LTC3602

DESCRIPTION

Demonstration circuit 1015 is a step-down converter, using the LTC3602 monolithic synchronous buck regulator. The DC1015 has an input voltage range of 4.5V to 10V, and is capable of delivering up to 2.5A of output current. The output voltage of the DC1015 can be set as low as 0.6V, the reference voltage of the LTC3602. At low load currents, the DC1015 can operate in either noise sensitive applications, due to the capability of the LTC3602 to operate in pulse-skipping mode, or in high efficiency applications, because the LTC3602 can also operate in Burst-Mode®. Of course, in continuous mode, or large load current applications, the DC1015 is a high efficiency circuit - over 90%. The DC1015 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 LTC3602, which is programmable up to 3 MHz, the DC1015 uses low profile surface mount components. These features, plus the LTC3602 coming in a 20-Lead QFN package, make the DC1015 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		10V
Run/Shutdown		GND = Shutdown
		V_{IN} = Run
Output Voltage V_{OUT} Regulation	V_{IN} = 4.5V to 10V, 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} = 10V, V_{OUT} = 5V, I_{OUT} = 2.5A (20 MHz BW)	< 20mV$_{P-P}$
Operation Modes	Burst Mode - V_{IN} = 8.4V, V_{OUT} = 3.3V	< 1.25 A
	Pulse-Skip - V_{IN} = 8.4V, V_{OUT} = 3.3V	< 650 mA
Nominal Switching Frequency	R_T = 105k	1 MHz
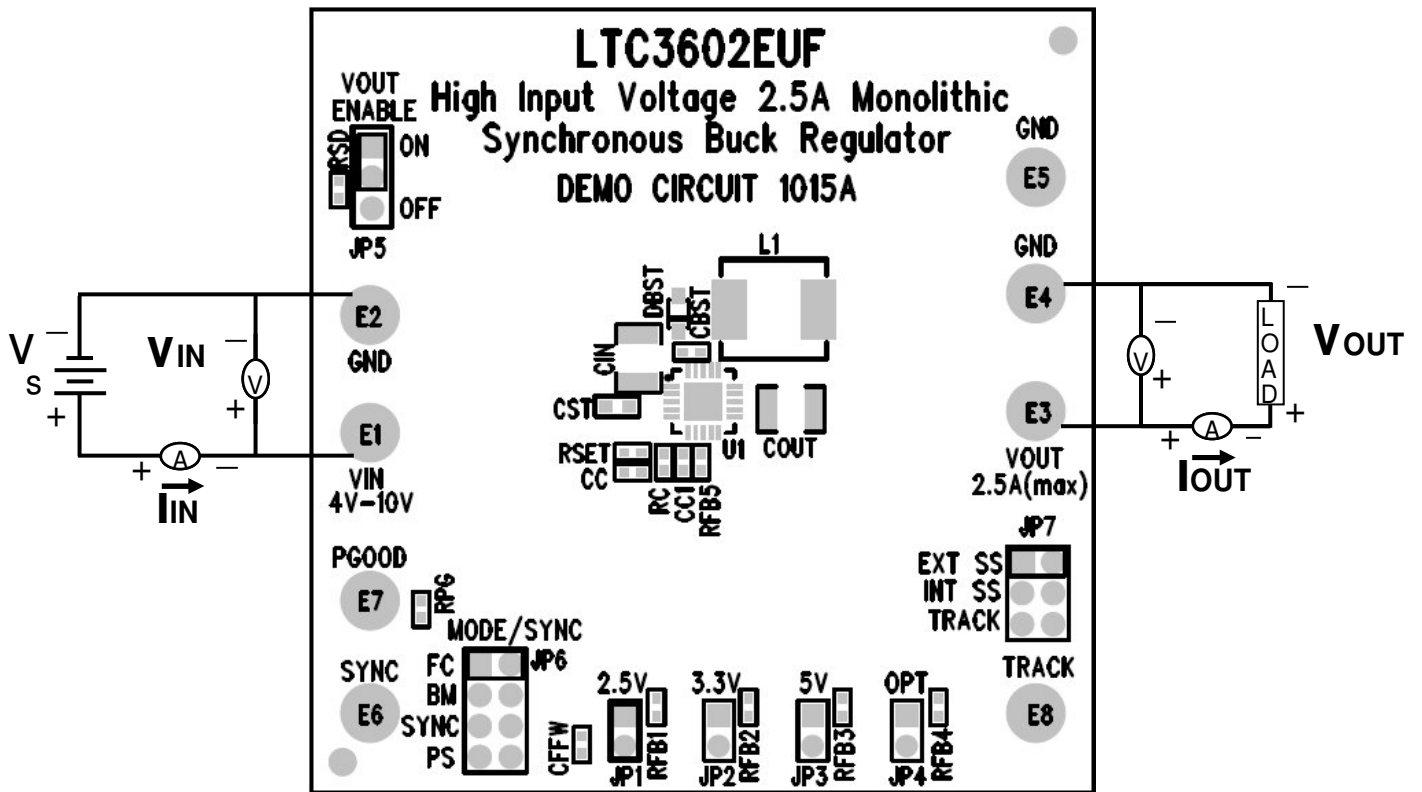
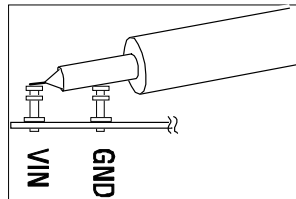**Figure 1.   Proper Equipment Measurement Set-Up**

Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE

Demonstration Circuit 1015 is easy to set up to evaluate the performance of the LTC3602. 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 position of header JP6, the external soft-start 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 DC1015 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 10V, 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 10V 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 8.4V and the output current to any current less than 1.25A. 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 2.2 uH on the DC1015 should be changed to 1 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).

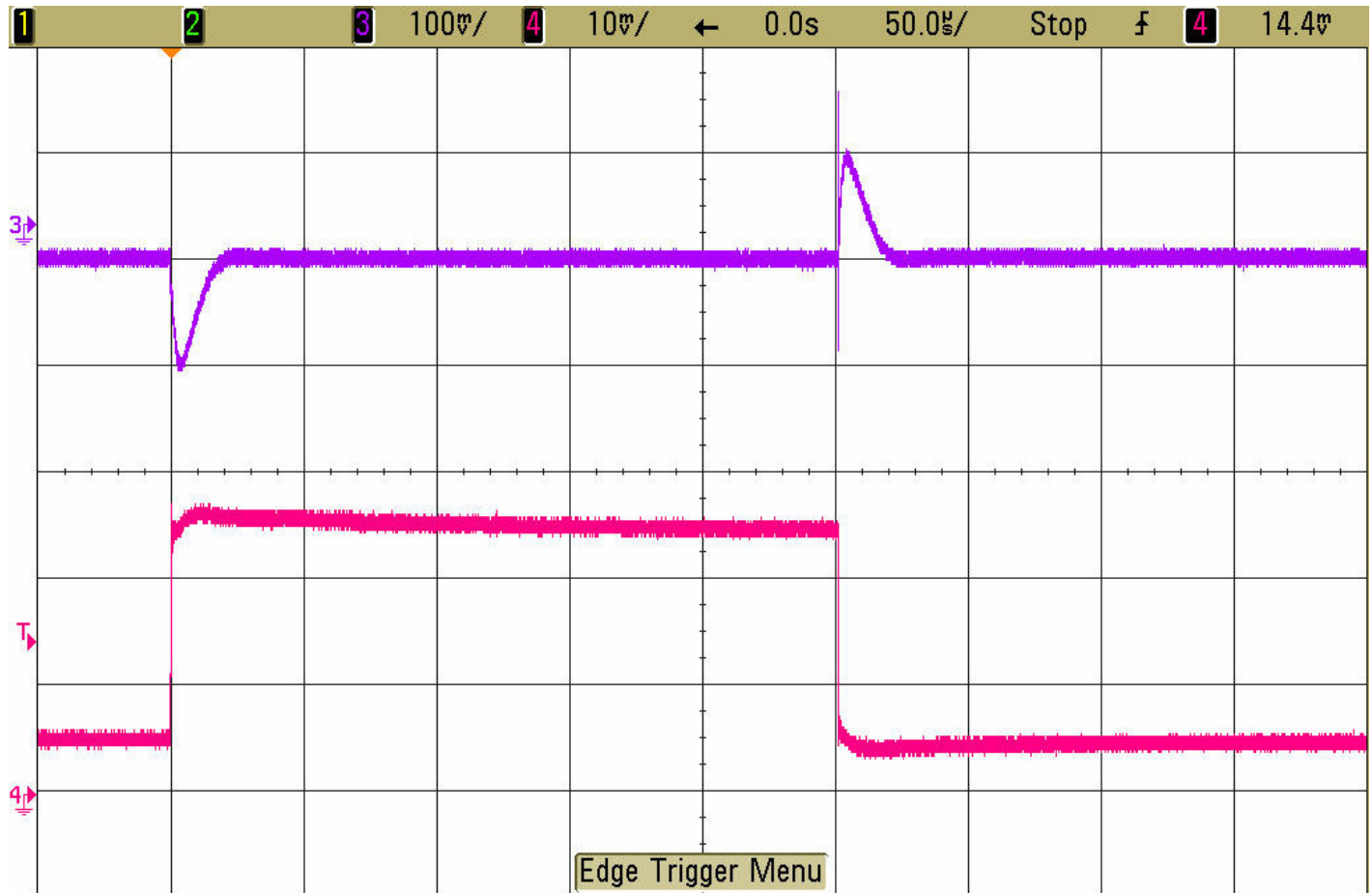# Normal Switching Frequency & Output Ripple Voltage

Waveforms
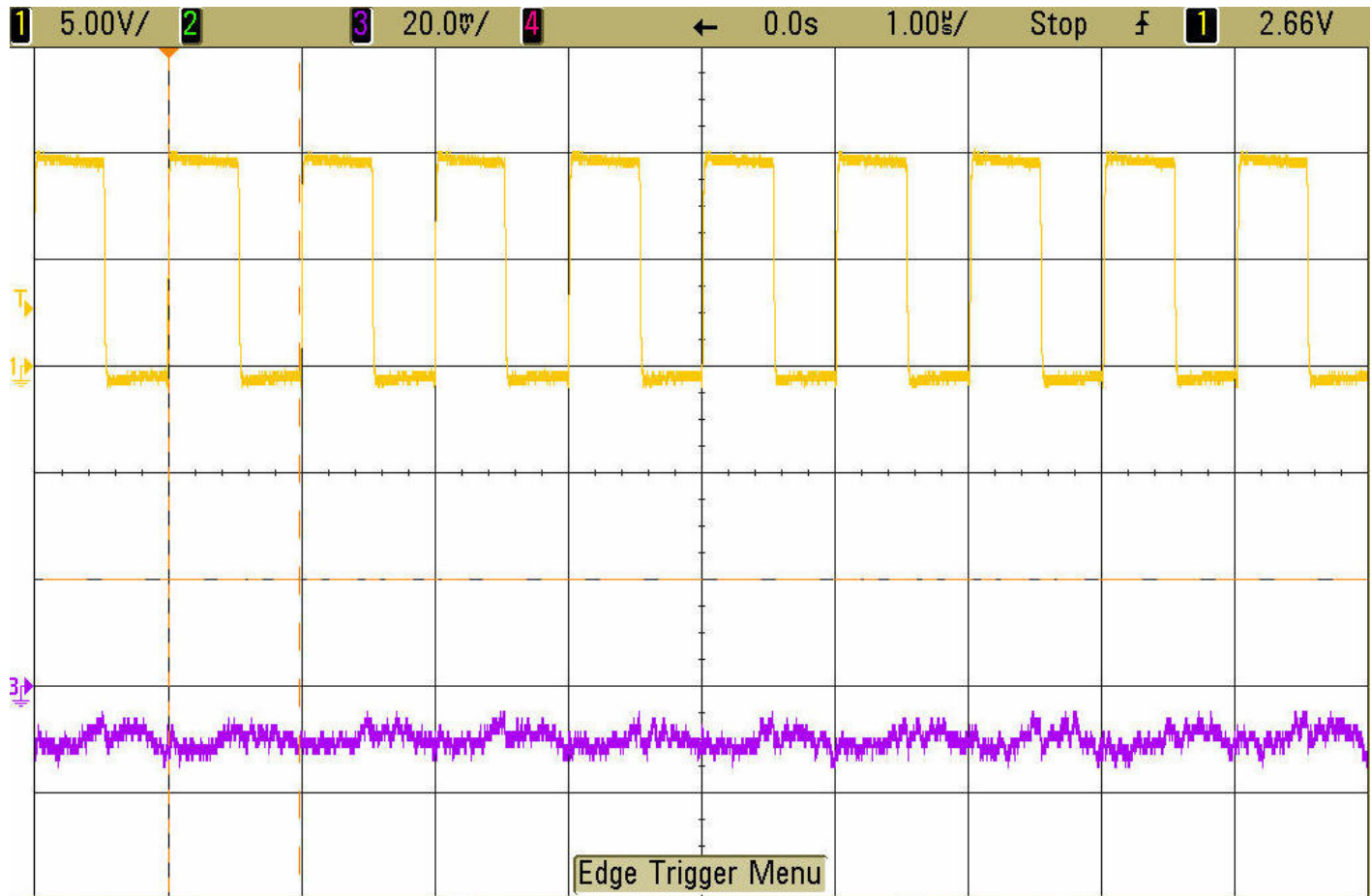
Figure 3. Switch Waveform & Output Ripple Voltage
V_{IN} = 8.4V, V_{OUT} = 3.3V, I_{OUT} = 2.5A, Fsw = 1 MHz
Trace 1: Switch Voltage (5 V/div)
Trace 3: Output Ripple Voltage (20 mV/div AC)

Load Step Response Waveform

Figure 4. Load Step Response
V_{IN} = 8.4V, V_{OUT} = 3.3V, 2A Load Step (500mA <-> 2.5A)
Forced Continuous Mode, Fsw = 1 MHz
Trace 3: Output Voltage (100mV/div AC)
Trace 4: Output Current (1A/div)

CONTRACT NO.

APPROVALS		DATE
DRAWN	HELEN	1/28/08
CHECKED		
APPROVED		
ENGINEER	Tom Gross	1/28/08
DESIGNER		

Monday, April 14, 2008

LINEAR TECHNOLOGY

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TITLE   LTC3602EUF   High Input Voltage 2.5A
Monolithic Synchronous Buck Regulator

SIZE	CAGE CODE	DWG NO	DC1015A	REV A

SCALE: FILENAME: SHEET   1   OF   1

* CIN1 IS AN OPTIONAL CAPACITOR. IT IS INSERTED ON THE DC1015A 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.
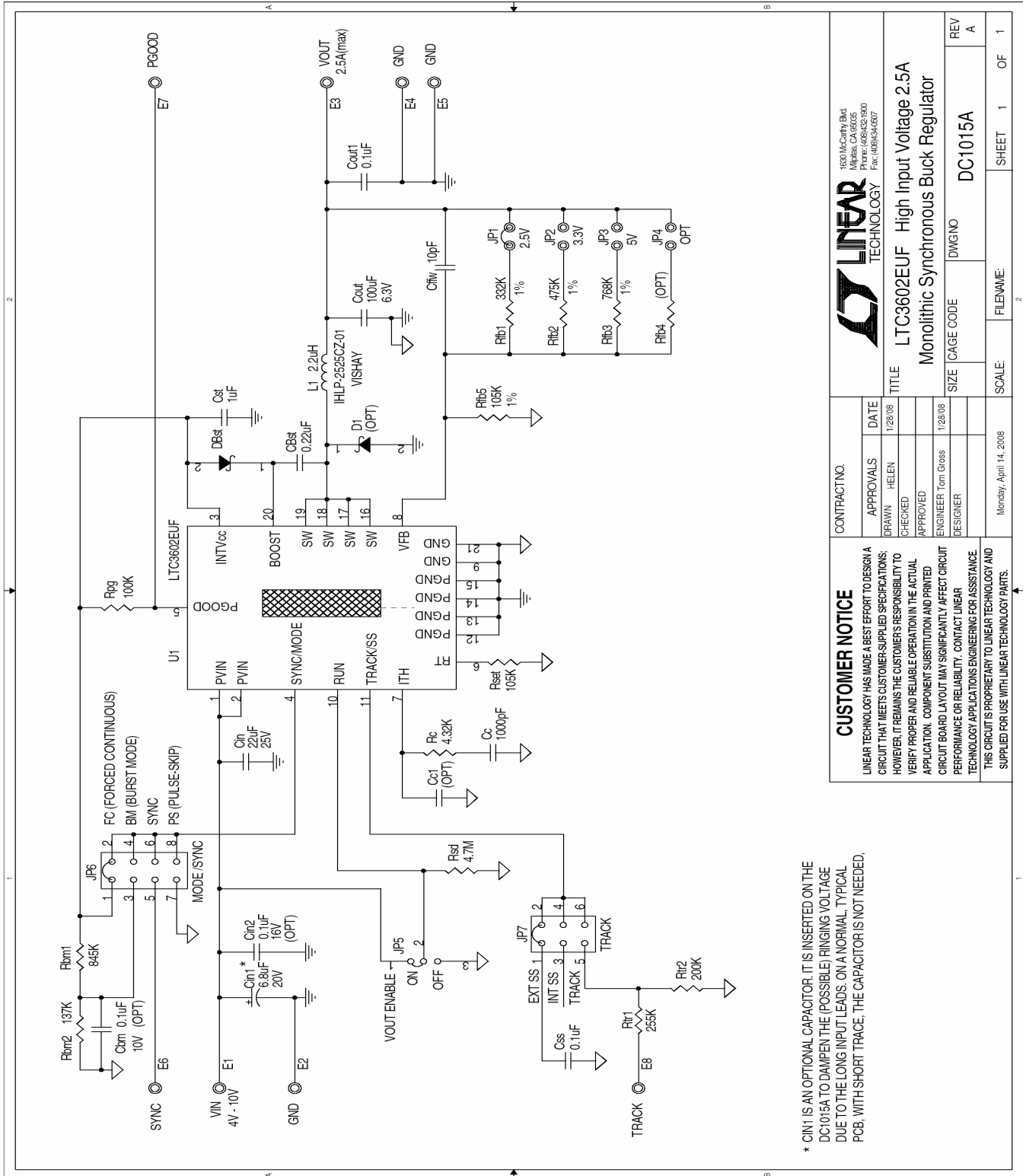
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