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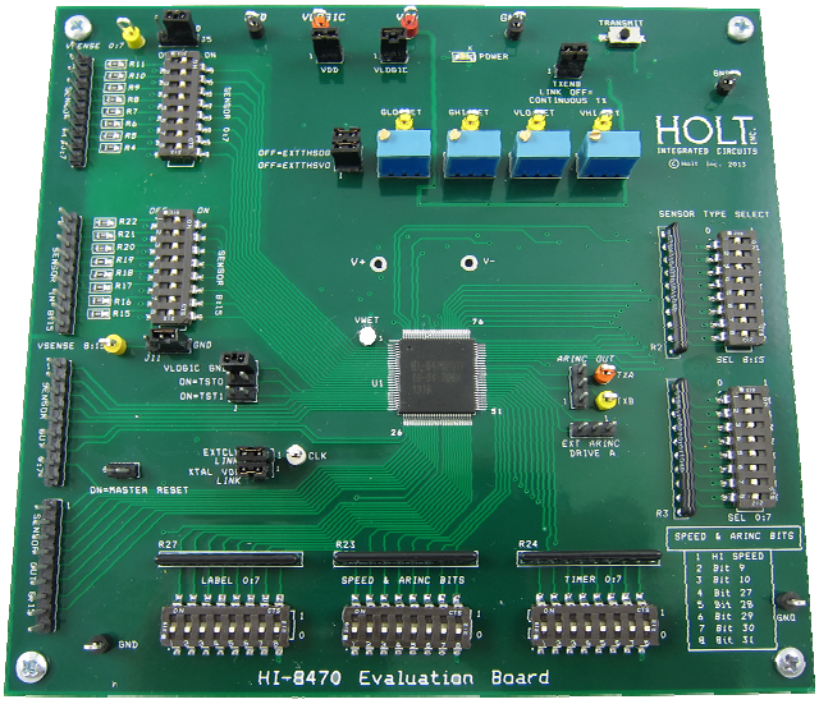
HI-8470 16 Sensor Array with ARINC 429 Output, Ground/Open or Supply/Open Sensors Evaluation Board

User Guide

March 2, 2015

INTRODUCTION

The Holt HI-8470 Evaluation Board demonstrates features of the HI-8470 16 Sensor to ARINC 429 output IC. The board and the HI-8470 can be run from a single 3.3V+/- 5% supply voltage. The device has preset internal sensor thresholds, external thresholds can also be set with board-mounted potentiometers. The HI-8470 and EVM (Evaluation Module) require no software for control; all functions are set by hardware switches. DIP switches configure the device and data inputs. The EVM is shown in the picture below:

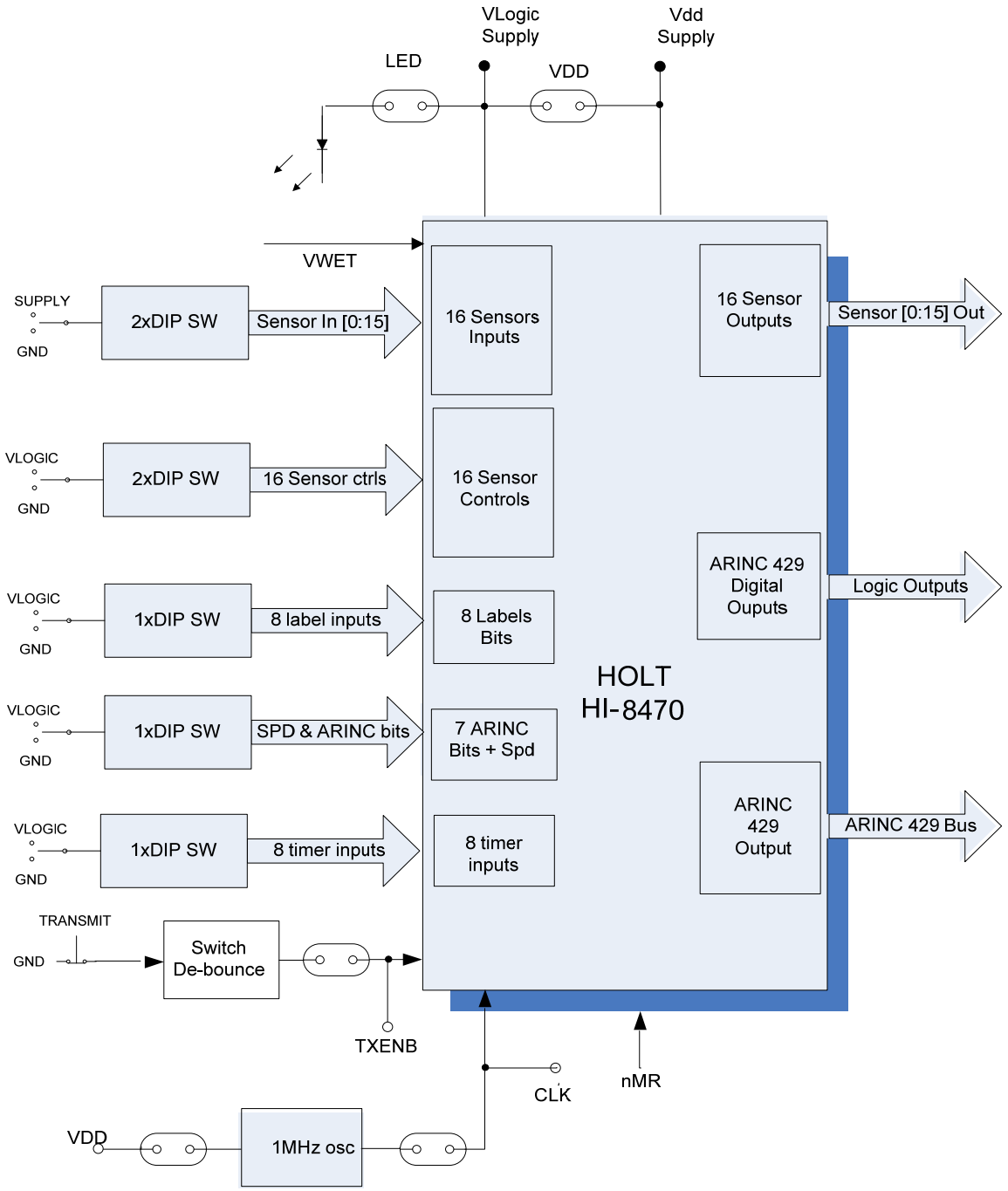


This guide summarizes how to get set up and running quickly.

KIT CONTENTS

- This User Guide
- HI-8470 Evaluation Board

Board Block Diagram



Jumper Functions

JUMPER	DEFAULT	DESCRIPTION
VLOGIC	ON	Link for VLOGIC supply to the LED
VDD	ON	Link for VDD supply current (this supplies the HI-8470 converter for the ARINC 429 outputs)
XTAL VDD	ON	Supplies 3.3V to the 1MHz crystal oscillator
EXTCLK	ON	To use external clock, disconnect link and apply Vlogic level clock to the CLK test point
MASTER RESET	OFF	In place, this holds HI-8470 in reset
TXENB	ON	In place; push button 'TRANSMIT' is pressed to transmit. For continuous transmit, remove the link.
EXTTHSOG	ON	When not in place, the external GLO_SET and GHI_SET potentiometers set the GND/Open thresholds. With jumper in place, the device uses internal thresholds.
EXTTHSVO	ON	When not in place, the external VLO_SET and VHI_SET potentiometers set the Supply/Open thresholds. With jumper in place, the device uses internal thresholds.
J5	GND	Sensor input switch 0:7 source; GND when switches are 'ON'. In non-GND position, the voltage on the VSENSE 0:7 test point is applied, for the switches in 'ON' position.
J11	GND	Sensor input switch 8:15 source; GND when switches are 'ON'. In non-GND position, the voltage on the VSENSE 8:15 test point is applied, for switches in the 'ON' position.
TST0	OFF	When in place, the sensor inputs are all set to Low, and results in Highs at the sensor outputs.
TST1	OFF	When in place, the sensor inputs are all set to High, and results in Lows at the sensor outputs. With TST1 and TST0 in place, sensor inputs are alternately 1,0

Switch Functions

SWITCH	DEFAULT	DESCRIPTION
LABEL 0:7	OFF	ARINC 429 label bits 0:7. ON = '1'
SPEED & ARINC BITS	SPEED = ON ARINC = OFF	ARINC 429 speed and ARINC 429 bits 9, 10, & 27:31. ON = '1' (see table on board for positions)
TIMER 0:7	OFF	Sets ARINC 429 message transmission timer. ON = '1'
SEL 0:7	OFF	Sets sensor type for SI 0:7. OFF = GND/Open ON = Supply/Open
SEL 8:15	OFF	Sets sensor type for SI 8:15. OFF = GND/Open ON = Supply/Open
SENSOR 0:7	ON	Sets state of sensor inputs 0:7 stimuli. ON corresponds to GND or Supply. OFF corresponds to Open state.
SENSOR 8:15	ON	As above, sets state of sensor inputs 8:15.

Connector Functions

Connector	PIN	DESCRIPTION
SENSOR IN 0:7	1 to 8 9	Sensor inputs; Sensor 0:7 → Pins 1:8 GND
SENSOR IN 8:15	1 to 8 9	Sensor inputs; Sensor 8:15 → Pins 1:8 GND
SENSOR OUT 0:7	1 to 8 9	Sensor outputs; Sensor 0:7 → Pins 1:8 GND
SENSOR OUT 8:15	1 to 8 9	Sensor outputs; Sensor 8:15 → Pins 1:8 GND

Board Set Up

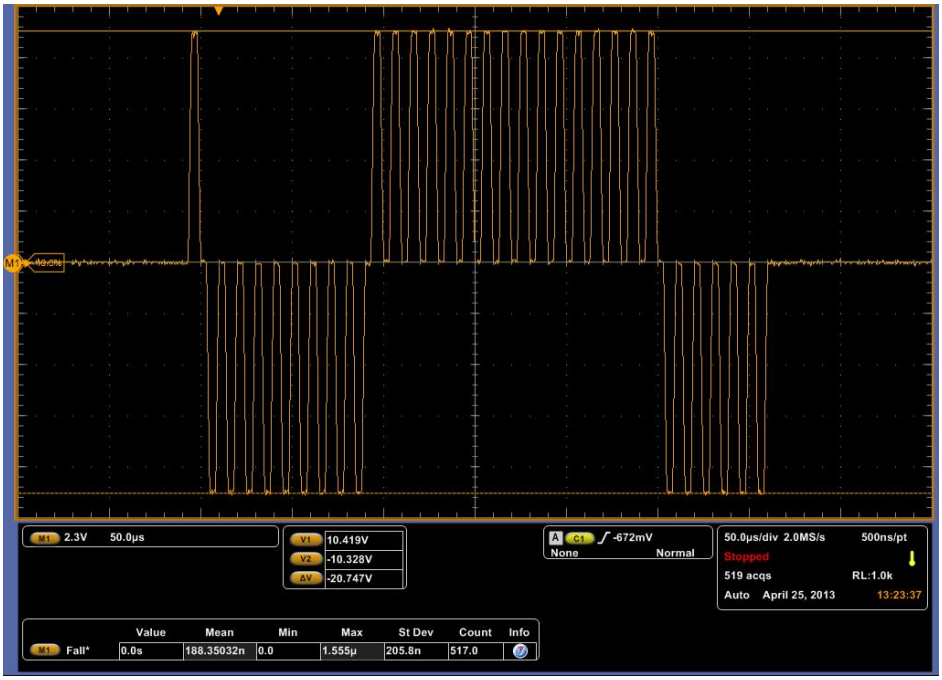
1. Make sure the link and switch positions are as listed in the tables above. Connect a 3.3V supply to the Vlogic test point. The VDD link connects power from VLogic to the HI-8470 VDD pin, which supplies the internal converter. The Vlogic jumper supplies only the LED.

2. To measure the device's Vlogic supply current; remove the Vlogic GND jumper and connect an ammeter across the jumper pins. This measures only the device current and not the other circuitry on the board. To measure Vdd current, remove the Vdd jumper and connect the ammeter across the jumper pins. Remove the XTAL VDD link; the current measured will be for the device 'unclocked'. To measure the device clocked current consumption, an external 1MHz clock should be used, connected to the CLK test point, after removing the EXTCLK link.

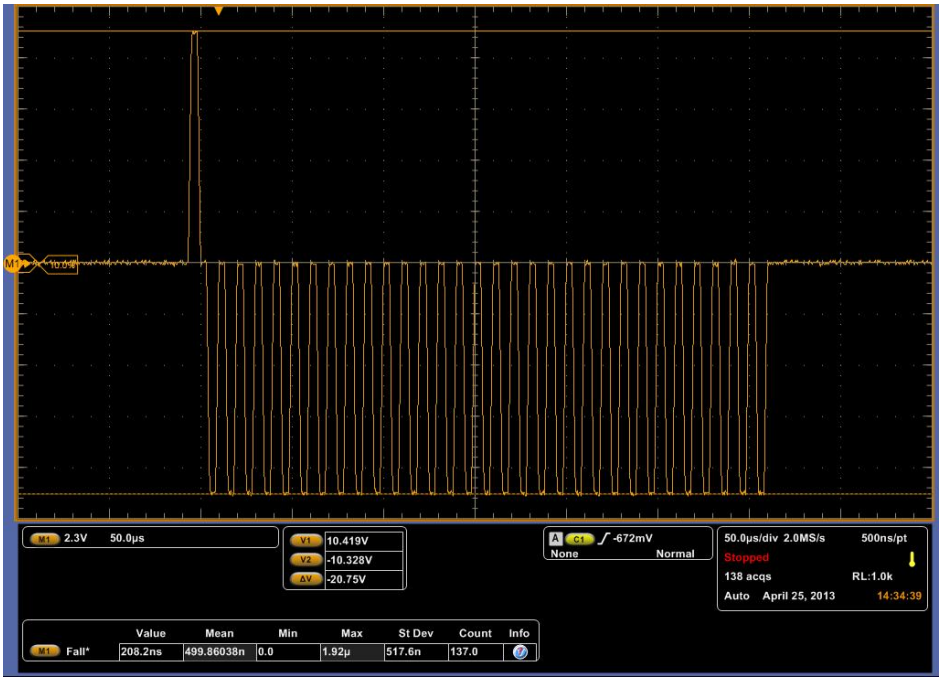
ARINC 429 Output Testing

1. The device transmits the sensor data to the ARINC 429 output when the TXENB is switched high. To generate just one ARINC 429 word, press the Transmit button. To enable continuous ARINC 429 transmission, remove the TXENB link. Before testing ensure the switches and links are in the default states shown in previous tables, then set Label Switch #8 to a '1' and Timer Switch #1 to '1'.

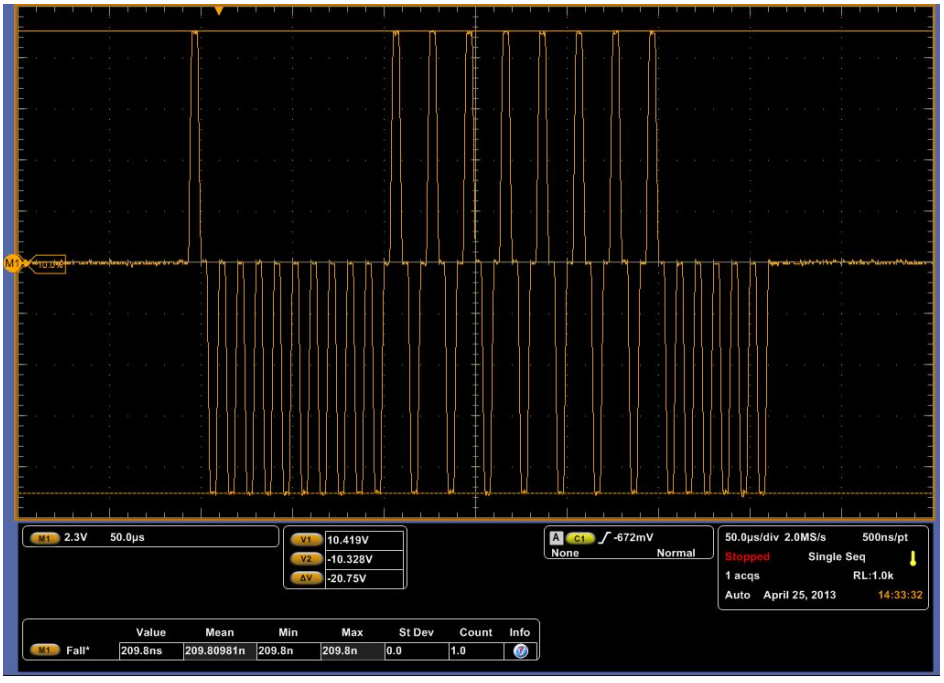
2. Enable continuous ARINC 429 transmission by removing the TXENB link. Connect an oscilloscope to the ARINC 429 outputs. For best results, use differential mode. Jumper TST0 forces all the sensor inputs to '0', this forces the sensor outputs to a '1'. Observe the ARINC 429 output waveform. It should look similar to the waveform shown below:



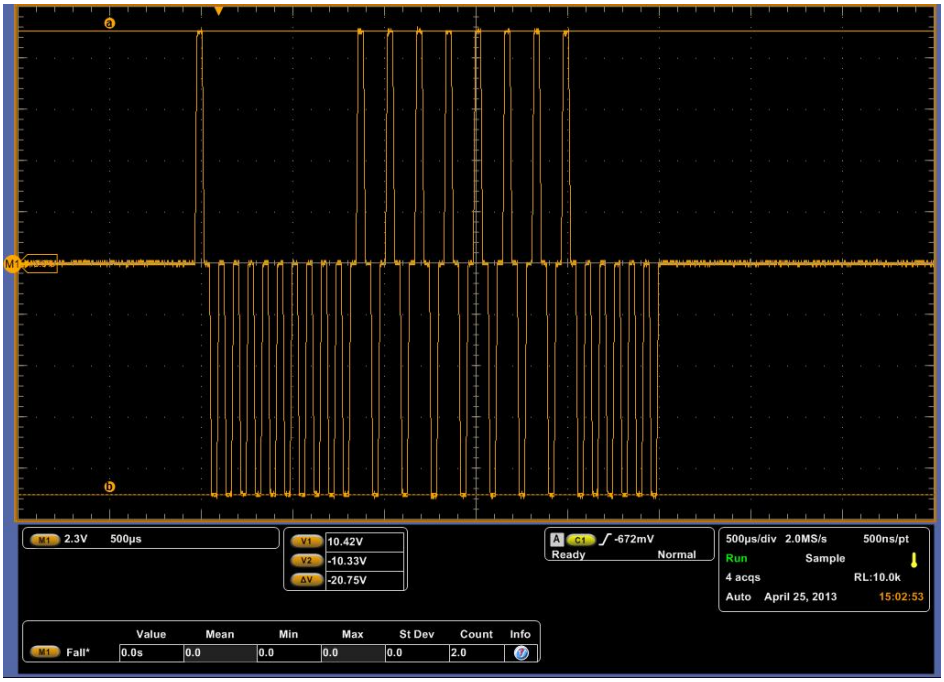
3. Now link jumper TST1 only, forcing the sensor inputs to all 1's. The output pattern for the data should be all 0's as shown below:



4. Now link jumper TST1 and TST0, forcing the sensor inputs to a continuously alternating 01. The output pattern for the data should be 1010101010101010 be as shown below:



5. Replace TXENB link. Press Transmit, only one ARINC 429 word is transmitted. Change the Speed switch to '0', the waveform, should change to 12 kbps rate as shown below:

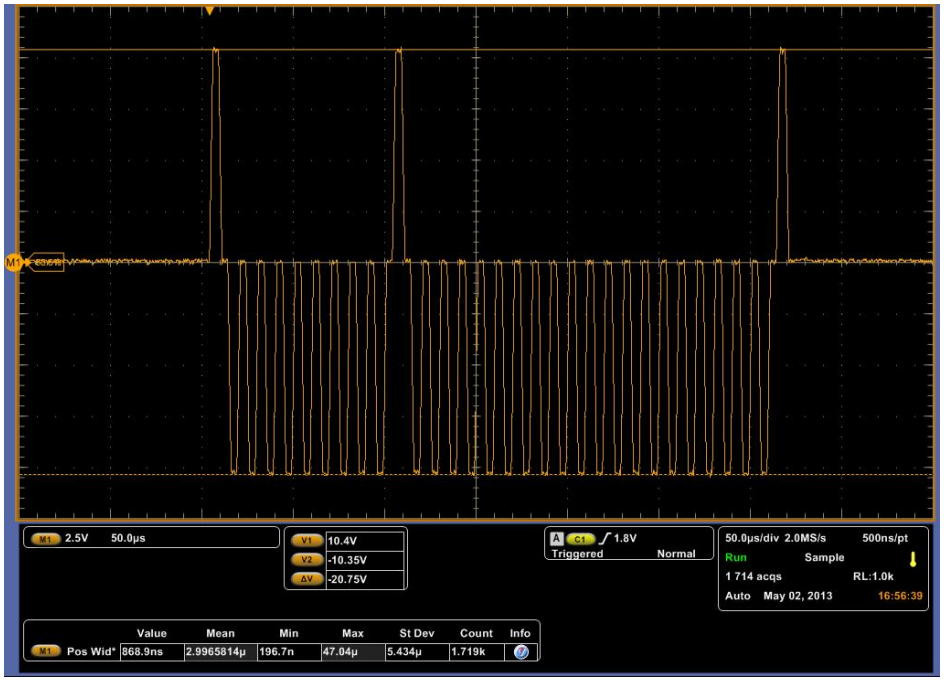


6. Set speed switch back to '1'. The TIMER switch allows for changing the transmit repetition rate. To use this feature, remove the TXENB link to enable continuous transmission. Ensure the timer switch is set to '10000000'; one word will be transmitted every 10ms. Observe this on the oscilloscope; it should look like the picture below:

7. Remove jumpers TST0 and TST1. Use the Speed and ARINC 429 bits switch to toggle ARINC 429 output bits 9, 10 and 27 to 31, see table on the board for switch positions. Check the corresponding bit changes on the ARINC 429 output.

Sensor Input and Output Testing

1. Remove jumpers TST0 and TST1. Leave the TXENB link off. Set up the board in default state, the sensors are in GND/Open state and inputs to switched to GND (ON). Now change all the Sensor input switches to 'OFF', the output waveform should show the all '1s' pattern, shown earlier in this document. Switch Sensor input 0 to 'ON' (GND). The ARINC 429 output should change to the one below, with the changed sensor output state transmitted on as a '1' on bit 11.



2. Set all the sensor input switches to 'ON' (GND), all the ARINC 429 data outputs (bits 11:26) should change to a '1'. This can also be checked on the connectors SENSOR OUT 0:7 and 8:15.

3. A similar test can be done with the sensors in Supply/Open mode. In this mode, the internal thresholds are VTHImin = 15.5V and VTHLOmax = 11V. Set all the 'Sensor Type Select' switches to '1'. Put J5 and J11 in the non-GND position. Connect a 15.5V supply on the VSense 0:7 and VSense 8:15 terminals. The guaranteed switching threshold of 15.5V is being applied to the input, with all the sensor input switches 'ON', all sensor outputs should be a '0'.

4. Lower the input voltage to 11V, this is the guaranteed low switching threshold, all the sensors outputs should now have changed to a '1'. This can be observed on the ARINC 429 output or on the Sensor Out pins.

5. To change the thresholds, remove the EXTTHSOG and EXTTHVO jumpers. External thresholds can now be applied using the potentiometers VR1 to VR4. Connect a voltmeter to the terminal above the potentiometer, adjust the potentiometer to set the threshold voltage. Note that threshold set is 10x the voltage on the test point. A typical set of threshold settings is shown in the table below:

TEST POINT	VOLTAGE	THRESHOLD (X10)
THSLOGO	0.45	4.5
THSHIGO	1.05	10.5
THSLOVO	0.6	6.0
THSHIVO	1.2	12.0

6. To test the external thresholds, the sensor input switches should be set to 'Open' and the sensor input voltage applied to the Sensor Input pin (see table in next section).

Connecting an external ARINC 429 driver

The connector 'EXT ARINC 429 DRIVER', provides CMOS logic level outputs for connecting an external ARINC 429 driver. In this case, the VDD supply is still required on the board as this supplies the Crystal Oscillator and the Clean Switch circuit. However if pin one of the XTAL VDD link and pin 1 of TXENB link are connected to an external 3.3V, then VDD link can be removed.

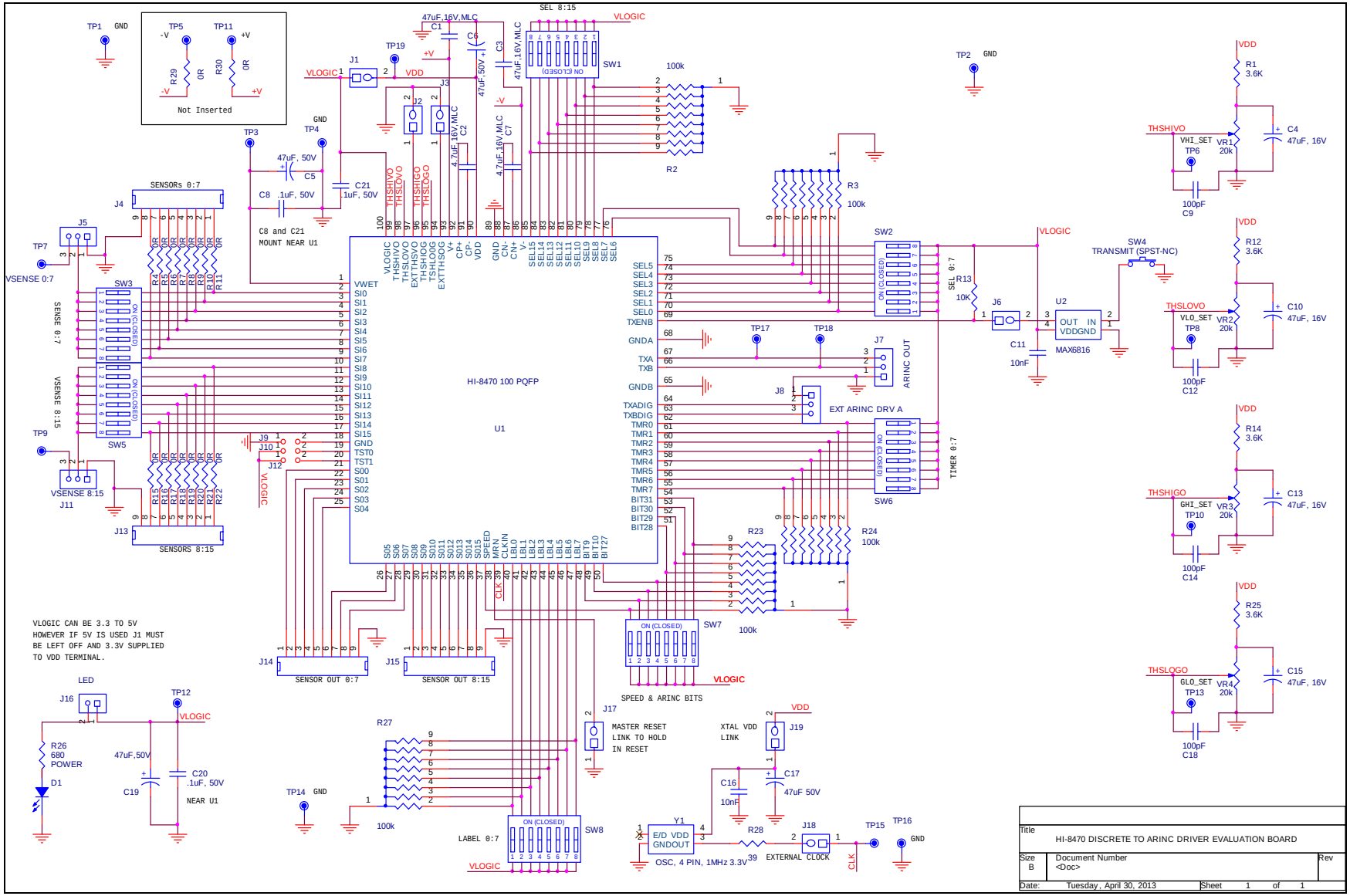
Connecting external sensors

To connect an external sensor, first verify the corresponding sensor DIP switch is the 'OPEN' state. The sensor wires can be connected to the board on the pin headers Sensor In 0:7 and 8:15. See table below.

When using GND/Open sensors, the VWET terminal must be used to pull up the sensors inputs. With VWET at 28V and VLOGIC at 3.3V, the wetting current will be approximately 1mA. If additional wetting current is required, connect an external resistor from VWET to the sense line. See datasheet for more guidance on wetting current tables and adjustment.

Pin Number	Sensor Number	
	0:7	8:15
1	0	8
2	1	9
3	2	10
4	3	11
5	4	12
6	5	13
7	6	14
8	7	15
9	GND	GND

Connection pins for external sensors


HI-8470 100 PQFP
U1
VLOGIC CAN BE 3.3 TO 5V
HOWEVER IF 5V IS USED J1 MUST
BE LEFT OFF AND 3.3V SUPPLIED
TO VDD TERMINAL.
Not Inserted
C8 and C21
MOUNT NEAR U1
SENSOR OUT 0:7
SENSOR OUT 8:15
SPEED & ARINC BITS
MASTER RESET
LINK TO HOLD
IN RESET
XTAL VDD
LINK
EXTERNAL CLOCK
OSC, 4 PIN, 1MHz 3.3V
ARINC OUT
EXT ARINC DRV A
MAX6816
TRANSMIT (SPST-NC)
HI-8470 DISCRETE TO ARINC DRIVER EVALUATION BOARD
Tuesday, April 30, 2013

Appendix 1 Lightning Protection

The sense inputs and ARINC 429 driver outputs (TXA and TXB) are protected to RTCA/DO-160G, Section 22 Level 3 Pin Injection Test Waveform Set A (3 & 4), Set B (3 & 5A) and Set Z (3 & 5B) without the use of any external components. For more details please see the latest datasheet and Application Note AN-305.

The level of lightning protection can be increased by using external components, please see the Application Notes available on Holt's website http://www.holtic.com.

The layout of a HI-8470 board should always have low conductivity paths from the device power/ground pin to the relevant power or ground origin. These paths should avoid proximity to sense or other signal traces; this applies to above and below as well as horizontally. It is good practice to have a power and ground 'moat' beneath the sense line to prevent disturbance on these lines during a 'lightning' event.

Bill of Materials: HI-8470 Evaluation Board

Item	Qty	Description	Reference	DigiKey	Mfr P/N
1	1	PCB, Bare, Eval Board	N/A	--------	JetTech 35005
2	4	Capacitor, Cer 0.1uF 20% 50V Z5U 0805	C20, C8, C21, C11	399-1176-1-ND	Kemet C0805C104M5UACTU
3	1	Capacitor, Cer 0.01uF 20% 50V Z5U 0805	C16	399-1160-1-ND	Kemet C0805C103M5RACTU
4	4	Capacitor, Cer 100pF 20% 50V Z5U 0805	C9, C12, C14, C18	399-1122-1-ND	Kemet C0805C101J5GACTU
5	2	Cap Cer 4.7uF 16V X7R 20% 1210 SMD	C2, C7	587-1392-1-ND	Taiyo EMK325B7475KN-T
6	2	Cap Cer 47uF 10V X7R 20% 1210 SMD	C1, C3	587-2783-1-ND	Taiyo LMK325B7476MM-TR
7	4	Cap Alum 47uF 50V 20% SMD	C4, C10, C13, C15	PCE4222CT-ND	Panasonic EEE-HA1H470XPS
8	4	Cap Alum 47uF 16V 20% SMD	C5, C6, C17, C19	PCE3889CT-ND	Panasonic EEE-1CA470SP
9	4	Header, Male 1x9, .1" Pitch	J4, J13, J14, J15	S1012E-09-ND	Sullins S1012E-09-ND
10	4	Header, Male 1x3, .1" Pitch	J5, J11, J7, J8	S1012E-03-ND	Sullins S1012E-03-ND
11	10	Header, Male 1x2, .1" Pitch	J1, J2, J3, J6, J16, J18, J19, J9, J10, J12	S1012E-02-ND	Sullins S1012E-02-ND
12	1	LED Green 0805	D1	160-1179-1-ND	LiteOn LTST-C170GKT
13	18	Resistor, 0 5% 1/8W 0805	R4-R11, R15-R22, R29, R30	P0.0ACT-ND	Panasonic ERJ-6GEY0R00V
14	1	Resistor, 39 5% 1/8W 0805	R28	P39ACT-ND	Panasonic ERJ-6GEYJ390V
15	1	Resistor, 680 5% 1/8W 0805	R26	P680ACT-ND	Panasonic ERJ-6GEYJ681V
16	4	Resistor, 3.6K 5% 1/8W 0805	R1, R12, R14, R25	P3.6KACT-ND	Panasonic ERJ-6GEYJ362V
17	1	Resistor, 10K 5% 1/8W 0805	R13	P10KACT-ND	Panasonic ERJ-6GEYJ103V
18	5	Resistor Network, 100K 5% 9 Res 10SIP	R27, R23, R24, R3, R2	770-101-R100KP-ND	CTS 770101104P
19	4	Resistor Trim Pot 20K, 0.5W, 20T, Th.	VR1, VR2, VR3, VR4	490-2881-ND	Murata PV36W203C01B00
20	7	Switch Tape Seal 8Pos SMD	SW1, SW2, SW3, SW5, SW6, SW7, SW8	CT2198MST-ND	CTS 219-8MST

Continued on next page.

Bill of Materials (cont.): HI-8470 Evaluation Board

Item	Qty	Description	Reference	DigiKey	Mfr P/N
21	1	Osc 1.MHz 3.3V, 5x7mm SMD	Y1	631-1122-1-ND	FOX FXO-HC735-1
22	1	Switch Tactile SPST-NC 0.05A, 50V	SW4	EG4588CT-ND	E-Switch TL3310AF120QG
23	1	Test Point, Red Insulator, 0.062" hole	TP19	5010K-ND	Keystone 5010
24	5	Test Point, Black Insulator, 0.062" hole	TP1, TP14, TP2, TP16, TP4	5011K-ND	Keystone 5011
25	2	Test Point, White Insulator, 0.062" hole	TP15, TP3	5012K-ND	Keystone 5012
26	2	Test Point, Orange Insulator, 0.062" hole	TP12, TP18	5013K-ND	Keystone 5013
27	7	Test Point, Yellow Insulator, 0.062" hole	TP17, TP6, TP8, TP10, TP13, TP7, TP9	5014K-ND	Keystone 5014
28	1	HI-8470PQI - 100PQFP	U1	HOLT IC	Holt IC
29	1	IC Debouncer SW SGL SOT143-4	U2	Max6816EUS	Maxim MAX6816EUS+T
30	4	Stand-off, Threaded #4-40F, 1/2" Long Round	Any	3480K-ND	Keystone 3480
31	4	Machine Screw, #4-40 x 1/4"	Any	H343-ND	PMS 440 0031 PH
32	4	Lock Washer, Int.Tooth #4-40	Any	H236-ND	B&F Intlwz 004

REVISION HISTORY

Revision	Date	Description of Change
AN-8470, Rev. New	5-3-13	New
AN-8470, Rev. A	3-2-15	Add BOM. Make minor corrections.