

**LTC3255EMSE**
**Wide  $V_{IN}$  Range Fault Protected  
50mA Step-Down Charge Pump**
**DESCRIPTION**

Demonstration circuit 2041A is a switched-capacitor step-down power supply featuring the [LTC®3255](#). The LTC3255 has the ability to step down voltage 2:1 to efficiently regulate output voltages less than half the  $V_{IN}$  voltage reducing the input current needed. As  $V_{IN}$  reduces below twice  $V_{OUT}$ , the LTC3255 will automatically switch to 1:1 mode.

The LTC3255 also has an integrated shunt regulator allowing it to provide a regulated output from a 4mA to 20mA current loop.

The LTC3255 is a robust device that can survive reverse-polarity input supplies with current limit and overtemperature protection.

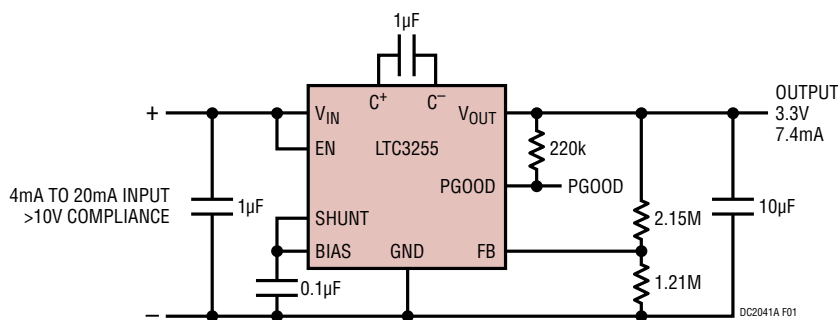
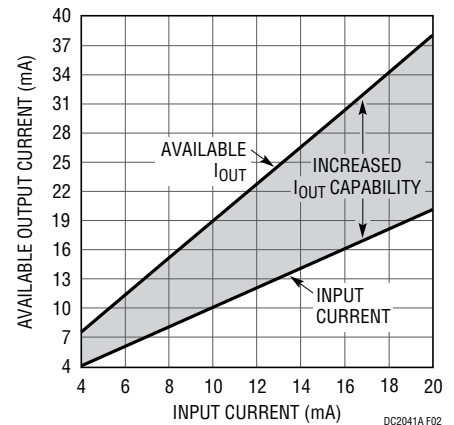
Refer to the LTC3255 data sheet for more details on the electrical and timing specifications.

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

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

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply Range		4		48	V
$V_{OUT}$		2.4		12.5	V
$I_{OUT}$	Shunt Jumper = OFF (SHUNT = GND) Shunt Jumper = ON (SHUNT = BIAS) $I_{IN} = 4\text{mA}$	50 7.4	7.8		mA mA

**7.4mA DC Supply from 4mA to 20mA Current Loop**

**Available Output Current vs Input Current**


## QUICK START PROCEDURE

The DC2041 is easy to set up to evaluate the performance of the LTC3255 with the shunt disabled. Refer to Figure 1 for proper measurement equipment setup with the shunt disabled and follow the evaluation procedure below. To evaluate the LTC3255 with the shunt enabled, go to the SHUNT ENABLED section.

**NOTE.** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the  $V_{IN}$  or  $V_{OUT}$  and GND terminals. See Figure 2 for proper scope probe technique.

1. Set the EN jumper, JP1, on the DC2041 board to the ON position.
2. Set the SHUNT jumper, JP3, to the OFF position.
3. Set the  $V_{OUT}$  jumper, JP2, to the desired output voltage.

**NOTE.** Do not set the  $V_{OUT}$  jumper to the OPT setting unless the appropriate resistor is installed in R7. The  $V_{OUT}$  jumper OPT position is to allow an alternate  $V_{OUT}$  setting. This can be accomplished by adding a resistor to R7 to set the output to a desired voltage. Refer to the LTC3255 data sheet to calculate the appropriate value for R7.

4. With power off, connect a 0V to 48V, 100mA power supply to  $V_{IN}$  and GND with a voltmeter as shown in Figure 1.
5. Turn on the  $V_{IN}$  input power supply and increase the supply until the  $V_{OUT}$  voltage is in regulation and the PGOOD voltage is pulled to  $V_{OUT}$ .

**NOTE.** Make sure that the input voltages do not exceed 60V.

6. With  $V_{IN}$  at least 1V above  $V_{OUT}$ , increase the load on  $V_{OUT}$  from 0mA to 50mA and observe the input current. The output ripple may also be observed using an oscilloscope with the probe connected as shown in Figure 2.
7. With a 50mA load on  $V_{OUT}$ , increase  $V_{IN}$  until the current on  $V_{IN}$  drops to approximately  $\frac{1}{2}$  the  $V_{OUT}$  current.
8. Refer to the LTC3255 data sheet for more details on how the LTC3255 operates.
9. When done, turn off all loads and power supplies.

**QUICK START PROCEDURE**

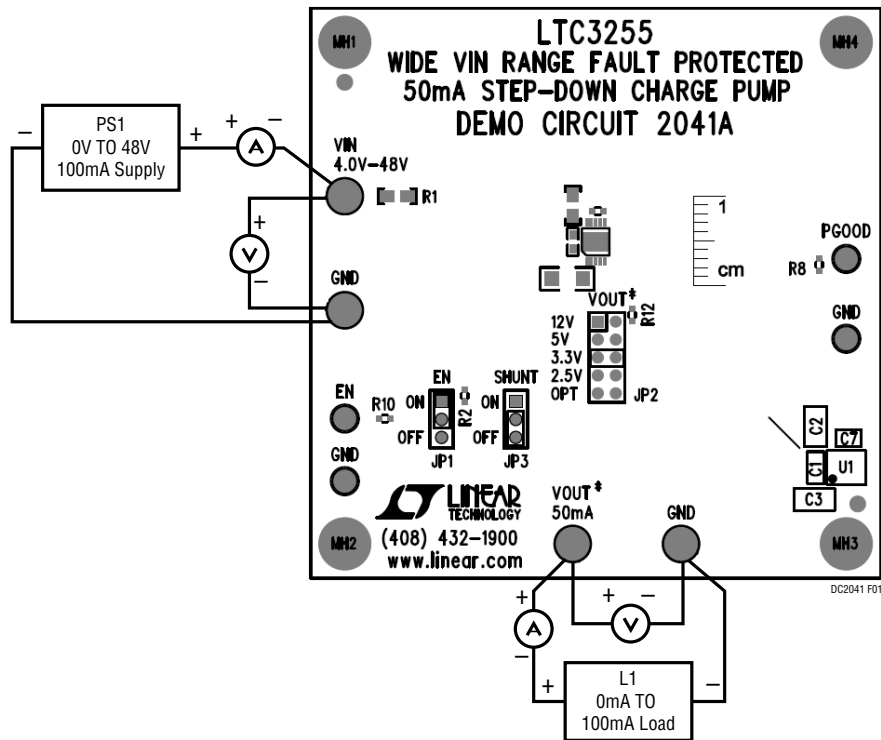


Figure 1. Proper Measurement Equipment Setup with Shunt Disabled

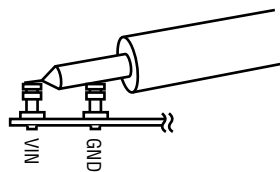


Figure 2. Measuring Input or Output Ripple

## SHUNT ENABLED

The DC2041 is easy to set up to evaluate the performance of the LTC3255 with the shunt enabled. Refer to Figure 3 for proper measurement equipment setup of the LTC3255 with the shunt enabled and follow the evaluation procedure.

NOTE. When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the  $V_{IN}$  or  $V_{OUT}$  and GND terminals. See Figure 2× for proper scope probe technique.

1. Set the EN jumper, JP1, on the DC2041 board to the ON position.
2. Set the SHUNT jumper, JP3, to the ON position.
3. Set the  $V_{OUT}$  jumper, JP2, to the desired output voltage.

NOTE. Do not set the  $V_{OUT}$  jumper to the OPT setting unless the appropriate resistor is installed in R7. The  $V_{OUT}$  jumper OPT position is to allow an alternate  $V_{OUT}$  setting. This can be accomplished by adding a resistor to R7 to set the output to a desired voltage. Refer to the LTC3255 data sheet to calculate the appropriate value for R7.

4. With power off, connect a 0V to 48V, 100mA power supply to a controlled current source, a 250Ω ¼ Watt resistor,  $V_{IN}$  and GND with a voltmeter and ammeter as shown in Figure 3.

5. Turn on the  $V_{IN}$  input power supply, PS1, and increase the supply above twice the  $V_{OUT}$  voltage setting plus 9V. ( $V_{PS1} > 2V_{OUT} + 2V + V_{CS1} + V_{RS1} + V_{ammeter}$ ). For example, if  $V_{OUT}$  is set to 3.3V, set PS1 above  $3.3V \cdot 2 + 9V$  or 15.6V.

NOTE. Make sure that the input voltages do not exceed 60V.

6. Turn on and set the input current source to 4mA. Observe the voltage across the  $V_{IN}$  and GND terminals and across the  $V_{OUT}$  and GND terminals. The output ripple may also be observed using an oscilloscope with the probe connected as shown in Figure 2.
7. Increase the load on  $V_{OUT}$  to about 7.4mA and observe the input current, input voltage and output voltage.
8. Increase the input current source from 4mA to 20mA. Observe the voltage across the  $V_{IN}$  and GND terminals and across the  $V_{OUT}$  and GND terminals. Adjust PS1 as per equation described in step 5 if needed.
9. Increase the load on  $V_{OUT}$  to about 38mA and observe the output voltage. Observe the input current and input voltage as the load on  $V_{OUT}$  is changed.
10. Refer to the LTC3255 data sheet for more details on how the LTC3255 operates.
11. When done, turn off all loads and power supplies.

**SHUNT ENABLED**

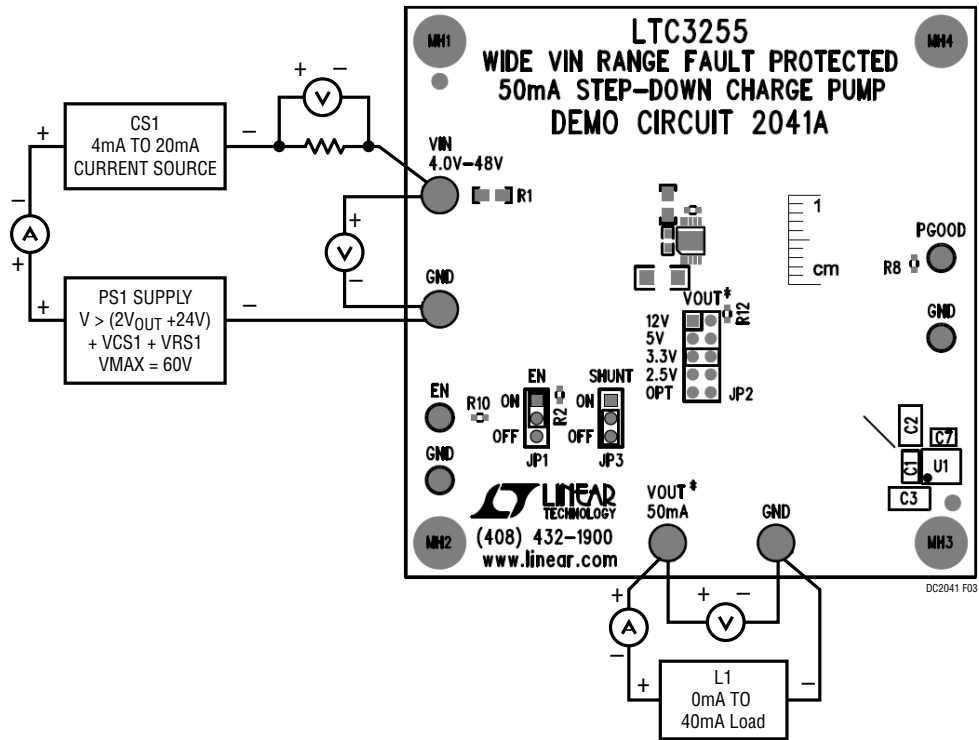


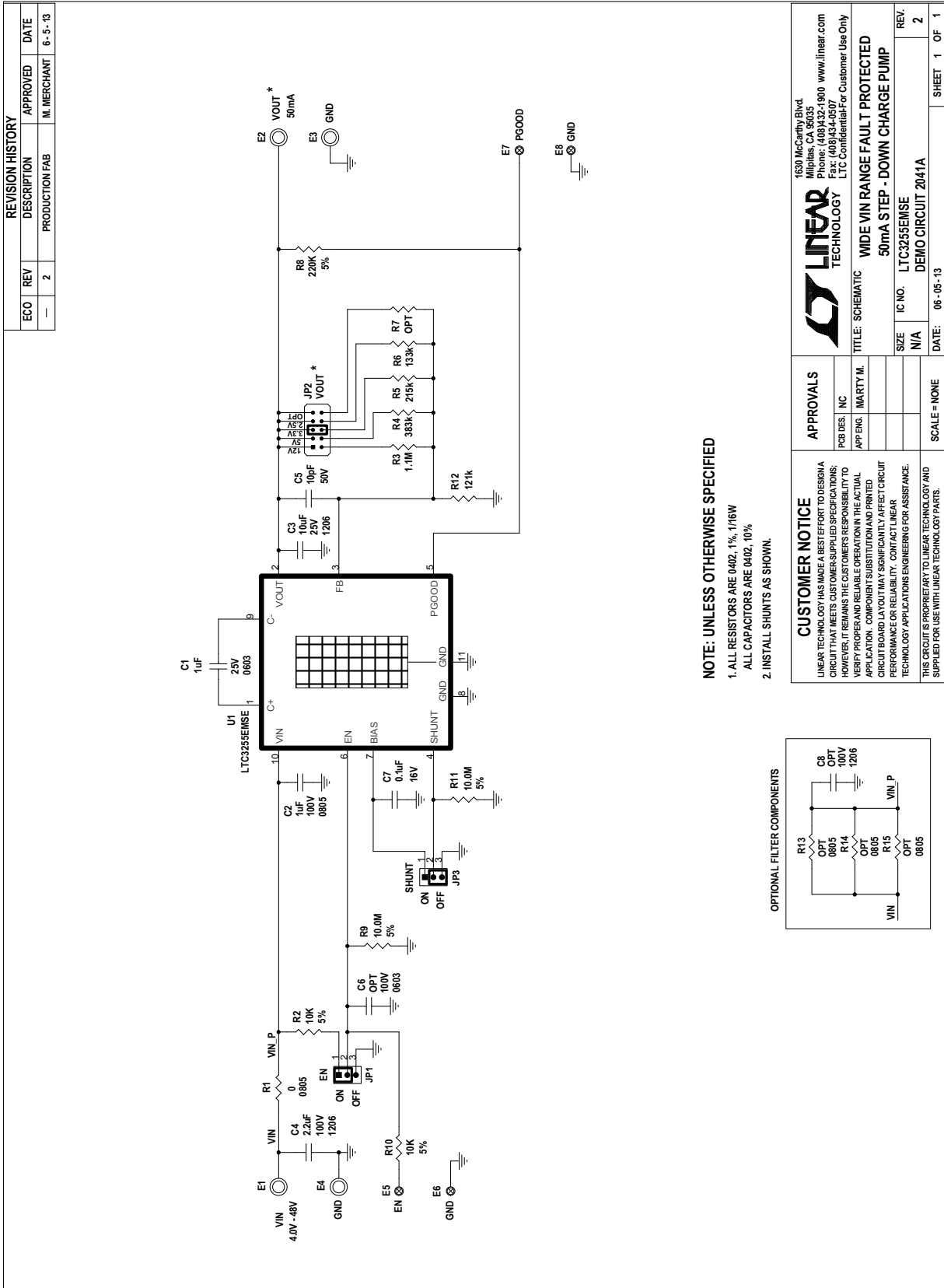
Figure 3. Proper Measurement Equipment Setup with Shunt Enabled

# DEMO MANUAL DC2041A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP CER, 1 $\mu$ F, 25V, X7R 10% 0603	MURATA, GRM188R71E105KA12D
2	1	C2	CAP CER, 1 $\mu$ F, 100V, X7R 10% 0805	TDK, C2012X7S2A105K
3	1	C3	CAP CER, 10 $\mu$ F, 25V, 10% X7R 1206	MURATA, GRM31CR71E106KA12L
4	1	C5	CAP CER, 10pF, 50V, 5% NP0 0402	MURATA, GRM1555C1H100JA01D
5	1	C7	CAP CER, 0.1 $\mu$ F, 16V, 10%, X7R 0402	MURATA, GRM155R71C104KA88D
6	1	R3	RES 1.1M, 1/16W, 1%, 0402 SMD	VISHAY, CRCW04021M10FKED
7	1	R4	RES 383k $\Omega$ , 1/16W, 1%, 0402 SMD	VISHAY, CRCW0402383KFKED
8	1	R5	RES 215k $\Omega$ , 1/16W, 1%, 0402 SMD	VISHAY, CRCW0402215KFKED
9	1	R6	RES 133k $\Omega$ , 1/16W, 1%, 0402 SMD	VISHAY, CRCW0402133KFKED
10	1	R8	RES 220k $\Omega$ , 1/16W, 5%, 0402 SMD	VISHAY, CRCW0402220KJNED
11	2	R12	RES 121k $\Omega$ , 1/16W, 1%, 0402 SMD	VISHAY, CRCW0402121KFKED
12	1	U1	50mA STEP-DOWN CHARGE PUMP	LINEAR TECH., LTC3255EMSE#PBF
<b>Additional Demo Board Circuit Components</b>				
13	1	C4	CAP CER 2.2 $\mu$ F, 100V, 10%, X7R 1206	MURATA, GRM31CR72A225KA7
14	0	C6	CAP, 0603 SMD	OPT
15	0	C8	CAP, 1206 SMD	OPT
16	1	R1	RES 0.0 $\Omega$ , 1/8W, 0805 SMD	VISHAY, CRCW08050000Z0EA
17	2	R2, R10	RES 10k $\Omega$ , 1/16W, 5%, 0402 SMD	VISHAY, CRCW040210K0JNED
18	0	R7	RES, 0402 SMD	OPT
19	2	R9, R11	RES 10.0M, 1/16W, 5%, 0402 SMD	VISHAY, CRCW040210M0JNED
20	0	R13, R14, R15	RES, 0805 SMD	OPT
<b>Hardware: For Demo Board Only</b>				
21	4	E1, E2, E3, E4	TP, TURRET, 0.094", PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
22	4	E5, E6, E7, E8	TURRET, 0.061 DIA	MILL-MAX, 2308-2-00-80-00-00-07-0
23	2	JP1, JP3	HEADER, 3 PIN, 1 ROW .079CC	SAMTEC, TMM-103-02-L-S
24	3	JP1-JP3	SHUNT, 2mm	SAMTEC, 2SN-KB-G
25	1	JP2	HEADER, 2.0mm, 2 $\times$ 5	SAMTEC, TMM-105-02-L-D
26	4	MH1-MH4	STAND-OFF, NYLON 0.375" TALL	EYSTONE, 8832 (SNAP ON)

## SCHEMATIC DIAGRAM



# DEMO MANUAL DC2041A

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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