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Dear Jay:

Dale just reminded me that I had promised you some information regarding use of the ST-6 with RS-232 interfaces. Sorry - it had slipped my mind (getting gray like my hair, I guess).

Enclosed are manuals for the ST-6, ST-5000, and ST-6000 for your library. The ST-6 and ST-5000 are both discontinued products - manuals (and everything else) are in short supply. Basically all three products are directly "compatible" with RS-232 data with no more than a couple of cuts and jumpers. In order:

ST-6: The most common version that we sold included the XTK-100 crystal AFSK oscillator board; very early ST-6's had the AK-1 board. Connections to the XTK-100 and AK-1 are identical; either plugs into slot 1 of the HAL ST-6 cabinet. The ST-6 was also sold as parts kits, with and without cabinets; some even without HAL boards. I must restrict my comments to ST-6's that used HAL boards and the HAL cabinet.

RS-232 RXD (Receive Data) Output:

Ref: ST-6 Manual, Page 29, Figure 7 (Circuit Board 5). Note pin "B" on circuit board 5. This is a voltage divider output from the loop supply. It also provides an "RS-232 compatible" receive data output. To understand how it works, note that the loop keying transistor Q301 (Figure 6, board #3) connects through the loop connector (J12) and meter switch (S9) to the plus output of the loop power supply (board #5, pin "C"). Received MARK data keys the loop supply plus terminal to ground. Note also that the minus terminal of the loop supply (board #5, pin "F") returns to ground through the loop current resistor R9. Therefore, when received data is MARK, the loop plus terminal is grounded and there is about -150 volts DC at the loop minus terminal (pin "F"). The dual divider of R502/R504 and then R503/R505 lowers this to about -15 VDC (4.7K load). When SPACE is received, the keyer transistor is open, no loop current flows through R9, and pin "C" goes up to +150 VDC above ground. Again, this is divided by the resistors to give about +15 volts DC at pin "B". So, board #5, pin "B" produces an "RS-232 compatible" RXD output - with a qualification. You need to be sure that you have a 4.7K load between pin "B" and ground.

Note that board #5 pin "B" connects via a wire to rear panel connector J11, pin 3 - labeled "FSK". This connection therefore is an RS-232 compatible RXD output.

#### TXD (Transmit Data) Output:

Note that pin "B" of board #5 also connects to pin #6 of the AFSK card (AK-1 or XTK-100). This is the transmit data input to the AFSK oscillator. Also note that the normal loop connection to the ST-6 was to wire the teleprinter keyboard and printer in series and connect them between pins 1 and 4 of J12 (Figure 6). Therefore, typing on the keyboard also interrupts the loop current and the voltage at board #5 pin "B" acts just like it did on receive - and drives the TXD input to the AFSK oscillator. This was great for simple loop circuits but needs a change to work with computers - you need to be able to drive the AFSK oscillator separate from the receive circuits. This requires a simple modification.

Also note that for some weird and wonderful reason, Irv Hoff had us short the "FSK" line to ground when ST-6 AC Power was turned OFF (S7B, Figure 7). This is a dubious feature that I recommend be removed!

**CAUTION:** The fold-out drawing in the ST-6 manual represents just one of quite a few wiring harnesses that have been used on the ST-6; HAL had 3 different harnesses I know of, and many kit builders "rolled their own". Wire colors on this drawing are also not necessarily what you will find inside. For this reason, I will make references to the schematics only and you may need to do some wire tracing on your own ST-6.

#### ST-6 Modification to separate RXD and TXD for RS-232:

1. Disconnect the wire between S7B and board 5 pin "B".
2. Disconnect the wire between pin 6 of the AFSK connector and board #5 pin "B".
3. Disconnect both wires between the rear panel "CW SHIFT" pot and connector J11. This pot will no longer be used.
4. Use an ohm-meter to confirm that there is still a wire connection between board #5 pin "B" and connector J11, pin 3.
5. Add a 4.7K, 1/2 Watt resistor between J11 pin 3 and ground (terminal strip "I", pin 3 on HAL-wired cabinets).
6. Add a new wire between pin 6 of the AFSK board connector and pin 1 of connector J11.
7. Be sure that you plug-in either a loop machine or a wire jumper between pins 1 and 4 of connector J12.

RS-232 RXD output is now on J11 pin 3; RS-232 TXD input is now on J11 pin 1; ground is on pin 2.

This is the minimum change to operate full-duplex (FDX) RS-232 data I/O with the ST-6. The only change in operation is that the AFSK oscillator tones will no longer echo received data.

One "added feature" that some may wish to consider is RS-232 control of the ST-6 autostart feature. When the "REMOTE" input (J11, pin 6) is grounded, the RXD loop keyer transistor (Q307) is locked in MARK-hold and the motor relay is turned ON. This feature may not even be needed for computer connection, but some folks like to use the RS-232 RTS (Request To Send) signal to control transmit/receive. Unfortunately, RTS is +V for "transmit" and -V to "receive". So, you will have add an NPN switch transistor to control the ST-6 "Remote" input. Connect as follows:

1. NPN transistor = MPS3395/2N2222/etc.
2. Ground the emitter
3. RS-232 RTS signal through 10K, 1/4W resistor to base
4. 1N4148 diode anode to ground, cathode to NPN base
4. NPN collector to ST-6 "Remote".

Well, that took lots of words, but is very simple to do.

#### ST-5000:

ST-5000 circuitry is very similar to that of the ST-6, especially the loop supply and keying circuits. Two versions of the ST-5000 were produced - one in a blue cabinet and later versions in a brown cabinet. The brown cabinet versions added an RS-232 input/output connector that does just what I explained for the ST-6 above. These changes are apparent if you look at the obvious revision to ST-5000 schematic A1242A (coordinates C-1). "Blue cabinet" ST-5000's can be converted by just following the schematic. Like the ST-6, the ST-5000 has a "Remote" TX/RX control input which should be grounded for TX. The same NPN transistor addition will work on the ST-5000 for RS-232 RTS control.

#### ST-6000:

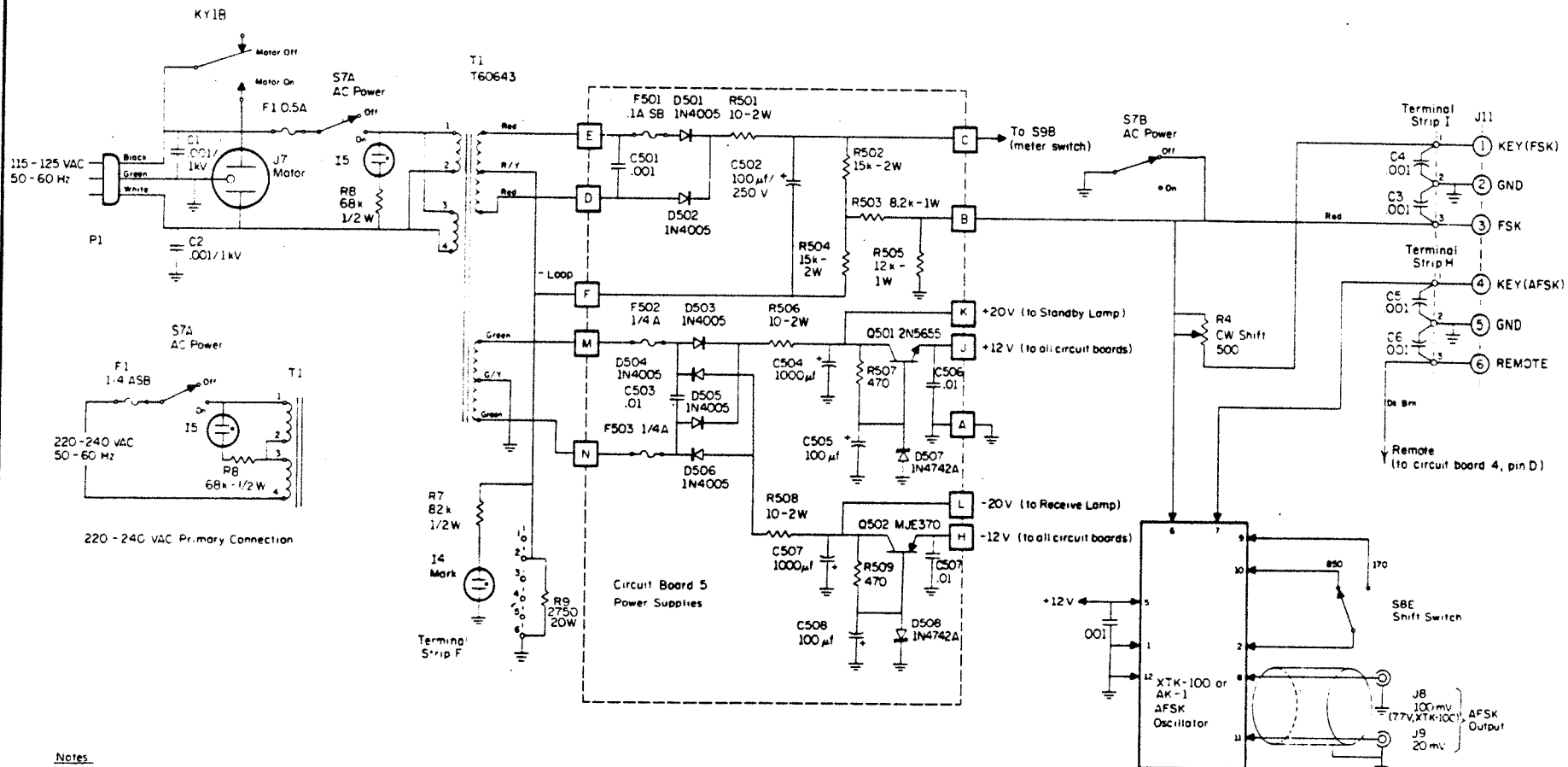
The ST-6000 goes the other way - it has so many different ways to run RS-232 I/O that it can be confusing! I suggest that you use Figure 3.6 (page 3-13) as a starting point. I usually end up studying Figure 5.1 (page 5-14) as it gives the best picture of all the I/O connections and interactions. "KOS IN" (J6 pin 3) can be used to drive the internal ST-6000 TX/RX circuit but it is again an input that GND = TX; the RTS NPN transistor described for the ST-6 will also work here. An extra "AUX JUMPER PLUG" is enclosed for your use - handy for playing with different I/O configurations.

Jay, I hope this helps - more than you wanted to know, no doubt!

73,



Bill Henry



**Notes**

1. All resistors 1/4 W unless otherwise noted.
2. Resistor R9 dissipates 9.9 Watts under Mark conditions and should have adequate ventilation.
3. I-3, I-4, & I-5 are NE-2 type neon lamps.
4. Component Numbering System:  
X001 - X099, Main Frame  
X501 - X599, Circuit Board 5

Rev A: Dec 26, 1974  
Rev B: Jul 11, 1975

		<b>COMMUNICATIONS CORP.</b> BOX 365, URBANA ILLINOIS, 61801	
		ST-6 Demodulator Circuit Board 5	
DATE	July 8, 1972	SCALE	
APPROVED		No.	A919B

Figure 7. ST-6 Circuit Board 5