DEMO CIRCUIT 1461A
QUICK START GUIDE

LTC3616
6A, 4MHz, MONOLITHIC SYNCHRONOUS DC/DC STEP-DOWN CONVERTER

DESCRIPTION

Demo Circuit 1461 is a high efficiency, high frequency step-down converter, incorporating the LTC3616 monolithic synchronous regulator. The DC1461A has an input voltage range of 2.25V to 5.5V, and is capable of delivering up to 6A of output current. The output voltage of the DC1461A can be set as low as 0.6V, the reference voltage of the LTC3616. The operating frequency range of the DC1461A 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 DC1461A can operate in either noise sensitive applications, due to the capability of the LTC3616 to operate in pulse-skipping mode, or in high efficiency applications, because the LTC3616 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 DC1461A is a very efficient circuit - over 90%. The DC1461A consumes less than 300 uA of quiescent current during sleep operation, and during shutdown, it consumes less than 1 uA. The DC1461A can track another voltage, due to the LTC3616 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 LTC3616, which is programmable up to 4 MHz, the DC1461A uses low profile surface mount components. All these features make the DC1461A 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 6A	1.2V ±4% (1.152V – 1.248V)
	V_{IN} = 2.5V to 5.5V, I_{OUT} = 0A to 6A	1.8V ±4% (1.728V – 1.872V)
	V_{IN} = 3.3V to 5.5V, I_{OUT} = 0A to 6A	2.5V ±4% (2.4V – 2.6V)
	V_{IN} = 4.2V to 5.5V, I_{OUT} = 0A to 6A	3.3V ±4% (3.168V – 3.432V)
Typical Output Ripple Voltage	V_{IN} = 5V, V_{OUT} = 1.8V, I_{OUT} = 6A (20 MHz BW)	<40mV$_{P-P}$
Burst Mode	V_{IN} = 5V, V_{OUT} = 1.8V	<1.3A
Pulse-Skip Mode	V_{IN} = 5V, V_{OUT} = 1.8V	<1.2A
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 (FC), Burst Mode (BM or BMEC), or Pulse-Skip Mode(SYNC)	(FC) – 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
J7	External Burst Mode Clamp Voltage	(SET) – EXT

QUICK START PROCEDURE

Demonstration Circuit 1461 is easy to set up to evaluate the performance of the LTC3616. 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 J7.

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 DC1461 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 6A. Vout should regulate around 1.2V. Measure the output ripple voltage; it should measure less than 40 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 1A. 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.

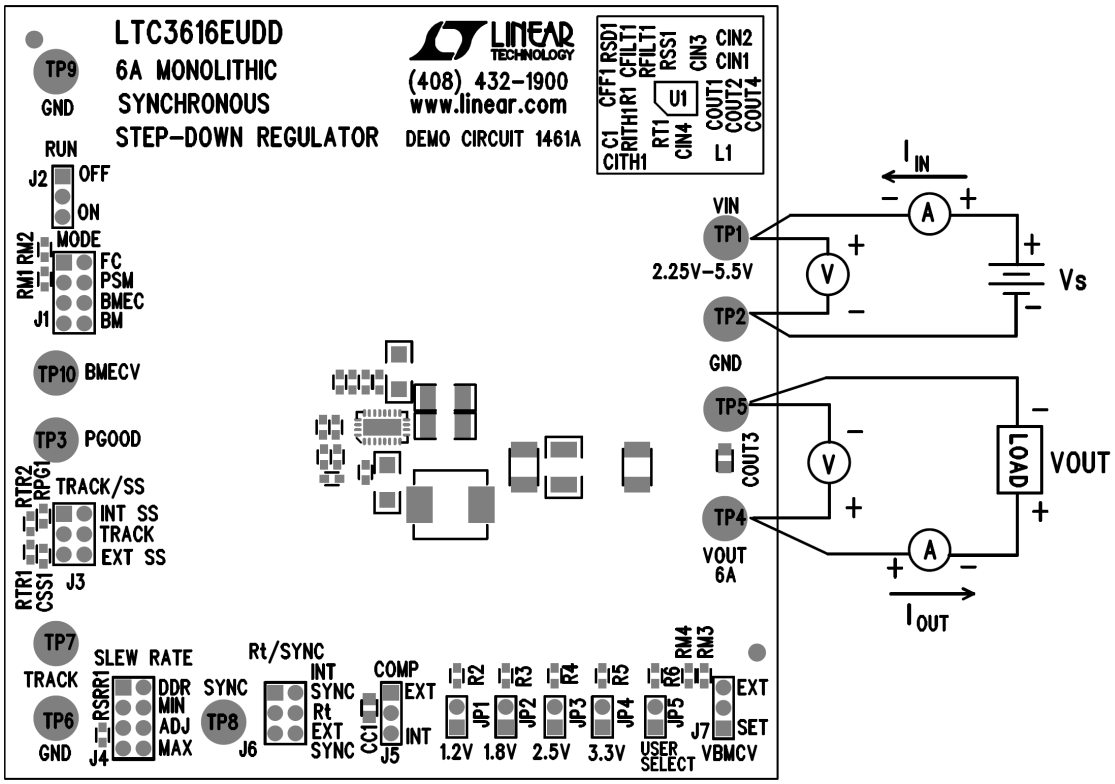


Figure 1. Proper Measurement Equipment Set-Up

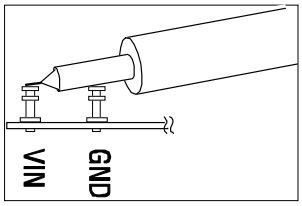


Figure 2. Measuring Input or Output Ripple

Normal Switching Frequency & Output Ripple Voltage Waveforms

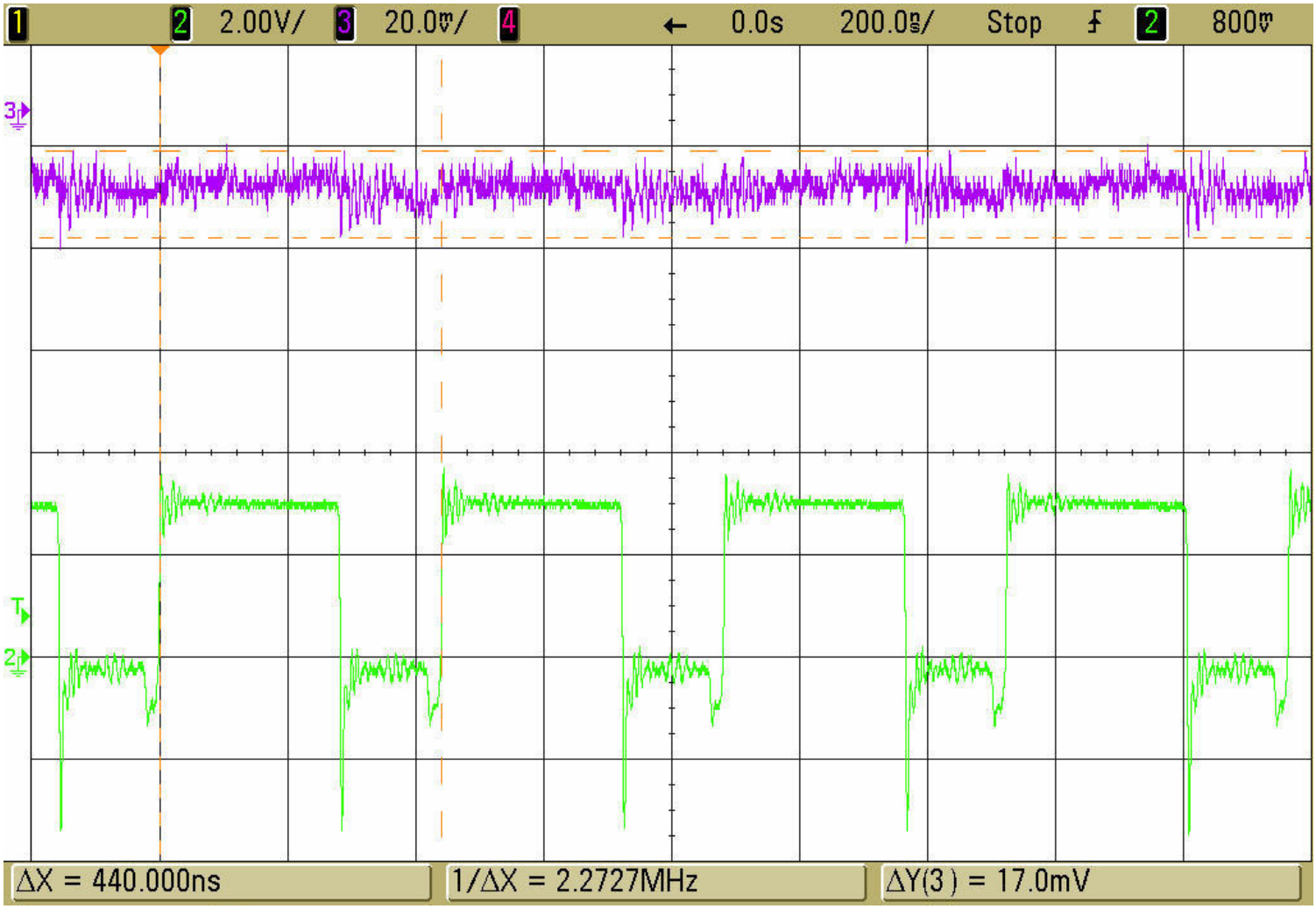


Figure 3. Switch Node & Output Ripple Voltage Waveforms

V_{IN} = 3.3V, V_{OUT} = 1.8V, I_{OUT} = 6A

F_{SW} = 2.25 MHz (Internally Synchronized: V_{RT} = V_{IN})

Trace 3: Output Ripple Voltage (20 mV/div AC)

Trace 2: Switch Voltage (2 V/div)

Load Step Response Waveform

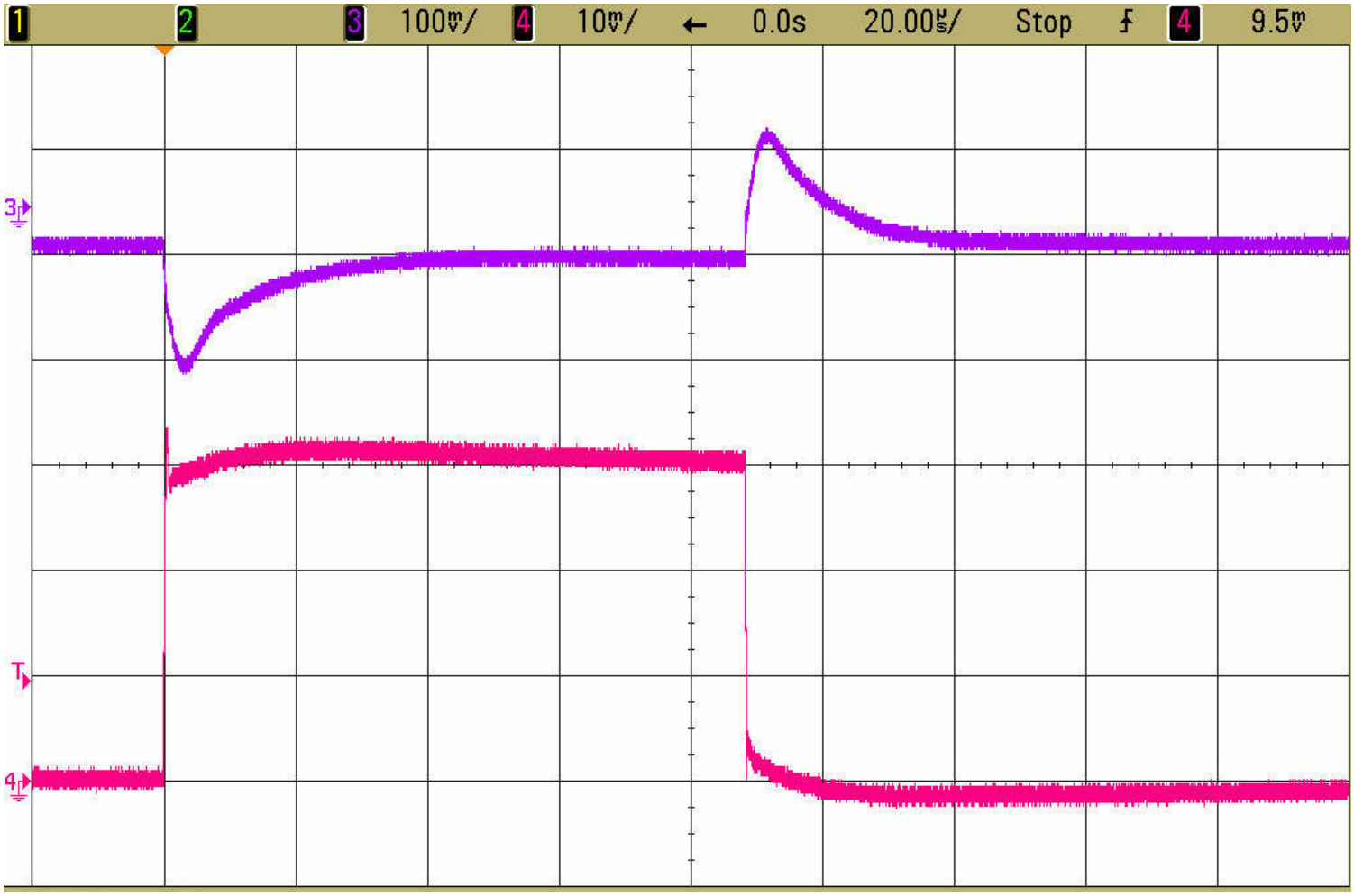


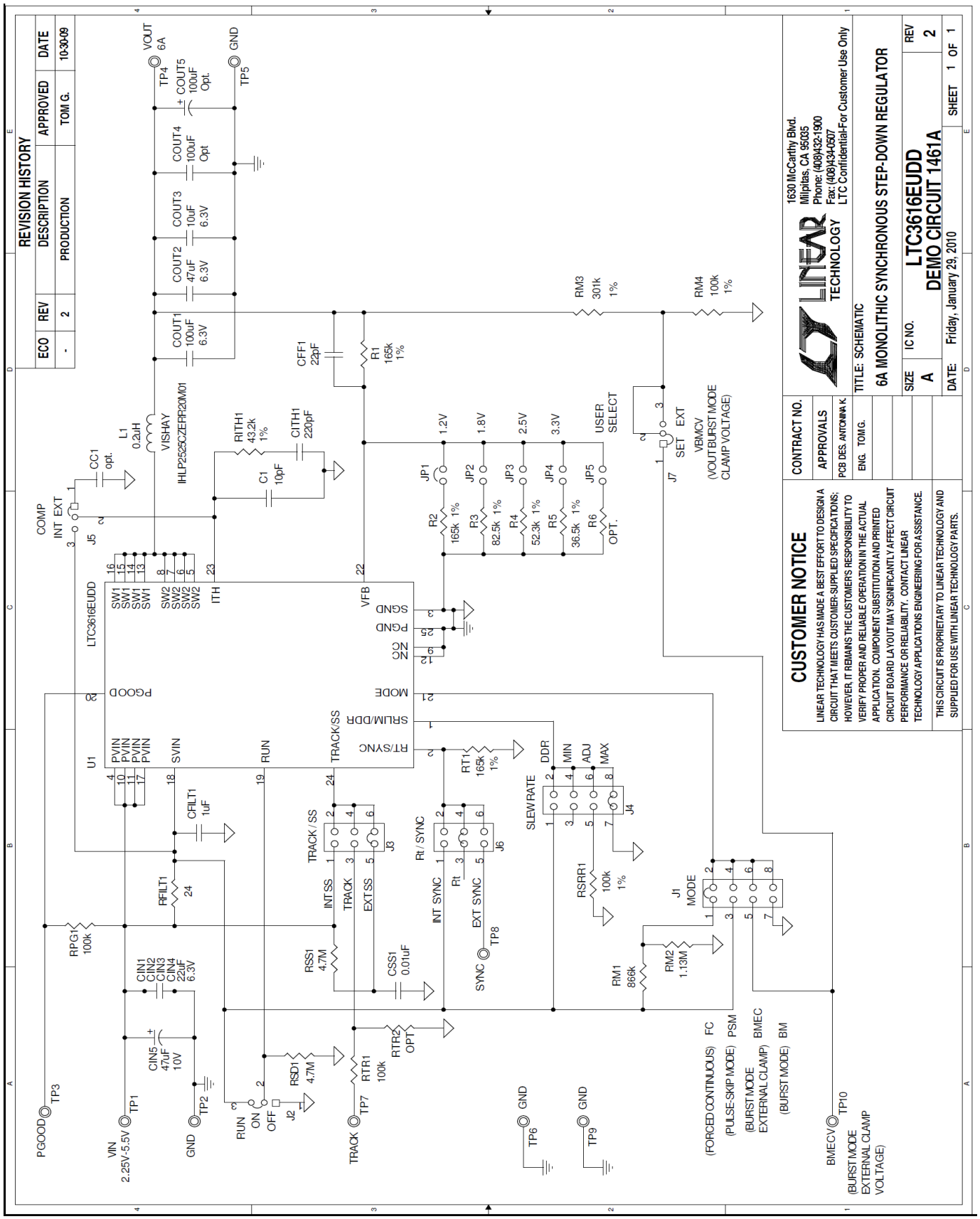
Figure 4. Load Step Response

V_{IN} = 3.3V, V_{OUT} = 1.8V, 6A Load Step (0.1A <-> 6A)

Forced Continuous Mode F_{SW} = 2.25 MHz

External Compensation: Rith = 43k, Cith = 220 pF

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


REVISION HISTORY
ECO REV DESCRIPTION APPROVED DATE
- 2 PRODUCTION TOM G. 10-30-09
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.
CONTRACT NO.
APPROVALS
PCB DES. ANTONINA K.
ENG. TOM G.
LINEAR TECHNOLOGY
1630 McCarthy Blvd.
Milpitas, CA 95035
Phone: (408)432-1900
Fax: (408)434-0507
LTC Confidential-For Customer Use Only
TITLE: SCHEMATIC
6A MONOLITHIC SYNCHRONOUS STEP-DOWN REGULATOR
SIZE A
IC NO. LTC3616EUDD
DEMO CIRCUIT 1461A
REV 2
DATE: Friday, January 29, 2010
SHEET 1 OF 1
U1
LTC3616EUDD
PGOOD
PVIN
SVIN
RUN
TRACK/SS
RT/SYNC
SRLIM/DDR
MODE
NC
PGND
SGND
VFB
ITH
SW1
SW2
COMP
INT EXT
J5
CC1
opt.
L1
0.2uH
VISHAY
IHLP2525CZER200M01
RITH1
43.2k
1%
CITH1
220pF
C1
10pF
CFF1
22pF
R1
165k
1%
COUT1
100uF
6.3V
COUT2
47uF
6.3V
COUT3
10uF
6.3V
COUT4
100uF
Opt
COUT5
100uF
Opt.
VOUT
6A
TP4
GND
TP5
RM3
301k
1%
RM4
100k
1%
JP1
JP2
JP3
JP4
JP5
1.2V
1.8V
2.5V
3.3V
USER
SELECT
R2
165k 1%
R3
82.5k 1%
R4
52.3k 1%
R5
36.5k 1%
R6
OPT.
J7
SET
EXT
VBMCV
(VOUT BURST MODE
CLAMP VOLTAGE)
CFILT1
1uF
RFILT1
24
RPG1
100k
CIN1
CIN2
CIN3
CIN4
22uF
6.3V
CIN5
47uF
10V
VIN
2.25V-5.5V
TP1
TP2
TP3
PGOOD
GND
RUN
ON
OFF
J2
RSD1
4.7M
TRACK
TP7
RTR1
100k
RTR2
OPT
TRACK / SS
INT SS
TRACK
EXT SS
J3
RSS1
4.7M
CSS1
0.01uF
Rt / SYNC
INT SYNC
Rt
EXT SYNC
SYNC
TP8
J6
RT1
165k
1%
SLEW RATE
DDR
MIN
ADJ
MAX
J4
RSRR1
100k
1%
RM1
866k
RM2
1.13M
J1
MODE
(FORCED CONTINUOUS) FC
(PULSE-SKIP MODE) PSM
(BURST MODE
EXTERNAL CLAMP) BMEC
(BURST MODE) BM
BMECV
TP10
(BURST MODE
EXTERNAL CLAMP
VOLTAGE)
GND
TP6
GND
TP9