DEMO CIRCUIT 1310A
QUICK START GUIDE

LTC3612
3A, 4MHz, MONOLITHIC SYNCHRONOUS STEP-DOWN REGULATOR

DESCRIPTION

Demo Circuit 1310 is a high efficiency, high frequency step-down converter, incorporating the LTC3612 monolithic synchronous regulator. The DC1310A has an input voltage range of 2.25V to 5.5V, and is capable of delivering up to 3A of output current. The output voltage of the DC1310A can be set as low as 0.6V, the reference voltage of the LTC3612. The operating frequency range of the DC1310A is either set to a fixed 2.25 MHz by connecting the frequency pin to SVin, set by an external resistor, or synchronized to an external clock, with a range up to 4 MHz. At low load currents, the DC1310A can operate in either noise sensitive applications, due to the capability of the LTC3612 to operate in pulse-skipping mode, or in high efficiency applications, because the LTC3612 also has Burst-Mode capability. The Burst Mode clamp can be set externally. Of course, in (forced) continuous mode, or large load current applications, the DC1310A is a very efficient circuit - over 90%. The DC1310A consumes less than 200 uA of quiescent current during sleep operation, and during shutdown, it consumes less than 1 uA. The DC1310A can track another voltage, due to the LTC3612 track function, for easy power supply sequencing. Extra features include frequency and current foldback, and an adjustable 0.3V-to-0.6V external reference. Because of the high switching frequency of the LTC3612, which is programmable up to 4 MHz, the DC1310A uses low profile surface mount components. All these features make the DC1310A perfectly suited for portable computer and distributed power applications.

Design files for this circuit board are available. Call the LTC factory.

As Shipped Performance Summary

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		2.25V
Maximum Input Voltage		5.5V
Run/Shutdown		GND = Shutdown
		V_{IN} = Run
Output Voltage Regulation	V_{IN} = 2.25V to 5.5V, I_{OUT} = 0A to 3A	1.2V ±4% (1.152V – 1.248V)
	V_{IN} = 2.25V to 5.5V, I_{OUT} = 0A to 3A	1.8V ±4% (1.728V – 1.872V)
	V_{IN} = 3.1V to 5.5V, I_{OUT} = 0A to 3A	2.5V ±4% (2.4V – 2.6V)
	V_{IN} = 3.9V to 5.5V, I_{OUT} = 0A to 3A	3.3V ±4% (3.168V – 3.432V)
Typical Output Ripple Voltage	V_{IN} = 5V, V_{OUT} = 1.8V, I_{OUT} = 3A (20 MHz BW)	<30mV_{P-P}
Burst Mode	V_{IN} = 5V, V_{OUT} = 1.8V	<600 mA
Pulse-Skip Mode	V_{IN} = 5V, V_{OUT} = 1.8V	<500 mA
Nominal Switching Frequency	R_T = 165k	2 MHz ± 20%

Table 1. Jumper Description

JUMPER	FUNCTION	RANGE/SETTING (DEFAULT)
JP1	Output Voltage Setting.	1.2V
J1	Mode: Forced Continuous Mode (FCM), Burst Mode (BM or BMEC), or Pulse-Skip Mode(SYNC)	(FCM) – BMEC – BM - PSM
J2	Run	(ON) - OFF
J3	Tracking (TRACK), Internal Soft-Start (INT SS), or External Soft-Start (EXT SS)	(EXT SS) – (INT SS) - TRACK
J4	DDR Memory Termination	(OFF) - ON
J5	External or Internal ITH Compensation	(EXT) – INT
J6	Frequency Setting: Timing Resistor (RT), Internally Synchronized (2.25 MHz), or Externally Synchronized	(Rt) – INT SYNC – EXT SYNC
J9	External Burst Mode Clamp Voltage	(SET) – EXT

QUICK START PROCEDURE

Demonstration Circuit 1310 is easy to set up to evaluate the performance of the LTC3612. For proper measurement equipment configuration, set up the circuit according to the diagram in **Figure 1**. Before proceeding to test, insert shunts into the 1.2V position of the output voltage header JP1, into the FCM (Forced Continuous Mode) position of MODE header J1, into the OFF position of RUN header J2, into the EXT SS (external soft-start) position of Track/SS header J3, into the OFF position of DDR header J4, into the EXT (external) position of COMP header J5, into the Rt position of Rt/SYNC header J6, and into the SET position of VBMCV header J9.

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 DC1310 set up according to the proper measurement configuration 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 5.5V, or the part may be damaged.). Measure Vout; it should read 0V. Turn on the circuit by inserting the shunt in header J2 into the ON position. The output voltage should be regulating. Measure Vout - it should measure 1.2V +/- 2% (1.176V to 1.224V).

Vary the input voltage from 2.25V to 5.5V and adjust the load current from 0 to 3A. Vout should regulate around 1.2V. Measure the output ripple voltage; it should measure less than 30 mVAC.

Observe the voltage waveform at the switch pins (the other side of the inductor from the output). Verify the switching frequency is between 1.6 MHz and 2.4 MHz (T = 625 ns and 416 ns), and that the switch node waveform is rectangular in shape.

Change the J1 shunt from forced continuous mode to Burst Mode or pulse-skip mode. Set the input voltage to 5V and the output current to any current less than 600 mA. Observe the discontinuous mode of operation at the switch node, and measure the output ripple voltage. It should measure less than 100 mV.

Insert the J2 shunt into the OFF position and move the shunt in the 1.2V output JP1 header into any of the two remaining output voltage option headers: 1.8V (JP2), 2.5V (JP3), or 3.3V (JP4). Just as in the 1.2V 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 discontinuous mode will be the same. When finished, turn off the circuit by inserting the shunt in header J2 into the OFF position.

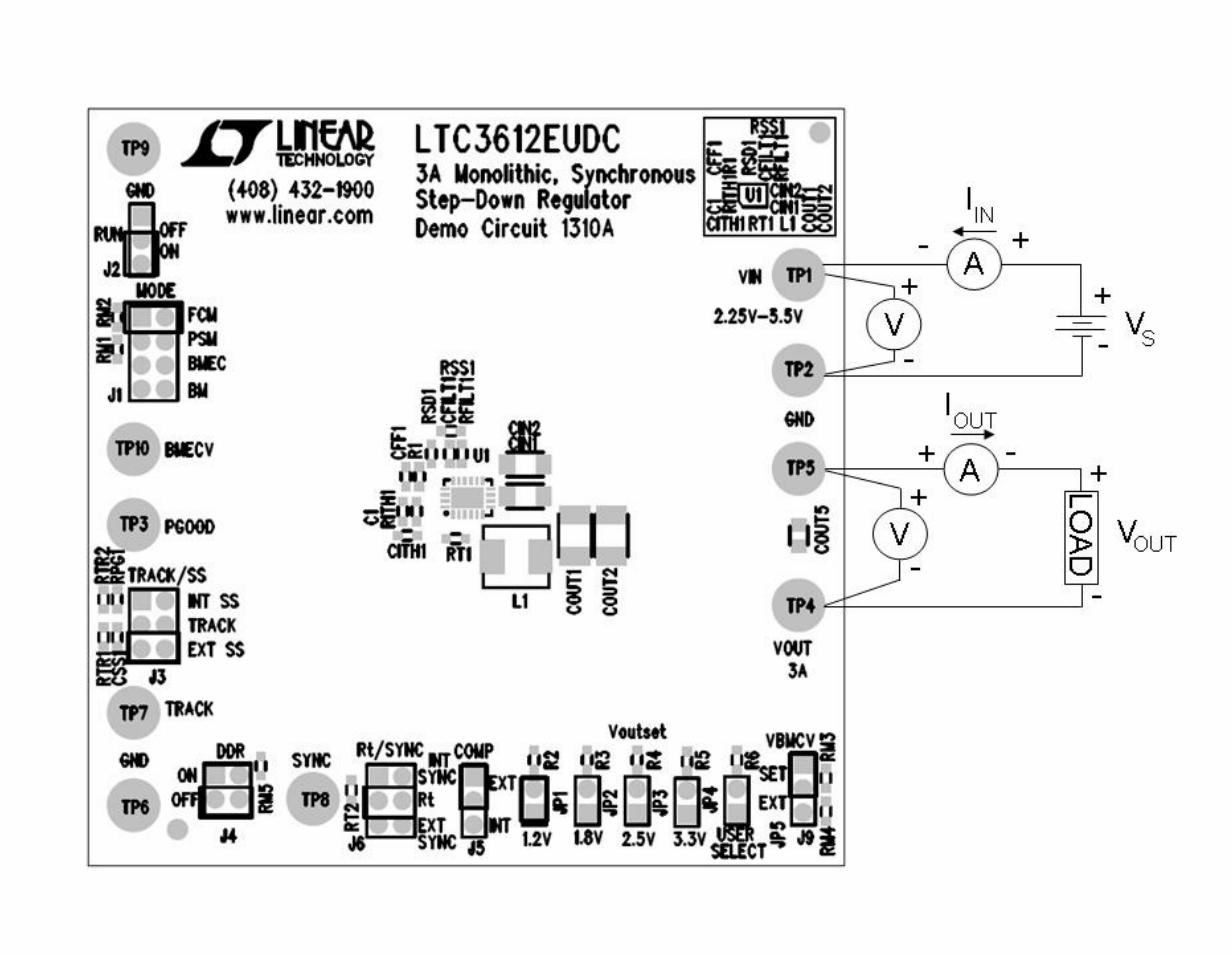


Figure 1. Proper Equipment Measurement Set-Up

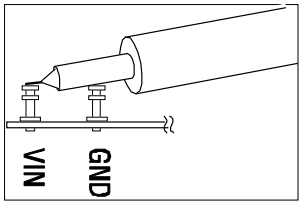


Figure 2. Measuring Input or Output Ripple

Normal Switching Frequency & Output Ripple Voltage Waveforms

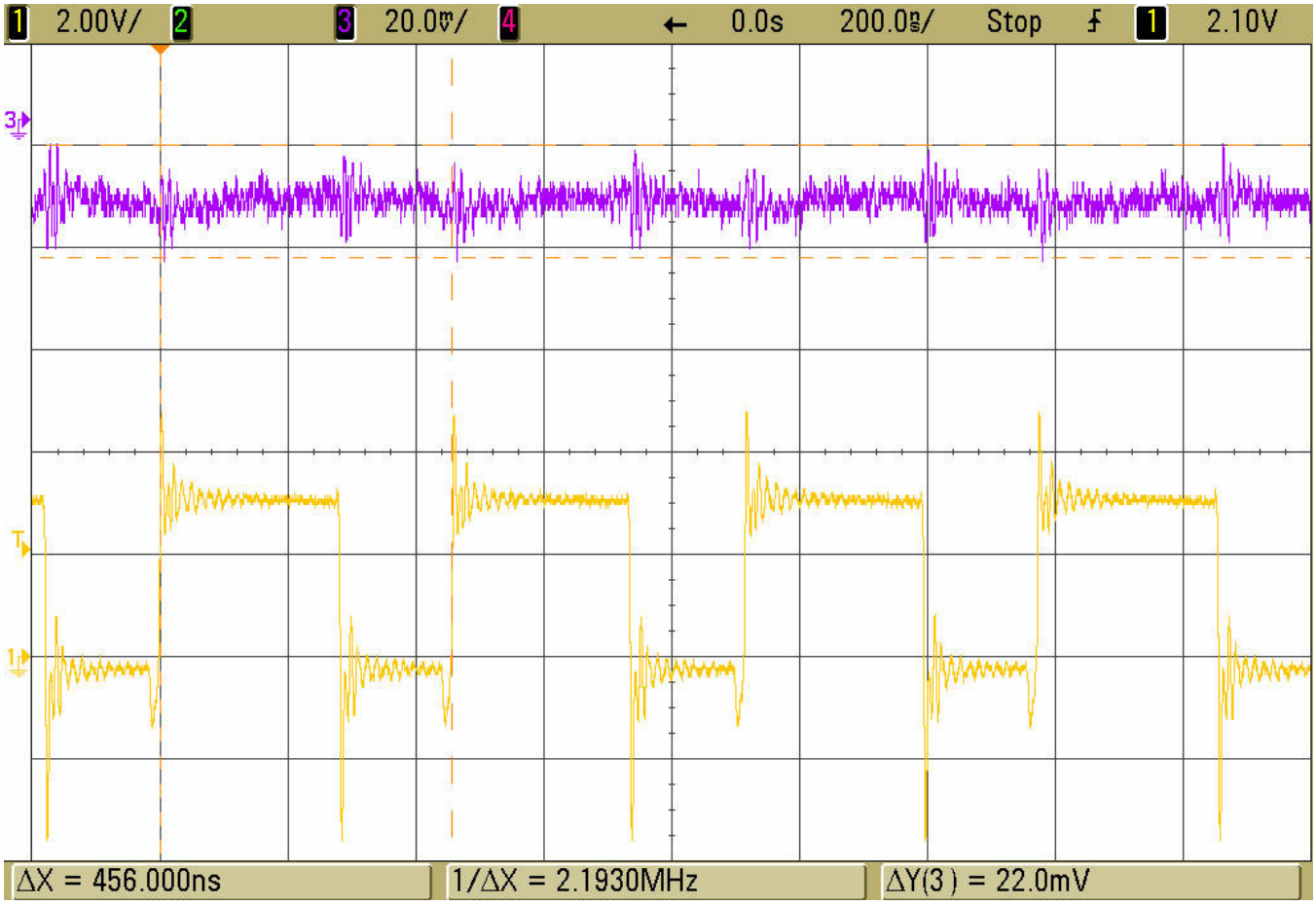


Figure 3. Switch Node & Output Ripple Voltage Waveforms
V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 3A

F_{SW} = 2.25 MHz (Internally Synchronized: V_{IN} = R_T/SYNC)
Trace 1: Switch Voltage (2 V/div)
Trace 3: Output Ripple Voltage (20 mV/div AC)

Load Step Response Waveform

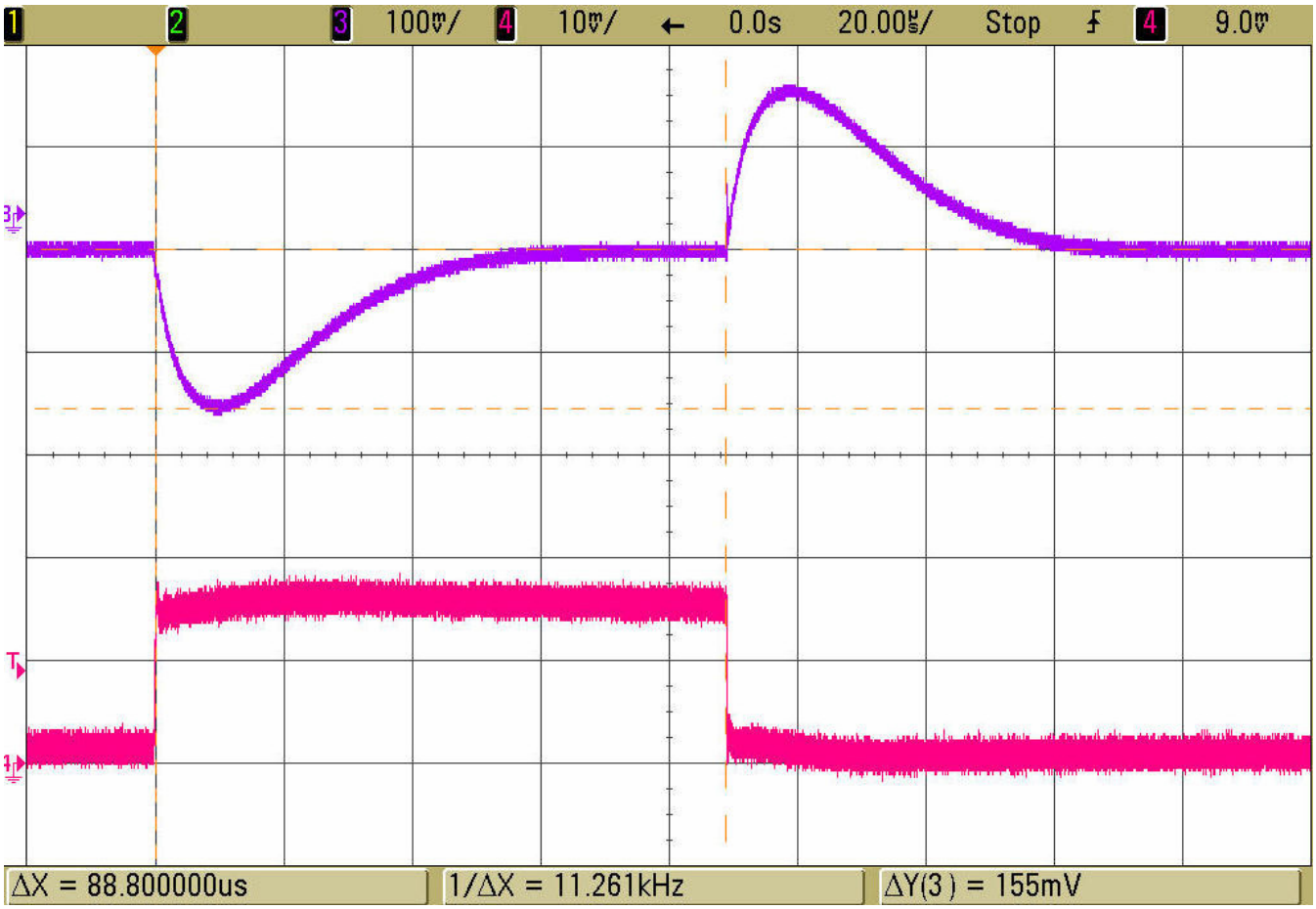
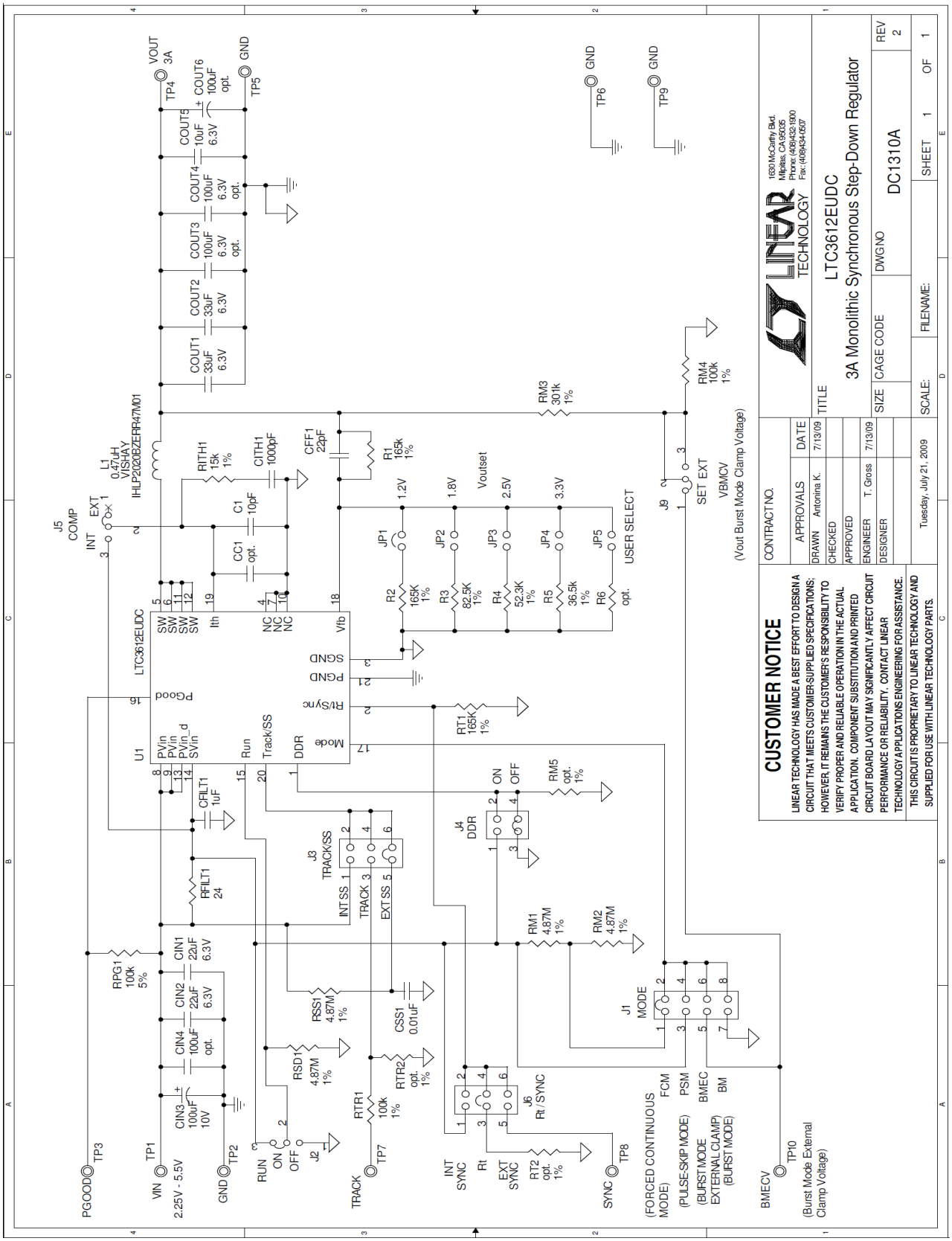


Figure 4. Load Step Response

V_{IN} = 3.3V, V_{OUT} = 1.8V, 2.5A Load Step (0.5A <-> 3A)

Forced Continuous Mode F_{SW} = 2 MHz

Trace 3: Output Voltage (100mV/div AC)
Trace 4: Output Current (2A/div)


LTC3612EUDC
LTC3612EUDC
3A Monolithic Synchronous Step-Down Regulator
DC1310A
LINEAR TECHNOLOGY
CUSTOMER NOTICE
VOUT 3A
GND
PGOOD
VIN
2.25V - 5.5V
RUN
TRACK
INT SYNC
Rt
EXT SYNC
SYNC
(FORCED CONTINUOUS MODE)
(PULSE-SKIP MODE)
(BURST MODE EXTERNAL CLAMP) (BURST MODE)
BMECV
(Burst Mode External Clamp Voltage)
SET EXT
VBMCV
(Vout Burst Mode Clamp Voltage)
USER SELECT
Voutset
1.2V
1.8V
2.5V
3.3V
ON
OFF
INT SS
TRACK
EXT SS
L1 0.47uH VISHAY IHLP2020BZERR47M01
RITH1 15k 1%
CITH1 1000pF
CFF1 22pF
R1 165k 1%
C1 10pF
CC1 opt.
RM3 301k 1%
RM4 100k 1%
RM5 opt. 1%
RM1 4.87M 1%
RM2 4.87M 1%
RT1 165K 1%
RFILT1 24
CFILT1 1uF
RPG1 100k 5%
RSS1 4.87M 1%
CSS1 0.01uF
RSD1 4.87M 1%
RTR1 100k 1%
RTR2 opt. 1%
R2 165K 1%
R3 82.5K 1%
R4 52.3K 1%
R5 36.5k 1%
R6 opt.
COUT1 33uF 6.3V
COUT2 33uF 6.3V
COUT3 100uF 6.3V opt.
COUT4 100uF 6.3V opt.
COUT5 10uF 6.3V
COUT6 100uF opt.
CIN1 22uF 6.3V
CIN2 22uF 6.3V
CIN3 100uF 10V
CIN4 100uF opt.
CONTRACT NO.
APPROVALS
DRAWN Antonina K. 7/13/09
CHECKED
APPROVED
ENGINEER T. Gross 7/13/09
DESIGNER
DATE
TITLE
SIZE
CAGE CODE
DWG NO
REV 2
SCALE:
FILENAME:
SHEET 1 OF 1
Tuesday, July 21, 2009
1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408)432-1900 Fax: (408)434-0507
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.
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.