Required Equipment
- EDI Board
- Test Cables
  - J1: Male 26 Pin Connector with 3 wires
    - Red in pin 1 (other end is banana clip)
    - White in pin 10 (other end is banana clip)
    - Black in pin 19 (other end is banana clip)
  - J2: Male 44 Pin Connector with 8 wires
    - Blue in pins 1, 16 (other ends are open wires)
    - Green in pins 2, 17 (other ends are open wires)
    - Purple in pins 3, 18 (other ends are open wires)
    - Red in pin 31 (other end is banana clip)
    - Black in pin 32 (other end is banana clip)
- Static mat with grounding strap
- Wrist grounding strap
- 4 power supplies (at least two with current limiting capability for the CTSPS and VTSPS)
- 3 multimeters capable of making high precision volt measurements
  - One is for diagnostics, in case voltages need to be tested on the fly.
- Alligator and banana clip wires
- Small jewelers flathead screwdriver
- Interface Breadboard with the proper circuitry (I do not have a copy of the schematic diagram of the breadboard as I create this document)
- Big rainbow ribbon cable from EDI to IB
- Resistors: one each of 10 and 1000 ohm (for voltage divider)
- Data sheet: for recording the results of the functional test and the calibrations scale factors.

Symbols
- Question marks signify steps for which I do not have instructions or schematic diagrams.
- Blue boxes signify steps for which you have to check or redo the Test Source Power Supply circuitry to the J1 or J2 test dangles.
Green boxes signify the beginning of a set of steps that will later be repeated.

Red boxes signify the end of a set of steps that will later be repeated

Exclamation points signify steps for which you need to record a value or observation on the data sheet.

**Important**—I do not have the know-how to trouble shoot the EDI board. If a problem with the EDI board is diagnosed or found, you need to ask David McGaw to investigate and fix if possible.

**Procedure**

1. Review this procedure and become familiar with the purpose of this test, the logic conventions for each switch, and the nuances of the way the IB lights work.
2. Put on your grounding wrist strap as soon as the static mat is properly set up and grounded.
3. Setup the Test Jig (everything except the EDI board) on the static mat without turning anything on. There is no schematic diagram for the IB or the big rainbow ribbon cable from the EDI to the IB, but as long as nothing happens to the version of these that are already in place, we’ll be fine. Follow the schematics for connecting the EDI Power Supplies to the EDI and the Test Source Power Supplies to the J1 and J2 test dangles.
   i. See Photos 1, 5, 6, and 9
4. Set up the IB by insuring the switches are set as:
   i. BAS=0030
   ii. CS=all up, except right-most bit (bit 0, labeled as switch 1) is down
      1. i.e. IAES=up/off
      2. i.e. RS=up/off
      3. Note: The only two bits on the CS that will be changed during this are the IAES and RS.
   iii. WS=down/off
   iv. IAS=00
5. Without connecting the EDI board to anything, turn on the EDI Power Supplies and insure with a multimeter that the voltages they supply are correct.
   i. At this time, the wires on the big rainbow ribbon cable need to be wired as:
      1. Red = +5V
      2. Green = ground
      3. Black = -5V
   ii. To make it consistent with the normal scheme for the rest of the payload, David McGaw may at some point change the wiring to be:
      1. Red = +5V
      2. Black = ground
      3. Green = -5V

6. Turn off EDI Power Supplies.

7. Without the J1 or J2 test dangles being connected to the EDI, set up the Test Source Power Supplies and insure they are providing the proper CTSPSV and VTSPSV required.
   i. Note that the CTSPSV will always be set to 50.00 mV.
      1. Use a voltage divider as shown in the schematics.
   ii. Note that you can set the VTSPSV to 10.000V since that is the first HSV that we will be testing.
   iii. Note also that changing the VTSPSV will cause the CTSPSV to change as well. This is just important to be aware of.
   iv. IMPORTANT: Current limit each Test Source Power Supply to 10 mA.

8. Connect the J1 test dangle into the Test Source Power Supplies:
   i. White = plus of VTSPS
   ii. Black = minus of VTSPS
   iii. Red = plus of CTSPS

9. Turn off the Test Source Power Supplies.

10. Prepare the EDI board to be tested. Place EDI on static mat. Do not plug anything in. Insure jumper shorts are placed on slots 3, 6, 7, 8, 9, 10. This correctly sets the “address select” for the EDI board.
   i. See Photo 2

11. Connect the EDI to the test jig by plugging the big rainbow ribbon cable into the EDI.
12. Turn on the EDI Power Supplies.
13. Turn on power to the IB.
14. Check that the currents on the EDI Power Supplies are nominal
   i. ~30 mA on the +5V
   ii. ~0 mA on the -5V
15. If this is the first time the EDI board has been turned on or used, its programmable logic chip needs to be programmed. Use a PC computer and use the Lattice ISP interface. David McGaw knows how to do this, I do not know the details here.
16. Check that the currents on the EDI Power Supplies are nominal
   i. ~20 mA on the +5V
   ii. ~0 mA on the -5V
17. Turn on the Test Source Power Supplies.
18. VTSPSV = 10.000 V (use high resolution multimeter)
   i. Note that this is because the first HSV (V₀) is 10 V
19. CTSPSV = 50.00 mV (use high resolution multimeter)
   i. Note that this is because the first (and all) HSV for the currents is 50.00 mV.
20. BAS=0030
   i. Note that this allows us to access the input address on the EDI
21. IAS=00
   i. Note that this is because we are first testing V₀, which has the Input Address of “00”.
22. IAES=down/on
   i. Note that this enables us to write the IAS to the EDI.
23. Verify that the right-most 8 IB Lights display the IAS address correctly.
   i. Note: in this case, all the lights will be off.
24. WS=up/on
25. WS=down/off (just flick the WS on then off)
26. IAES=up/off
27. RS=down/on
28. Verify that the right-most 8 IB Lights display the IAS address that was just written to the EDI.
   i. Note: in this case, all the lights will be off.
29. RS=up/off
30. BAS=0031
   i. Note that this allows us to access the ADC data
31. RS=down/on
   i. Note that this displays the most recent ADC data for the Input Address you have selected.
32. WS=up/on
   i. Note that the ADC is now running continually, and the lights will flicker in real time as the ADC outputs different values. Changing the VTSPSV will cause the digital output, and hence the lights, to change. Also the small amount of noise in the signal causes the very fast fluctuations of small magnitude in the digital output.
33. Verify that the IB Lights are NOT lighting up.
   i. The J1 test dangle is not plugged in, so no lights should be lit up. If lights light up, there is a problem.
   ii. If a few right-most lights light up, that can be okay, as long as it just looks like noise, and not a problem with the circuitry on the EDI.
      o Plug in the J1 test dangle exactly as in Photo 7, with the test voltage leads plugging into the furthest-right holes in the EDI (so that the J1 test dangle frame lines up exactly with the EDI pin-out frame.)
   iii. Now the IB lights should be on and displaying the ADC output.
34. THIS STEP WILL ONLY BE DONE ONCE PER EDI BOARD.
   i. Verify the VTSPSV is exactly 10.000 V with the high resolution multimeter
   ii. With the small screwdriver, gently twist the lead on the potentiometer on the EDI board so that the IB lights display HSV.
   iii. The EDI board is now calibrated. Do not touch the potentiometer again.
35. Record the VTSPSV HSV value for \( V_0 \) (10.000 V) on the data sheet.
36. WS=down/off
37. RS=up/off
38. BAS=0030
39. IAS=10
   i. Note that now we’ll be testing the \( I_0 \) input.
40. IAES=down/on
41. Verify that the right-most 8 IB Lights display the IAS address correctly.
42. WS=up/on
43. WS=down/off
44. IAES=up/off
45. RS=down/on
46. Verify that the right-most 8 IB Lights display the IAS address that was just written to the EDI.
47. RS=up/off
48. BAS=0031
49. RS=down/on
50. WS=up/on
51. Adjust the CTSPSV to display HSV on the IB Lights
52. Record the CTSPSV HSV value for $I_0$ on the data sheet, use the reading off of the multimeter for the CTSPSV.
53. WS=down/off
54. RS=up/off
55. You have now verified and calibrated $V_0$ and $I_0$. Now we move on to $V_1$ and $I_1$. This next part will be quite similar to steps 18-57, and I will now only refer to switches as being on or off.
56. BAS=0030
57. IAS=01
58. IAES=on
59. Verify the lights correctly display the IAS
60. WS=on then off
61. IAES=off
62. RS=on
63. Verify the lights correctly display what was just written
64. RS=off
65. BAS=0031
66. RS=on
67. WS=on
68. Verify the lights are all off, (except maybe a few of the right-most bits) since J1 test dangle is not plugged in to the correct location. If lights are on, there is a problem.
69. Change the VTSPSV if necessary
   i. Check to see what the next FSV is for the next voltage input.
   ii. Pull the J1 test dangle out of the EDI.
iii. Adjust the VTSPSV to roughly the HSV for the next voltage input.
70. Carefully plug the J1 test dangle into the next input on the EDI.
   i. Move the test dangle over one column of pins from the previous placement, as demonstrated in Photos 7 and 8.
   ii. The IB lights should be lit, now.
71. Adjust the VTSPSV so the lights read HSV.
72. Record the VTSPSV HSV reading off the high resolution multimeter on the data sheet.
73. WS=off
74. RS=off
75. BAS=0030
76. IAS=11
77. IAES=on
78. Verify the lights correctly display the IAS
79. WS=on then off
80. IAES=off
81. RS=on
82. Verify the lights correctly display what was just written
83. RS=off
84. BAS=0031
85. RS=on
86. WS=on
87. Adjust the CTSPSV so the lights display HSV
88. Record the CTSPSV HSV reading off the high resolution multimeter on the data sheet. Make sure to get 4 sig figs.
   Depending on the multimeter, you may need to bring the CTSPSV way down, let the multimeter readjust to get a high resolution reading, and then bring CTSPSV back up to ~50 mV.
89. WS=off
90. RS=off
91. Repeat steps 57 through 91 for V_2 and I_2 through V_5 and I_5.
   i. Adjust steps 58 and 77 accordingly
      1. V_2 and I_2: IAS=02 and IAS=12
      2. V_3 and I_3: IAS=03 and IAS=13
      3. V_4 and I_4: IAS=04 and IAS=14
      4. V_5 and I_5: IAS=05 and IAS=15
ii. Be very careful not to put an out of range voltage into any input!

92. Remove the J1 test dangle from the EDI.

93. Turn off the CTSPS and the VTSPS and rewire the Test Source Power Supplies to J1 test dangle circuit for V₆ and I₆ and V₇ and I₇ inputs following the schematics provided.

94. Reconnect the J1 test dangle to the Test Source Power Supplies but do not plug into EDI.

95. Turn on the CTSPS and VTSPS and set roughly to the next HSVs.

96. Repeat steps 57 through 91 for V₆ and I₆ and V₇ and I₇.
   i. Adjust steps 58 and 77 accordingly
      1. V₆ and I₆: IAS=06 and IAS=16
      2. V₇ and I₇: IAS=07 and IAS=17
   ii. Be very careful not to put the J1 connector into the wrong input on the EDI!

97. Remove the J1 test dangle from the EDI.

98. Turn the CTSPS and the corresponding multimeter off. You will not need them again.

99. Turn off the VTSPS and rewire the VTSPS to J2 test dangle circuit for V₈ through V₁₁ following the schematics provided.
   i. You’ll be using the red and black wires at this point.

100. Connect the J2 test dangle to the VTSPS circuit, but do not plug it into the EDI.

101. Turn on the VTSPS and set to roughly the next HSV.

102. BAS=0030

103. IAS=08

104. IAES=on

105. Verify the lights correctly display the IAS

106. WS=on then off

107. IAES=off

108. RS=on

109. Verify the lights correctly display what was just written

110. RS=off

111. BAS=0031

112. RS=on

113. WS=on
114. Verify the lights are all off, (except maybe a few of the right-most bits) since the J2 test dangle is not plugged into to the correct location (if plugged in at all). If lights are on, there is a problem.

115. Change the VTSPSV if necessary
   i. Check to see what the next FSV is for the next voltage input.
   ii. Pull the J2 test dangle out of the EDI (if it was in)
   iii. Adjust the VTSPSV to the HSV for the next voltage input.

116. Carefully plug the J2 test dangle into the appropriate input on the EDI.
   i. For $V_8$, it’ll be exactly as in Photo 10, with the test voltage leads plugging into the furthest-right holes in the EDI (so that the test dangle frame lines up exactly with the EDI pin-out frame.)
   ii. For subsequent inputs, move the J2 test dangle over TWO columns each time, as in Photos 10 and 11.
   iii. The IB Lights should be lit, now.

117. Adjust the VTSPSV so the lights read HSV.

118. Record the VTSPSV HSV reading off the high resolution multimeter on the data sheet.

119. WS=off

120. RS=off

121. Repeat steps 102 through 120 for $V_9$ through $V_{11}$.
   i. Adjust step 103 accordingly
      1. $V_9$: IAS=09
      2. $V_{10}$: IAS=0a
      3. $V_{11}$: IAS=0b
   ii. Be very careful not to put the J2 connector into the wrong input on the EDI!

122. Now we move on to testing the $T_0$ through $T_{15}$ inputs, still using the J2 test dangle, but now utilizing the green, purple, and blue wires.
   i. Important: Note that on the J2 test dangle, there are two rows of blue/green/purple wires. For $T_0$ through $T_7$ use the top row and for $T_8$ through $T_{15}$ use the middle row. See Photo 9.

123. Unplug the J2 test dangle from the EDI.

124. Turn off the VTSPS and rewire the VTSPS to J2 test dangle circuit for $T_0$ through $T_6$ following the schematics provided.
i. Be sure to wire in the blue and green wires from the top row of the J2 test dangle, not from the middle row.

125. Connect the J2 test dangle to the VTSPS circuit, but do NOT plug into EDI.

126. Turn on the VTSPS and set to roughly the next HSV: 2.500 V.
   i. Note that all the rest of the HSVs will be 2.500 V.
   ii. However, now we should have a pull-up on each input $T_0$ through $T_{12}$. We will have to check and verify the pull-up now, including that the pull-up is not present for $T_{13}$ through $T_{15}$.

127. BAS=0030
128. IAS=20
129. IAES=on
130. Verify the lights correctly display the IAS
131. WS=on then off
132. IAES=off
133. RS=on
134. Verify the lights correctly display what was just written
135. RS=off
136. BAS=0031
137. RS=on
138. WS=on
139. Verify all the lights display FSV. All of the left-most lights should be lit. This shows the pull-up of 5 V. If the lights are not all lit up, there is a problem.

140. Record whether or not there was a pull-up for the given input.
141. Insure the VTSPSV is still roughly 2.500 V.
142. Carefully plug the J2 test dangle into the appropriate input on the EDI.
   i. For $T_0$, it’ll be exactly as in Photo 10, with the test voltage leads plugging into the furthest-right holes in the EDI (so that the test dangle frame lines up exactly with the EDI pin-out frame.)
   ii. For subsequent inputs, move the J2 test dangle over TWO columns each time, as in Photos 10 and 11.
143. The IB Lights should be lit to show roughly HSV, now.
144. Adjust the VTSPSV so the lights read HSV.
145. Record the VTSPSV HSV reading off the high resolution multimeter on the data sheet.
146. WS=off
147. RS=off
148. Repeat steps 127 through 147 for T₁ through T₆.
   i. Adjust step 128 accordingly
      1. T₁: IAS=21
      2. T₂: IAS=22
      3. T₃: IAS=23
      4. T₄: IAS=24
      5. T₅: IAS=25
      6. T₆: IAS=26

149. Rewire the VTSPS to J2 test dangle circuit for the T₇ input following the schematics provided.
   i. Disconnect the blue wire of the non-EDI end of the J2 test dangle from the VTSPS and connect in its place the purple wire from the J2 test dangle.
   ii. Leave the J2 test dangle plugged into the EDI exactly as it was for measuring T₆.

150. Repeat steps 127 through 147 for T₇, with these changes:
   i. Step 128: IAS=27
   ii. Skip step 139 through 142.
   iii. After step 145, unplug the J2 test dangle from the EDI.
   iv. Now go back and perform steps 139 and 140.
   v. Leave the J2 test dangle unplugged.

151. Rewire the VTSPS to J2 test dangle circuit for the T₈ through T₁₄ inputs, following the schematics provided.
   i. Be sure to wire in the blue and green wires from the middle row of the J2 test dangle, not the top row.

152. Connect the J2 test dangle to the VTSPS circuit, but do NOT plug into the EDI.

153. Insure the VTSPSV is roughly the HSV: 2.500 V.

154. Repeat steps 127 through 150 for T₈ through T₁₅.
   i. Everything is exactly the same except you are now using the middle row on the J2 test dangle instead of the top row.
   ii. Note: Adjust step 128 accordingly
      1. T₈: IAS=30
      2. T₉: IAS=31
      3. T₁₀: IAS=32
      4. T₁₁: IAS=33
      5. T₁₂: IAS=34
6. $T_{13}$: IAS=35
7. $T_{14}$: IAS=36
8. $T_{15}$: IAS=37

iii. No pull-up is expected for $T_{13}$ through $T_{15}$, but for all values, record whether or not there is a pull-up.

155. Power off the VTSPS, then the IB, then the EDI power supplies, and then the multimeter.

156. Scan the data sheet and print a copy. The copy stays with the EDI board, and the original stays at Dartmouth(?) . The scanned copy can be uploaded to a BARREL website.

157. You are now done testing the EDI. If it had no problems, it is fully functional! Congratulations! If it had issues, seek out David McGaw for assistance.
**Acronyms**

- ADC—Analog to Digital Converter
- BAS—Board Address Switch
- CS—Control Switch
- CTSPS—Current Test Source Power Supply
- CTSPSV—Current Test Source Power Supply Voltage
- EDI—???
- FSV—Full Scale Voltage
- GSC—Ground Station Computer
- HSV—Half Scale Voltage
- IAES—Input Address Enable Switch
- IAS—Input Address Switch
- IB—Interface Breadboard
- RS—Read Switch
- VTSPS—Voltage Test Source Power Supply
- VTSPSV—Voltage Test Source Power Supply Voltage
- WS—Write Switch

**The Purpose of the EDI**—To create a digital signal of the housekeeping data for the payload, which can then be transmitted back to the GSC. Throughout the payload, various voltage measurements are sent to the EDI for it to sample and convert.

- On some inputs we are actually interested in measuring the voltage, but on other inputs we are interested in measuring temperature or current.
  - We extrapolate to a temperature by knowing the scaling of voltage to temperature for the thermistors we use.
  - And we extrapolate to current by knowing the resistor value over which we measured the voltage.
- The EDI converts each analog voltage input into a digital number between $2^0$-$2^{16}$, based linearly on where the analog input signal is between 0V and the FSV. To be clear, the HSV is the FSV/2.
- At the GSC, then, we take the resultant value and multiply it by the FSV for that particular input to get what the voltage that was measured by the EDI.
The Purpose of the EDI Functional Test—We need to make sure that each EDI is fully functional and we need to calibrate each EDI so that we know exactly how it scales the analog signal to the digital output. Each EDI may be slightly different, which is why we need to record the results of the calibration for each EDI individually. The GSC knows which EDI is on each payload—this is given in the initialization file for the GSC.

The How of the EDI Functional Test—For each input to the EDI, we want to test the functionality of the input and corresponding circuitry as well as find the scale factor for that input. The circuitry corresponding to each input is designed to scale the analog input signal to another analog signal from 0V to 5V. Then the ADC takes this analog signal and converts it to a digital signal. Ideally, for each input, we would feed in a precise voltage equal to the corresponding HSV and record the resultant digital output of the ADC. However, with the current setup, since it is impossible with the human eye to visually read out the digital output (shown on the IB lights), we reverse engineer the process. As is described below, we can detect when the lights read out the HSV value, so we find the CTSPSV or VTSPSV that make the IB lights read the HSV value. This is less precise since it involves the subjective determination of when the lights display the HSV value, but it is good enough for our purposes. Then we record what that HSV value was so we can determine the scale factor to tell the GSC for that input. By knowing this scale factor, we should fully know exactly how the ADC scales the analog signal to the digital output.

Overall Outline—We begin by verifying and calibrating inputs $V_0$ and $I_0$ and then move to inputs $V_1$ and $I_1$ and then move up through $V_5$ and $I_5$. Then you have to change the Test Source Power Supplies to facilitate negative voltages for $V_6$ and $I_6$ and $V_7$ and $I_7$. This all uses the J1 connector and two Test Source Power Supplies. Then you have to switch to the J2 connector and you’ll only need one Test Source Power Supply from here on out. You then test $V_8$ through $V_{11}$. Then you move on to $T_0$ through $T_6$, then you test $T_7$, then you test $T_8$ through $T_{14}$, and then finally you test $T_{15}$. 

14
Notes

• **BAS Addresses**
  o 0030
    ▪ Write: Set input multiplexer address
    ▪ Read: Read input multiplexer address
  o 0031
    ▪ Write: Start ADC Converting
    ▪ Read: Read ADC Data

• **Full Scale Voltage Choices**—The FSV for each input is chosen to best cover the range of voltages possible for that input. In particular, for the current measurements, we don’t want the resistor used to measure each current to draw a lot of power (i.e. we don’t want to “waste” too much power in getting the current measurements) so we pick the resistor across which the EDI samples the voltage such that the voltage drop will be approximately 50 mV. Hence we use FSV=100 mV for the current inputs. In addition, FSV=5 V for all T0 through T15.

• **IAS Addresses**
  o 00 = V0
  o 01 = V1
  o 02 = V2
  o 03 = V3
  o 04 = V4
  o 05 = V5
  o 06 = V6
  o 07 = V7
  o 08 = V8
  o 09 = V9
  o 0a = V10
  o 0b = V11
  o 20 = T0
  o 21 = T1
  o 22 = T2
  o 23 = T3
  o 24 = T4
  o 25 = T5
  o 26 = T6
  o 27 = T7

15
• **Lights**—The 16 LED lights display a 16-bit number. When the lights are displaying an analog-to-digital result, there is a linear scale between the lowest and highest possible analog signal and the resultant number (between $2^0-2^{16}$).
  
  o **FSV**—When the lights display the FSV, all the left-most lights are lit up, which makes sense because when the 16-bit number is largest is when the left-most bits of the 16-bit number are all “1” or on.
  
  o **HSV**—When the lights display a value just under the HSV, the left-most light is off and all of the lights just to the right of it are on. When the lights display a value just above the HSV, the left-most light is on and all of the lights just to the right of it are off. The EDI has some small level of noise, so when the analog input is roughly equal to the HSV, the lights for any given reading may either display just above or just below the HSV. So to find the HSV, you turn the RS on and the WS on and change the input voltage value until the left-most light and the one right next to it are the same brightness (see note on “Read and Write” below).

• **Pull-Up**—On some of the temperature sensor inputs to the EDI ($T_0$-$T_{12}$, i.e. the ones actually used for temperature sensors), if nothing is connected to the input, there is a 5V potential across the input and the ADC, and thus the IB Lights, will read full scale (FSV). The reason for this is that this is the source of power for the temperature sensors in the first place. $T_{13}$-$T_{15}$ are not used for actual temperature sensors, and hence there is no pull-up on these.

• **Read and Write**—When the Read Switch (RS) is flipped on and the Write Switch (WS) is not, the lights on the Interface Breadboard will display the most recent recorded value of whatever you’re asking the lights to show. When only the WS is flipped on and the RS is not, the value of whatever you’ve given as the BAS and IAS is recorded but not necessarily displayed. When both the RS and WS are flipped on, the EDI board is continually writing and reading values and is doing so very quickly. For any given reading, the lights will display some 16-bit number and each individual light is either fully on or fully off, but when the EDI is constantly reading and writing, the lights may flicker on and off, depending on the number they’re trying to display, at a rate much too fast to see.
This is why the brightness of the lights can range from full brightness to nearly off.

- **Switches—Logic and Syntax** (see Photo 3)
  - **BAS**—Positive Logic, i.e. “up=on=1” and “down=off=0”
    - When referring to what to set the BAS to, I list four nibbles, each of which take 4 bits to represent. Hence BAS=0030 means that the BAS should be set to “00000000 00110000”.
  - **CS (including RS and IAES)**—Negative Logic, i.e. “up=off=0” and “down=on=1”
  - **IAS**—Positive Logic, i.e. “up=on=1” and “down=off=0”
    - When referring to what to set the IAS to, I list two nibbles, each of which take 4 bits to represent. Hence IAS=12 means the IAS should be set to “00010010”.
  - **WS**—Positive Logic, i.e. “up=on=1” and “down=off=0”

- **Test Jig**—The test station, i.e. everything that isn’t the EDI board.

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**Background Theory**

- **Hexadecimal**—Refers to numbers in base-16. 0-9,a,b,c,d,e,f
  - e.g. The base-10 number “31” is “1f” in hexadecimal.
- **Nibble**—a 4-bit number; often, as in the case here, a nibble refers to a hexadecimal digit.
  - Upper Nibble: In a 2-digit hexadecimal number, the left digit is the upper nibble
  - Lower Nibble: In a 2-digit hexadecimal number, the right digit is the lower nibble
  - e.g. In the hexadecimal number “1f” the “1” is the upper nibble and the “f” is the lower nibble.
  - The hexadecimal number “1” can be represented by the nibble “0001” and the hexadecimal number “f” can be represented by the nibble “1111.” Hence, the hexadecimal number “1f” can be represented on an 8-bit switch as the two nibbles concatenated: “00011111”.
  - See Photo 4
1. Overview Photo of Workbench

Test Source Power Supplies

Interface Breadboard

EDI Board

EDI Power Supplies
2. EDI Board

- J1 26-pin Connector
- J2 44-pin Connector
- Potentiometer
- “Jumper” Shorts
- Big Rainbow Ribbon Cable to Interface Breadboard
3. Interface Breadboard

BAS – Board Address Switch (16 bits)

CS – Control Switch (8 bits)

IAES – Input Address Enable Switch (left-most bit, bit 7, on the CS)
(Note: it’s labeled as switch 8 on the CS)

RS – Read Switch (2nd from the right bit, bit 1, on CS)
(Note: it’s labeled as switch 2 on the CS)

WS – Write Switch

IAS – Input Address Switch (8 bits)

Lights (16 bits)
4. Example Switch

Bit 7, labeled as switch 8

Upper Nibble

Lower Nibble

Bit 0, labeled as switch 1
5. **CTPS and VTSPS**

![Image of CTSPS and VTSPS setup](image)

- VTSPS
- CTSPS
- Voltage Divider
- VTSPS Multimeter
- CTSPS Multimeter (not pictured)
6. J1 26-pin Connector

- Red wire in pin 1
- White wire in pin 10
- Black wire in pin 19
7. Positioning the J1 Connector (a)
8. Positioning the J1 Connector (b)

Note: It is moved over ONE space!
9. J2 44-pin Connector

- Red wire in pin 31
- Black wire in pin 32
- Blue wires in pins 1 and 16
- Green wires in pins 2 and 17
- Purple wires in pins 3 and 18
10. Positioning the J2 Connector (a)
11. Positioning the J2 Connector (b)

Note: It is moved over TWO spaces!!!!!
<table>
<thead>
<tr>
<th>Input</th>
<th>HSV (measured)</th>
<th>Pull-Up?</th>
<th>Input</th>
<th>HSV (measured)</th>
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<td>( I_0 )</td>
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**Issues:**
EDI test setup

Vφ - 5, Iφ - 5

V6 - 7, I6 - 7

V8 - 11
EDI test setup

T6-6:

T7:

T8-14:

T15:

Tips and Tyes are in same position. Do not move the T2. Always double check the active types.

Some Tips and Tyes