QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 1176
1.25A, 4 MHZ SYNCHRONOUS STEP-DOWN DC/DC CONVERTER

LTC3411A

DESCRIPTION

Demonstration circuit 1176 is a step-down converter, using the LTC3411A monolithic synchronous buck regulator. The DC1176 has an input voltage range of 2.5V to 5.5V, and is capable of delivering up to 1.25A of output current. The output voltage of the DC1176 can be set as low as 0.8V, the reference voltage of the LTC3411A. At low load currents, the DC1176 can operate in either noise sensitive applications, due to the capability of the LTC3411A to operate in pulse-skipping mode, or in high efficiency applications, because the LTC3411A can also operate in Burst-Mode®. During Burst-Mode® operation, the output ripple voltage is still low – less than 20 mV – due to the improvements made in the design of the LTC3411A. Of course, in continuous mode, or large load current applications, the DC1176 is a high efficiency circuit - over 95%. The DC1176 consumes less than 60 uA of quiescent current during sleep operation, and during shutdown, it consumes less than 1 uA. Because of the high switching frequency of the LTC3411A, which is programmable up to 4 MHz, the DC1176 uses low profile surface mount components. These features, plus the LTC3411A coming in a small 10-Lead DFN or MS package, make the DC1176 an ideal circuit for use in battery-powered, hand-held applications.

Design files for this circuit are available. Call the LTC Factory.

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Table 1. Performance Summary (T_A = 25°C)

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		2.5V
Maximum Input Voltage		5.5V
Run/Shutdown		GND = Shutdown
		V_{IN} = Run
Output Voltage V_{OUT}	V_{IN} = 2.5V to 5.5V, I_{OUT} = 0A to 1.25A	1.8V ±4% (1.728V – 1.872V)
		2.5V ±4% (2.4V - 2.6V)
		3.3V ±4% (3.168V – 3.432V)
Typical Output Ripple V_{OUT}	V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 1.25A (20 MHz BW)	< 20m$V_{P–P}$
Operation Modes	Burst Mode - V_{IN} = 3.3V, V_{OUT} = 1.8V	< 250 mA
	Pulse-Skip - V_{IN} = 3.3V, V_{OUT} = 1.8V	< 200 mA
Nominal Switching Frequency	R_T = 549k	1 MHz ±20%

QUICK START PROCEDURE

Demonstration Circuit 1176 is easy to set up to evaluate the performance of the LTC3411A. For proper measurement equipment configuration, set up the circuit according to the diagram in **Figure 1**. Before proceeding to test, insert shunts into the OFF position of header JP3, which connects the RUN pin to ground (GND), and thus, shuts down the circuit, the pulse-skip position of header JP1, and the 1.8V output voltage header – JP2.

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 Vin or Vout and GND terminals. See **Figure 2** for proper scope probe measurement technique.

With the DC1176 set up according to the proper measurement and equipment in **Figure 1**, apply 3.3V at Vin (Do not hot-plug Vin or increase Vin over the rated maximum supply voltage of 5.5V, or the part may be damaged.). Measure Vout; it should read 0V. Turn on the circuit by inserting the shunt in header JP3 into the ON position. The output voltage should be regulating. Measure Vout - it should measure 1.8V +/- 2% (1.764V to 1.836V).

Vary the input voltage from 2.5V to 5.5V and adjust the load current from 0 to 1.25A. Vout should read 1.8V +/- 4% (1.728V to 1.872V).

Adjust the output current to 1A. Measure the output ripple voltage; it will measure less than 20 mVAC.

Observe the voltage waveform at the switch node. Verify the switching frequency is between 850 kHz and 1.15 MHz (T = 1.176 us and 0.869 us), and that the switch node waveform is rectangular in shape.

Adjust the input voltage to 3.3V and the output current to any current less than 200 mA. Observe the pulse-skip mode of operation at the switch node. Also, measure the output ripple voltage; it should measure less than 40 mV. Change the JP1 shunt from pulse-skip mode to Burst Mode®. Observe the Burst Mode® of operation at the switch node, and measure the output ripple voltage. It should measure less than 100 mV.

Insert the JP3 shunt into the OFF position and move the 1.8V Vout JP2 shunt into any of the two remaining output voltage option headers: 2.5V or 3.3V. Just as in the 1.8Vout test, the output voltage should read Vout +/- 2% tolerance under static line and load conditions, and +/- 1% tolerance under dynamic line and load conditions (+/- 2% total). Also, circuit operation in either Burst Mode® or pulse-skip will be the same.

When finished, turn off the circuit by inserting the shunt in header JP3 into the OFF position (connecting the RUN pin to ground).

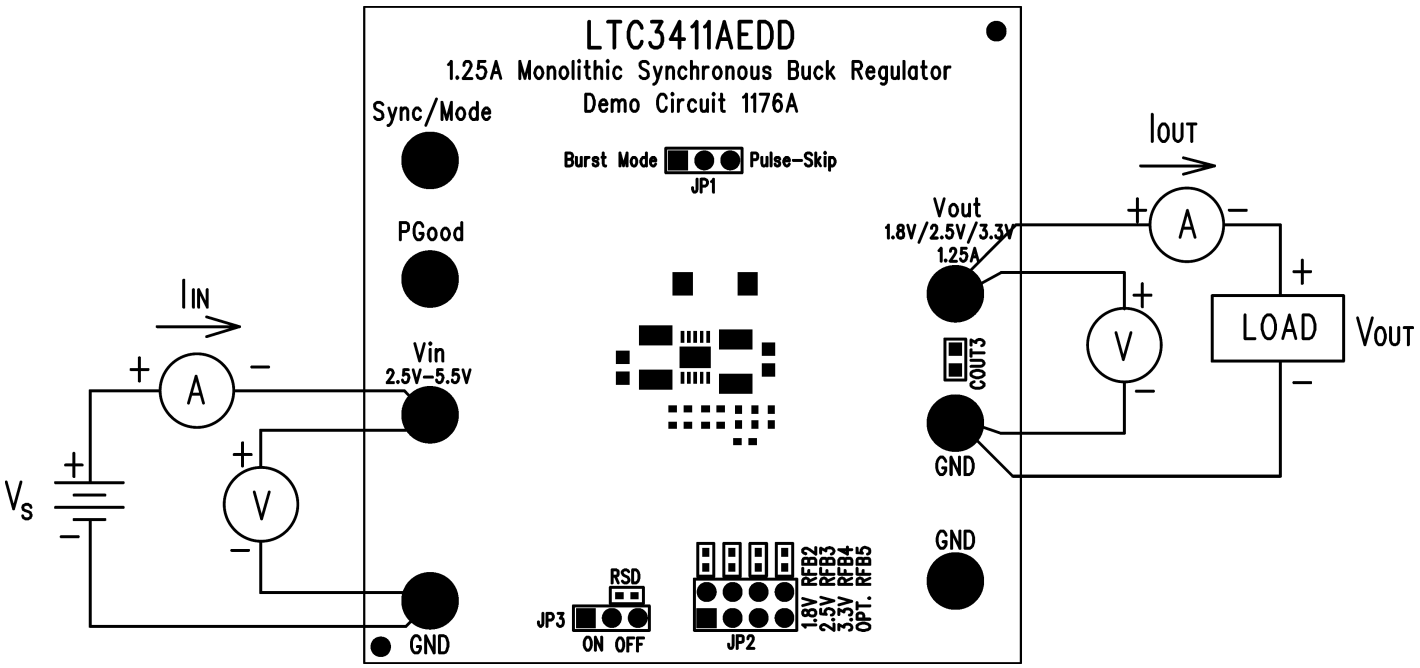


Figure 1. Proper Equipment Measurement Set-Up

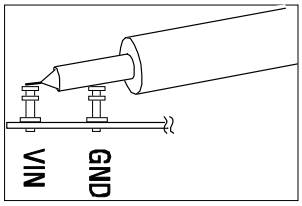


Figure 2. Measuring Input or Output Ripple

Normal Switching Frequency & Output Ripple Voltage Waveforms

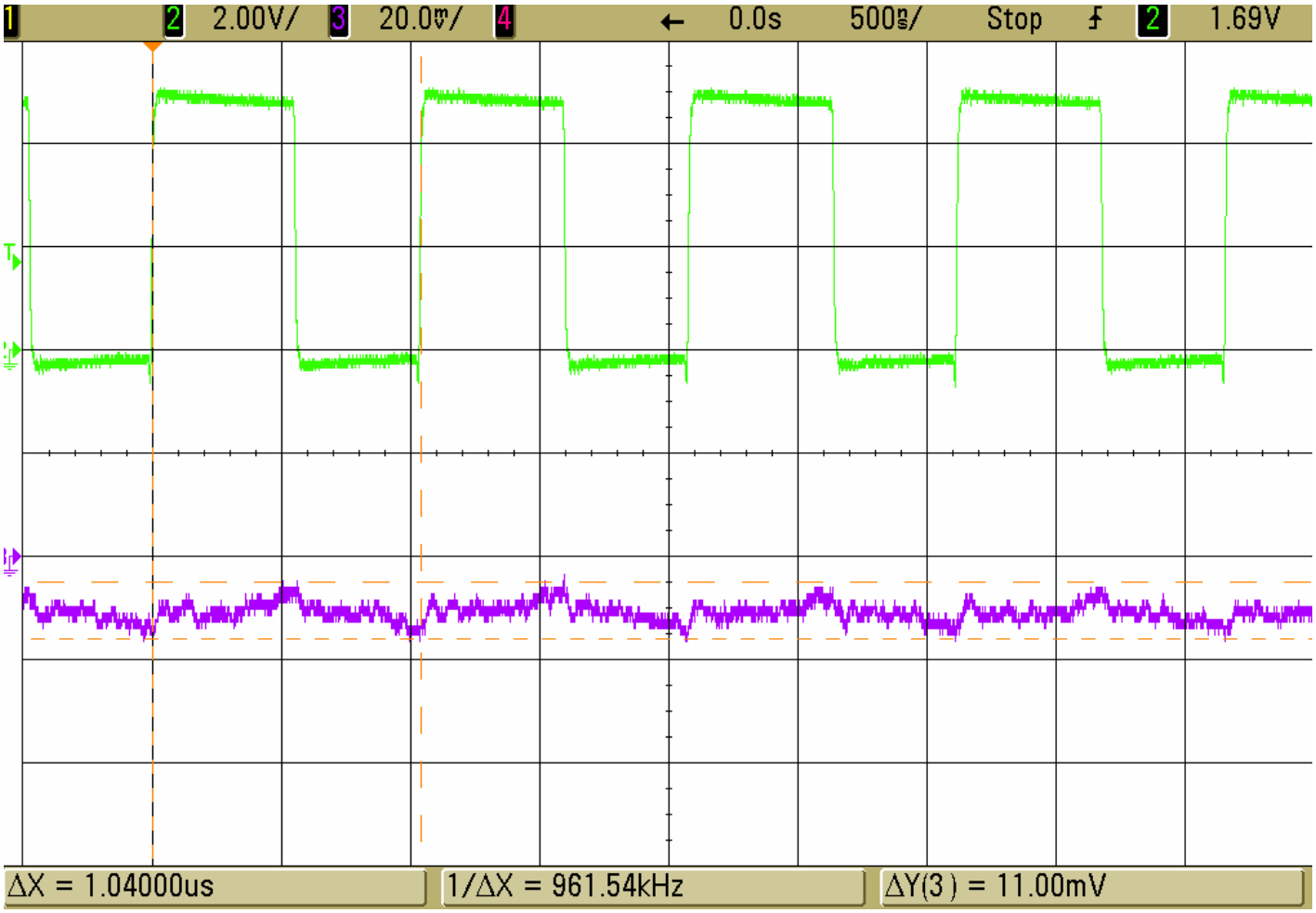


Figure 3. Switch Waveform & Output Ripple Voltage
V_{IN} = 5V, V_{OUT} = 2.5V, I_{OUT} = 1.25A
Trace 2: Switch Voltage (2 V/div)
Trace 3: Output Ripple Voltage (20 mV/div AC)

Load Step Response Waveform

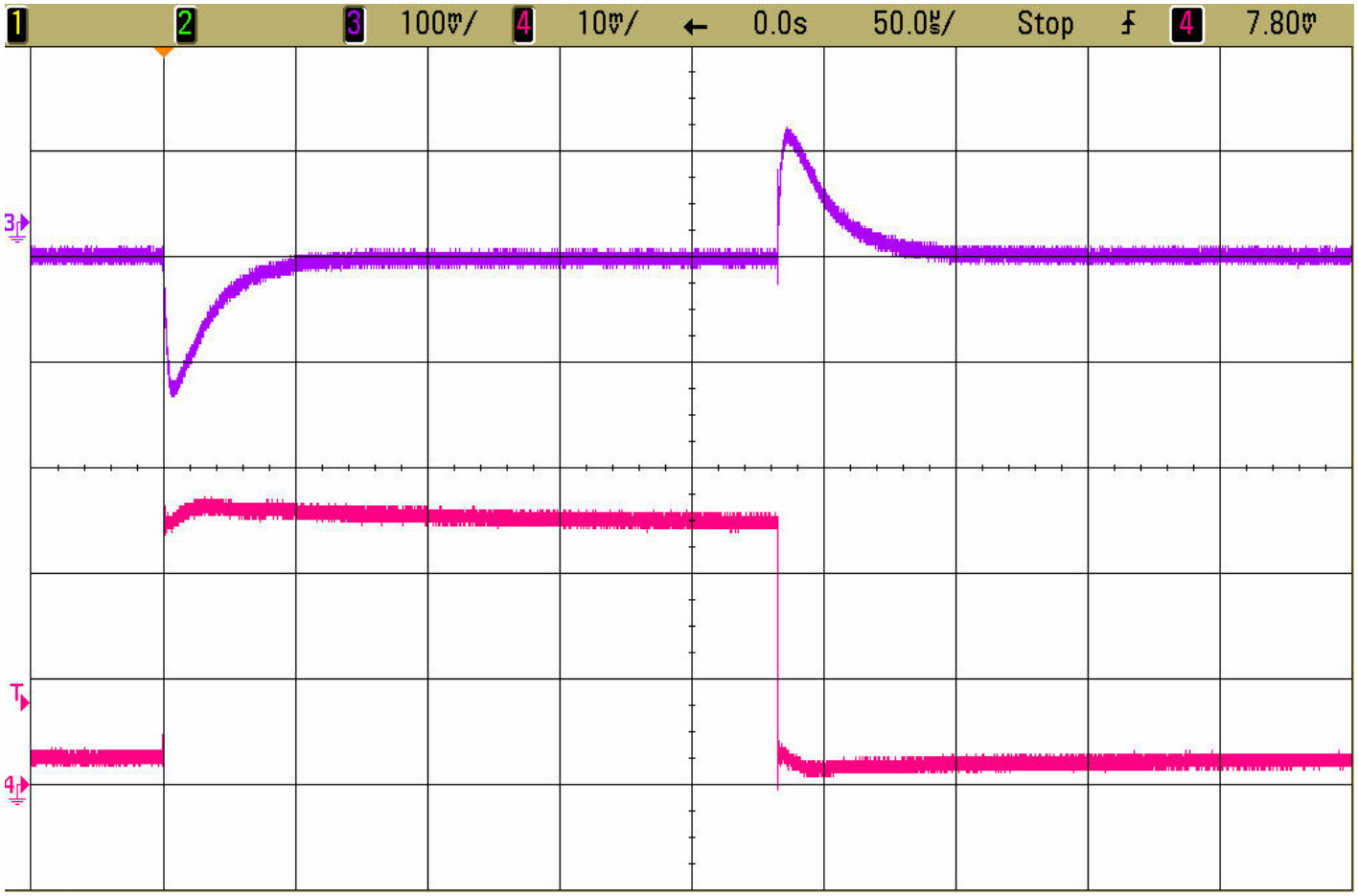
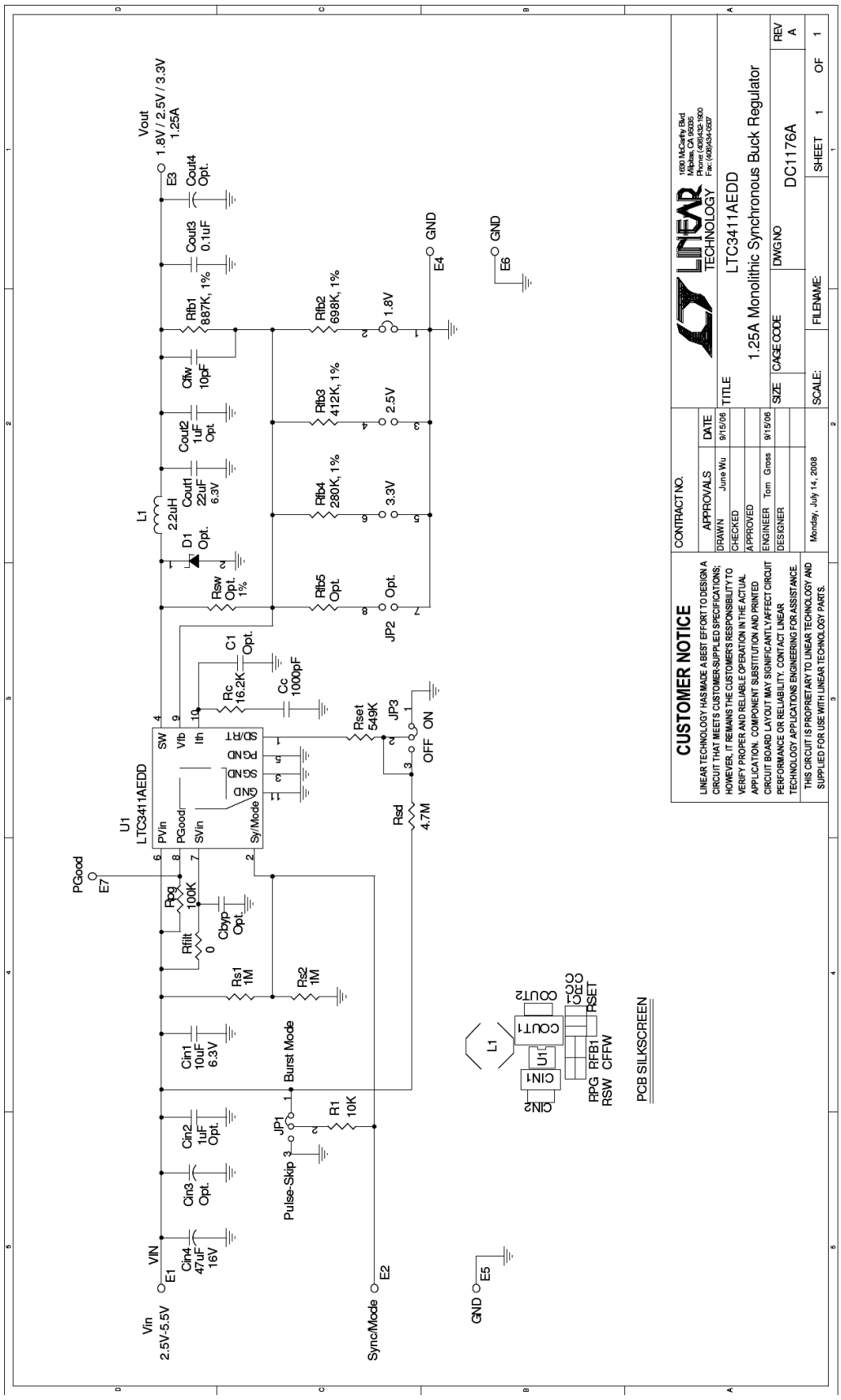


Figure 4. Load Step Response
V_{IN} = 3.3V, V_{OUT} = 1.8V, 1.125A Load Step (125mA <-> 1.25A)

Pulse-Skip Mode Fsw = 1 MHz
Trace 3: Output Voltage (100mV/div AC)
Trace 4: Output Current (0.5A/div)


Vout
1.8V / 2.5V / 3.3V
1.25A
E3
Cout4
Opt.
Cout3
0.1uF
Rfb1
887K, 1%
Rfb2
698K, 1%
Cfbw
10pF
Cout2
1uF
Opt.
Rfb3
412K, 1%
Cout1
22uF
6.3V
Rfb4
280K, 1%
L1
2.2uH
D1
Opt.
Rsw
Opt.
1%
Rfb5
Opt.
JP2
C1
Opt.
Rc
16.2K
Cc
1000pF
Rset
549K
JP3
OFF ON
Rsd
4.7M
U1
LTC3411AEDD
PVin
PGood
SVin
Sy/Mode
SW
Vfb
Ith
SP/RT
PGND
SGND
GND
PGood
E7
Rpg
100K
Rfilt
0
Cbyp
Opt.
Rs1
1M
Rs2
1M
Cin1
10uF
6.3V
Cin2
1uF
Opt.
Cin3
Opt.
Cin4
47uF
16V
VIN
E1
Vin
2.5V-5.5V
Burst Mode
JP1
Pulse-Skip
R1
10K
SyncMode
E2
GND
E5
GND
E4
GND
E6
1.8V
2.5V
3.3V
Opt.
L1
COUT2
COUT1
U1
CIN1
CIN2
RPG
RSW
CFFW
RFB1
CC1
CC2
RSET
PCB SILKSCREEN
CONTRACT NO.
APPROVALS
DATE
DRAWN June Wu 9/15/06
CHECKED
APPROVED
ENGINEER Tom Gross 9/15/06
DESIGNER
Monday, July 14, 2008
SIZE
CAGE CODE
DWG NO
DC1176A
REV A
SCALE:
FILENAME:
SHEET 1 OF 1
TITLE
LTC3411AEDD
1.25A Monolithic Synchronous Buck Regulator
LINEAR TECHNOLOGY
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THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.