QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 1442A
HIGH INPUT VOLTAGE 2.5A MONOLITHIC SYNCHRONOUS BUCK REGULATOR

LTC3603EUF

DESCRIPTION

Demonstration circuit 1442A is a step-down converter, using the LTC3603EUF monolithic synchronous buck regulator. The DC1442A has an input voltage range of 4.5V to 15V, and is capable of delivering up to 2.5A of output current. The output voltage of the DC1442A can be set as low as 0.6V, the reference voltage of the LTC3603EUF. At low load currents, the DC1442A can operate in either noise sensitive applications, due to the capability of the LTC3603EUF to operate in pulse-skipping mode, or in high efficiency applications, because the LTC3603EUF can also operate in Burst-Mode®. Of course, in continuous mode, or large load current applications, the DC1442A is a high efficiency circuit - over 90%. The DC1442A consumes less than 75 uA of quiescent current during sleep operation typically, and during shutdown, it consumes less than 1 uA. Because of the high switching frequency of the LTC3603EUF, which is programmable up to 3 MHz, the DC1442A uses low profile surface mount components. These features, plus the LTC3603EUF coming in a 20-Lead QFN package, make the DC1442A an ideal circuit for use in high voltage portable, battery-powered 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		4.5V
Maximum Input Voltage		15V
Run/Shutdown		GND = Shutdown
		V_{IN} = Run
Output Voltage V_{OUT} Regulation	V_{IN} = 4.5V to 15V, I_{OUT} = 0A to 2.5A	2.5V ±4% (2.4V – 2.6V)
		3.3V ±4% (3.168V – 3.432V)
		5V ±4% (4.8V – 5.2V)
Typical Output Ripple V_{OUT}	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 2.5A (20 MHz BW)	< 20m$V_{P–P}$
Operation Modes	Burst Mode - V_{IN} = 12V, V_{OUT} = 3.3V	< 1.5 A
	Pulse-Skip - V_{IN} = 12V, V_{OUT} = 3.3V	< 650 mA
Nominal Switching Frequency	R_T = 105k	1 MHz

QUICK START PROCEDURE

Demonstration Circuit 1442A is easy to set up to evaluate the performance of the LTC3603EUF. 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 JP5, which connects the RUN pin to ground (GND), and thus, shuts down the circuit, the forced continuous (FC) position of header JP6, the external soft-start (EXT SS) position of header JP7, and the 3.3V 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 DC1442A set up according to the proper measurement and equipment in Figure 1, apply 6.3V at Vin (Do not hot-plug Vin or increase Vin over the rated maximum supply voltage of 15V, or the part may be damaged.). Measure Vout; it should read 0V. Turn on the circuit by inserting the shunt in header JP5 into the ON position. The output voltage should be regulating. Measure Vout - it should measure 3.3V +/- 2% (3.234V to 3.366V).

Vary the input voltage from 4.5V to 15V and adjust the load current from 0 to 2.5A. Vout should read 3.3V +/- 4% (3.168V to 3.432V).

Adjust the output current to 2A. Measure the output ripple voltage; it will measure less than 20 mVAC.

Observe the voltage waveform at the switch node (pins 16 thru 19). Verify the switching frequency is between 800 kHz and 1.2 MHz (T = 1.25 us and 0.833 us), and that the switch node waveform is rectangular in shape.

Change the JP6 shunt from forced continuous mode to Burst Mode®. Also set the input voltage to 12V and the output current to any current less than 1.5A. Observe the Burst Mode® operation at the switch node, and measure the output ripple voltage. It should measure less than 200 mV. For lower output ripple voltage, set the mode to pulse-skip and adjust the output current to any current less than 625 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.

Insert the JP5 shunt into the OFF position and move the shunt in 3.3V Vout JP2 header into any of the two remaining output voltage option headers: 2.5V or 5V. Just as in the 3.3V Vout 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, the 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 JP5 into the OFF position (connecting the RUN pin to ground).

Low Output Voltage Configuration

For applications with output voltages less than 2V, the inductor value of 3.3 uH on the DC1442A should be changed to 1.5 uH. This is required so that the inductor ripple current “ramp” waveform has a large enough slope for the current comparator (to distinguish it from noise voltages).

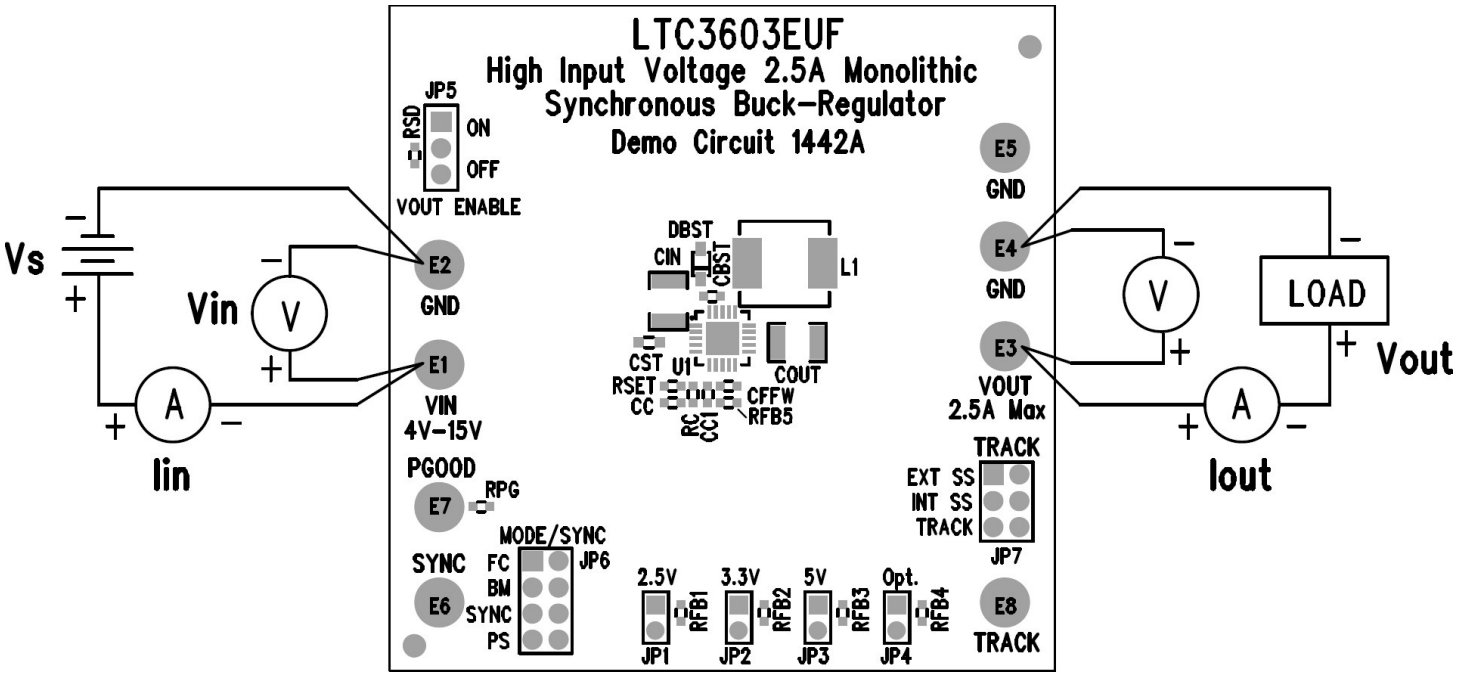


Figure 1. Proper Equipment Measurement Set-Up

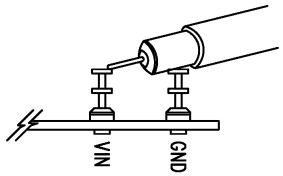


Figure 2. Measuring Input or Output Ripple

Normal Switching Frequency & Output Ripple Voltage Waveforms

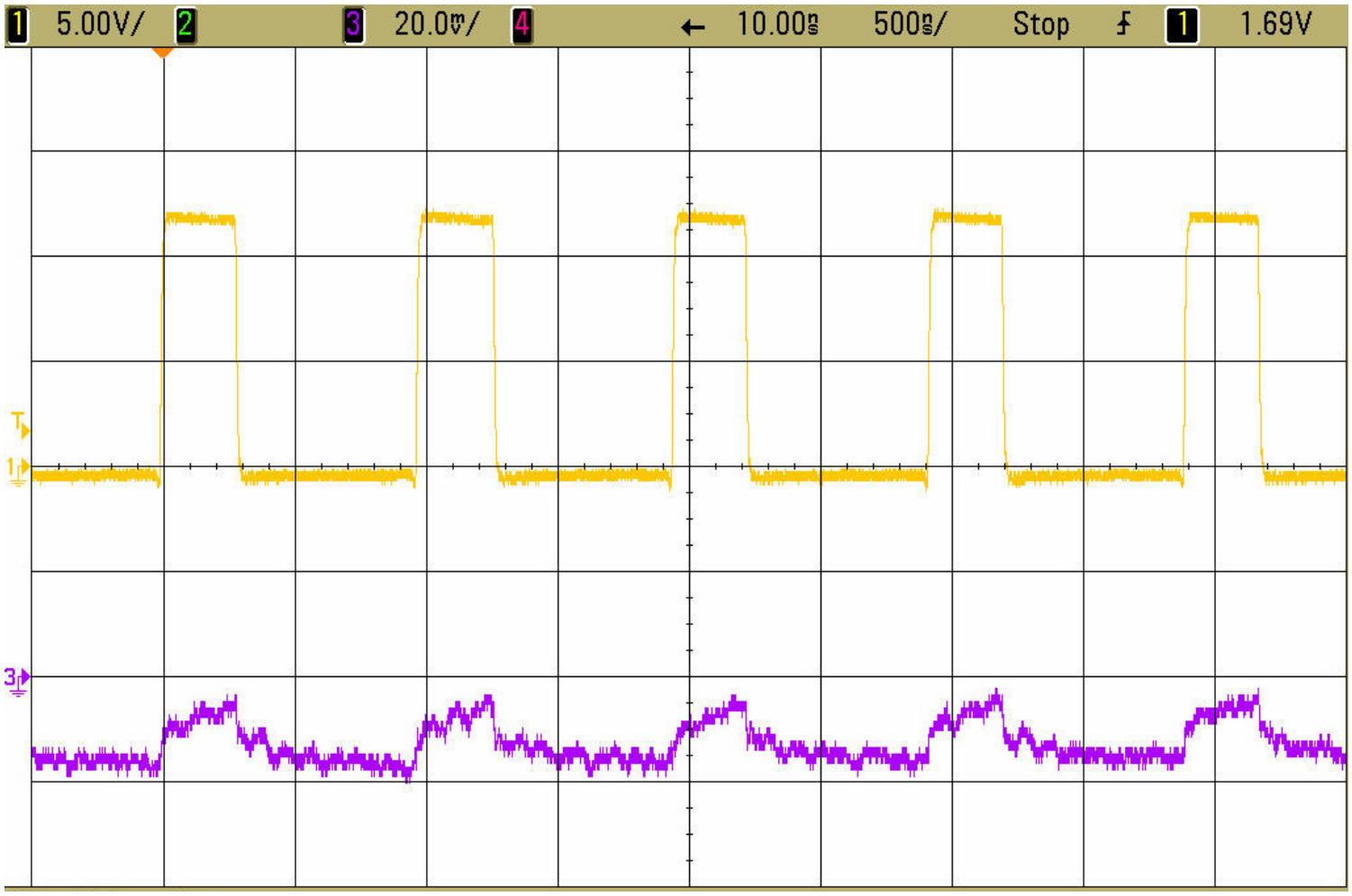


Figure 3. Switch Waveform & Output Ripple Voltage
V_{IN} = 12V, V_{OUT} = 3.3V, I_{OUT} = 2.5A, Fsw = 1 MHz
Trace 1: Switch Voltage (5 V/div)
Trace 3: Output Ripple Voltage (20 mV/div AC)

Load Step Response Waveform

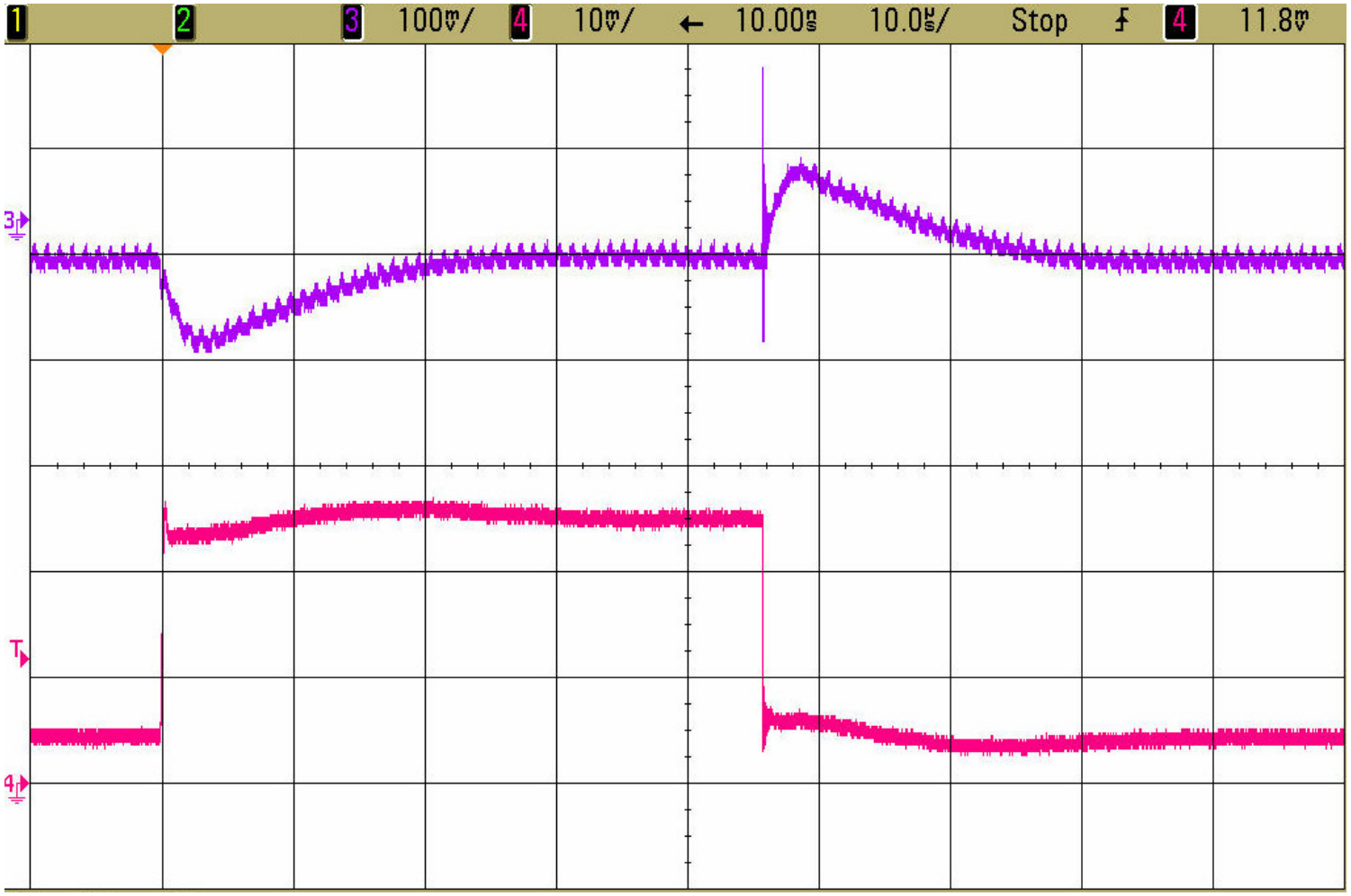
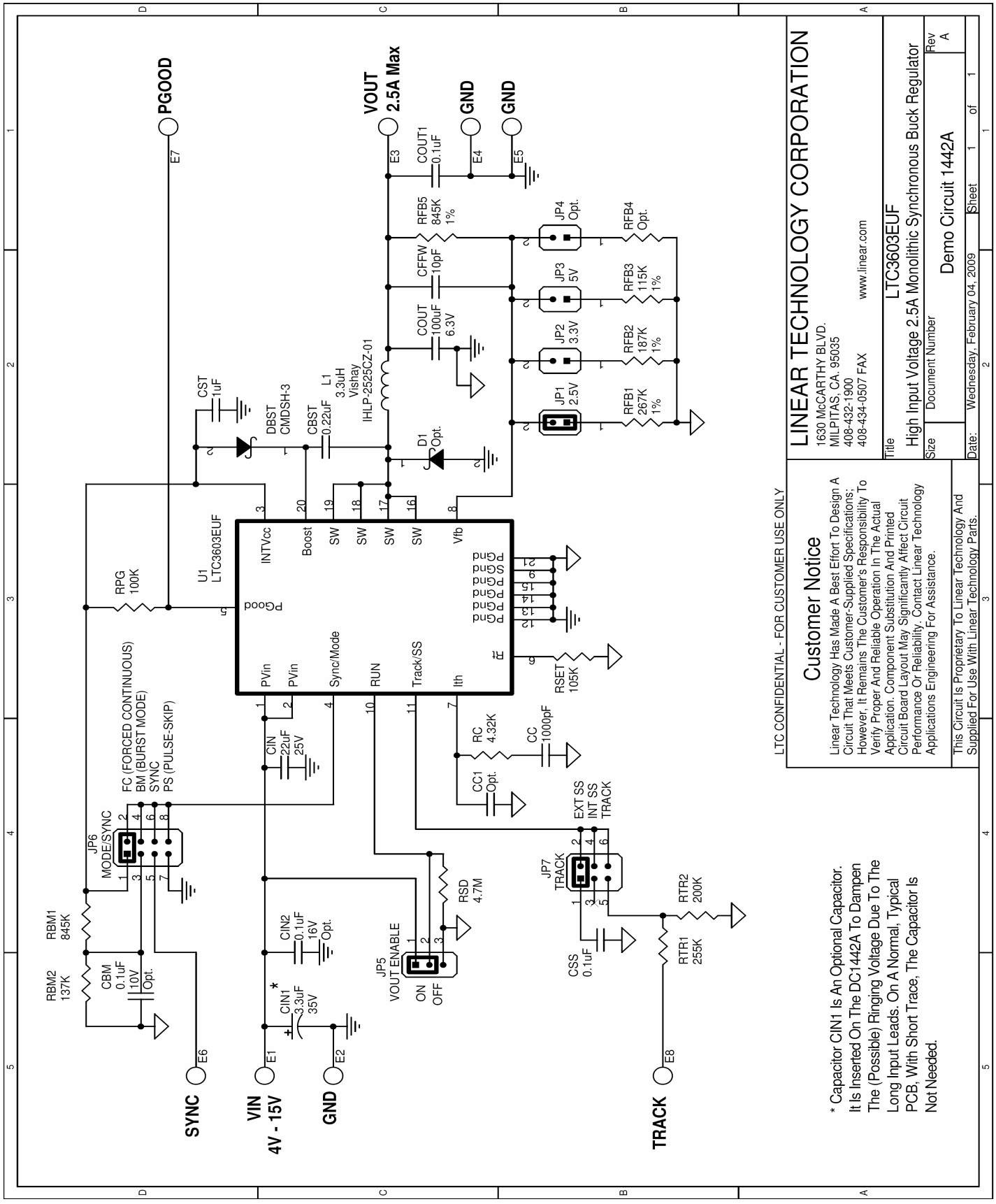


Figure 4. Load Step Response
V_{IN} = 12V, V_{OUT} = 3.3V, 2A Load Step (500 mA <-> 2.5A)
Forced Continuous Mode Fsw = 1 MHz

Trace 3: Output Voltage (100mV/div AC)
Trace 4: Output Current (1A/div)


PGOOD
VOUT 2.5A Max
GND
GND
SYNC
VIN 4V - 15V
GND
TRACK
U1 LTC3603EUF
INTVcc
Boost
SW
SW
SW
SW
Vfb
PGood
PVin
PVin
Sync/Mode
RUN
Track/SS
Ith
PGnd
SGnd
RPG 100K
CST 1uF
DBST CMDSH-3
CBST 0.22uF
L1 3.3uH Vishay IHLP-2525CZ-01
D1 Opt.
COUT 100uF 6.3V
CFFW 10pF
COUT1 0.1uF
RFB5 845K 1%
RFB4 Opt.
RFB3 115K 1%
RFB2 187K 1%
RFB1 267K 1%
JP1 2.5V
JP2 3.3V
JP3 5V
JP4 Opt.
CIN 22uF 25V
RSET 105K
RC 4.32K
CC 100pF
CC1 Opt.
JP6 MODE/SYNC
FC (FORCED CONTINUOUS)
BM (BURST MODE)
SYNC
PS (PULSE-SKIP)
RBM1 845K
RBM2 137K
CBM 0.1uF 10V Opt.
CIN2 0.1uF 16V Opt.
CIN1 * 3.3uF 35V
JP5 VOUT ENABLE
ON
OFF
RSD 4.7M
JP7 TRACK
EXT SS
INT SS
TRACK
CSS 0.1uF
RTR1 255K
RTR2 200K
* Capacitor CIN1 Is An Optional Capacitor. It Is Inserted On The DC1442A To Dampen The (Possible) Ringing Voltage Due To The Long Input Leads. On A Normal, Typical PCB, With Short Trace, The Capacitor Is Not Needed.
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Customer Notice
Linear Technology Has Made A Best Effort To Design A Circuit That Meets Customer-Supplied Specifications; However, It Remains The Customer's Responsibility To Verify Proper And Reliable Operation In The Actual Application. Component Substitution And Printed Circuit Board Layout May Significantly Affect Circuit Performance Or Reliability. Contact Linear Technology Applications Engineering For Assistance.
This Circuit Is Proprietary To Linear Technology And Supplied For Use With Linear Technology Parts.
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High Input Voltage 2.5A Monolithic Synchronous Buck Regulator
Size
Document Number
Demo Circuit 1442A
Rev A
Date: Wednesday, February 04, 2009
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