DESCRIPTION

Demonstration circuit 1215 is a step-down converter, using the LTC3605 monolithic synchronous buck regulator. The DC1215A has a maximum input voltage 15V, and is capable of delivering up to 5A of output current at a minimum input voltage of 4V. The output voltage of the DC1215A can be set as low as 0.6V, the reference voltage of the LTC3605. At low load currents, the DC1215A operates in discontinuous mode, and during shutdown, it consumes less than 10 uA of quiescent current. In continuous mode operation, the DC1215A is a high efficiency circuit - over 80%. The LTC3605 has phase lock circuits, allowing high current multiphase operation of several DC1215As in parallel.

The DC1215A can also track another voltage with the LTC3605 track function. Because of the high switching frequency of the LTC3605, which is programmable up to 4 MHz, the DC1215A uses low profile surface mount components. All these features make the DC1215A an ideal circuit for use in industrial applications and distributed power systems. Gerber files for this circuit are available. Call the LTC Factory.

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

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

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		4V
Maximum Input Voltage		15V
Run/Shutdown		GND = Shutdown
		V_{IN} = Run
Output Voltage V_{OUT} Regulation	V_{IN} = 4V to 15V, I_{OUT} = 0A to 5A	2.5V ±4% (2.4V – 2.6V)
	V_{IN} = 4.5V to 15V, I_{OUT} = 0A to 5A	3.3V ±4% (3.168V – 3.432V)
	V_{IN} = 6.4V to 15V, I_{OUT} = 0A to 5A	5V ±4% (4.8V – 5.2V)
Typical Output Ripple V_{OUT}	V_{IN} = 12V, V_{OUT} = 2.5V, I_{OUT} = 2.5A (20 MHz BW)	< 40mV$_{P-P}$
Discontinuous Mode	V_{IN} = 12V, V_{OUT} = 2.5V	< 2A
Nominal Switching Frequency	R_T = 162k	1 MHz

QUICK START PROCEDURE

Demonstration Circuit 1215 is easy to set up to evaluate the performance of the LTC3605. 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 the RUN header JP7, the forced continuous mode position (FCM) of the MODE header JP6, the 2 phase position of the PHMODE header JP5, 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 DC1215 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 15V, or the part may be damaged.). Measure Vout; it should read 0V. Turn on the circuit by inserting the shunt in header JP7 into the ON position. The output voltage should be regulating. Measure Vout - it should measure 2.5V +/- 2% (2.45V to 2.55V).

Vary the input voltage from 4V to 15V and adjust the load current from 0 to 5A. Vout should read 2.5V +/- 4% (2.4V to 2.6V).

Adjust the output current to 5A. Measure the output ripple voltage; it will measure less than 40 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 discontinuous mode (DCM). Also set the input voltage to 12V and the output current to any current less than 1.5A. Observe the discontinuous mode of operation at the switch node, and measure the output ripple voltage. It should measure less than 150 mV.

Insert the JP7 shunt into the OFF position and move the shunt in the 2.5V output JP1 header into any of the two remaining output voltage option headers: 3.3V (JP2) or 5V (JP3). Just as in the 2.5V 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 JP7 into the OFF position.

Low Output Voltage Configuration

For applications with output voltages less than 2V, the inductor value of 1 uH on the DC1215 should be changed to 0.33 uH. This is required so that the inductor ripple current ramp has a large enough slope for the current comparator can distinguish it from noise voltages.

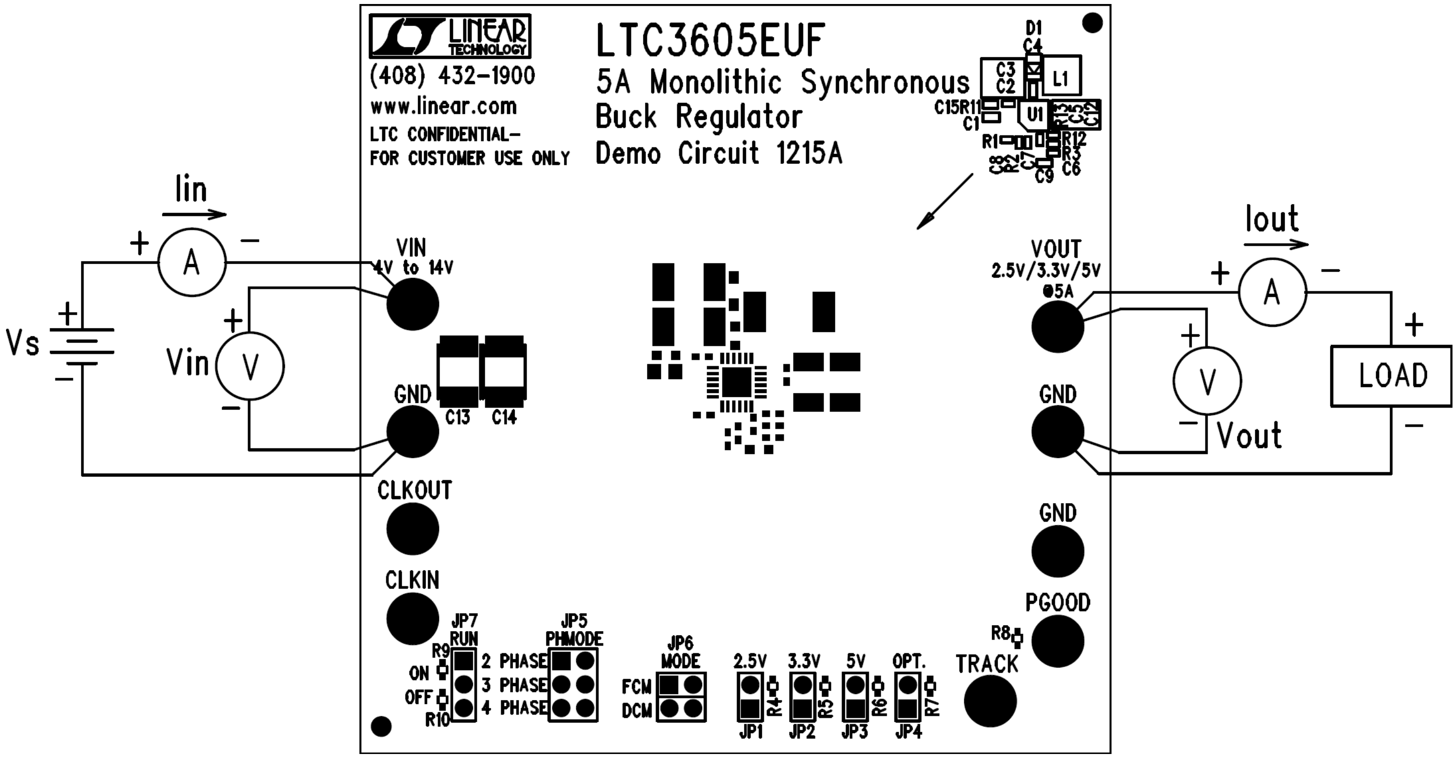


Figure 1. Proper Equipment Measurement Set-Up

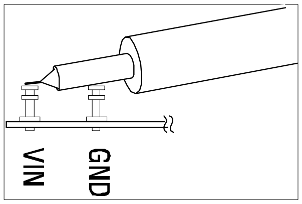


Figure 2. Measuring Input or Output Ripple

Normal Switching Frequency & Output Ripple Voltage Waveforms

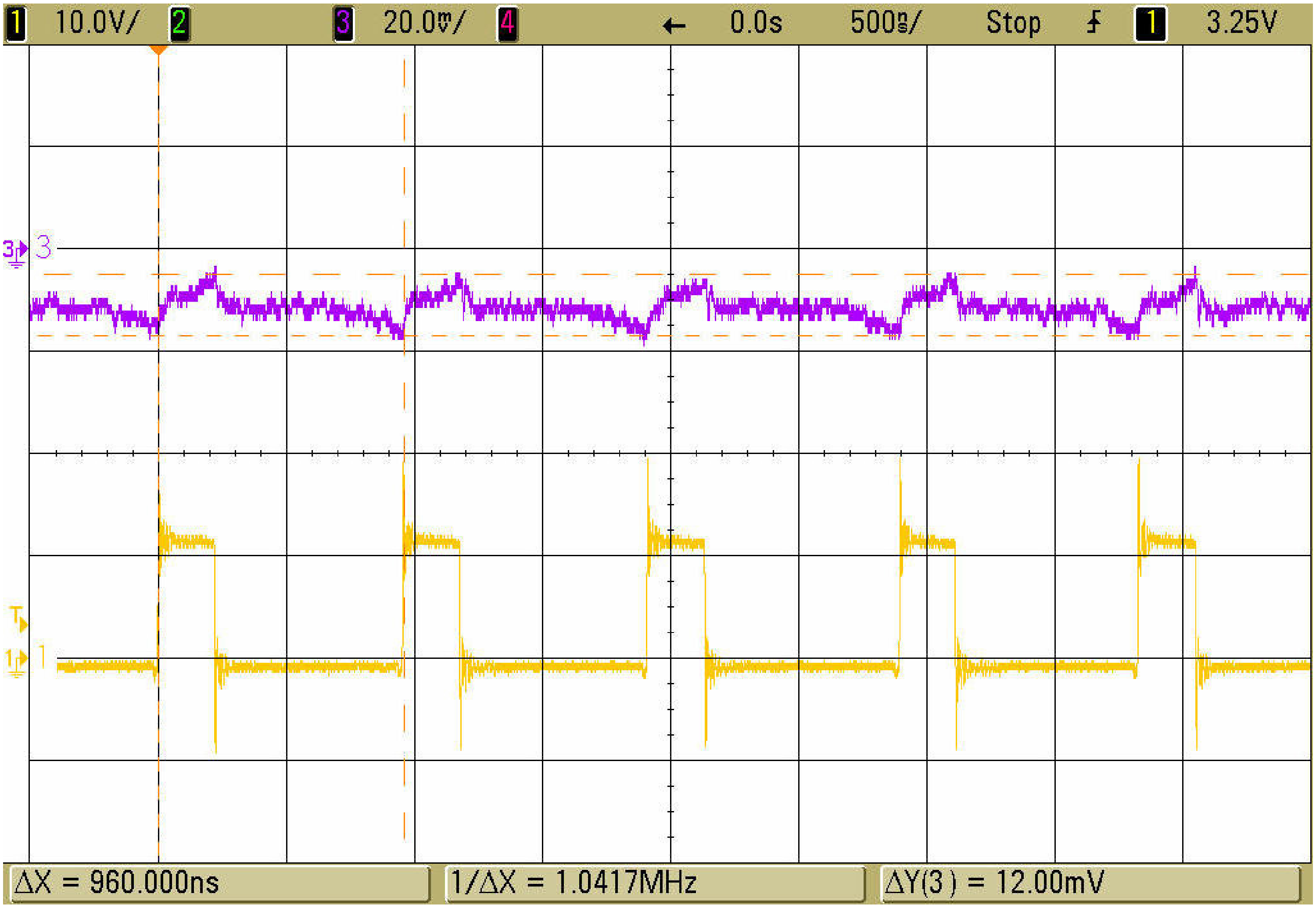


Figure 3. Switch Waveform & Output Ripple Voltage
V_{IN} = 12V, V_{OUT} = 2.5V, I_{OUT} = 5A, Fsw = 1 MHz
Trace 3: Output Ripple Voltage (20 mV/div AC)
Trace 1: Switch Voltage (5 V/div)

Load Step Response Waveform

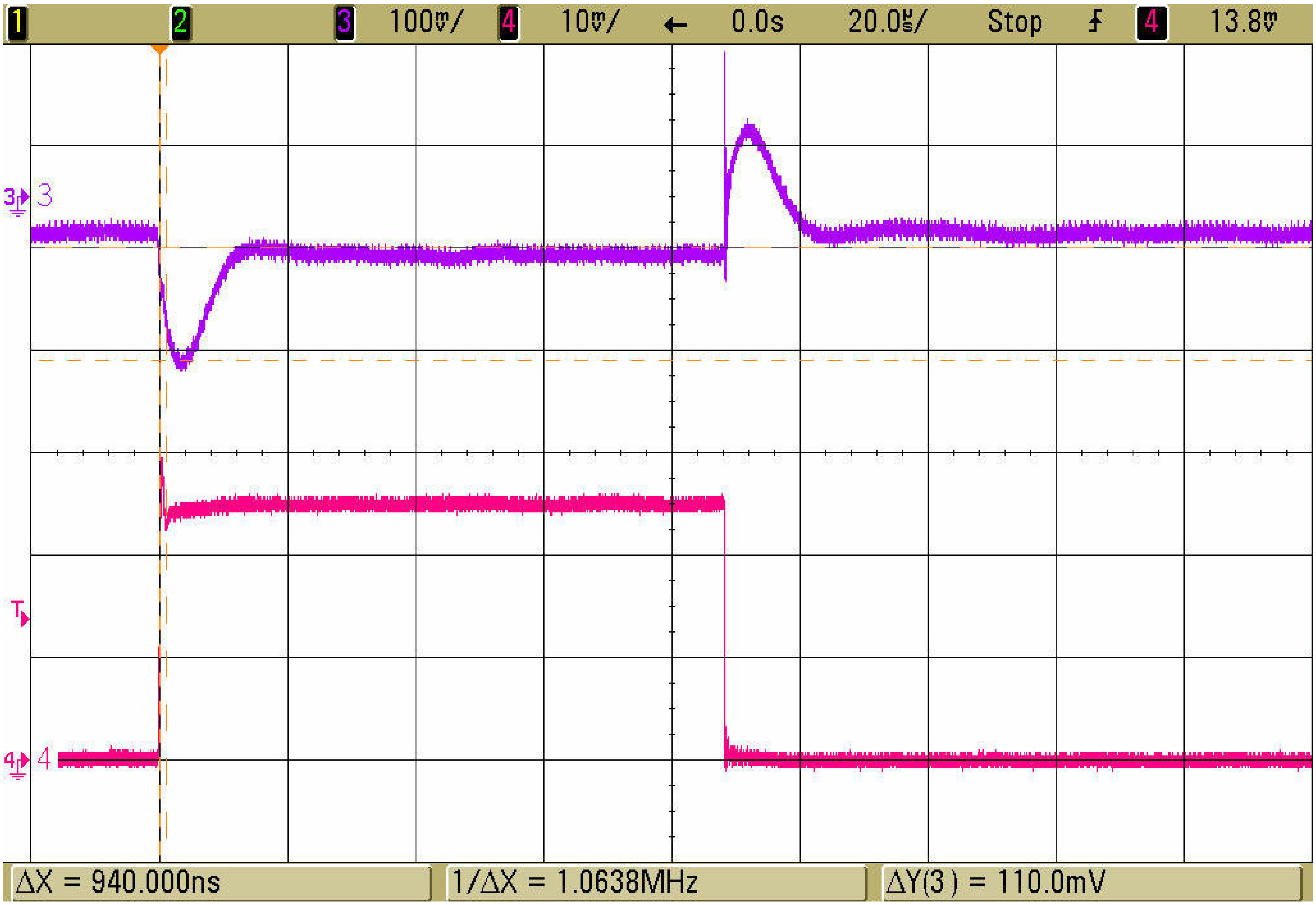


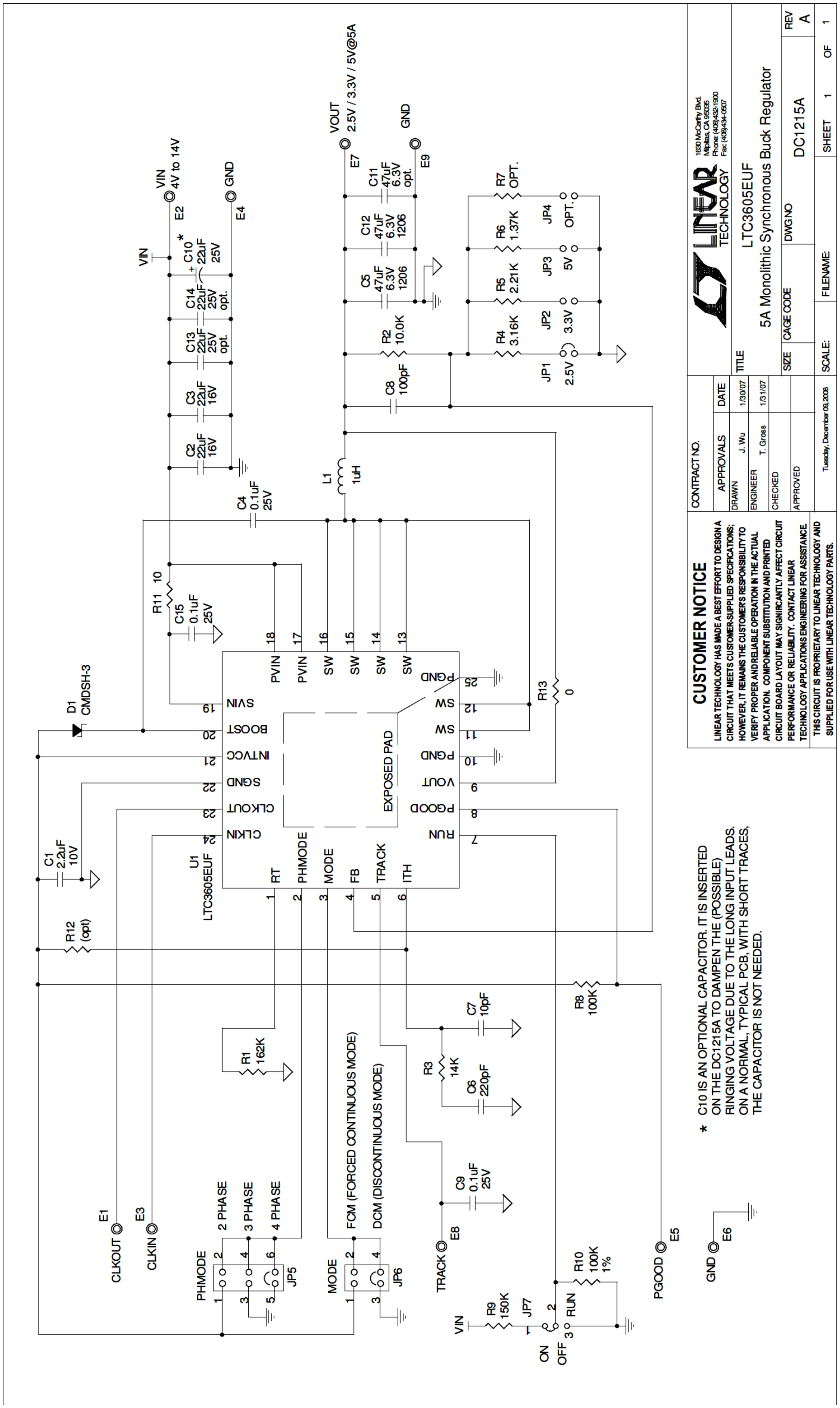
Figure 4. Load Step Response

V_{IN} = 12V, V_{OUT} = 2.5V, 5A Load Step (0A <-> 5A)

Forced Continuous Mode   Fsw = 1 MHz

Trace 3: Output Voltage (100mV/div AC)

Trace 4: Output Current (2A/div)


VIN
4V to 14V
E2
GND
E4
VOUT
2.5V / 3.3V / 5V@5A
E7
GND
E9
C10 *
22uF
25V
C14
22uF
25V
opt.
C13
22uF
25V
opt.
C3
22uF
16V
C2
22uF
16V
C4
0.1uF
25V
L1
1uH
C11
47uF
6.3V
opt.
C12
47uF
6.3V
1206
C5
47uF
6.3V
1206
R2
10.0K
C8
100pF
R7
OPT.
R6
1.37K
R5
2.21K
R4
3.16K
JP1
2.5V
JP2
3.3V
JP3
5V
JP4
OPT.
R11 10
C15
0.1uF
25V
D1
CMDSH-3
R13
0
C1
2.2uF
10V
U1
LTC3605EUF
PVIN
PVIN
SW
SW
SW
SW
PGND
SVIN
BOOST
INTVCC
SGND
CLKOUT
CLKIN
SW
SW
PGND
VOUT
PGOOD
RUN
RT
PHMODE
MODE
FB
TRACK
ITH
EXPOSED PAD
R12
(opt)
R8
100K
C7
10pF
R1
162K
R3
14K
C6
220pF
C9
0.1uF
25V
FCM (FORCED CONTINUOUS MODE)
DCM (DISCONTINUOUS MODE)
2 PHASE
3 PHASE
4 PHASE
E1
CLKOUT
E3
CLKIN
PHMODE
JP5
MODE
JP6
TRACK
E8
VIN
R9
150K
JP7
RUN
ON
OFF
R10
100K
1%
PGOOD
E5
GND
E6
* C10 IS AN OPTIONAL CAPACITOR. IT IS INSERTED ON THE DC1215A TO DAMPEN THE (POSSIBLE) RINGING VOLTAGE DUE TO THE LONG INPUT LEADS. ON A NORMAL, TYPICAL PCB, WITH SHORT TRACES, THE CAPACITOR IS NOT NEEDED.
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
DATE
DRAWN
J. Wu
1/30/07
ENGINEER
T. Gross
1/31/07
CHECKED
APPROVED
TITLE
LTC3605EUF
5A Monolithic Synchronous Buck Regulator
SIZE
CAGE CODE
DWG NO
DC1215A
REV
A
SCALE:
FILENAME:
SHEET 1 OF 1