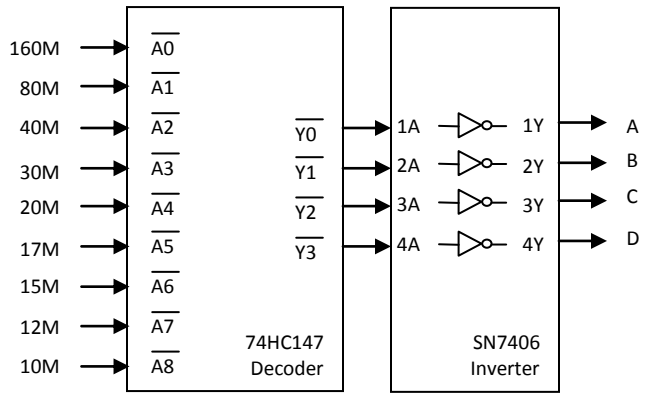

Figure 1: Orion-to-BCD Simplified Block Diagram

Table 2 – Logic states		74HC147	Inverter
Band	Orion Band Output	Y0-3 Output	ABCD Output
160M	0 1 *1 1 1 1 1 1 1 1	0 1 1 1	1 0 0 0
80M	1 0 *1 1 1 1 1 1 1 1	1 0 1 1	0 1 0 0
60M	1 1 *0 1 1 1 1 1 1 1	1 1 1 1	0 0 0 0
40M	1 1 *1 0 1 1 1 1 1 1	0 0 1 1	1 1 0 0
30M	1 1 *1 1 0 1 1 1 1 1	1 1 0 1	0 0 1 0
20M	1 1 *1 1 1 0 1 1 1 1	0 1 0 1	1 0 1 0
17M	1 1 *1 1 1 1 0 1 1 1	1 0 0 1	0 1 1 0
15M	1 1 *1 1 1 1 1 0 1 1	0 0 0 1	1 1 1 0
12M	1 1 *1 1 1 1 1 1 0 1	1 1 1 0	0 0 0 1
10M	1 1 *1 1 1 1 1 1 1 0	0 1 1 0	1 0 0 1

*The 60 meter Orion band output is not used, but is inferred from the non-selection of other bands.

Figure 2 is the schematic of the full implementation of the Orion-to-BCD interface. The inverted 74HC147 encoder outputs are fed to a SN7406 hex inverter whose open collector outputs have pull-up resistors connected to 5VDC. Table 3 is the parts list. Most of the parts come from Mouser Electronics (www.mouser.com). The exceptions are the in/out cables and perf-board which came from All Electronics (www.allelectronics.com).

Table 3: Orion/BCD Band Data components

	Description	Mouser Part Number
U1	74HC147	771-74HC147N
U2	SN7406	595-SN7406NE4
U3	78L05 voltage regulator	512-LM78L05ACZXA
R1-R9	4.7KΩ ¼-watt resistor	660-MF1/4LCT52R472G
R10-R14	2.2KΩ ¼-watt resistor	660-MF1/4LCT52R222G
C1,C2	0.1uf disk capacitor	81-RPER71H104K2P1A03
C3	4.7uf electrolytic capacitor	667-EEA-GA1H4R7
C4-C7	0.01uf disk capacitor	581-SR215C103K

Qty 1	AMP Plug Housing	571-16405230
Qty 1	Strain Relief	571-3505231
Qty 10	Female pins	571-7940011
Qty 1	16 pin IC socket	517-4816-3004-CP
Qty 1	14 pin IC socket	517-4814-3004-CP
Qty 1	Plastic Box (3.2x1.6x0.8”)	546-1551KGY
Qty 1	¼” grommet	534-739
Qty 1	3/16” grommet	534-731
Qty 1	Perf-board (cut to size)	All Electronics PC-3
1ft	10-conductor shielded cable	All Electronics 10CS22
5ft	5-conductor shielded cable	All Electronics 5CS22

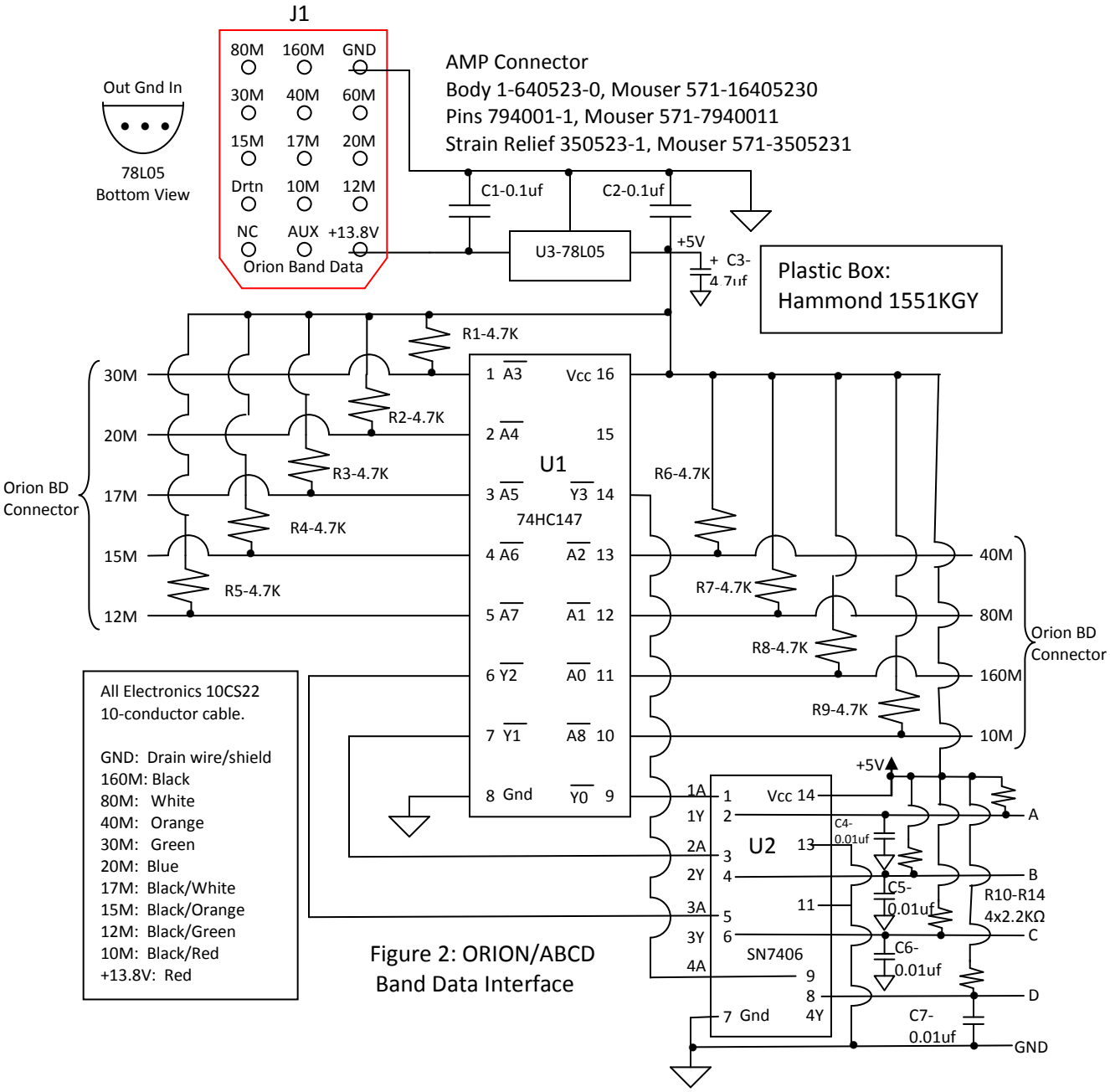

Figure 2: ORION/ABCD
Band Data Interface

All circuitry is built on a 1.3" x 2.4" piece of perf-board. This provides the necessary room for the components, and fits nicely into the small plastic box called out in the parts list. Most of the resistors and capacitors are mounted vertically to save room. Slide grommets onto the input and output cables before stripping the cables. Then nibble 0.3"-wide slots in the plastic box with a nibbling tool so the input/output cable grommets can be slipped in-place. Figure 3 shows the slotted plastic box, Figure 4 shows the perf-board with all components mounted, and Figure 5 shows the completed assembly. When finished, add a few blobs of hot glue to hold the perf-board firmly in place. A little hot-glue on the inside of the grommets will also provide cable strain relief.

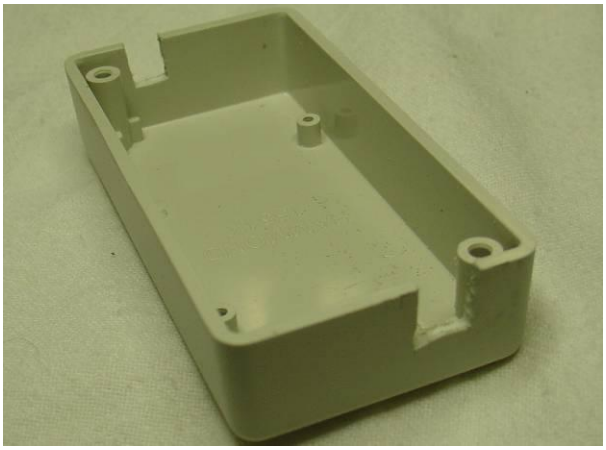

Figure 3: Slotted box

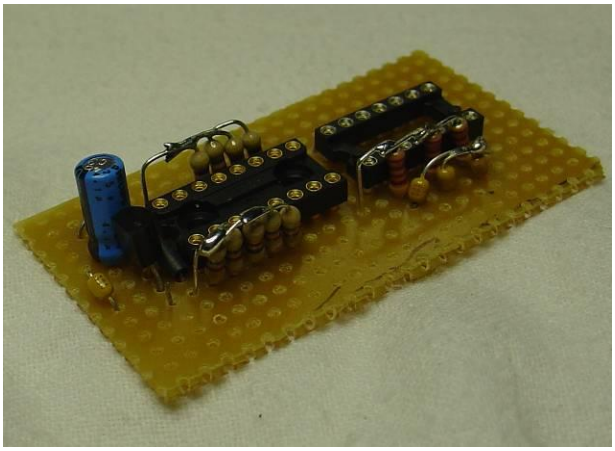

Figure 4: Components mounted on perf-board

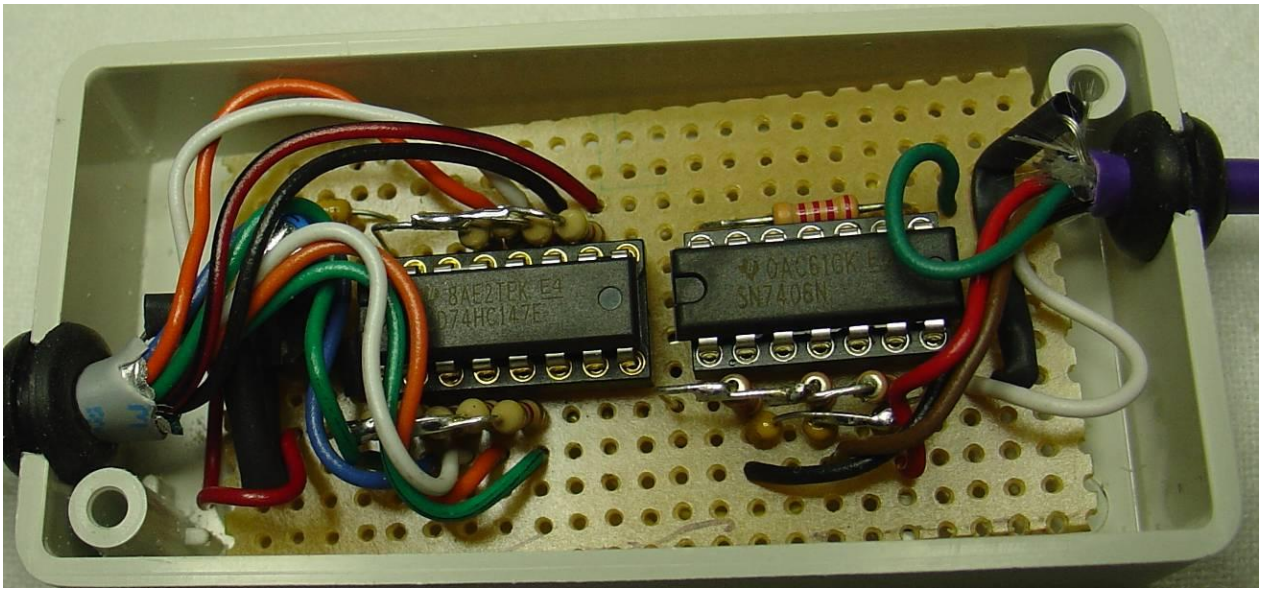

Figure 5: Final completed assembly ready to be hot-glued in place. Note the I/O grommets.

Operation is easy. Simply connect the interface between your ORION and your BCD-controlled accessory. Figures 6-9 show the connector interfaces for popular solid-state amplifiers (Tokyo Hi-Power HL1.5 and HL2.5, Elecraft KPA500, and the Ameritron ARI-500 used with the ALS-500/600/1300 amplifiers).

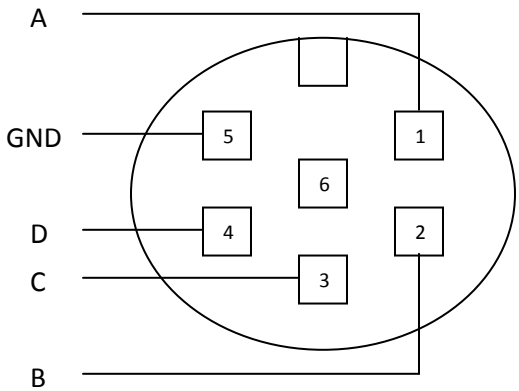

Figure 6: THP HL-1.5KFx Band Data, DIN6P or DIN5P/240 deg. Solder-pin view

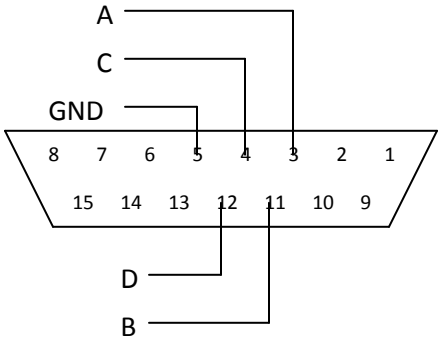

Figure 7: THP HL-2.5KFx Band Data, DB15P. Solder-pin view

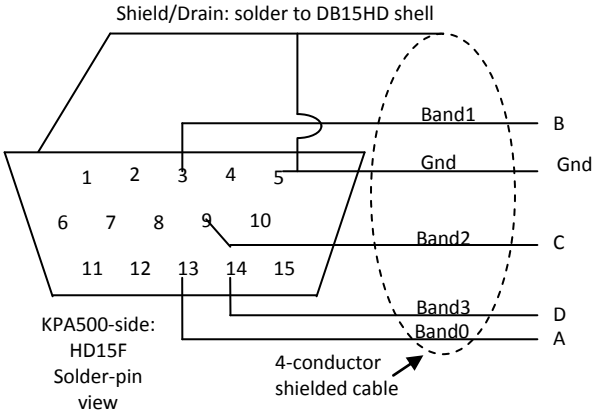

Figure 8: Elecraft KPA500, DB15HD Female. Solder pin view.

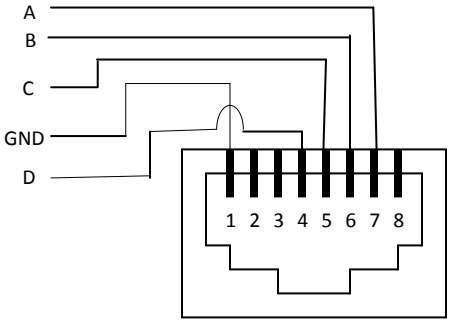

Figure 9: Ameritron ARI-500, RJ45

ICOM amplifier interface

The BCD interface works well for interfacing the Orion with most auto band-switching amplifiers. However, if you have an ICOM amplifier (such as a PW1) you need either ICOM band voltage or CI-V. The ICOM band voltage interface is easy to implement. The schematic is shown in Figure 10. The disadvantage of this interface is that 15- and 17-meters are decoded as the same band, as are 12- and 10-meters. And 60-meters is not supported. There are no photos of this interface as I only bread-boarded the circuitry to verify that the band voltages were correct (I don't have an ICOM solid-state amplifier).

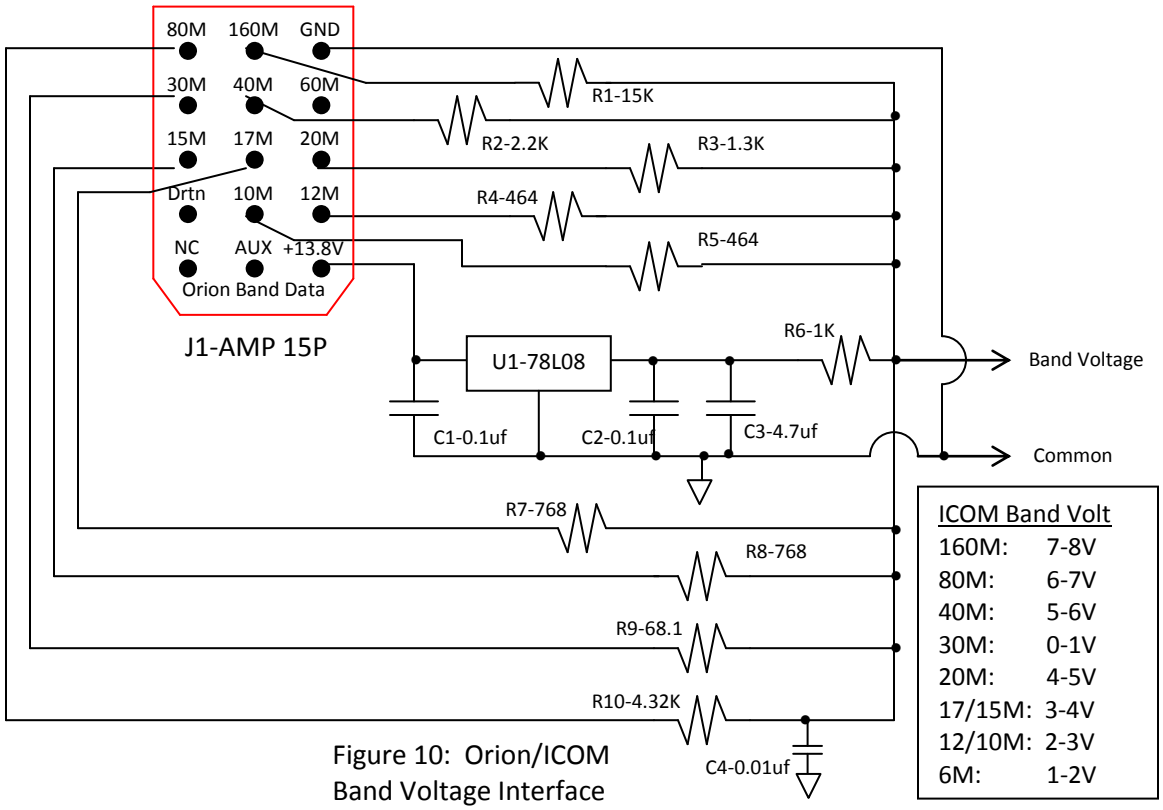

Figure 10: Orion/ICOM Band Voltage Interface

	Description	Mouser Part Number
U1	78L08 voltage regulator	512-MC78L08ACP
R1	15KΩ ¼-watt resistor	271-15K-RC
R2	3.3KΩ ¼-watt resistor	271-3.3K-RC
R3	1.3KΩ ¼-watt resistor	660-MF1/4DCT52R1301F
R4, R5	464Ω ¼-watt resistor	271-464-RC
R6	1KΩ ¼-watt resistor	660-MF1/4DCT52A1001F
R7, R8	768Ω ¼-watt resistor	660-MF1/4DCT52R7680F
R9	68.1Ω ¼-watt resistor	660-MF1/4DCT52R68R1F
R10	4.32KΩ ¼-watt resistor	660-MF1/4DC4321F
C1,C2	0.1uf disk capacitor	81-RPER71H104K2P1A03
C3	4.7uf electrolytic capacitor	667-EEA-GA1H4R7
C4	0.01uf disk capacitor	581-SR215C103K
Qty 1	Plastic Box	546-1551KGY
Qty 1	AMP Plug Housing	571-16405230
Qty 1	Strain Relief	571-3505231
Qty 10	Female pins	571-7940011
1ft	10-conductor shielded cable	All Electronics 10CS22

Conclusion

The above article describes a standard BCD band data or ICOM band voltage interface for TenTec Orion I/II transceivers. The BCD interface is the most usefull, but the band voltage interface may be necessary if you have an ICOM solid-state amplifier.