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## LTC7106EDDB A 7-Bit Current DAC with Digital PMBus Interface

### DESCRIPTION

Demonstration circuit 2620A-A uses the [LTC7106EDDB](#), a precision, bidirectional, 7-Bit current DAC with PMBus interface and can be used to adjust the output voltage of any conventional  $V_{FB}$  referenced regulator. The LTC7106 can work with the vast majority of power management controllers, regulators or modules to enable digital control of the output voltage.

The DC2620A-A requires input voltage range from 2.5V to 5.5V, which can be powered either by external supply or directly from the DC1613A dongle. The LTC7106 provides three ranges of IDAC output current: Nominal Range ( $-64\mu\text{A}$  to  $63\mu\text{A}$ ), Range High ( $-256\mu\text{A}$  to  $252\mu\text{A}$ ) and Range Low ( $-16\mu\text{A}$  to  $15.75\mu\text{A}$ ). Only the nominal range is optimized with the highest accuracy. It is recommended that users design the resistor divider using the nominal range of the IDAC setting.

To explore the power system management features of the parts, download the GUI software LTpowerPlay<sup>®</sup> onto your PC and use ADI's I<sup>2</sup>C/SMBus/PMBus Dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on-the-fly, view IDAC current value and fault status.

#### GUI Download

The software can be downloaded from:

<http://www.linear.com/LTpowerPlay>

For more details and instructions of LTpowerPlay, please refer to LTpowerPlay for LTC7106 Quick Start Guide.

**Design files for this circuit board are available at**  
<http://www.linear.com/demo/DC2620A-A>

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### PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{DD}$	IC Bias Voltage		2.5		5.5	V
$V_{IDAC}$	$I_{DAC}$ Operation Voltage		0.4		2.0	V
$I_{DAC}$	Output Current Range	Nominal, LSB = $1\mu\text{A}$	-64		63	$\mu\text{A}$
		Range High, LSB = $4\mu\text{A}$	-256		252	$\mu\text{A}$
		Range Low, LSB = $0.25\mu\text{A}$	-16		15.75	$\mu\text{A}$
$A_{CC}$	$I_{DAC}$ Accuracy	Nominal Range	-1.5		0.8	%

## QUICK START PROCEDURE

Demonstration circuit 2620A-A makes it easy to use the LTC7106 to adjust any conventional  $V_{FB}$  referenced regulator and evaluate its performances. Refer to Figure 1 for the system setup and boards connection.

### Connecting a PC and a Regulator to DC2620A-A

You can use a PC to reconfigure the power management features of the LTC7106 such as: program IDAC current, margin IDAC high/low, read back IDAC value and check fault status. The DC1613A dongle may be plugged in regardless of whether  $V_{IN}$  is present. Dongle can be hot plugged.

DC2620A-A can adjust the output voltage of any  $V_{FB}$  referenced regulator. Use a twisted wire pair to connect the IDAC and GND pins of DC2620A-A to  $V_{FB}$  and GND pins of the regulator board.

Follow the procedure below:

1. Make sure JP3 is in OFF position to disable the LTC7106 before turning on the regulator.
2. Turn on the regulator and check for the output voltage as expected.
3. Once the proper output voltage is established on the regulator, put JP3 to the ON position to enable the LTC7106.
4. Open the LTpowerPlay software and adjust the IDAC current value of the LTC7106 through it. Monitor the regulator's output voltage as IDAC is changing. See LTpowerPlay Quick Start session for details

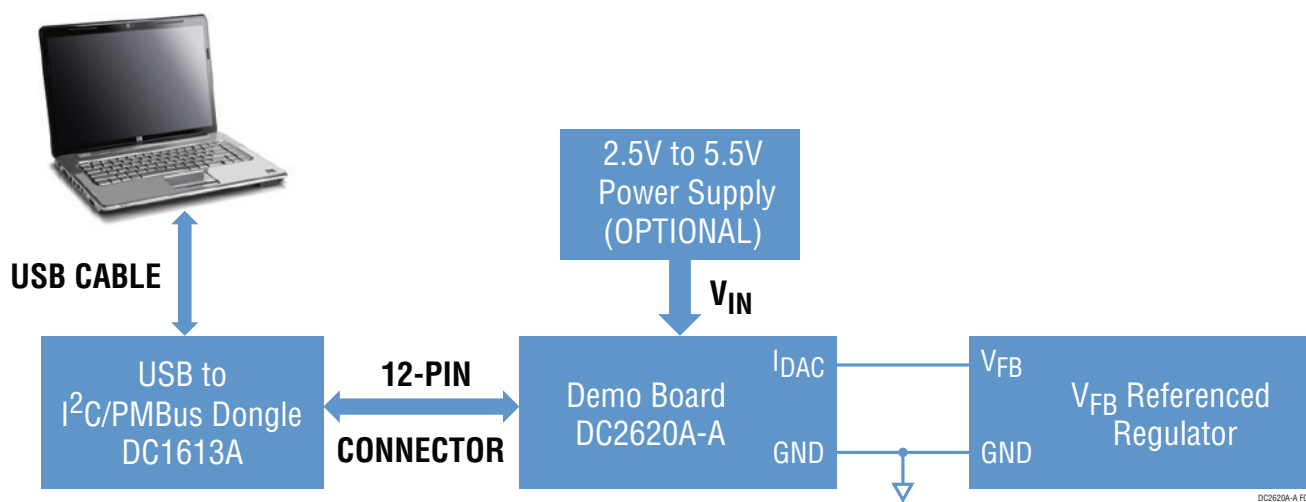


Figure 1. Demo Setup with PC

## QUICK START PROCEDURE

Figure 2 shows an application diagram using the LTC7106 with a typical DC/DC voltage regulator. By connecting IDAC to the feedback node of the voltage regulator, IDAC can change the output voltage of the regulator with the equation:

$$V_{OUT} = V_{REF} \left[ 1 + \frac{R_{FB1}}{R_{FB2}} \right] - I_{DAC} \cdot R_{FB1}$$

where  $V_{REF}$  is the reference voltage of the voltage regulator.  $R_{FB1}$  and  $R_{FB2}$  are the resistor divider for the voltage regulator. IDAC is the programmed bidirectional current of the LTC7106.

In order to achieve the best IDAC current accuracy of the LTC7106, it's recommended to carefully design the voltage divider so that the LTC7106 uses its nominal range. A design tool has been developed to help customers optimize their design. It's built in the LTpowerCAD® software tool and can be downloaded from:

<http://www.linear.com/solutions/LTpowerCAD>

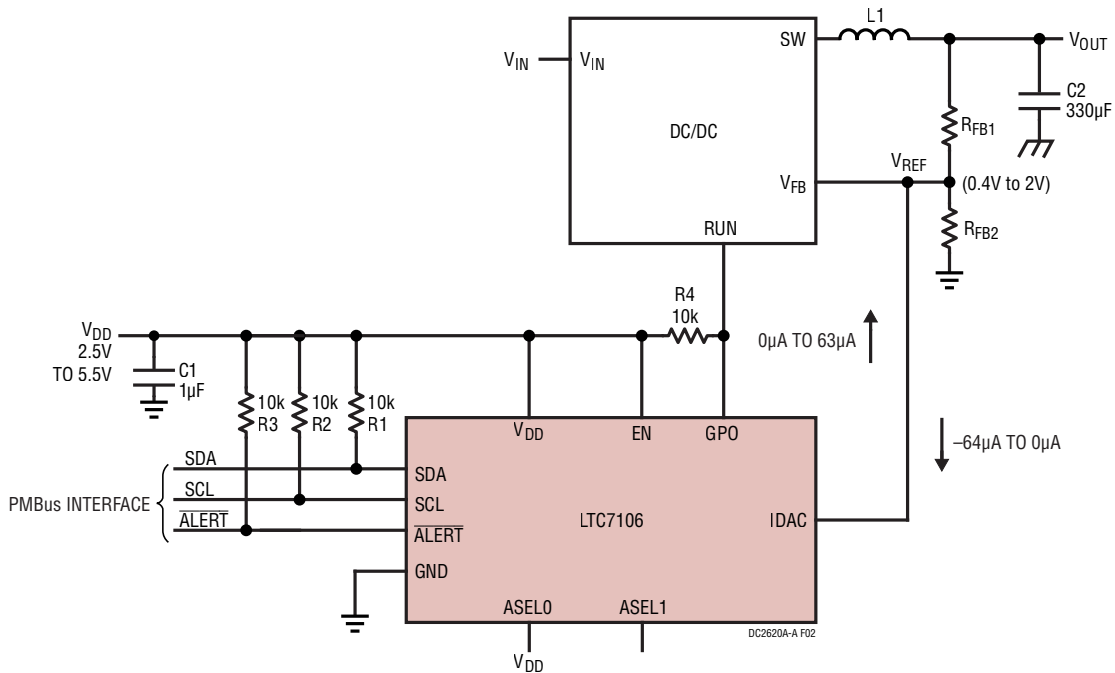


Figure 2. An Application Diagram Using the LTC7106 with a Typical DC/DC Voltage Regulator

## LTpowerPlay SOFTWARE GUI

LTpowerPlay is a powerful Windows-based development environment that supports Analog Devices power system management ICs, including the LTC3880, LTC3883, LTC3882, LTC3815, LTC2974 and LTC2978. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Analog Devices ICs by connecting to a demo board system. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of many potential targets, including

the LTC7106's DC2620A-A demo system, or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded from:

<http://www.linear.com/LTpowerPlay>

To access technical support documents for ADI Digital Power Products visit Help. View online help on the LTpowerPlay menu.

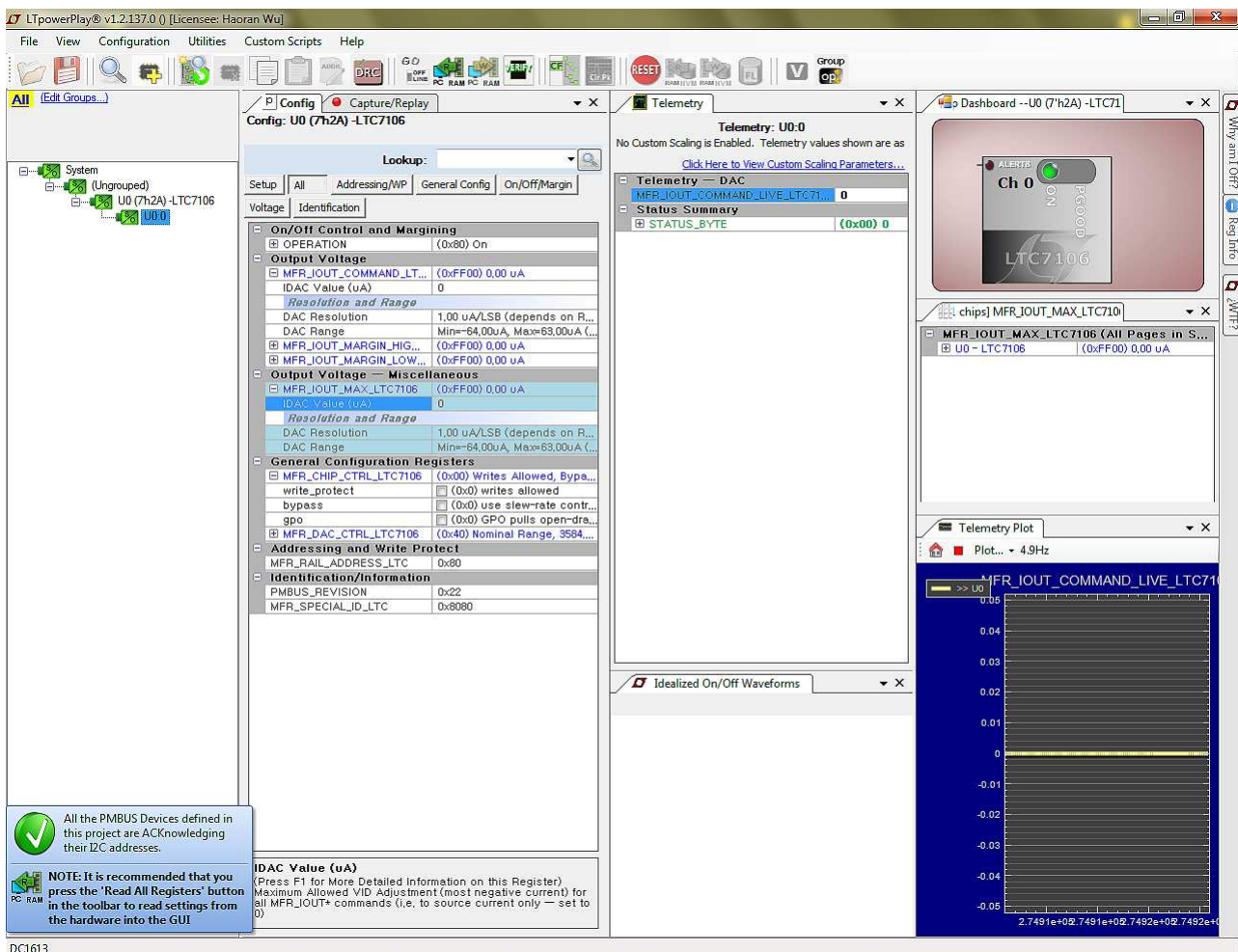


Figure 3. LTpowerPlay Main Interface for LTC7106

## LTpowerPlay QUICK START PROCEDURE

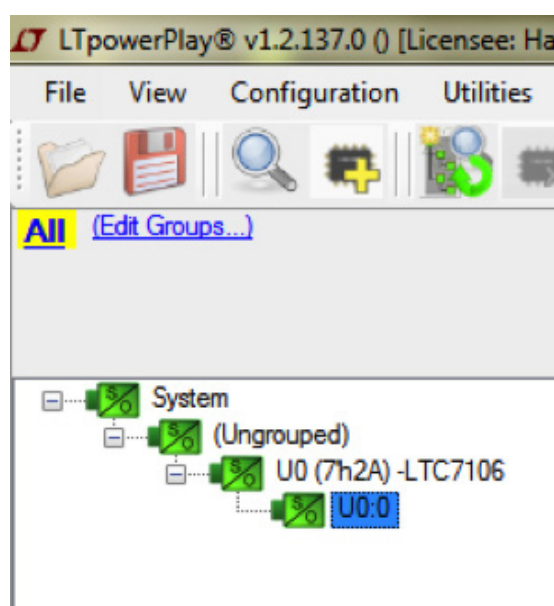
The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTC7106.

1. Download and install the LTpowerPlay GUI:

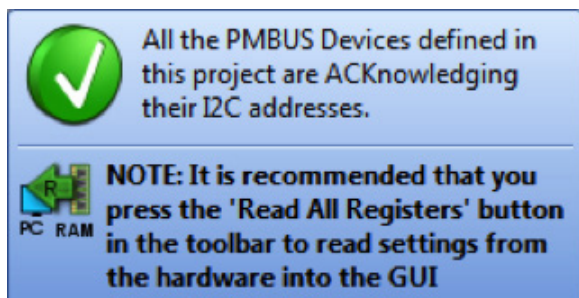
<http://www.linear.com/LTpowerPlay>


2. Launch the LTpowerPlay GUI.

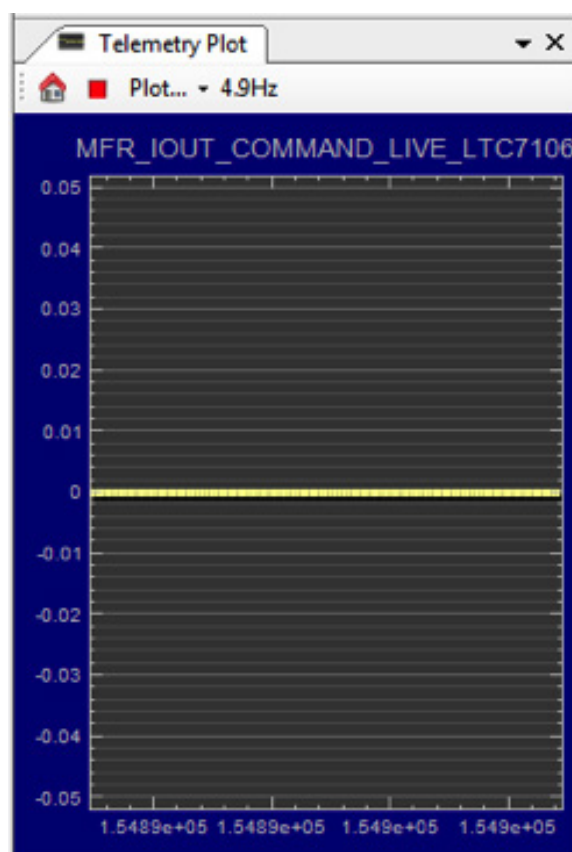
- a. The GUI should automatically identify the DC2620A-A. The system tree on the left-hand side should look like this:



- b. A blue message box shows for a few seconds in the lower left-hand corner, confirming that the LTC7106 is communicating:

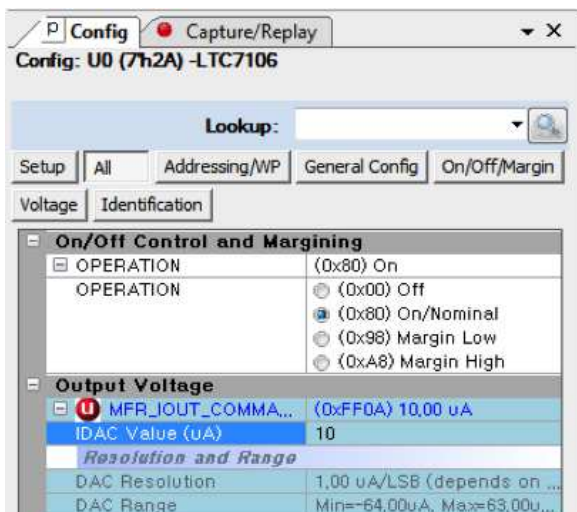


- c. In the Toolbar, click the “R” icon  (RAM to PC) to read the RAM from the LTC7106. This reads the configuration from the RAM of LTC7106 and loads it into the GUI. When first powering on, you should read IDAC current at zero (high impedance IDAC) due to the LTC7106’s internal power-on reset circuitry until a valid write takes place. The IDAC current value can be plotted in real time, shown in the following screenshot (at zero when first powering on):



## LTpowerPlay QUICK START PROCEDURE

- d. If you want to change the IDAC current to 10 $\mu$ A for example, in the Config tab, type “10” in the MFR\_IOUT\_COMMAND\_LTC7106:

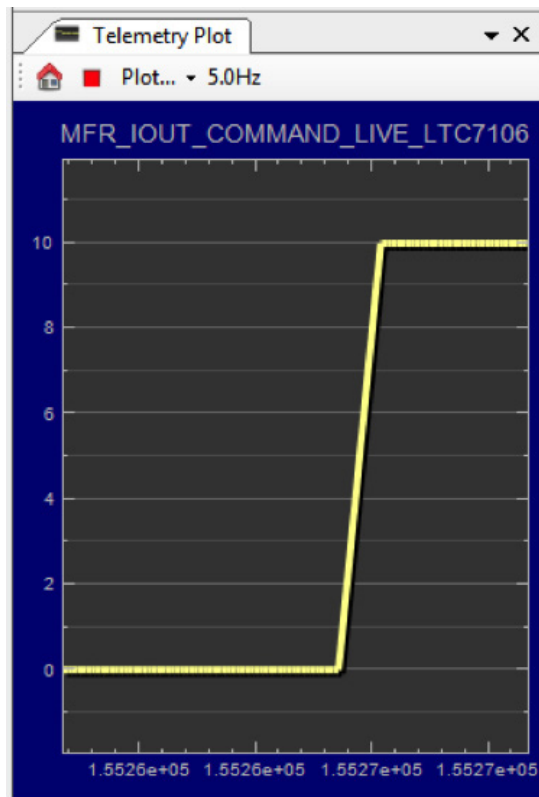


Then, click the “W” icon (PC to RAM) to write these register values to the LTC7106.

If the write is successful, you will see the following message:



In the Telemetry Plot, you will see IDAC current value change to the commanding value:



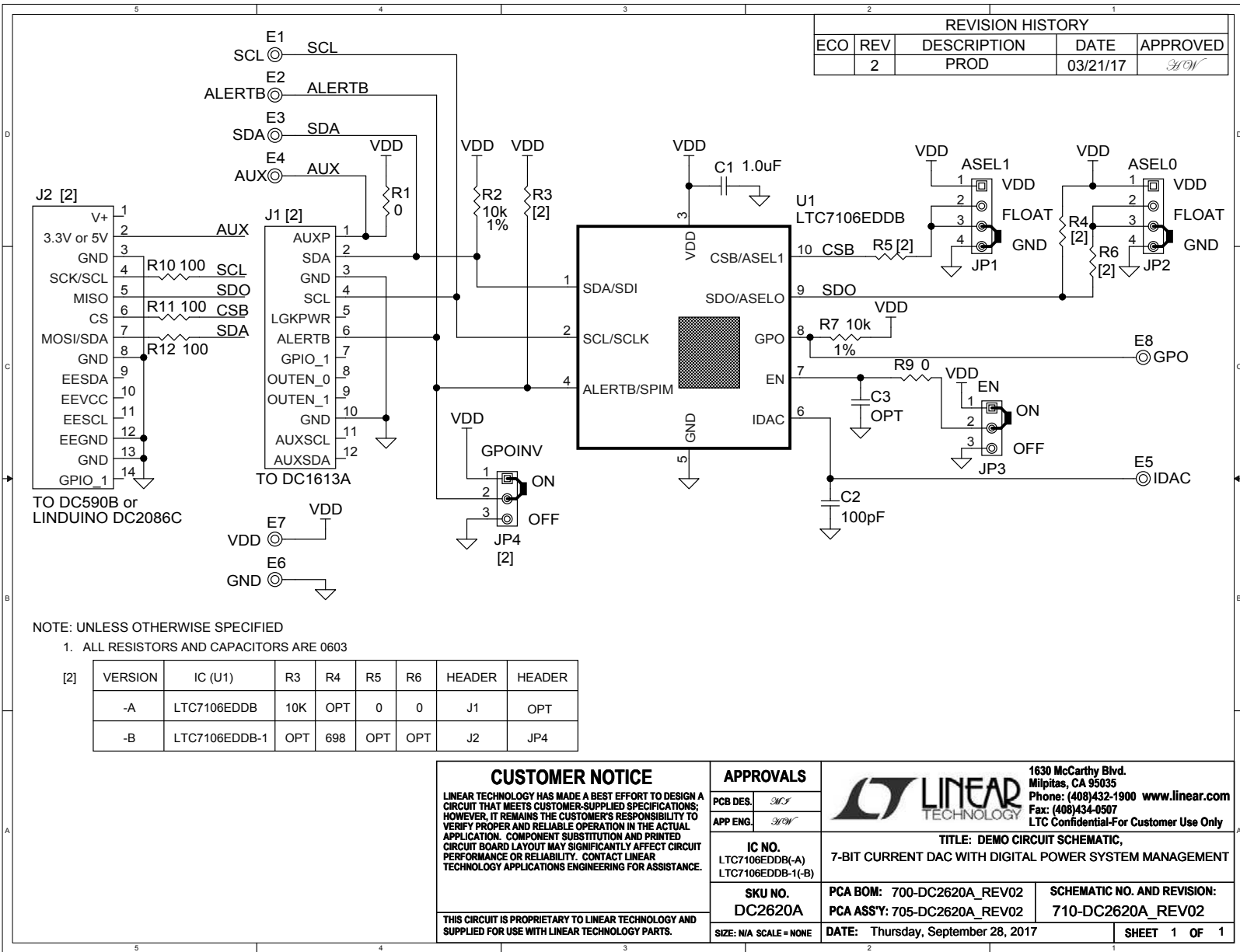
- e. If you want to change the IDAC current to a negative value (meaning sinking current), you need to change the MFR\_IOUT\_MAX\_LTC7106 to a negative value first (see data sheet for more details).



## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP., 1.0 $\mu$ F, X5R, 10V, 10%, 0603	AVX, 0603ZD105KAT2A
2	1	C2	CAP., 100pF, X7R, 25V, 5%, 0603	AVX, 06033C101JAT2A
3	4	R1, R5, R6, R9	RES., 0 $\Omega$ , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
4	3	R2, R3, R7	RES., 10k, 1%, 1/10W, 0603	KOA SPEER, RK73H1JTTD1002F
5	3	R10, R11, R12	RES., 100 $\Omega$ , 1%, 1/10W, 0603	NIC, NRC06F1000TRF
6	1	U1	IC, DAC 7-BIT CURRENT DAC	ANALOG DEVICES, LTC7106EDDB
<b>Additional Demo Board Circuit Components</b>				
1	0	C3	CAP., OPTION, 0603	OPTION
2	0	R4	RES., OPTION, 0603	OPTION
3	0	JP4	CONN., OPTION	OPTION
4	0	J2	CONN., OPTION	OPTION
<b>Hardware</b>				
1	8	E1, E2, E3, E4, E5, E6, E7, E8	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	J1	CONN., HDR, SHROUDED, 2mm $\times$ 6mm, 2mm, THT, VERT	FCI, 98414-G06-12ULF
3	2	JP1, JP2	CONN., HDR, MALE, 1mm $\times$ 4mm, 2mm, THT, STR	WURTH ELEKTRONIK, 62000411121
4	1	JP3	CONN., HDR., MALE, 1mm $\times$ 3mm, 2mm, THT, STR	SULLINS CONNECTOR SOLUTIONS, NRPN031PAEN-RC
5	1	LB1	LABEL SPEC, DEMO BOARD SERIAL NUMBER	BRADY, THT-96-717-10
6	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.250"	KEYSTONE, 8831
7	1	PCB1	PCB, DC2620A	ANALOG DEVICES, 600-DC2620A
8	4	XJP1, XJP2, XJP3, XJP4	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421









## 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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