LTC6373
Programmable Gain Instrumentation Amplifier

DESCRIPTION

Demo circuit DC2398A features the LTC®6373 Programmable Gain Instrumentation Amplifier. The circuit's gain can be controlled in several ways, such as by simply setting onboard jumpers or by connecting an Arduino or Linduino (DC2026A) microcontroller board. The LTC6373 has fully differential outputs with independent common mode level shifting. The output common mode level can be set by the IC's internal default or overdriven by the user.

The DC2398A can be powered by external bench supplies (typically ±15V), but optionally also demonstrates the use of the LTC3265 dual low noise charge pump to generate ±15V rails from a single 9V to 12V input supply.

Design files for this circuit board are available.

QUICK START PROCEDURE

1. Set the jumpers labeled “V– PWR” and “V+ PWR” to the “INT” position. This configures the board to route internally generated supplies to the LTC6373 amplifier.
2. Connect a power supply of 9V to 12V between the “AUX PWR” and “GND” pins.
3. Connect an input voltage source between the VIN+ and VIN– inputs, using either the SMA connectors or turrets (but not both—the SMA and turret are shorted together on the board).
4. Set the jumpers for A2/A1/A0 to the desired gain configuration, described in the table on the board. For example, for a Gain=16, set all jumpers A2/A1/A0 to GND.
5. Observe the differential output between the VOUT+ and VOUT– turrets.

See Figure 1 for a minimal effort initial hook-up of the board. To adapt to specific needs, read the Hardware Configuration section.

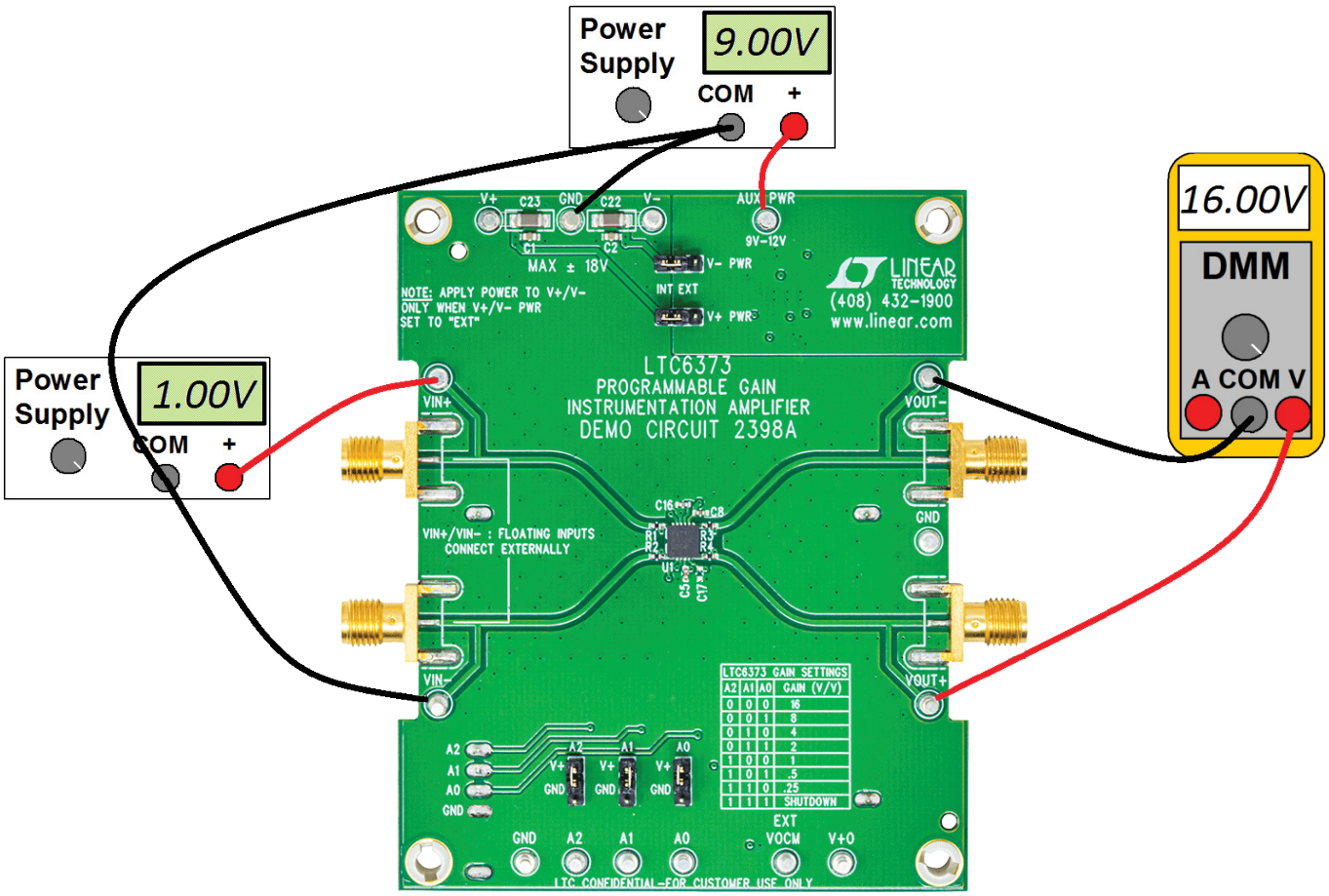


Figure 1. Quick Connection

HARDWARE CONFIGURATION

Apply power to the board using either the AUX PWR or the V^+/V^- pins, but not both. To use a conventional lab power supply rather than the onboard LTC3265 dual charge-pump, first set jumpers "V– PWR" and "V+ PWR" to the "EXT" position. Then, apply power between the V^+, V^-, and GND turrets.

Table 1. Choose One of the Above Two Methods to Apply Power to the Board

POWER SOURCE	V^- PWR JUMPER	V^+ PWR JUMPER	OPERATION
AUX PWR	INT	INT	LTC3265 dual charge pump (on back of board) generates ±15V supplies from AUX PWR and delivers to LTC6373
V^+, V^-	EXT	EXT	Lab power supply connected to V^+, V^- turrets delivers power to LTC6373

By default, leave the "EXT VOCM" turret disconnected. Optionally, to bias the output common mode at a voltage different from the level generated internally by the LTC6373, connect the desired voltage bias between the "EXT VOCM" turret and GND. Alternatively, placeholders R7/R8/R9 (on the back of the board) can set an output common mode voltage by onboard resistor dividers (see schematic).

By default, leave the "V+O" turret disconnected. Optionally, the LTC6373 features a separate positive output power supply pin V+O. By default, the board shorts this together to the V^+ power supply. To bias V+O separate from V^+, first remove R22 (on the back of the board) and then apply the desired voltage level to the "V+O" jumper. To ensure good linearity, verify that there is at least 0.1uF of bypass capacitance stuffed at C17. See the LTC6373 data sheet for details.

By default, leave the A2/A1/A0 turrets disconnected, because the A2/A1/A0 jumpers already determine the voltage levels at these programming pins. Optionally, to configure the LTC6373 by using the A2/A1/A0 turrets, first remove the A2/A1/A0 jumpers.

By default, leave the HD1 header pins (on the back of the board) disconnected. Optionally, these header pins can be used to configure the LTC6373 gain setting, overriding the setting determined by the jumpers. Referring to the back of the board, header HD1, along with associated corner pins, are spaced so that an Arduino Uno compatible microcontroller board (such as DC2026A Linduino One) can connect to the programming pins of this demo board. If connected in this manner, the table lists the mapping of the Arduino pins to the LTC6373 pins. Associated Arduino code is trivial, and an example can be found online along with this demo manual.

Table 2. Mapping of LTC6373 Pins to Arduino Pins When Using Optional Header HD1

LTC6373 PIN	ARDUINO UNO PIN
A2	Pin 11
A1	Pin 12
A0	Pin 13
GND	GND

By default, observe the outputs of the circuit using turrets VOUT+ and VOUT–. Optionally, to observe the LTC6373 outputs by using the SMA connectors rather than the VOUT+, VOUT– turrets, the board has the flexibility to replace the 50Ω R3/R4 resistors with back-termination resistors. This may be needed depending on length and impedance of output cable and termination on the other side of the cable.

By default, the board does not apply separate filtering between the input/output connectors and the LTC6373. Optionally, RC lowpass filters can be installed at the input and/or output of the amplifier. Replace 0Ω R1/R2 and 50Ω R3/R4 by the desired series resistor value, and populate the desired capacitors on the back of the board. See the board schematic for details.

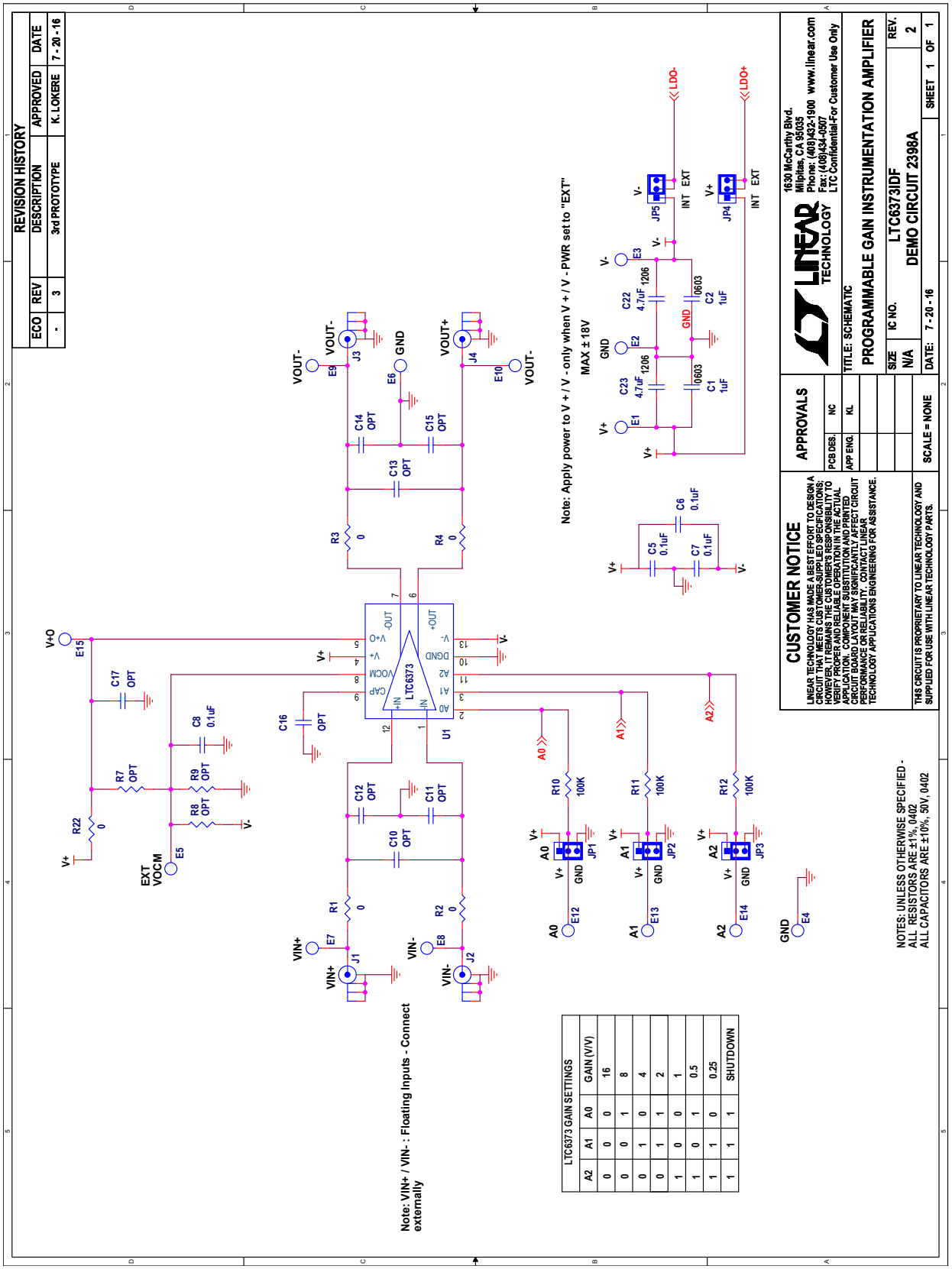
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C1, C2, C3, C4	CAP., 1uF, X7R, 50V, 10%, 0603	AVX, 06035C105KAT2A YAGEO, CC0603KRX7R9BB105 TAIYO YUDEN, UMK107AB7105KA-T
2	4	C5, C6, C7, C8	CAP., 0.1uF, X7R, 50V, 10%, 0402	AVX, 04025C104KAT2A MURATA, GRM155R71H104KE14D MURATA, GRM155R71H104KE14J TAIYO YUDEN, UMK105B7104KV-FR TDK, C1005X7R1H104K050BB
3	0	C10, C11, C12, C13, C14, C15, C17	CAP., OPTION, 0402	
4	1	C16	CAP., 180pF, C0G, 50V, 5%, 0402	MURATA, GRM1555C1H181JA01D NIC, NMC0402NPO181J50TRPF SAMSUNG, CL05C181JB5NNND TAIYO YUDEN, UMK105CG181JV-F
5	6	C18, C19, C20, C21, C22, C23	CAP., 4.7uF, X7R, 50V, 10%, 1206	MURATA, GRM31CR71H475KA12L TDK, C3216X7R1H475K160AC AVX, 12065C475KAT2A NIC, NMC1206X7R475K50TRPLPF
6	2	C24, C26	CAP., 0.01uF, X7R, 50V, 10%, 0402	KEMET, C0402C103K5RAC7867 KEMET, C0402C103K5RACTU MURATA, GRM155R71H103KA88D TDK, C1005X7R1H103K050BB
7	1	C25	CAP., 4.7uF, X5R, 35V, +/-10%, 0805	AVX, 0805DD475KAT2A MURATA, GRM219R6YA475KA73D
8	15	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15	TEST POINT, TURRET, 0.064 MTG. HOLE, 0.125 THICK PCB	MILL-MAX, 2308-4-00-80-00-00-07-0
9	1	HD1	CONN., HDR., MALE, 1x4, 2.54mm, VERT, STR, THT	SAMTEC, TSW-104-07-L-S
10	4	HD2, HD3, HD4, HD5	CONN., HDR, MALE, 1 PIN, 2.54mm, STR, THT, 10u Au CONTACT, Sn TAIL	SAMTEC, TSW-101-07-L-S
11	4	J1, J2, J3, J4	CONN., SMA, JACK, RCPT, END LAUNCH, STR, 50 OHMS	CINCH/ BEL, 142-0701-851
12	5	JP1, JP2, JP3, JP4, JP5	CONN., HDR., MALE, 1x3, 2mm, VERT, STR, THT	SULLINS CONNECTOR SOLUTIONS, NRPN031PAEN-RC
13	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY, THT-96-717-10
14	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.375	KEYSTONE, 8832
15	1	PCB1	PCB, DC2398A	EAGLE ELECTRONICS INC., 600-DC2398A
16	3	R1, R2, R22	RES., 0 OHM, 1/16W, 0402	ROHM, MCR01MZPJ000 VISHAY, CRCW04020000Z0ED NIC, NRC04Z0TRF YAGEO, RC0402JR-070RL
17	2	R3, R4	RES., 49.9 OHMS, 1%, 1/16W, 0402	ROHM, MCR01MZPF49R9 YAGEO, RC0402FR-0749R9L
18	0	R7, R8, R9	RES., OPTION, 0402	
19	3	R10, R11, R12	RES., 100k OHMS, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW0402100KFKED NIC, NRC04F1003TRF
20	2	R13, R14	RES., 52.3k OHMS, 1%, 1/16W, 0402	VISHAY, CRCW040252K3FKED
21	2	R15, R16	RES., 604k OHMS, 1%, 1/16W, 0402	VISHAY, CRCW0402604KFKED NIC, NRC04F6043TRF

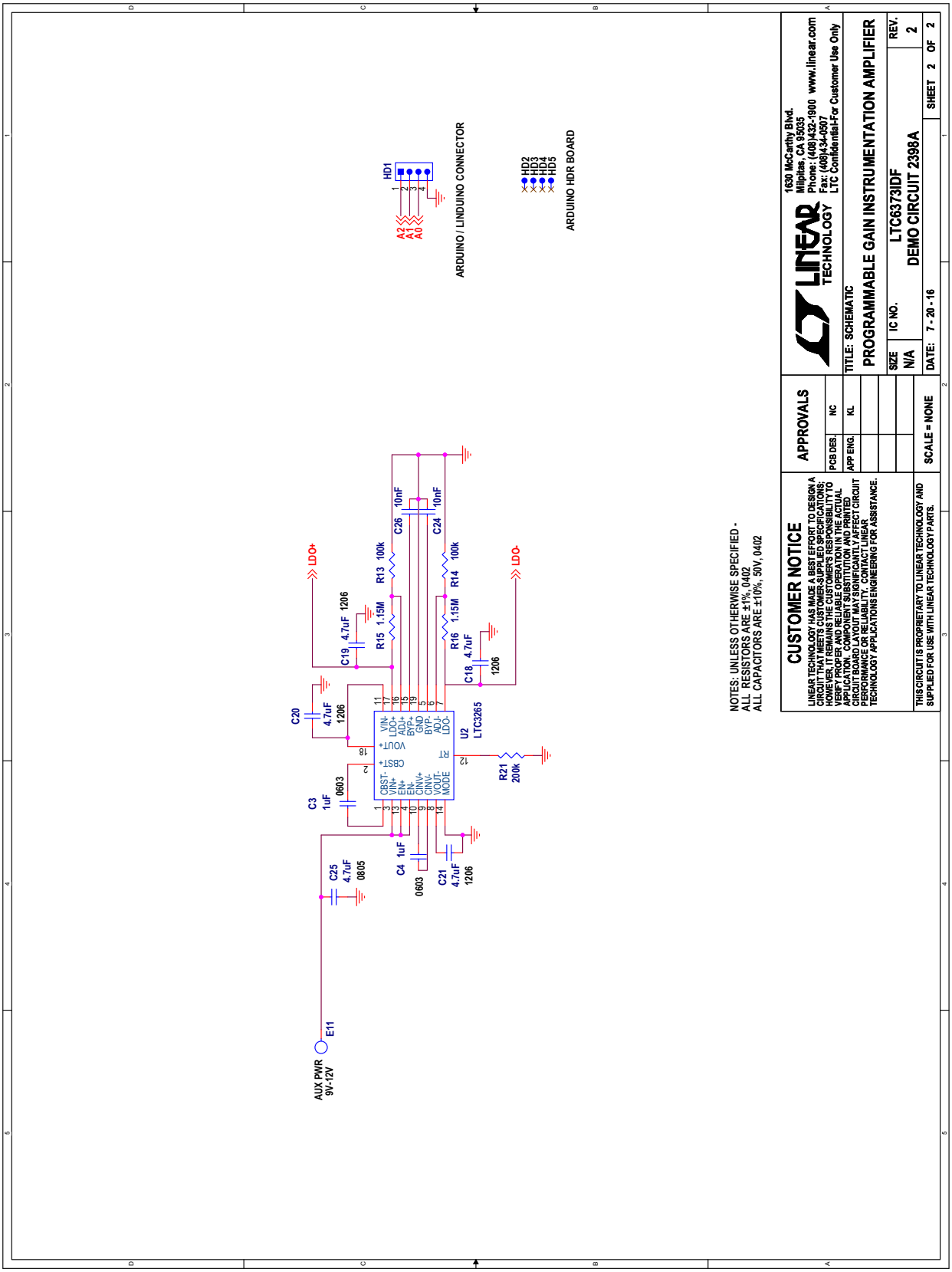
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
22	1	R21	RES., 200k OHMS, 1%, 1/16W, 0402	PANASONIC, ERJ2RKF2003X VISHAY, CRCW0402200KFKED YAGEO, RC0402FR-07200KL
23	1	STNCL1	TOOL, STENCIL, 700-DC2398A	ANALOG DEVICES INC., 830-DC2398A
24	1	U1	IC, 36V, FULLY-DIFFERENTIAL PROGRAMMABLE-GAIN INSTRUMENTATION AMPLIFIER WITH 10pA Ib	ANALOG DEVICES INC., LTC6373HDF#PBF ANALOG DEVICES INC., LTC6373HDF#TRPBF
25	1	U2	IC, LOW NOISE DUAL SUPPLY, 18-pin DFN	ANALOG DEVICES INC., LTC3265EDHC#PBF ANALOG DEVICES INC., LTC3265EDHC#TRPBF
26	5	XJP6, XJP7, XJP8, XJP9, XJP10	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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