ADK-8400 Evaluation Board
Quick Start Guide:
HI-8400 Isolated Discrete Sensor with ±800V Isolation

July 2018

REVISION HISTORY

Revision	Date	Description of Change
QSG-8400, Rev. New	07-25-18	Initial Release

Introduction

This board allows the customer to evaluate the features of the galvanically isolated HI-8400 four channel discrete sensor IC. Each input has full isolation from the digital domain and from the other sensor inputs. The HI-8400 logic is powered from a single 3.3V ±5% or 5V ±5% supply voltage. The isolated analog sensor input is supplied from a 16 to 36VDC supply. Each input channel can be individually configured as a GND/Open or Supply/Open Sensor type using hardware pins. Sensor thresholds are internally set at Airbus ABD0100H levels, an SPI port is used to read sensor data. A second board is also included to allow users to evaluate the daisy chain feature.

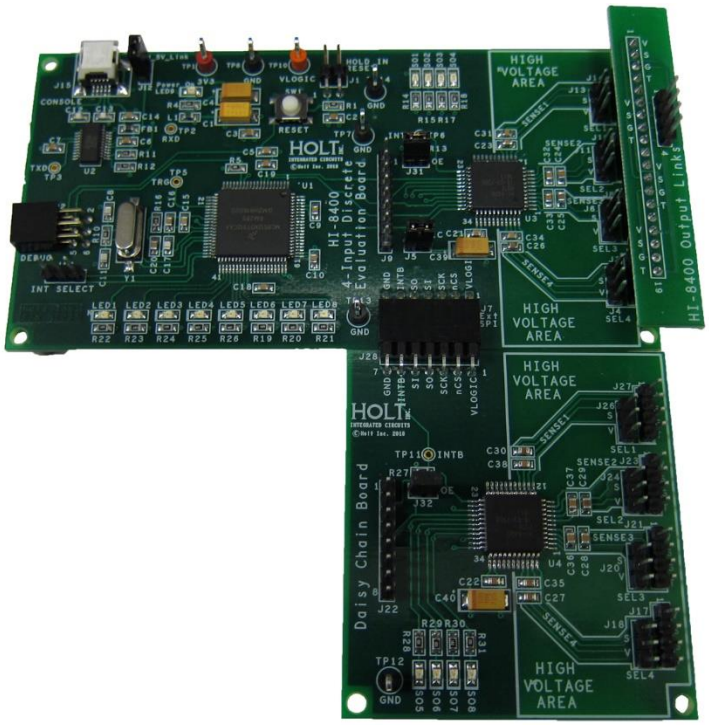


Figure 1 – Top View of HI-8400 Evaluation Set Up including Daisy Chain Board

WARNING – Before using High Voltage equipment ensure that you use the best safety operating practices, including, but not limited to the following precautions :

Do NOT work with high voltage by yourself, have another person (safety observer), qualified in first aid for electrical shock, present at all times.

Use rubber gloves where applicable and stand on approved rubber matting. Note that not all so-called rubber mats are good isolators.

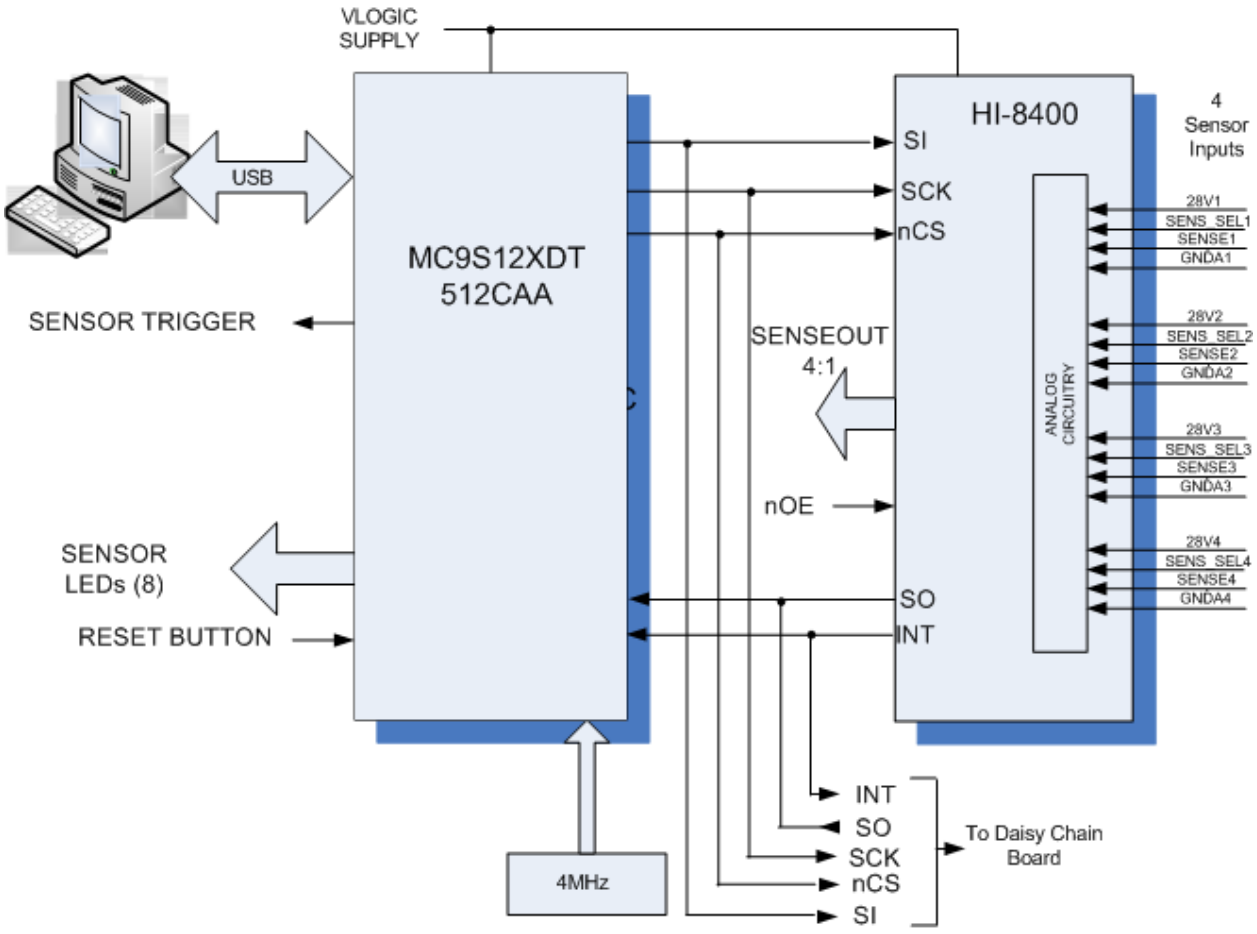
Always discharge the high voltage from components or terminals by using a safety probe. Do NOT hold the test probe when circuits over 300 volts are tested.

Always use equipment certified for operation at or above the peak voltages being tested.

KIT CONTENTS

- This User Guide.
- HI-8400 Evaluation Board.
- USB Flash drive with HI-8400 software
- USB to Mini USB Serial Cable.

Demonstration Set-up



Initial Board Set up

1. Make sure the board jumpers and switch positions match the default settings listed earlier. The VLOGIC supply can also use a 3.3V or 5V supply, in the case of 5V there is the option of using the USB supply by linking jumper J12 (this is the default set up), if you are not using the USB supply J12 should be open. If using an external supply then connect a +3.3V or +5V power supply to VLOGIC (RED) and 0V to GND terminals making sure J12 is open.

2. Each input channel of the HI-8400 is in its own isolated domain, the sensor type for each input is set by control pins, these are referenced only to the GND of that input; there is no common ground for the sensors inputs. Of course if desired all the sensor grounds of the device can be connected together. To set an input to GND/Open the SENS_SELx input for channelx must be connected to the GNDAx of that same channel. To set an input to Supply/Open the SENS_SELx input for that channel must be connected to the 28Vx of that same channelx. Jumpers J4, 6, 11, 13 on the board are provided to do this.

3. Reading of the sense data can be on the dedicated hardware pins SENSEOUT[1:4] or through the on board MCU, and interfacing with a terminal emulator. When using the SENSEOUT[1:4] pins, the nOE pin has to be low to enable the outputs. LEDS SO[1:4] are used to monitor these sensor outputs. In GND/Open an illuminated LED means that sensor is Open (High). In Supply/Open sensor mode an illuminated LED means that sensor is closed or at Supply level (High).

4. Each channel requires its own 28V supply, the positive and negatives of each supply should be connected to the 28Vx and GNDAx to pins on J3, J8, J10 and J14. Alternatively, the breakout board supplied with the kit can be used if a common GND and 28V is to be used for all four sense channels.

Software Control

1. Connect the mini USB lead to your PC and then to the console connector J15 on the HI-8400 board; your PC should automatically install the driver. If not the driver FT231 can be installed from the Holt Flash drive. If you have problems installing the driver, please refer to the FTDI website below:

2. http://www.ftdichip.com/Documents/InstallGuides.htm

3. SPI data from the HI-8400 is read through the 'Control Console'. This requires use of a terminal emulator for communication, such as HyperTerminal or Tera Term. Tera Term is used with Windows versions of Vista or later and is supplied on the Holt Flash drive.

   To install Tera Term:

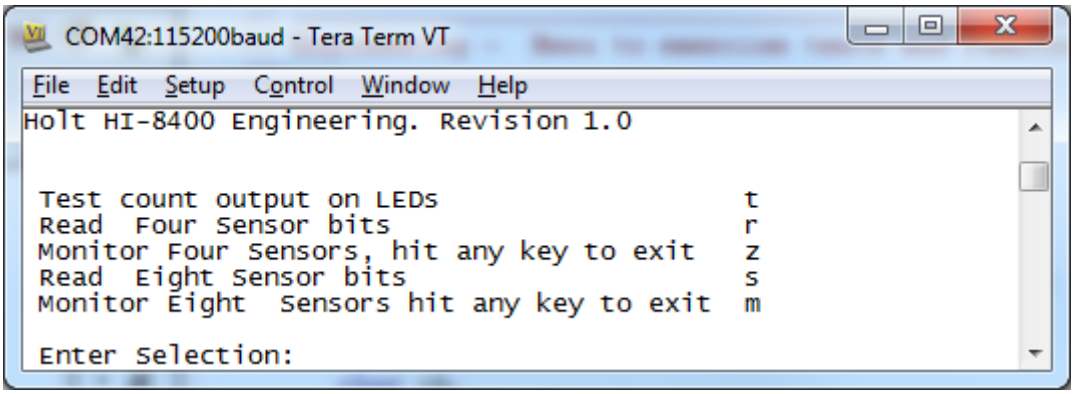
   - Use the Tera Term installer, supplied on the Holt Flash drive; run the teraterm-x.xx.exe installer program. Accept the license agreement stating redistribution is permitted provided that copyright notice is retained. The notice can be displayed from the Tera Term window by clicking **Help** then clicking **About Tera Term**.
   - Accept the default install destination and click **Next**.
   - At the Select Components screen, unselect all options except Additional Plugin = TTXResizeMenu and click **Next**.
   - Select the installed language, then click **Next**.
   - Accept the default Start Menu folder, then click **Next**.
   - Select any desired shortcuts, then click **Next**.
   - At the Ready to Install screen, click **Install**.

   Run the installed Tera Term program. At the **New Connection** screen, select **(x)Serial** and choose the selected COM port, find the correct COM port using **Device Manager**.

4. Click **Setup** then **Serial Port** to open the serial port setup window. Choose the COM port for the mini-USB connection and then select the following settings:
   Baud Rate = 115200, Data = 8 bits, Parity = none, Stop = 1 bit, Flow Control = none.

5. The evaluation software is pre-programmed into the MCU at the Holt Applications Support Center. Press the 'RESET MCU' button on the board, the general purpose LED bank, LED[1:8] will light for 1 sec, the software revision is then displayed on the same LEDs, LED[8:5] being the most significant digit and LED[4:1] being the least significant digit.

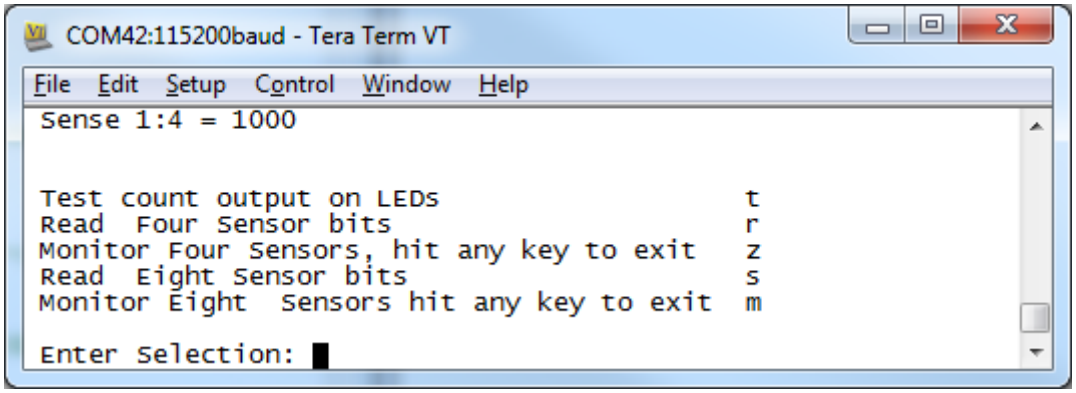
6. The software displays a message on the monitor, similar to the screenshot shown below.



5. Note: If under any circumstances, this software locks up, use the 'RESET' key to recover.

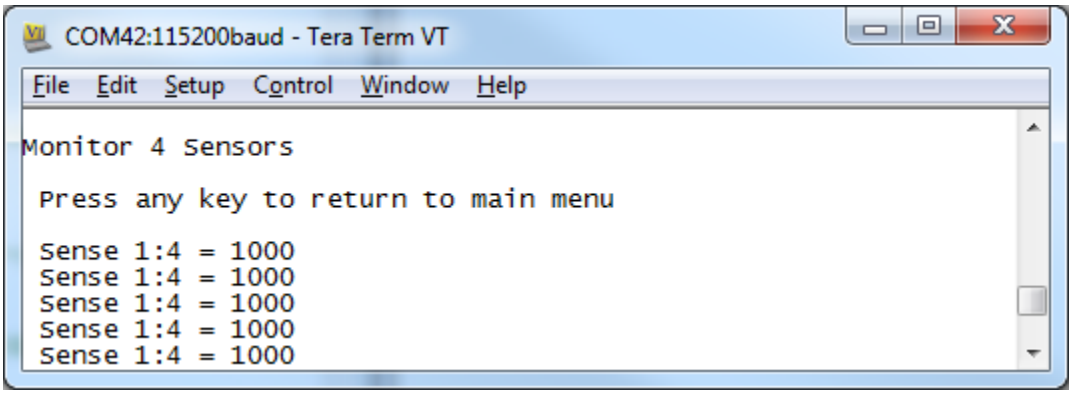
6. Press key 't' to perform an LED test. The Sensor1-8 LEDs and screen start counting in Hex.

7. Press key 'r' to read the four sensors data, this will be displayed on the screen as shown below:



This shows the binary output of each sensor, with sensor 1 first and sensor 4 last. If the sensor input is high then the correlating sensor LED is lit on the LED array Sense 1:8, this shows the sensor data read from SPI. LEDs S01 to S04 show the state of the devices hardwire sense outputs. The display above shows sensor 1 in the high state and sensors 2-4 in low state. To create this set up on the board just connect the 28V1 to 28V and GND1 to 0V, this produces an Open (high) in the GND/Open sensor 1, the other sensors will default to '0'.

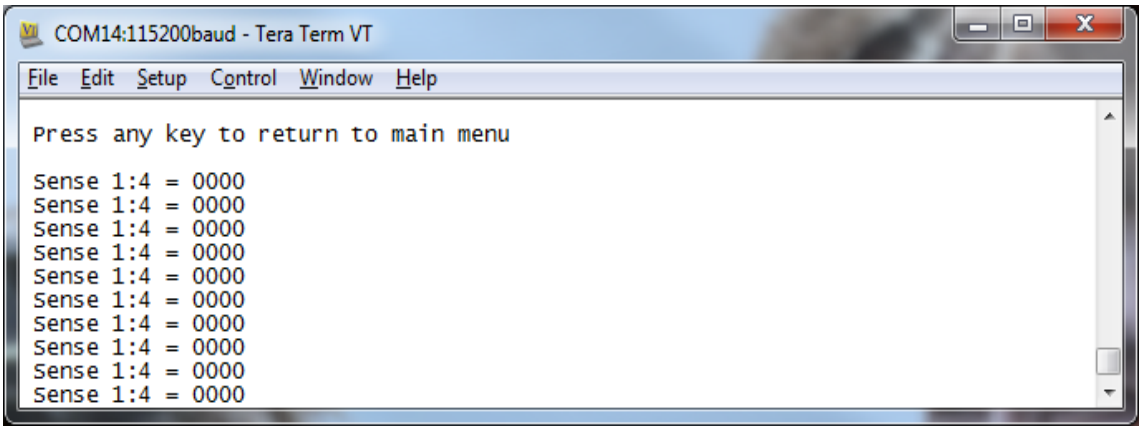
8. To continually monitor the four outputs then use the key 'z', this will show a screen similar to below:



Monitoring the four sensors above, it can be seen that sensor 1 is high. Press any key to exit this function.

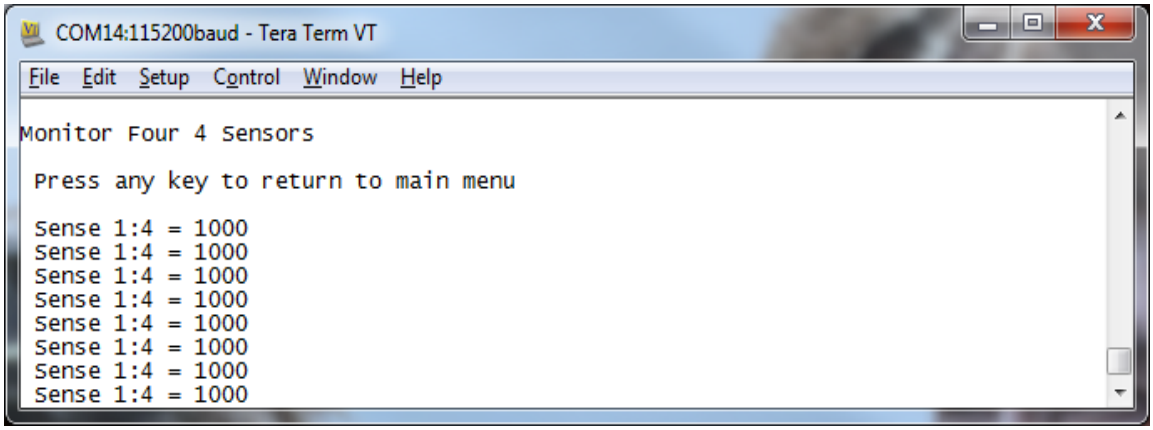
Testing Sense Thresholds

1. In GND/Open mode, VGTHL is 4.5V min and VGTHH is 10.5V max. This can be tested by connecting a voltage source to the Sensor1 input pins on connectors J3, J8, J10 and J14. Make sure the ground connection is connected to the GND reference for this channel. Set the Sense Input voltage to 0V, then press the short cut 'z' key to run the monitor program, all four sensors U3 will be read in a loop, as shown below.



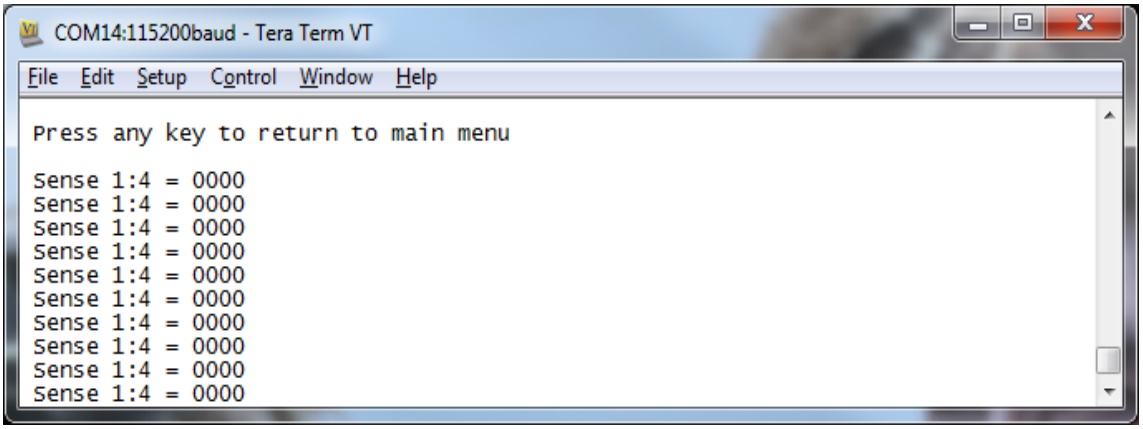
The screen above is monitoring U3 sensors, '0000' means all sensors are reading low.

2. Now increase the voltage source up to 9V, then increase the voltage slowly, to 10.5V, LED1 and LED S1 on the board should be lit, the screen should now read 1000, as shown below:

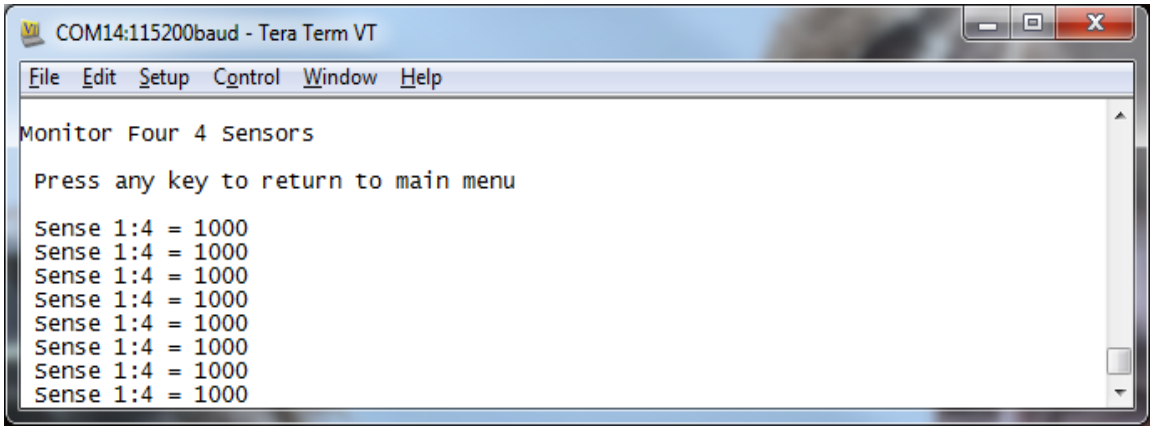


Now decrease the voltage, LED1 and S01 should go off before 4.5V is reached and the screen should go back to reading 0000.

3. To measure the Supply/Open thresholds follow the following procedure. Set sensor type to Supply/Open by connecting a jumper between S and V (pins 2 and 3) on J26. Using a procedure similar to 1. Connect a supply to the sensor input and adjust to 0V, press key 'z' , the screen should read '0000' as shown below:



4. Increase the voltage source up to 10.5V, then increase the voltage slowly, to 12V, LED1 and LED S1 on the board should be lit, the screen should now read 1000, as shown below:



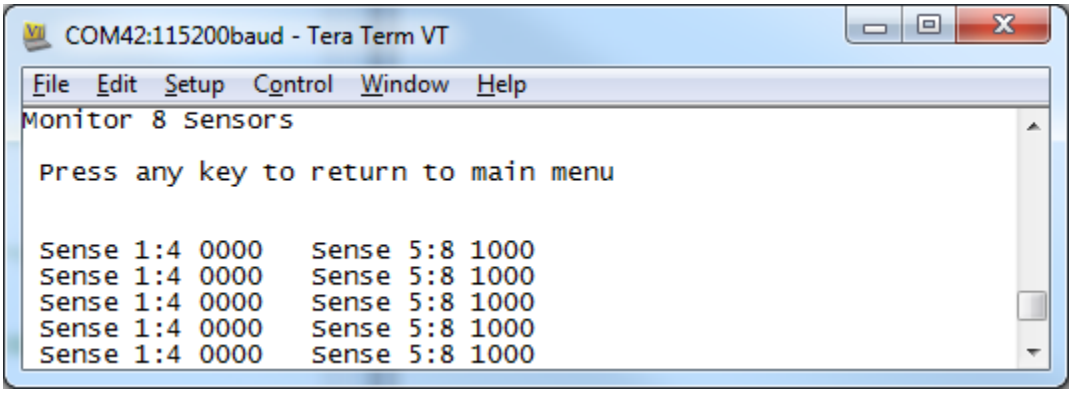
Now decrease the voltage, LED1 and S01 should go off before 6V is reached and the screen should go back to reading 0000.

5. An individual sensor can also be monitored from the INTB output to provide a hardware trigger, connect an oscilloscope probe to the INTB test point. Use this output as a trigger to an oscilloscope, input a ramp voltage to the sensor and monitor the ramp on another channel of the oscilloscope. When the sensor changes the INTB signal triggers the oscilloscope the negative edge of INTB will cross the ramp at the threshold point, allowing easy measurement.

Daisy Chained SPI Mode

1. Two HI-8400 boards are provided with the evaluation kit. Board 1 is the master board with a microprocessor to control the interface. Board2 is used for daisy chain testing and should be plugged into Board1 at connector J7. The console option 'm', continually reads the SPI data from both devices in the daisy chain configuration. To get active sensor data, the sensors on board2 will need to be connected to a 28V supply and sensor voltage. Connector J7 links the SPI connections of the two devices; the SO pin of Board1 is linked to the SI pin of Board2. The software has commands that read both devices through the SO pin of Board2.

2. Press key ‘m’, a screen similar to the one below should be seen.



The sense data for Device1 on board1 and Device2 on board2 are displayed, a ‘1’ meaning a high. Key ‘s’ can be used to just do one read. LED[1:8] also monitor the eight input states.

External SPI Operation

The HI-8400 devices are normally controlled through the on-board MCU. If required, an external SPI master connected to J7 can be used. When using this method close jumper J1 to hold the MCU RESET pin low, this forces the MCU GPIOs into a high impedance state. For normal operation, keep this jumper open and use the RESET button to reset the MCU during testing.

Power should be connected between the VDD terminal and ground. The SPI controller should then be connected to J7, using the following pin connections:

SPI Connector (J7)

Pin Number	**Label**	**Description**
1	VLOGIC	3.3V or 5V Logic supply
2	nCS	SPI Chip Select
3	SCK	SPI Serial Clock Input
4	SI	SPI Serial Data Input
5	SO	SPI Serial Output from U3
6	INTB	Interrupt output from U3
7	GND	Low voltage Ground

Parallel Data out connector (J9)

Pin Number	**Label**	**Description**
1	GND	Low voltage Ground
2	INTB	Interrupt output from U3
3	NC	Not Connected
4	nOE	Output Enable (active low)
5	SO1	Sense Output 1
6	SO2	Sense Output 2
7	SO3	Sense Output 3
8	SO4	Sense Output 4

Debug connector (for Freescale Processor) (J2)

Pin Number	**Label**	**Description**
1	BKGD	Debug data
2	GND	Ground
3	NC	Not Connected
4	nRESET	Reset Target
5	NC	Not Connected
6	NC	Not Connected

Default Jumper Settings

JUMPER	POSITION	DESCRIPTION
J1	OFF	Link to hold microprocessor in Reset (to use ext SPI)
J4	2:1	Link 3:2 Selects 28V/Open type for Sensor 4 Link 2:1 Selects GND/Open type for Sensor 4
J5	ON	VLOGIC Link for supply current to U3 (disconnect to measure HI-8400 VLOGIC supply current)
J8	2:1	Link 3:2 Selects 28V/Open type for Sensor 3 Link 2:1 Selects GND/Open type for Sensor 3
J10	2:1	Link 3:2 Selects 28V/Open type for Sensor 2 Link 2:1 Selects GND/Open type for Sensor 2
J14	2:1	Link 3:2 Selects 28V/Open type for Sensor 1 Link 2:1 Selects GND/Open type for Sensor 1
J12	OFF	Link to use USB 5V supply
J16	Open	Link 1:2 Selects non maskable interrupt Link 2:3 Selects maskable interrupt
J31	Closed	Link 1:2 Enables SENSEOUT [1:4] OF U3

Daisy Chain Board Connections

SPI Connector (J28)

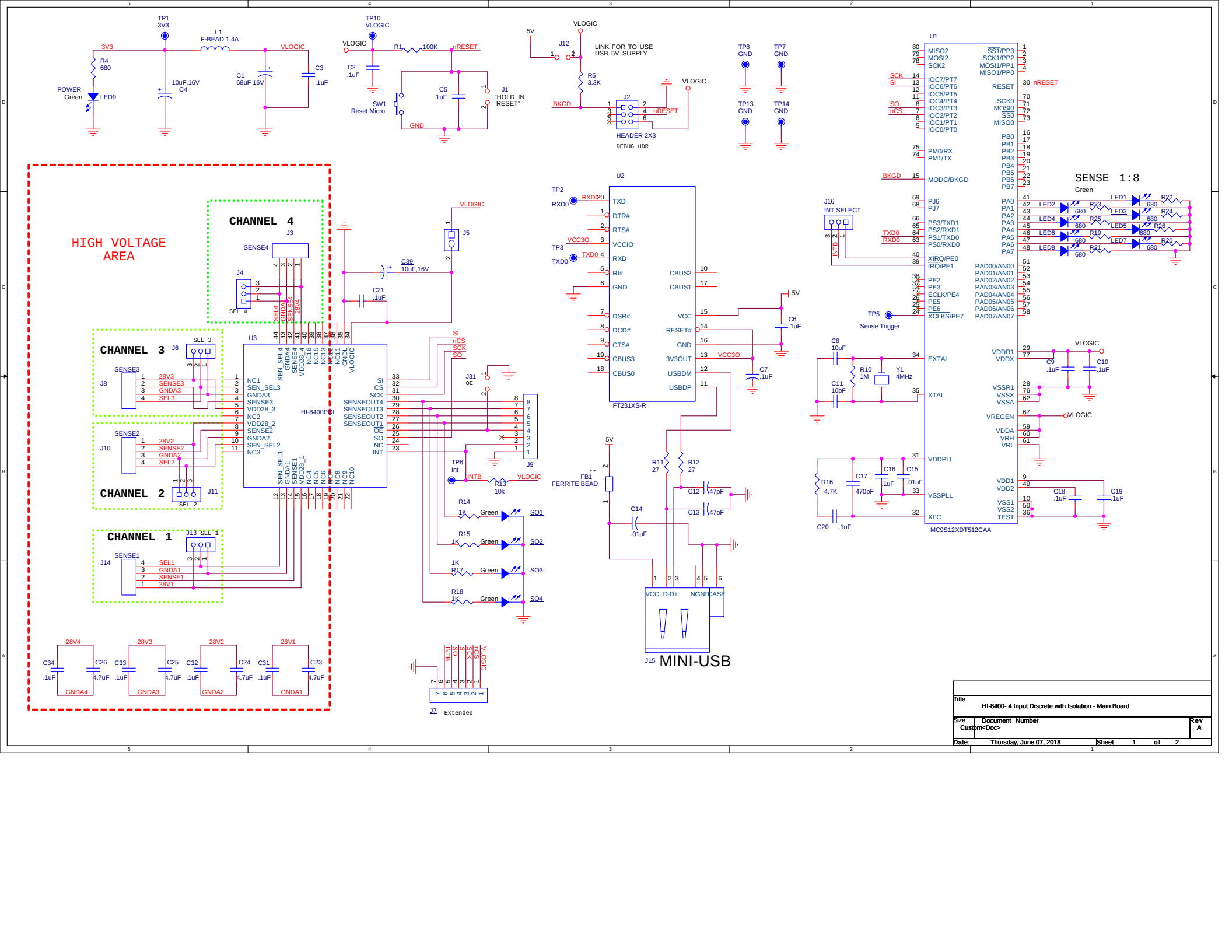
Pin Number	Label	Description
1	VLOGIC	3.3V/ 5V Logic supply
2	nCS	SPI Chip Select
3	SCK	SPI Serial Clock Input of U4
4	SO	SPI Serial Output from U4
5	SI	SPI Serial Input of U4
6	INTB	Interrupt output from U4
7	GND	Low voltage Ground

Parallel Data out connector (J22)

Pin Number	Label	Description
1	GND	Low voltage Ground
2	INTB	Interrupt output from U4
3	NC	Not Connected
4	nOE	Output Enable (active low)
5	SO1	Sense Output 1
6	SO2	Sense Output 2
7	SO3	Sense Output 3
8	SO4	Sense Output 4

Default Jumper Settings

JUMPER	POSITION	DESCRIPTION
J18	2:3	Link 1:2 Selects 28V/Open type for Sensor 4 Link 2:3 Selects GND/Open type for Sensor 4
J20	2:3	Link 1:2 Selects 28V/Open type for Sensor 3 Link 2:3 Selects GND/Open type for Sensor 3
J23	2:3	Link 1:2 Selects 28V/Open type for Sensor 2 Link 2:3 Selects GND/Open type for Sensor 2
J26	2:3	Link 1:2 Selects 28V/Open type for Sensor 1 Link 2:3 Selects GND/Open type for Sensor 1
J32	Closed	Link 1:2 Enables SENSEOUT [1:4] OF U4 Link 2:3 Selects GND/Open type for Sensor 1


HIGH VOLTAGE AREA
CHANNEL 4
CHANNEL 3
CHANNEL 2
CHANNEL 1
HI-8400PQI
U1
MC9S12XDT512CAA
U2
FT231XS-R
J15 MINI-USB
J7 Extended
SENSE 1:8
Green
INT SELECT
Sense Trigger
HEADER 2X3
DEBUG HDR
LINK FOR TO USE USB 5V SUPPLY
Reset Micro
"HOLD IN RESET"
FERRITE BEAD
POWER Green
F-BEAD 1.4A
10uF,16V
68uF 16V
.1uF
100K
680
3.3K
10pF
1M
4MHz
4.7K
470pF
27
47pF
1K
10k
.01uF
10uF,16V
Title
HI-8400- 4 Input Discrete with Isolation - Main Board
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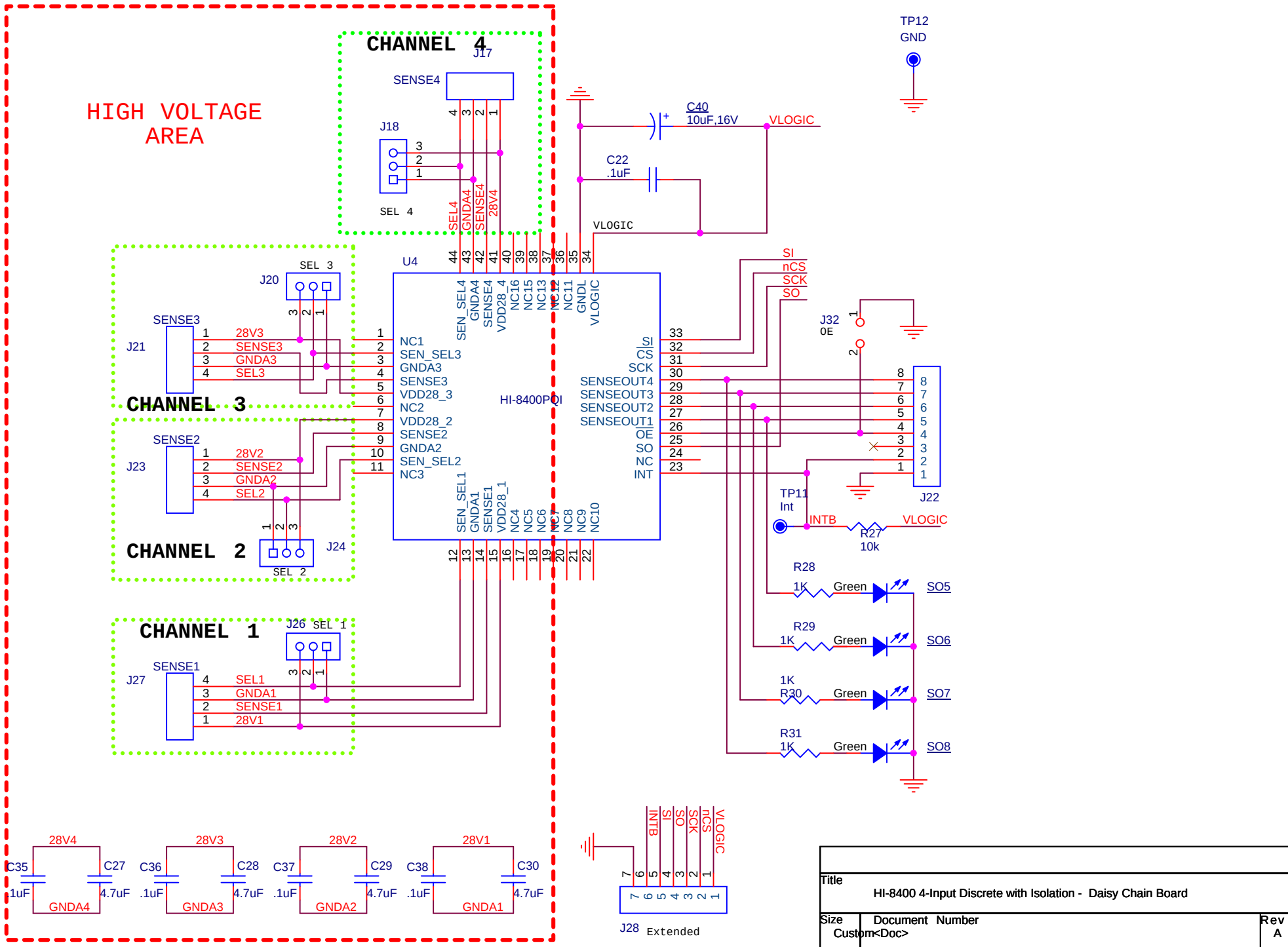

Title	HI-8400 4-Input Discrete with Isolation - Daisy Chain Board	
Size: Custom<Doc>	Document Number	Rev: A
Date: Thursday, May 17, 2018	Sheet 2 of 2	

Holt Integrated Circuits, Inc. Bill of Materials May 21, 2018

PCB P/N: HE035 HI-8400 4-Input Discrete Evaluation Board

Rev. A

	A	B	C	D	E	F
1	**Item**	**Qty**	**Description**	**Reference**	**Digikey P/N**	**Mfg P/N**
2						
3	1	1	PCB, Bare, Evaluation Board	N/A		Jet Tech 42737
4	2	1	Capacitor 68uF,20%, 16V Tant SMD 6032	C1	399-8399-1-ND	Kemet T491D686M016AT
5	3	2	Capacitor 10uF,20%, 16V Tant SMD 6032	C4,C39	399-3732-1-ND	Kemet T491C106K016AT
6	4	8	Capacitor, Cer 4.7uF 10% 50V X5R 0805	C23-C30	490-10751-1-ND	Murata GRM21BR61H475KE51L
7	5	20	Capacitor, Cer 0.1uF 20% 50V Z5U 0805	C2,C3,C5-C7,C9,C10,C16, C18-C22,C31-34,C35-C38	399-1176-1-ND	Kemet C0805C104M5UACTU
8	6	2	Capacitor, Cer 0.01uF 20% 50V 7XR 0805	C14,C15	399-1160-1-ND	Kemet C0805C103M5RACTU
9	7	2	Capacitor, Cer 10pF 50V 5% NP0 0805	C8,C11	399-1108-1-ND	Kemet C0805C100J5GACTU
10	8	2	Capacitor, Cer 47pF 50V 5% NP0 0805	C12,C13	399-1117-1-ND	Kemet C0805C470J5GACTU
11	9	1	Capacitor, Cer 470pF 50V 5% X7R 0805	C17	399-1133-1-ND	Kemet C0805C471J5GACTU
12	10	1	Ferrite 330 Ohm@100MHz 0805	FB1	490-5988-1-ND	Murata BLM21PG331SN1D
13	11	1	Ferrite 220 Ohm, 2A @100 MHz 0805	L1	490-1054-1-ND	Murata BLM21PG221SN1D
14	12	3	Conn Header .100 SGL STR 2Pos	J5,J12,J19	S1012E-02-ND	Sullins PEC02SAAN
15	13	11	Conn Header .100 SGL STR 3Pos	J4,J6,J11,J13,J16,J18, J20,J24, J26, J31,J32	S1012E-03-ND	Sullins PEC03SAAN
16	14	8	Conn Header .100 SGL STR 4Pos	J3,J8,J10,J14,J17, J21,J23,J27	S1012E-04-ND	Sullins PEC04SAAN
17	15	2	Conn Header .100 SGL STR 8Pos	J9,J22	S1012E-08-ND	Sullins PEC08SAAN
18	16	1	Conn Header .100 SGL R/A 7 Pos Female	J7	S5482-ND	Sullins PPPC071LGBN-RC
19	17	1	Conn Header .100 SGL R/A 2 Pos Male	J1	S1111E-02-ND	Sullins PBC02SBAN
20	18	1	Conn Header .100 SGL R/A 7 Pos Male	J28	S1111E-07-ND	Sullins PBC07SBAN
21	19	12	Conn Jumper Shorting .100" Gold	J4,J5,J6,J11,J12,J13,J18, J19,J20,J24, J25,J26	S9001-ND	Sullins SPC02SYAN
22	20	1	Header, Female 0.1", Right Angle 2 x 3	Debug Header	S5556-ND	SullinsPPPC032LJBN-RC
23	21	1	Conn Receptacle Mini USB2.0 5Pos	J15	H2959CT-ND	Hirose UX60-MB-5ST
24	22	17	LED Green SMD 0805	SO1-SO8, LED1-LED9	160-1179-1-ND	LiteOn LTST-C170GKT
25	23	2	Res 27, 1/8W 5% 0805 SMD	R11,R12	P27ACT-ND	Panasonic ERJ-6GEYJ270V
26	24	9	Res 680, 1/8W 5% 0805 SMD	R4,R19-R26	P680ACT-ND	Panasonic ERJ-6GEYJ681V
27	25	8	Res 1K, 1/8W 5% 0805 SMD	R14,R15,R17,R18, R28,R29,R30,R31	P1.0KACT-ND	Panasonic ERJ-6GEYJ102V
28	26	1	Res 4.7K, 1/8W 1% 0805 SMD	R16	P4.7KACT-ND	Panasonic ERJ-6GEYJ472V
29	27	1	Res 3.3K, 1/8W 5% 0805 SMD	R5	P3.3KACT-ND	Panasonic ERJ-6GEYJ332V
30	28	2	Res 10K 5% 1/8W 0805	R13,R27	P10KACT-ND	Panasonic ERJ-6GEYJ103V
31	29	1	Res 100K, 1/8W 5% 0805 SMD	R1	P100KACT-ND	Panasonic ERJ-6GEYJ104V
32	30	1	Res 1M, 1/8W 5% 0805 SMD	R10	P1MACT-ND	Panasonic ERJ-6GEYJ105V
33	31	1	Switch Tactile SPST-NO 0.02A 15V	SW1	P12943SCT-ND	Panasonic EVQ-Q2K03W
34	32	1	Test Point, Red Insulator, 0.062"	TP1 (3V3)	36-5010K-ND	Keystone 5010
35	33	5	Test Point, Black Insulator, 0.062"	TP8,TP12-TP15 (GND)	36-5011K-ND	Keystone 5011
36	34	1	Test Point, Orange Insulator, 0.062"	TP10 (VLOGIC)	36-5013K-ND	Keystone 5013
37	35	5	Test Point, White Insulator, 0.040"	TP2,TP3,TP5,TP6, TP11 - DNI	36-5002-ND	Keystone 5002
38	36	2	HI-8400PQ 44-QFP	U3,U4	HI-8400PQ	HI-8400PQ 44-QFP
39	37	1	IC USB SERIAL FULL UART 20SSOP	U2	768-1129-1-ND	FTD FT231XS-R
40	38	1	IC, MC9S12XDT512CAA 80 QFP 16-Bit MCU, 512K Flash 0-70C	U1	MC9S12XDT512CAA-ND	MC9S12XDT512CAA
41	39	1	Crystal 4.00MHz, SMD, 50ppm 20pF	Y1	631-1005-1-ND	FOXSDLF/040
42	40	6	Rubber Foot, Bumpon Black, .312 X.200 H	Place at the mounting holes	SJ5746-0-ND	3M SJ61A1