PROGRAMMABLE GAIN, INSTRUMENTATION AMPLIFIER, LTC6915

DESCRIPTION

A DC1070 demonstration circuit features the LTC6915 IC, a programmable gain instrumentation amplifier.

The LTC®6915 is a precision programmable gain instrumentation amplifier. The gain can be programmed to 0, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096 through a parallel or serial interface. The offset is below 10µV with a temperature drift of less than 50nV/°C. The LTC6915 uses charge balanced sampled data techniques to convert a differential input voltage into a single ended signal that is in turn amplified by a zero-drift operational amplifier. The LTC6915 can be used in single power supply applications as low as 2.7V, or with dual ±5V supplies.

The DC1070 contains an LTC6915, an LCD display and switches and a PIC (micro-controller). The PIC reads the settings of the switches, sends a parallel or a serial control word to the LTC6915 and displays the PGA gain on the LCD display. The LTC6915 on the DC1070 can be controlled with an external parallel or serial digital control by moving wire jumpers A-F from position 1-2 to 2-3 and connecting six external digital control lines to on board turrets.

Figure1. LTC6915 Block Diagram

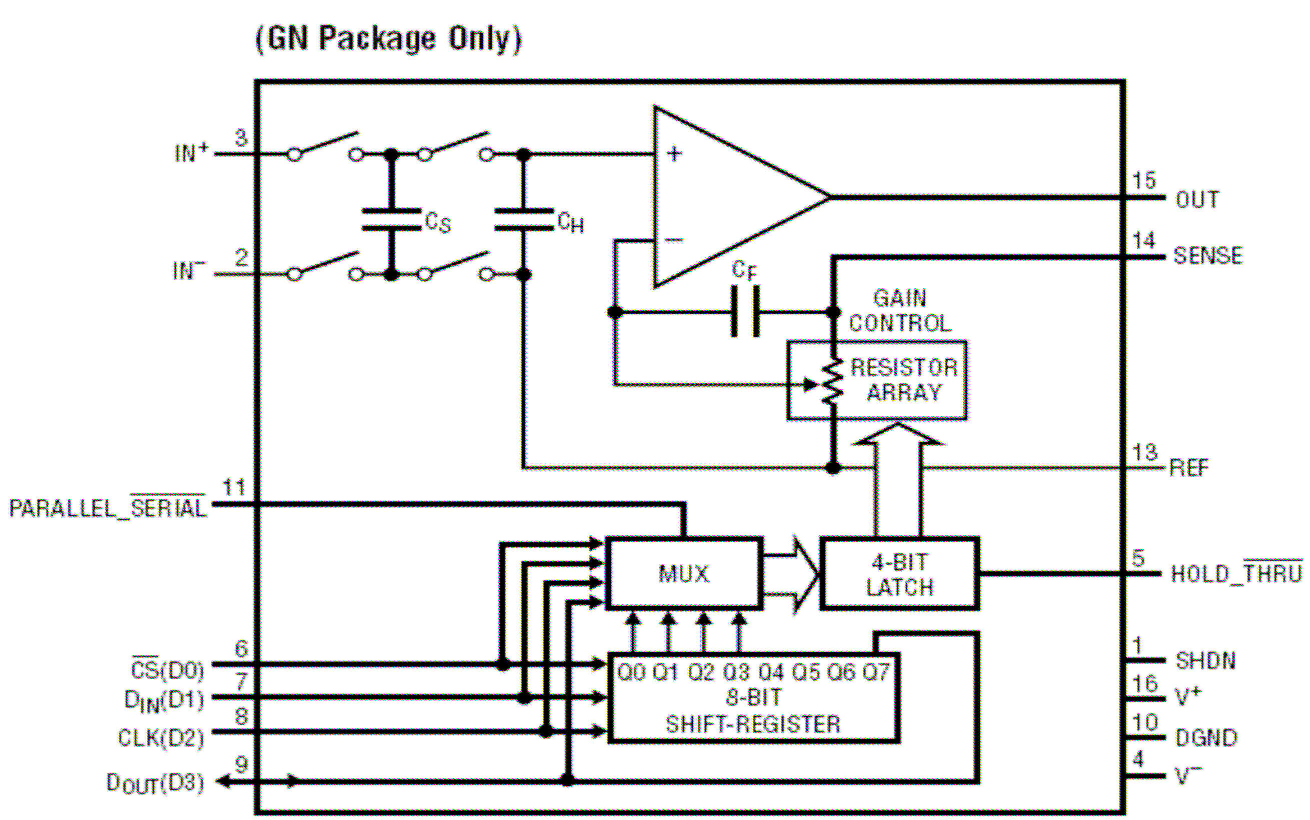
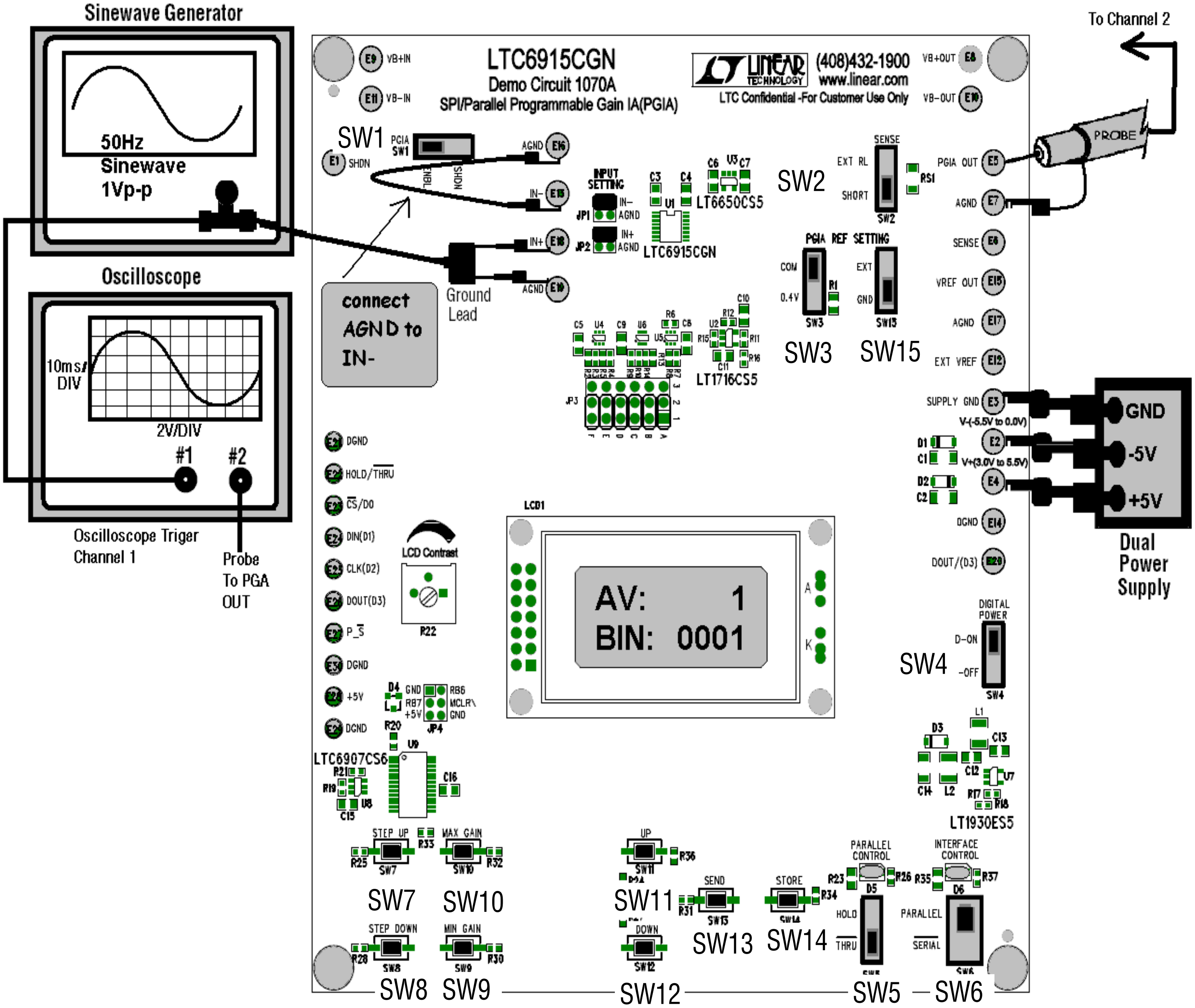


Figure 2. Quick Test Setup



Quick Test Setup:

1. Turn contrast pot clockwise to view LCD display.
2. Set red slide switches as shown in Figure 2: SW1 slide left; SW2 slide down; SW3 slide up; SW4 slide up; SW15 slide down; SW5 slide down; SW6 slide up (Parallel Mode).
3. Set sinewave generator for a 1Vp-p, 50Hz sinewave and connect to oscilloscope channel 1 and to IN+ of the DC1070. Use a clip to clip jumper to connect AGND to IN- (or connect the JP1 shunt to the AGND position).
4. Set oscilloscope for 10ms/Division and 2V/Division and trigger on channel 1.
5. Connect Dual +/-5V supply.

Quick Test Procedure:

1. Turn on power supply. The green LED over SW6 should be on.
2. Press the UP push button SW (SW11) repeatedly and the LCD display should step thru AV: 1 to Av: 4096 in powers of two (1, 2, 4, 8, 16, 32, 64, 128, 512, 1024, 2048, and 4096).
   Press the DOWN push button SW (SW12) until Av: 1. Press the SEND push button SW (SW13) and then the STORE push button SW (SW14). Channel 2 should show a 1Vp-p, 50Hz, sinewave (*the STORE push button SW saves a PGA gain setting so that it is the gain setting when the board is powered-up*). Press the MIN GAIN push button SW (SW9) and the LCD display should flash "MIN GAIN SET".
3. Press the UP push button SW until AV: 4. Press the MAX GAIN push button SW (SW10) and the LCD display should flash "MAX GAIN SET".
4. Press and hold the STEP UP push button SW (SW7) for about three seconds and channel 2 should show a 4Vp-p, 50Hz, sinewave (MAX GAIN setting).
5. Press and hold the STEP DOWN push button SW (SW8) for about three seconds and channel 2 should show a 1Vp-p, 50Hz, sinewave (MIN GAIN setting).
6. Set SW5 up (HOLD). The green LED over SW5 should be on and the gain setting can not be changed with any other switch (SW 7-14).
7. Set SW5 down (THRU).
8. Set SW6 down (SERIAL). Steps 2-8 can be repeated in Serial Mode.
   Note: *the LTC6915 -3dB bandwidth is approximately 400Hz*.

Using a Bridge Sensor with a DC1070

Figure 3 shows the DC1070 connections using a bridge sensor as an input signal source. The bridge sensor can be any sensor that is configured as a Wheatstone resitive bridge with one two or four sensor elements. Figure 4 shows a resistive bridge that can be used to simulate the output of a Wheatstone bridge sensor.

Test Procedure Using the Figure 4 Bridge

1. On DC1070 set SW3 to COM and SW15 to EXT and Connect Figure 4 bridge to DC1070 as per Figure 3.
2. Connect bridge supply, DC1070 power supply, voltage source and 6 1/2 DMM as per Figure 3.
3. Set the bridge supply and the DC1070 power supply to 3.0V and the voltage source connected to EXT VREF to 1.5V. Note: The external reference voltage sets the output DC reference (VREF). The bridge input is equal to [PGA OUT-VREF]/(PGA GAIN). In a single supply operation, if the bridge input is positive (IN+>IN-) then VREF can be 0V. If the bridge input is ±Volts then VREF should be at least equal to the maximum bridge input times the PGA gain. For example if the maximum bridge input is ±10mV and the PGA gain is set to 128 then VREF should ≥ 128 X 10mV or 1.28V. With a 3V LTC6915 and a VREF equal to 1.5V, the maximum [PGA OUT-VREF] range is ±1.5V (Rload≥10k).
4. Set the PGA gain to 1 using the UP and DOWN push button SW and adjust the bridge 100 ohm potentiometer until [PGA OUT-VREF]=10mV.
5. Measure the bridge voltage [VB+OUT - VB-OUT] (this is the voltage of the bridge supply). The ratio of [PGA OUT-VREF]/ [VB+OUT - VB-OUT] is a measure of the bridge unbalance or sensor sensitivity. For example, if the bridge sensor is measuring weight in lbs and for each lb [PGA OUT-VREF]=10mV then [PGA OUT-VREF]/ [VB+OUT - VB-OUT]=0.003333 and the sensor output is 0.003333/lb. The ratiometric bridge measurement provides for bridge sensor calibration in units of a physical variable (weight, pressure, temperature,…) and is insensitive to the absolute value of the bridge voltage or resistance (if the bridge voltage and resistance is stable during a measurement).

Figure 3. Test Setup Using a Bridge Sensor

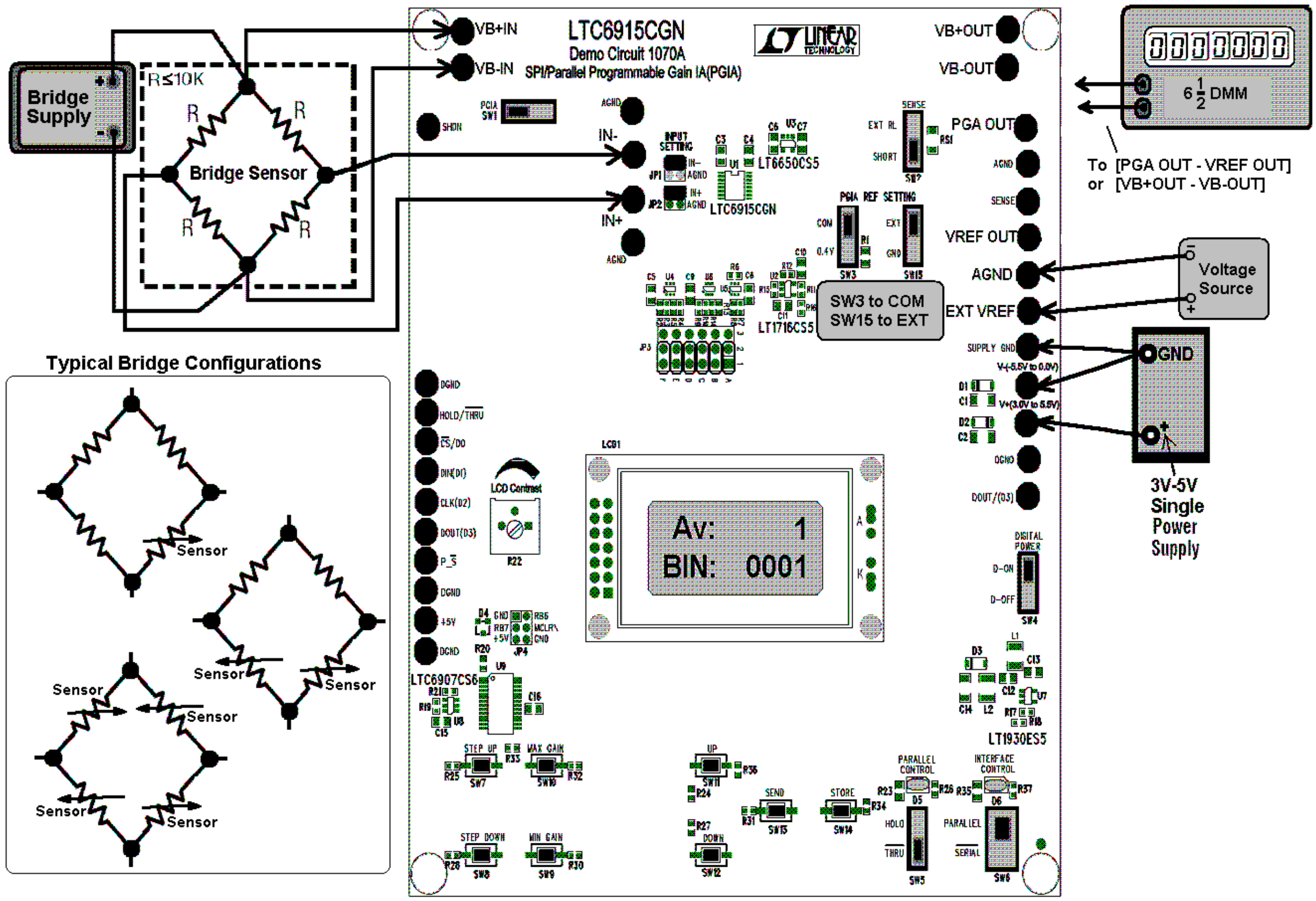


Figure 4. A Wheatstone Bridge

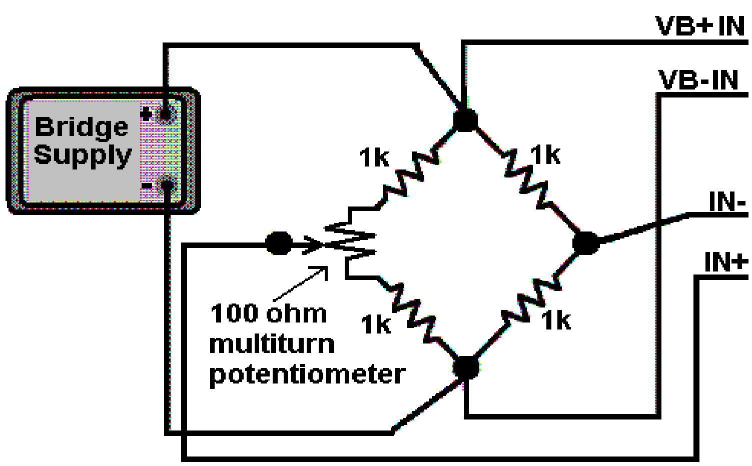
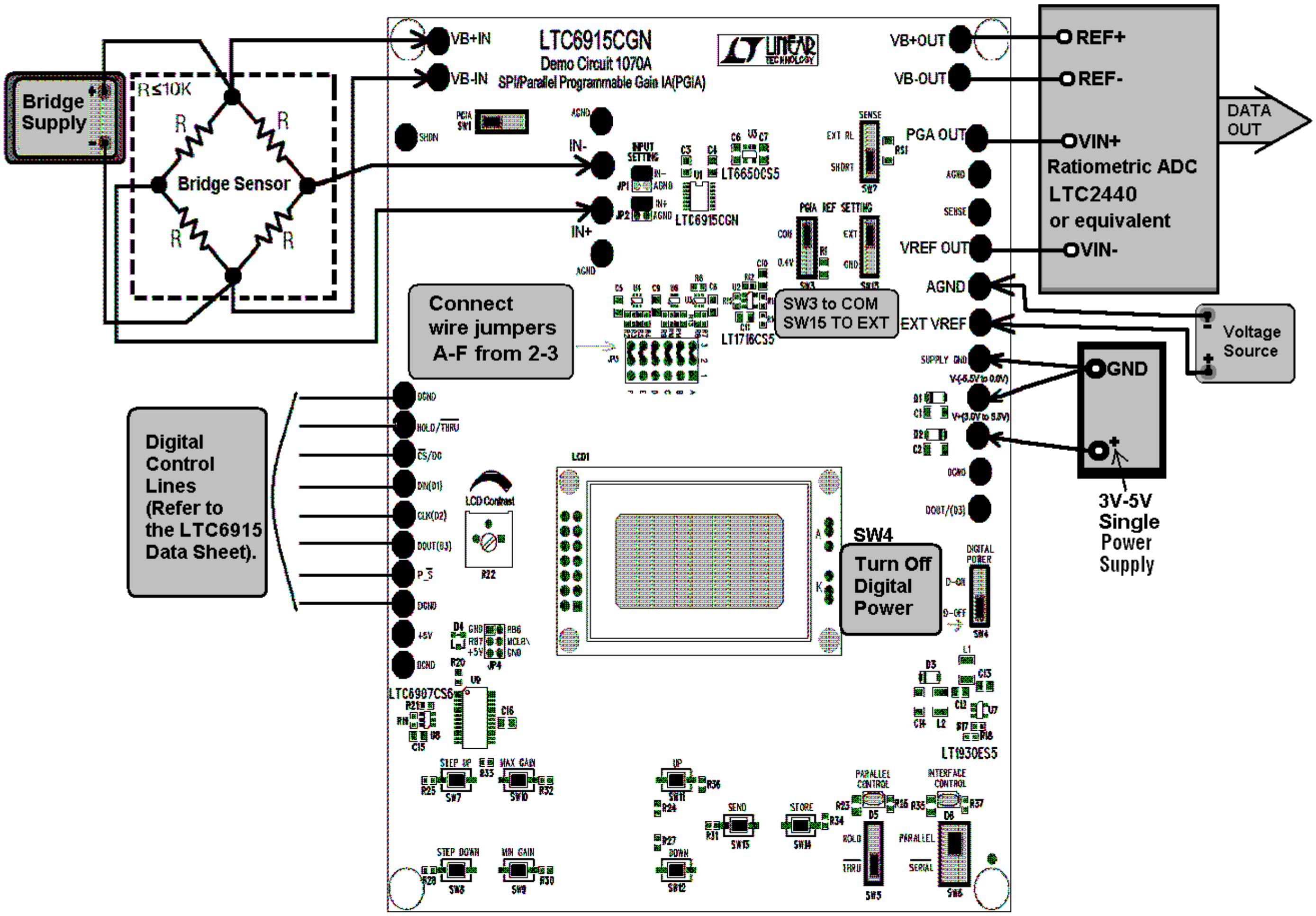


Figure 5. Test Setup Using External Digital Control and Measurement

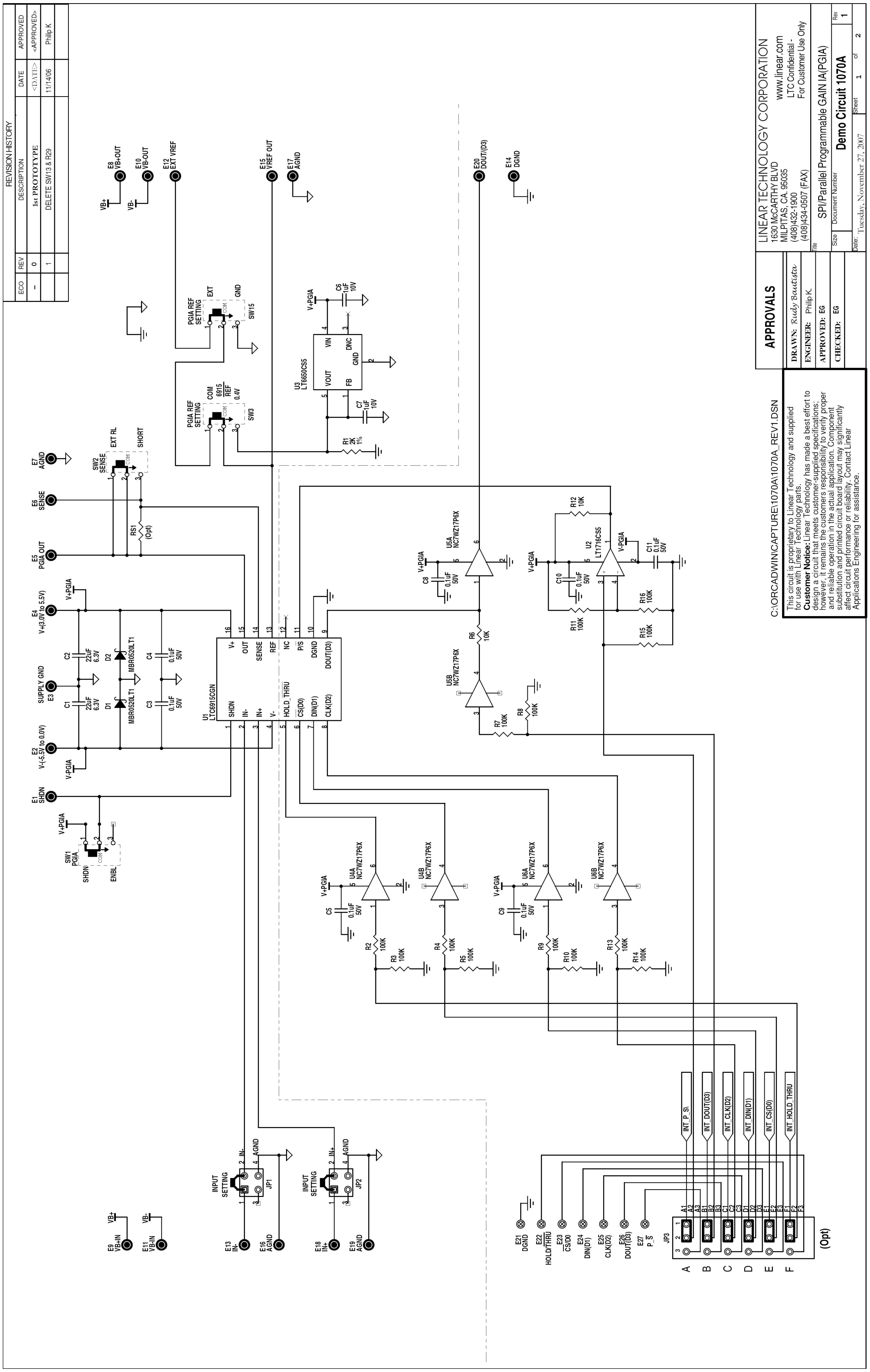


Using a DC1070 with External Control and Measurement

Figure 5 shows the DC1070 connections for external digital control and measurement. The digital control lines can be serial or parallel (the LTC6915 data sheet defines the digital control line functions and voltage levels).

Test Setup for External Control and Measuremant

1. The DC1070 is provided with wire jumpers A-F in position 1-2 and for external control the wire jumpers must be in position 2-3.
2. Set SW4 on DC1070 to D-OFF (the power to the DC1070 PIC and LCD display is disconected).
3. Connect a bridge sensor, supplies, external voltage source and ratiometric ADC as shown in Figure 5.
4. Using the Figure 5 setup and the the test procedure for Figure 3 setup as a guide, a complete system of digital control and measurement for a bridge sensor can be evaluated.


REVISION HISTORY
ECO REV DESCRIPTION DATE APPROVED
– 0 1st PROTOTYPE <DATE> <APPROVED>
1 DELETE SW13 & R29 11/14/06 Philip K
C:\ORCADWIN\CAPTURE\1070A\1070A_REV1.DSN
This circuit is proprietary to Linear Technology and supplied for use with Linear Technology parts.
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APPROVALS
DRAWN: Rudy Bautista
ENGINEER: Philip K.
APPROVED: EG
CHECKED: EG
LINEAR TECHNOLOGY CORPORATION
1630 McCARTHY BLVD
MILPITAS, CA. 95035
(408)432-1900
(408)434-0507 (FAX)
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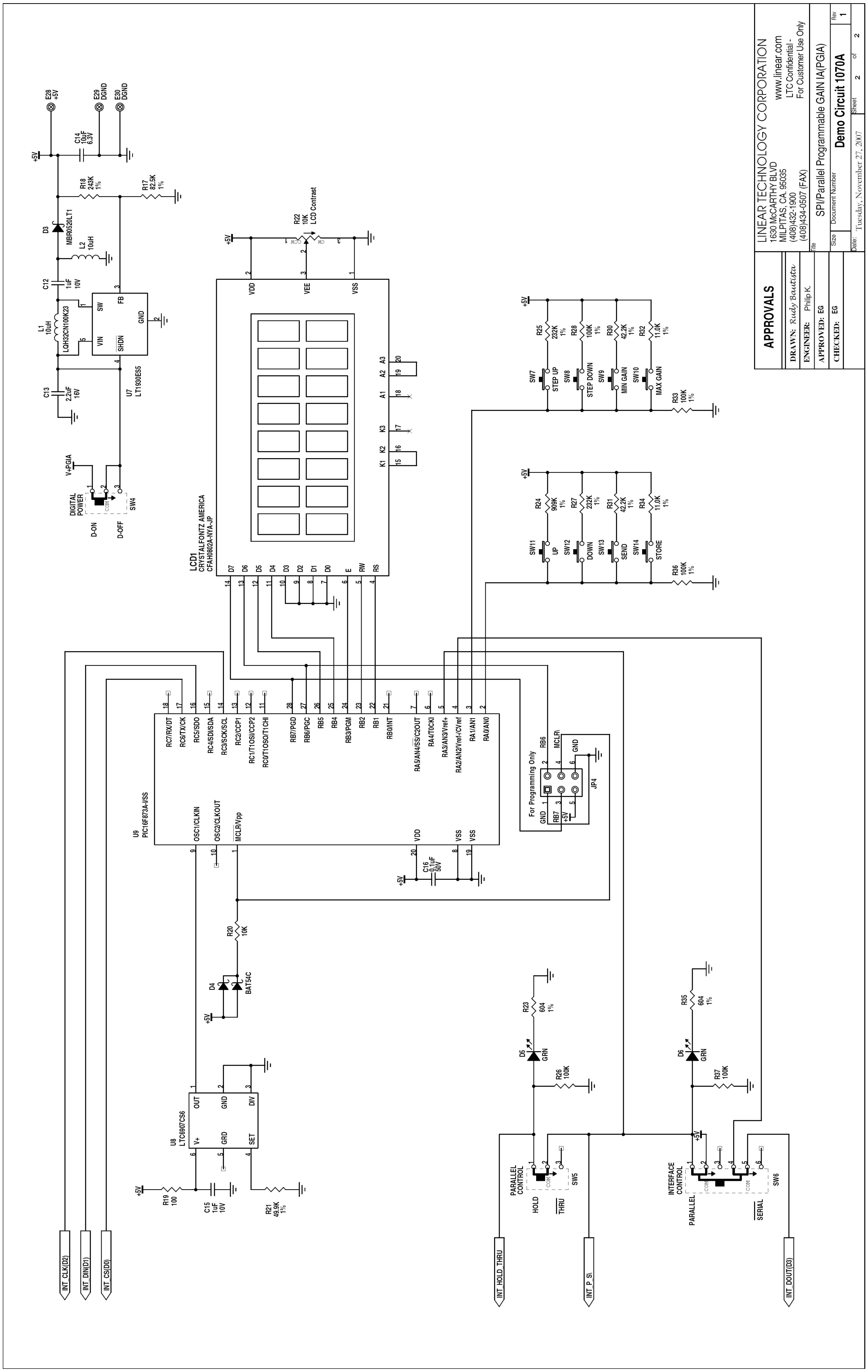
Demo Circuit 1070A
Tuesday, November 27, 2007
Sheet 1 of 2
Rev 1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SPI/Parallel Programmable GAIN IA(PGIA)
Demo Circuit 1070A
Tuesday, November 27, 2007
Sheet 2 of 2
Rev 1
U9
PIC16F873A-I/SS
U8
LTC6907CS6
U7
LT1930ES5
LCD1
CRYSTALFONTZ AMERICA
CFAH0802A-NYA-JP
R22
10K
LCD Contrast
For Programming Only
JP4
DIGITAL POWER
D-ON
D-OFF
SW4
PARALLEL CONTROL
HOLD
THRU
SW5
INTERFACE CONTROL
PARALLEL
SERIAL
SW6
STEP UP
STEP DOWN
MIN GAIN
MAX GAIN
UP
DOWN
SEND
STORE
INT_CLK(D2)
INT_DIN(D1)
INT_CS(D0)
INT_HOLD_THRU
INT_P_S\
INT_DOUT(D3)
E28
+5V
E29
DGND
E30
DGND

Linear Technology Corporation
LTC6915CGN

Bill Of Material
Demo Circuit 1070A

Item	Qty	Reference	Part Description	Manufacturer / Part #
1	2	C2,C1	Cap., X5R 22uF 6.3V 10%	Taiyo Yuden JMK316BJ226KL-T
2	8	C3-C5,C8-C11,C16	Cap., X7R 0.1uF 50V 10%	Taiyo Yuden UMK212BJ104KG-T
3	4	C6,C7,C12,C15	Cap., X7R 1uF 10V 20%	Taiyo Yuden LMK212BJ105MD-T
4	1	C13	Cap., X5R 2.2uF 16V 20%	Taiyo Yuden EMK212BJ225MG-T
5	1	C14	Cap., X5R 10uF 6.3V 20%	Taiyo Yuden JMK316BJ106ML-T
6	3	D1,D2,D3	Diode, Schotkky	Motorola MBR0520LT1G
7	1	D4	Schottky (Comm-Cath), BAT54C	Zetex BAT54C
8	2	D5,D6	LED, GRN	Panasonic LN1351CTR
9	20	E1-E20	Turret, Testpoint	Mill Max 2501-2-00-80-00-00-07-0
10	10	E21-E30	Turret, Testpoint	Mill Max 2308-2-00-80-00-00-07-0
11	2	JP1,JP2	Headers, Double Row, 2 x 2, 2mm Ctrs.	Samtec TMM-102-02-L-D
12	0	JP3 (Opt)	Headers, Double Row, 3 x 6 0.1"Ctrs.	Samtec TSW-106-07-L-T
13	1	JP4	Headers, Double Row, 2 x 3, 2mm Ctrs.	Samtec TMM-103-02-L-D
14	0	LCD1	I.C., 8x2 LCD NO BACKLT	CRYSTALFONTZ AMERICA CFAH0802A-NYA-JP
	1	LCD1 - ALTERNATE	I.C., 8x2 LCD NO BACKLT	CRYSTALFONTZ AMERICA CFAH0802A-NYG-JP
15	1	XLCD1	Headers, Dbl. Row 2 x 7 0.1" ctrs.	Samtec TSW-107-07-G-D
16	1	XLCD1	Headers, Single. Row 2 x 1 0.1" ctrs.	Samtec TSW-101-07-G-D
17	2	L2,L1	Inductor, 10uH 450mA 0.30 Ohm 10%	muRata LQH32CN100K23L
18	0	RS1 (Opt)	Res., 1206 TBD	
19	1	R1	Res., Chip 2K 0.1W 1%	AAC CR10-2001FM
20	15	R2-R5,R7-R11,R13-R16,	Res., Chip 100K 0.1W 5%	AAC CR16-104JM
		R26,R37		
21	3	R6,R12,R20	Res., Chip 10K 0.06W 5%	VISHAY CRCW060310K0JNEA
22	1	R17	Res., Chip 82.5K 0.06W 1%	VISHAY CRCW060382K5FKEA
23	1	R18	Res., Chip 243K 0.06W 1%	AAC CR16-2433FM
24	1	R19	Res., Chip 100 0.06W 5%	AAC CR16-101JM
25	1	R21	Res., Chip 49.9K 0.06W 1%	VISHAY CRCW060349K9FKEA
26	1	R22	Pot. 11 Turns 10K	Bourns 3386P-1-103
27	2	R23,R35	Res., Chip 604 0.1W 1%	VISHAY CRCW0805604RFKTA
28	1	R24	Res., Chip 909K 0.06W 1%	AAC CR16-9093FM
29	2	R25,R27	Res., Chip 232K 0.06W 1%	VISHAY CRCW0603232KFKEA
30	3	R28,R33,R36	Res., Chip 100K 0.06W 1%	VISHAY CRCW0603100KFKEA
31	2	R30,R31	Res., Chip 42.2K 0.06W 1%	VISHAY CRCW060342K2FKEA
32	2	R34,R32	Res., Chip 11.0K 0.1W 1%	AAC CR16-1102FM
33	6	SW1-SW5,SW15	Switch, SPDT	NKK Switches SS12SDP2
34	1	SW6	Switch, DPDT	NKK Switches SS22SDP2
35	8	SW7-SW14	SWITCH, Push Button	Panasonic EVQPPDA25
36	1	U1	I.C., Amplifier	Linear Technology Corp. LTC6915CGN
37	1	U2	I.C., Comparator	Linear Technology Corp. LT1716CS5
38	1	U3	I.C., Buffer Amp.	Linear Technology Corp. LT6650CS5
39	3	U4,U5,U6	I.C., UHS Dual Buffer	Fairchild Semi. NC7WZ17P6X
40	1	U7	I.C., Volt. Reg.	Linear Tech. Corp. LT1930ES5
41	1	U8	I.C., Resistor Set Osc.	Linear Tech. Corp. LTC6907CS6#TRPBF
42	1	U9	I.C., MicroController	MICROCHIP PIC16F873A-I/SS
43	6	XJP3E,XJP3D,XJP3C,XJP3B,	JUMPER, WIRE, .100CC 22-AWG	Samtec JL-100-25-T
		XJP3A,XJPF		
44	2	XJP1,XJP2	Shunt, 2mm Ctrs.	Samtec 2SN-BK-G
45	4		STAND-OFF, NYLON 0.25" tall	KEYSTONE, 8831 (SNAP ON)
46	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT #1070A
47	1		STENCIL	STENCIL #1070A

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