HOLT INC.
INTEGRATED CIRCUITS

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AN-8470ADC

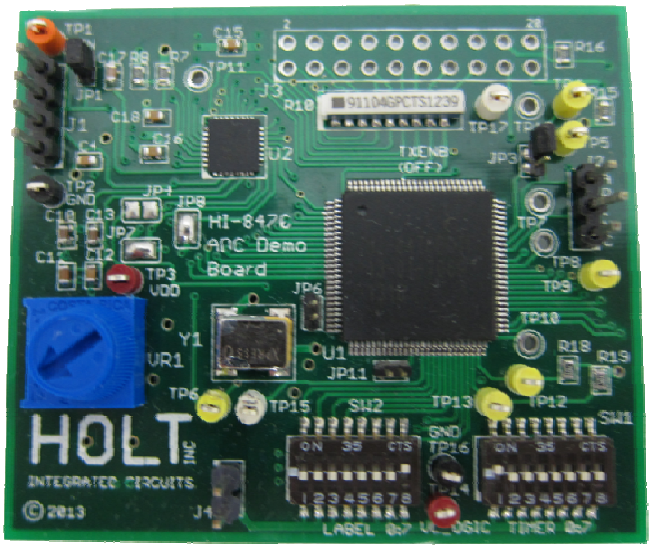
Interfacing an Analog Sensor to the HI-8470. An Application Example

INTRODUCTION

The Holt HI-8470 ADC Evaluation Board demonstrates the use of Holt's HI-8470 with an analog sensor using an Analog to Digital Converter (ADC) to interface to the sensor. The HI-8470 is a 16-channel discrete-to-digital sensor with built-in ARINC 429 transmitter. All sense input thresholds and ARINC 429 transmission control are programmed via logic level input pins, eliminating the need for a microprocessor or software interface.

A single 3.3V, ± 5% supply voltage supplies the board. It provides a compact (2.25" x 2") unit that can be used to send low frequency analog sensor data over an ARINC 429 bus, using only two integrated circuits. A single supply 12 bit ADC with a 1V or 2V input range from Linear Technology is mounted on the board, which is suitable for AC or DC inputs. If required the ADC can be upgraded to a 14-bit device with the same footprint. For demonstration purposes a potentiometer is provided to supply a variable input test voltage.

The board is self contained and requires no software; all functions are set by hardware switches. DIP switches are used to configure the device and data inputs. The Evaluation Board is shown in the picture below:

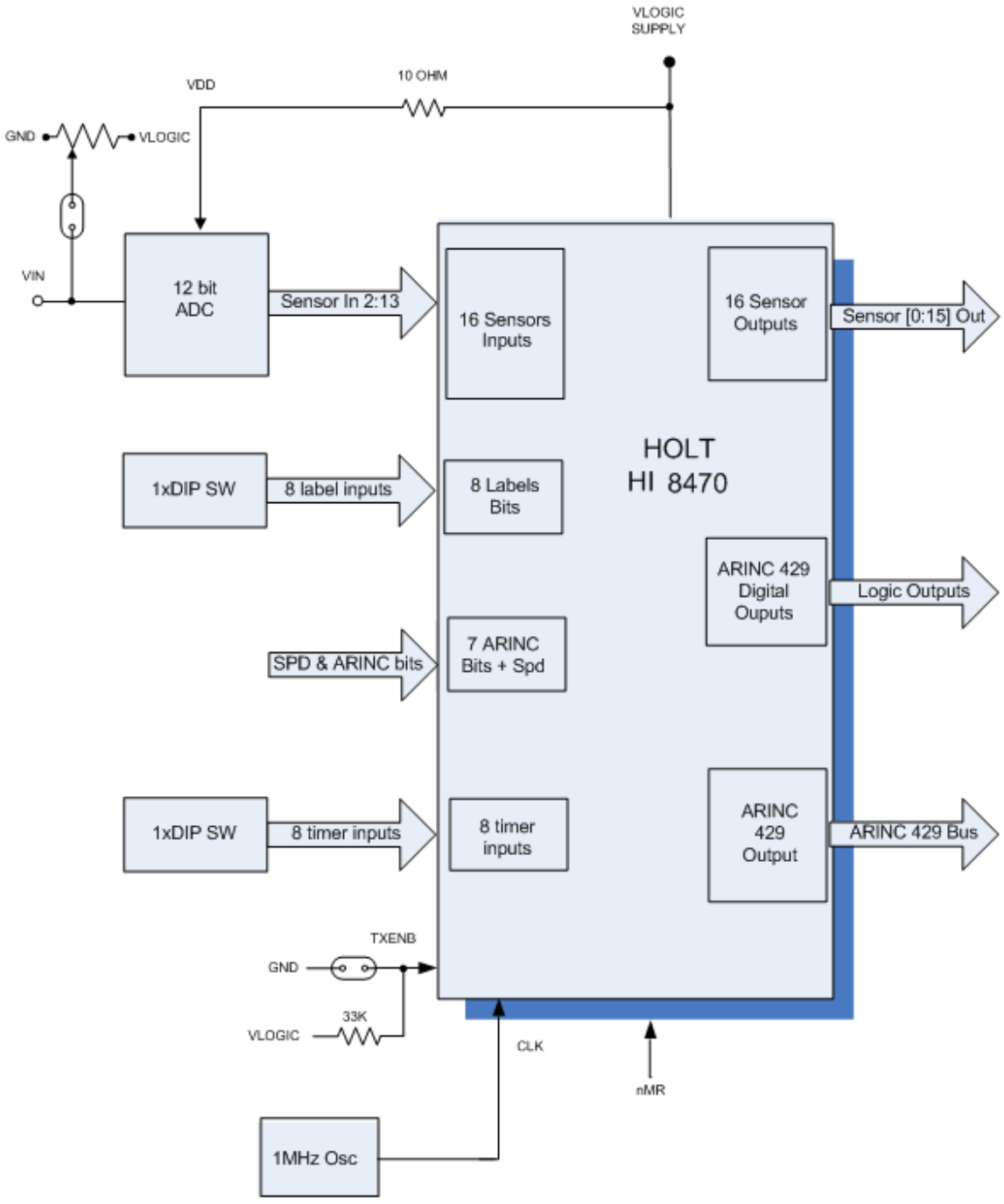


KIT CONTENTS

HI-8470 ADC Evaluation Board

This User Guide, HI-8470 Datasheet, LTC2225 Datasheet

BOM + Gerber Files



Jumper Functions

Jumper	Default	Link On	Link Off
JP			
1	ON	Pot connected	Ext input from J1
2	ON	C mode - AIN- = 1.5V	Ext input from J1
3		Transmit disabled	Transmit Enabled
4		Inverted clock	Non Inv Clk
5	ON	Non Inv Clk	Inverted clock
6		TST0 - Tx Ones	Normal
7	ON	Power Up	Shut down
8	ON	Output Enabled	Output Disabled
9		TST1 - Tx Zeros	Normal
10	ON	ADC +/-0.5V range	ADC +/-1.0V range
11		ARINC = Lo Speed	ARINC = Hi Speed
12		Master Reset	Normal
13	ON	Power Connected	Power Open
14		Disable Clock Oscillator	Enable Clock Oscillator

Switch Functions

SWITCH	DEFAULT	DESCRIPTION
LABEL 0:7	00000001	Sets ARINC label bits 0:7, ON = '1'
TIMER 0:7	10000000	Sets ARINC message transmission timer, ON = '1'

Connector Functions

Connector	PIN	DESCRIPTION
J1	2,3	ADC + and - inputs
	1,4	GND and VLOGIC supplies
J2	2 ,3	ARINC 429 output
	9	GND
J4	1	GND
	2	VLOGIC supply

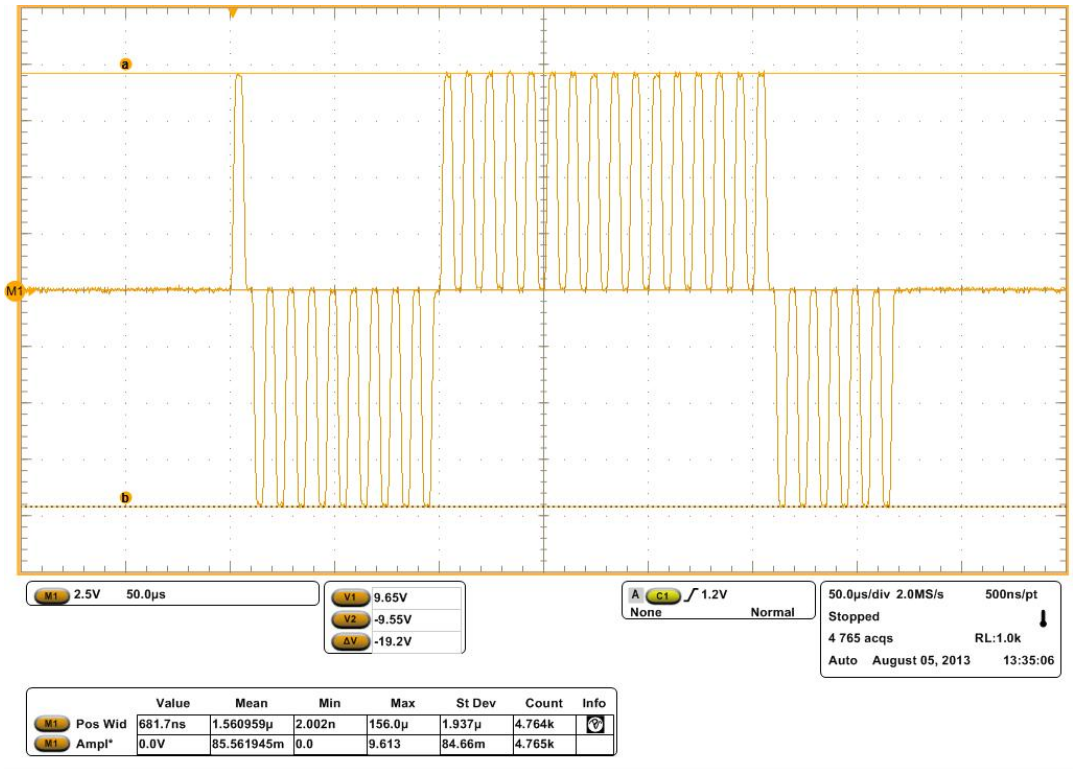
Board Set Up

1. Make sure the link and switch positions are in default positions. Connect a 3.3V supply to J4, the pin near the edge is VLOGIC while the other pin is GND. JP13 connects power to VDD, which is the ADC power line, note that the ADC operates from a nominal 3.1V, so a 10ohm resistor is used to drop ~0.2V.

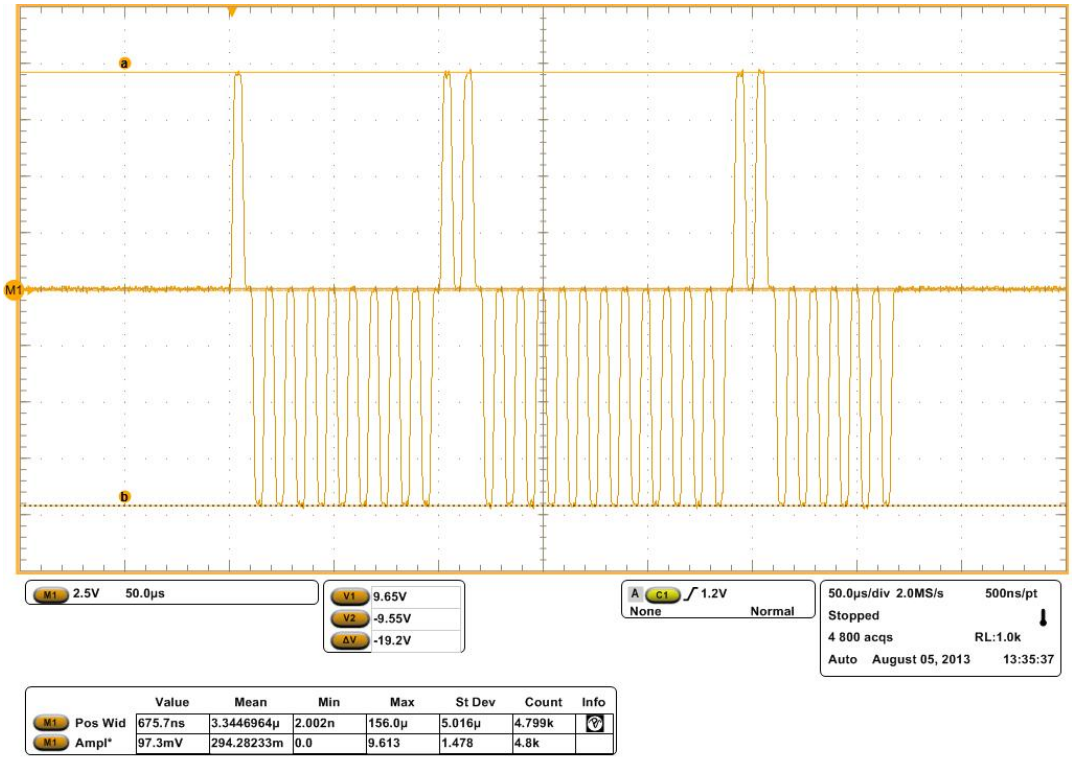
2. Both the HI-8470 and ADC run from an external 1MHz clock, if desired an external clock can be connected to TP15, after disabling the on board oscillator with JP14. By default the board is set up for the high speed ARINC 429 Output, to change to low speed insert JP11.

3. The ADC will transmit the voltage sensor data to the discrete sensor inputs, which by default are set to standard logic levels. When the TXENB input is high, ARINC words are transmitted according to the setting of the TIMER7:0 bits. Make sure these are set to 10000000.

4. Connect an oscilloscope to the ARINC outputs on J2, pins 2 and 3, for best results use the scopes differential mode. Set potentiometer to fully clockwise, this inputs the minimum voltage of about 0.950V. Observe the ARINC output; it should look similar to the waveform below, note that the data gets inverted when transmitted as the discrete inputs have an inversion built into them. If true data is required then the data should be inverted before being input to the HI-8470.

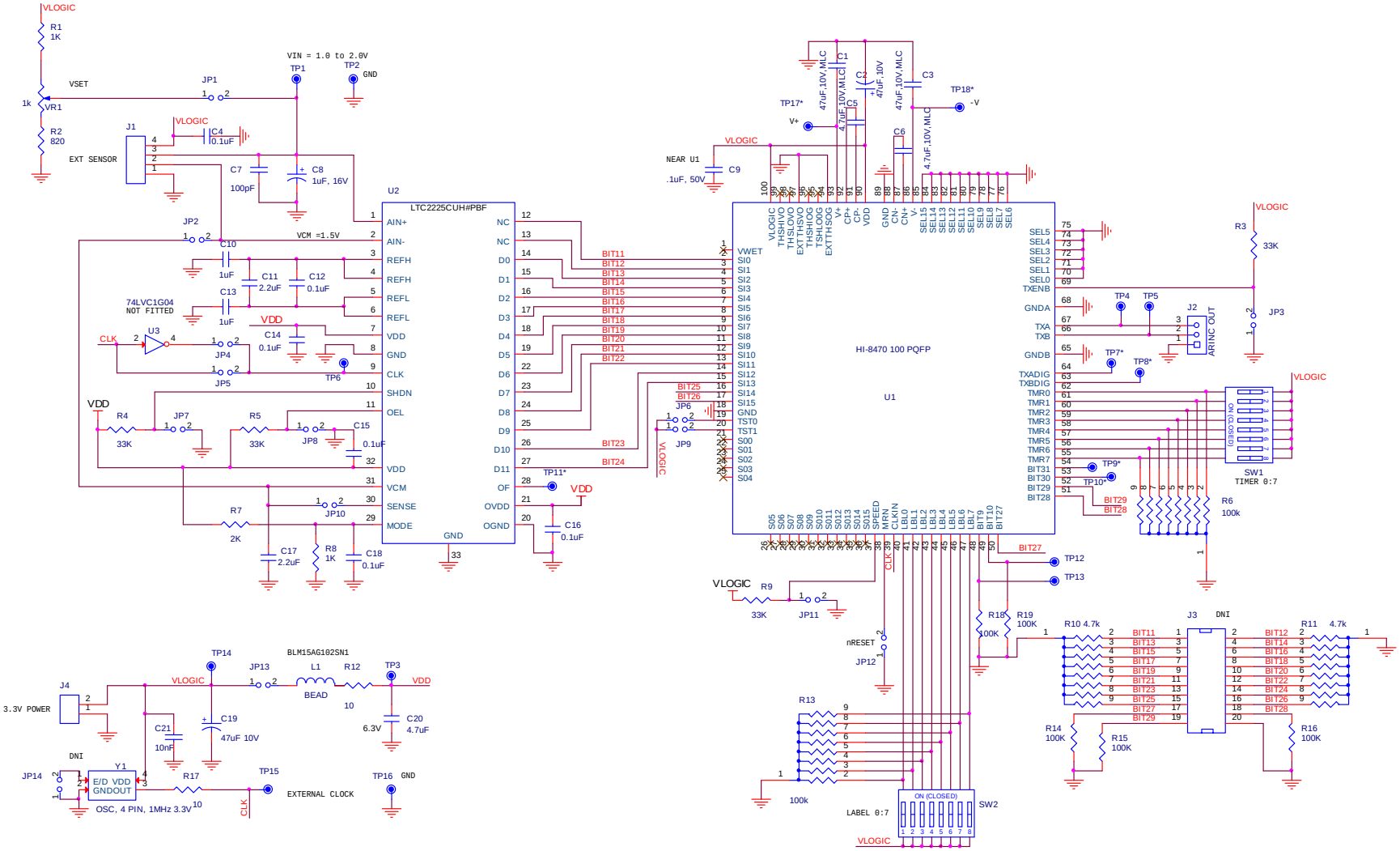


5. Now turn the pot counter-clockwise, to increase the input voltage (monitor on TP1); you should notice that data on bits 13 to 24 changes with the input voltage. When fully counter-clockwise the voltage is ~2.1, it should look like the screen below, since the bits are inverted this shows the ADC bits are all ones or approximately 2V. The two pairs of high pulses are unused bits 11,12 and 25,26, because they are pulled down they are transmitted as ones.



6. An external voltage source can be used by unlinking JP1 and connecting a source to J1. There are options on the board to change the voltage amplitude range and common mode. The digital output format can also be changed to two's complement. Please see the LTC2225 datasheet for full details. If an AC input is used, this should be capacitively coupled.

7. The ARINC 429 labels can be altered using SW2. Timer bits 7:0 are controlled by SW1, these increase the time period between transmissions; for details see HI-8470 datasheet. The data from the ADC can be accessed directly on J3 or an external ADC can be connected to J3 after first disabling the ADC outputs by disconnecting JP8. An external ARINC 429 driver can be connected at TP7/8.


VLOGIC
R1
1K
VSET
1k
VR1
R2
820
VIN = 1.0 to 2.0V
TP1
TP2
GND
JP1
J1
EXT SENSOR
C4
0.1uF
C7
100pF
C8
1uF, 16V
U2
LTC2225CUH#PBF
JP2
VCM =1.5V
C10
1uF
C11
2.2uF
C12
0.1uF
C13
1uF
74LVC1G04
NOT FITTED
U3
CLK
JP4
JP5
TP6
VDD
C14
0.1uF
R4
33K
JP7
R5
33K
JP8
C15
0.1uF
R7
2K
C17
2.2uF
R8
1K
C18
0.1uF
JP10
AIN+
AIN-
REFH
REFH
REFL
REFL
VDD
GND
CLK
SHDN
OEL
VDD
VCM
SENSE
MODE
GND
NC
NC
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
OF
OVDD
OGND
TP11*
C16
0.1uF
BIT11
BIT12
BIT13
BIT14
BIT15
BIT16
BIT17
BIT18
BIT19
BIT20
BIT21
BIT22
BIT23
BIT24
BIT25
BIT26
JP6
JP9
C1
47uF,10V,MLC
C2
47uF, 10V
C3
47uF,10V,MLC
C5
4.7uF,10V,MLC
C6
4.7uF,10V,MLC
TP17*
V+
TP18*
-V
NEAR U1
C9
.1uF, 50V
HI-8470 100 PQFP
U1
VWET
SI0
SI1
SI2
SI3
SI4
SI5
SI6
SI7
SI8
SI9
SI10
SI11
SI12
SI13
SI14
SI15
GND
TST0
TST1
S00
S01
S02
S03
S04
SEL5
SEL4
SEL3
SEL2
SEL1
SEL0
TXENB
GNDA
TXA
TXB
GNDB
TXADIG
TXBDIG
TMR0
TMR1
TMR2
TMR3
TMR4
TMR5
TMR6
TMR7
BIT31
BIT30
BIT29
BIT28
TP4
TP5
TP7*
TP8*
TP9*
TP10*
J2
ARINC OUT
R3
33K
JP3
SW1
TIMER 0:7
R6
100k
BIT29
BIT28
BIT27
TP12
TP13
R9
33K
JP11
nRESET
JP12
R18
100K
R19
100K
R10 4.7k
J3
DNI
R11
4.7k
R14
100K
R15
100K
R16
100K
R13
100k
LABEL 0:7
SW2
ON (CLOSED)
TP14
BLM15AG102SN1
JP13
L1
R12
TP3
BEAD
10
VDD
J4
3.3V POWER
C19
47uF 10V
C20
4.7uF
6.3V
C21
10nF
DNI
JP14
Y1
E/D VDD
GNDOUT
OSC, 4 PIN, 1MHz 3.3V
R17
10
TP15
TP16
EXTERNAL CLOCK
CLK

Bill of Materials			HI-8470 ADC Evaluation Board		5-Aug-13
Item	***Qty***	***Description***	***Reference***	***DigiKey***	***Mfr P/N***
1	1	PCB, Bare, Eval Board	N/A	--------	JetTech 35272
2	7	Capacitor, Ceramic 100nF 10% 50V X7R 0603	C4,C9,C12,C14, C15,C16,C18	399-5089-1-ND	Kemet C0603C104K5RACTU
3	1	Capacitor, Ceramic 10nF 10% 50V X7R 0603	C21	399-1091-1-ND	Kemet C0603C103K5RACTU
4	1	Capacitor Cer 100pF 50V 5% NP0 0603	C7	399-1061-1-ND	Kemet C0603C101J5GACTU
5	1	Capacitor Tantalum 4.7uF 10V 20% 0805	C20	493-2333-1-ND	Nichicon F921A475MPA
6	1	Capacitor Tantalum 1uF 16V 20% 0805	C8	493-2334-1-ND	Nichicon F921C105MPA
7	2	Capacitor Ceramic 4.7uF 10V 10% X5R 0603	C5,C6	445-7482-1-ND	TDK CGB3B1X5R1A475K055AC
8	4	Capacitor Ceramic 47uF 10V 20% JB 0805	C1,C3,C2,C19	445-11420-1-ND	TDK C2012JB1A476M125AC
9	2	Capacitor, Ceramic 1uF 16V 10% X7R 0603	C10,C13	445-1416-1-ND	TDK C1608X5R1C105K080AA
10	2	Capacitor, Ceramic 2.2uF 16V 10% X5R 0603	C11,C17	445-5157-1-ND	TDK C1608X5R1C225K080AB
11	4	Header, Male 1x2, .05" Pitch	JP1,JP3, JP6,JP11	S9014E-02-ND	Sullins GRPB021VWVN-RC
12	4	Conn Shunt 1.27mm Black	N/A	952-1730-ND	Harwin M50-1900005
13	4	Conn Shunt 2 Position, 0.1" Pitch	N/A	A31697-ND	TE 2-382811-1
14	1	Header, Male 1x2, .1" Pitch	J4	S1012E-02-ND	Sullins S1012E-02-ND
15	1	Header, Male 1x3, .1" Pitch	J2	S1012E-03-ND	Sullins S1012E-09-ND
16	1	Header, Male 1x4, .1" Pitch	J1	S1012E-04-ND	Sullins S1012E-03-ND
18	8	Solder Pads	N/A	N/A	N/A
19	1	Ferrite Chip 1000 Ohm 50mA 0603	L1	490-1031-1-ND	Murata BLM18HD102SN1D
20	2	Res 10 Ohm 1/10W 5% 0603 SMD	R12,R17	P10GCT-ND	Panasonic ERJ-3GEYJ100V
21	2	Res 1K Ohm 1/10W 5% 0603 SMD	R2,R8	P1.0KGCT-ND	Panasonic ERJ-3GEYJ102V
22	1	Res 820 Ohm 1/10W 5% 0603 SMD	R1	P1.3KGCT-ND	Panasonic ERJ-8GEYJ390V
23	1	Res 2.0K Ohm 1/10W 5% 0603 SMD	R7	P2.0KGCT-ND	Panasonic ERJ-3GEYJ202V
24	4	Res 33K Ohm 1/10W 5% 0603 SMD	R3,R4,R5,R9	P33KGCT-ND	Panasonic ERJ-8GEYJ333V
25	5	Res 100K Ohm 1/10W 5% 0603 SMD	R14,R15,R16,R18,R19	P100KGCT-ND	Panasonic ERJ-8GEYJ104V
26	2	Res Array 100K Ohm 8 RES 9SRT	R6,R13	752-091-100KPCT-ND	CTS 752091104GPTR7
26	2	Res Array 4.7K Ohm 8 RES 9SRT	R10,R11	752-091-4.7KPTR-ND	CTS 752091472GPTR7
27	1	Pot 1.0K Ohm 9mm SQ Plastic	VR1	3310P-001-102L-ND	Bourns 3386P-102TLF-ND
28	2	Switch DIP Half Pitch 8 Pos	SW1,SW2	CT2188LPST-ND	CTS 218-8LPST
29	1	Osc 1.0 Mhz 3.3V HCMOS, 5x7 mm SMD	Y1	631-1122-1-ND	FOX FXO-HC735-1
30	2	Test Point PC Mini .040"D Red	TP3,TP14,	5000K-ND	Keystone 5010
31	2	Test Point PC Mini .040"D Black	TP2,TP16	5001K-ND	Keystone 5011
32	2	Test Point PC Mini .040"D White	TP17,TP15	5002K-ND	Keystone 5012
33	1	Test Point PC Mini .040"D Orange	TP1	5003K-ND	Keystone 5013
34	6	Test Point PC Mini .040"D Yellow	TP6,TP4,TP5, TP9,TP12,TP13	5004K-ND	Keystone 5014
35	1	HI-8470 100 PQFP	U1	HI-8470PQIF	Holt IC
36	1	IC ADC 12-Bit 10Msps 3V 32-QFN	U2	LTC2225CUH#PBF-ND	Linear LTC2225CUH#PBF
37	1	IC Single Inverter-Gate SOT-23-5	U3 NOT FITTED	296-11599-1-ND	TI SN74LVC1G04DBVR
38	4	Bumpon Cylindrical .312X.200 Black	N/A	SJ5746-0-ND	3M SJ61A1

Revision	Date	Description of Change
AN-8470ADC, Rev. New	7-19-13	Initial Release
AN-8470ADC, Rev. A	8-05-13	Added BOM, changed waveform, pictures and schematic