

LTC3815EUFE

6A Monolithic Synchronous Step-Down Converter with Power System Management

DESCRIPTION

Demonstration circuit 2065A is a synchronous buck converter using the [LTC®3815EUFE](#), a 6A monolithic buck regulator with power system management. The LTC3815 has the PMBus compliant serial interface and features, such as programmable output voltage margining, temperature monitoring, current and voltage read back, and fault status, etc.

The DC2065A uses a single resistor to program output voltage. The input range of this board is from 2.25V to 5.5V, and the output voltage can be programmed from 0.4V to 72% of V_{IN} . The output voltage can be margined $\pm 25\%$ with 0.1% resolution via a PMBus-compliant serial interface. The serial interface can also be used for time-averaged ($\sim 4\text{ms}$) and peak input/output current, input/output voltage, temperature and fault status.

To explore the power system management features of the parts, download the GUI software LTpowerPlay™ onto your PC and use LTC's I²C/SMBus/PMBus Dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on the fly, view telemetry of voltage, current, temperature and fault status.

GUI DOWNLOAD

The software can be downloaded from:

<http://www.linear.com/ltpowerplay>

For more details and instructions of LTpowerPlay, please refer to LTpowerPlay for LTC3815 Quick Start Guide.

Design files for this circuit board are available at
<http://www.linear.com/demo/DC2065A>

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PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------|------------------------------------|---|------|------|---------------------|-------|
| V_{IN} | Input Supply Range | | 2.25 | | 5.5 | V |
| V_{OUT} | Output Voltage Range | $I_{OUT} = 0\text{A to } 6\text{A}$, $V_{IN} = 2.25\text{V to } 5.5\text{V}$ | 0.4 | | $0.72 \cdot V_{IN}$ | V |
| I_{OUT} | Output Current Range | | 0 | | 6 | A |
| F_{SW} | Factory Default Switching | | | 1 | | MHz |
| EFF | Full Load Efficiency | $V_{IN} = 5\text{V}$, $V_{OUT} = 1.8\text{V}$, See Figure 4 | | 88.4 | | % |
| OUTPUT RIPPLE | Output Voltage Peak-to-Peak Ripple | $V_{IN} = 5\text{V}$, $V_{OUT} = 1.8\text{V}$, $I_{OUT} = 6\text{A}$, See Figure 5 | | | 34.4 | mV |

QUICK START PROCEDURE

Demonstration circuit 2065A makes it easy to set up to evaluate the performances of the LTC3815. Refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip directly across the COUT3. See Figure 3 for proper scope probe technique.

1. Make sure jumpers are in the following positions:

| JUMPER | POSITION |
|----------|----------|
| RUN_STBY | ON |
| RUN_MSTR | ON |
| MODE | FCM |
| WP | OFF |
| MARGIN | NOM |
| VOUT SEL | 1.8V |

2. With power off, connect the input power supply to V_{IN} and GND. Connect active load to the output.

3. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 5.5V.

4. Check for the correct output voltage from VOUT to GND. $V_{OUT} = 1.8V \pm 1\%$ (1.782V ~ 1.818V)

NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

5. Once the proper output voltage is established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

6. Connect the dongle and control the output voltages from the GUI. See LTpowerPlay QUICK START session for details.

CONNECTING A PC TO DC2065A

You can use a PC to reconfigure the power management features of the LTC3815 such as: program output voltage margining, read back temperature, current and voltage,

check fault status etc. The DC1613A dongle may be plugged in regardless of whether or not V_{IN} is present. Dongle can be hot plugged.

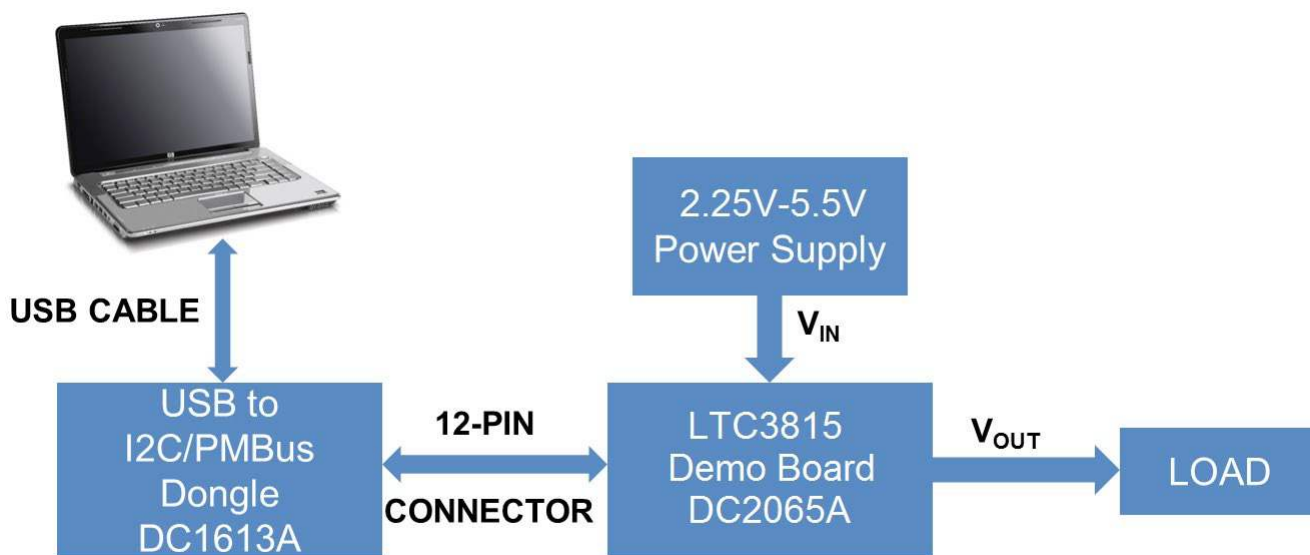


Figure 1. Demo Setup with PC

DEMO MANUAL DC2065A

CONNECTING A PC TO DC2065A

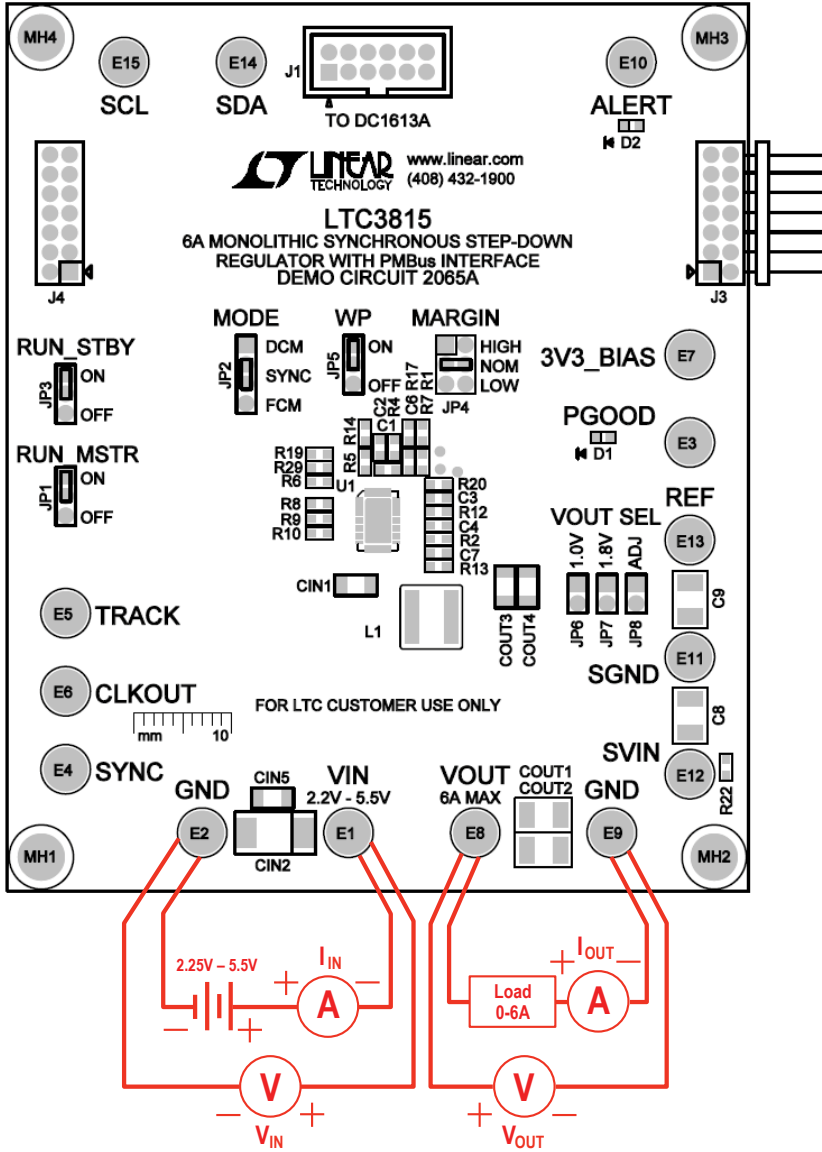


Figure 2. Power Test Setup for DC2065A

MEASURING OUTPUT RIPPLE VOLTAGE

An accurate ripple measurement may be performed by using the below configuration across C_{OUT}.

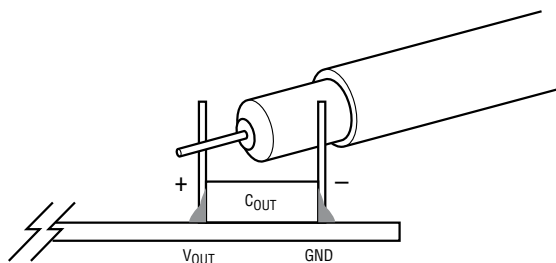
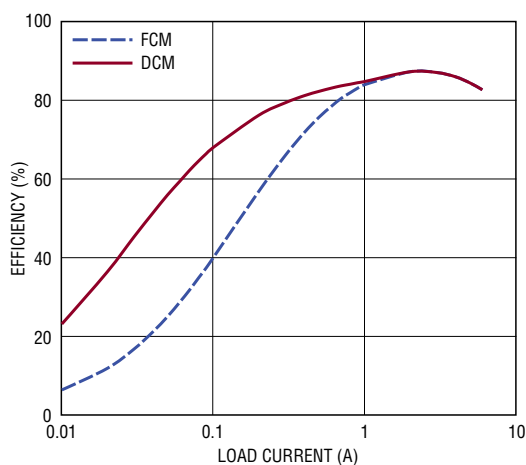
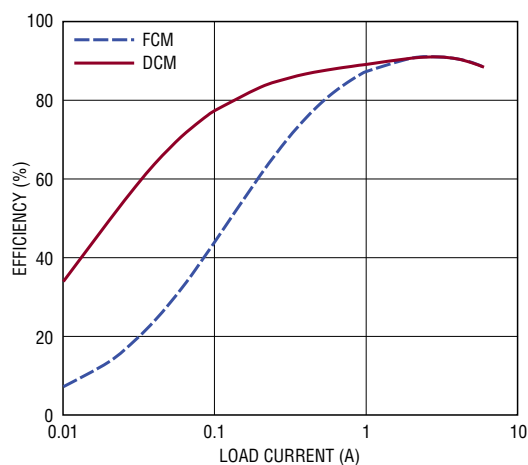


Figure 3. Measuring Output Voltage Ripple



(a) $V_{IN} = 5V$, $V_{OUT} = 1V$, $F_{SW} = 1MHz$



(b) $V_{IN} = 5V$, $V_{OUT} = 1.8V$, $F_{SW} = 1MHz$

Figure 4. Typical Efficiency Curves of DC2065A

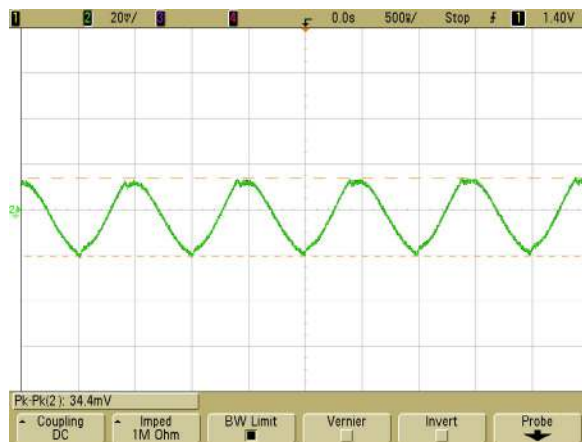


Figure 5. Output Ripple of DC2065A, $V_{IN} = 5V$, $V_{OUT} = 1.8V$, $V_{OUT} = 6A$, $F_{SW} = 1MHz$

LTpowerPlay SOFTWARE GUI

LTpowerPlay is a powerful Windows based development environment that supports Linear Technology power system management ICs, including the LTC3880, LTC3883, LTC3882, LTC3815, LTC2974 and LTC2978. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Linear Technology ICs by connecting to a demo board system. LTpowerPlay can also be used in an offline mode (with no hardware present) in order to build a multichip configuration file that can be saved and reloaded at a later time. LTpowerPlay provides unprecedented diagnostic and debug features. It becomes a valuable diagnostic tool during board bring-up to program or tweak the power management scheme in

a system, or to diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of many potential targets, including the LTC3815's DC2065A demo system, or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded from:

<http://linear.com/ltpowerplay>

To access technical support documents for LTC Digital Power Products visit Help. View online help on the LTpowerPlay menu.

LTpowerPlay SOFTWARE GUI

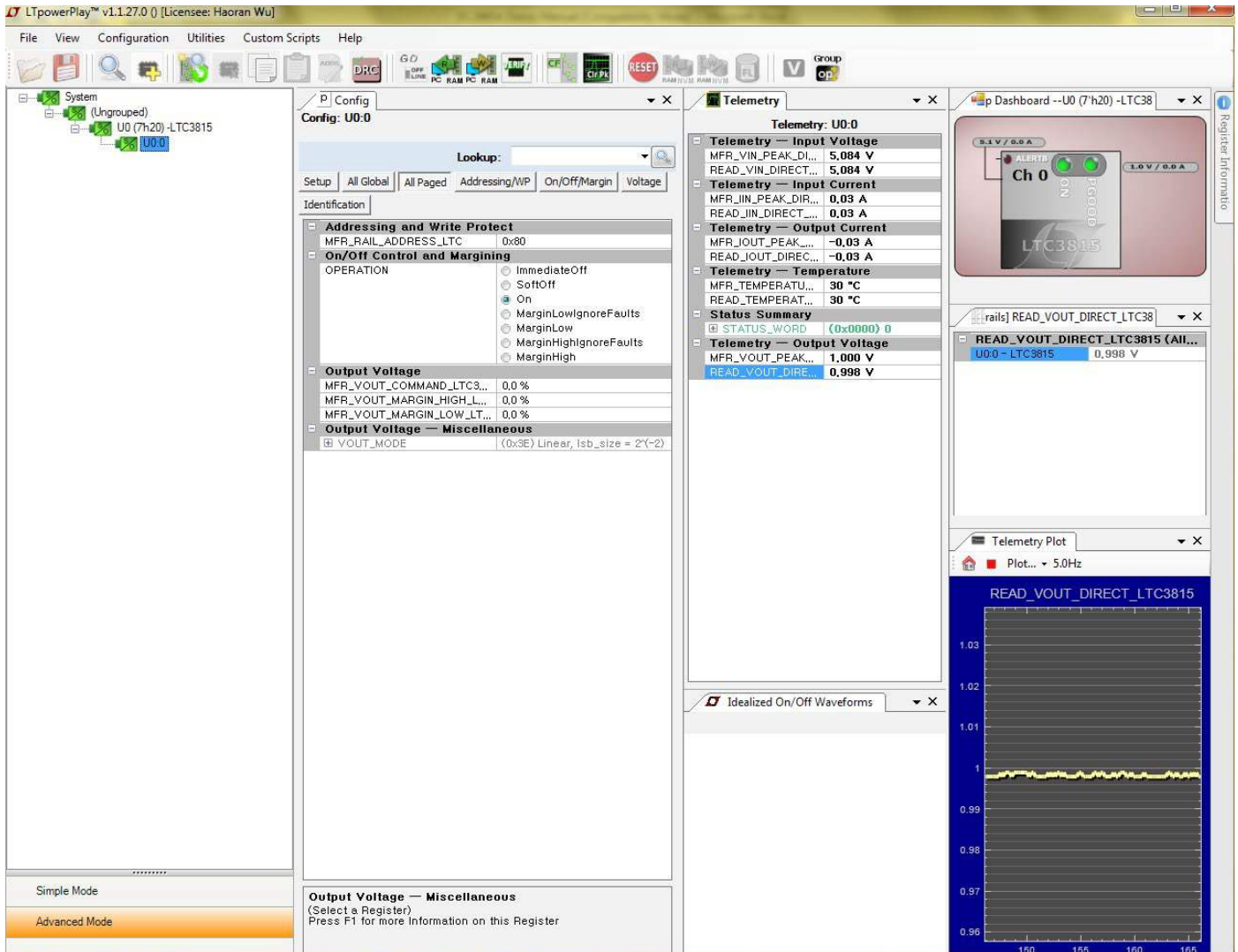


Figure 6. LTpowerPlay Main Interface

LTpowerPlay QUICK START PROCEDURE

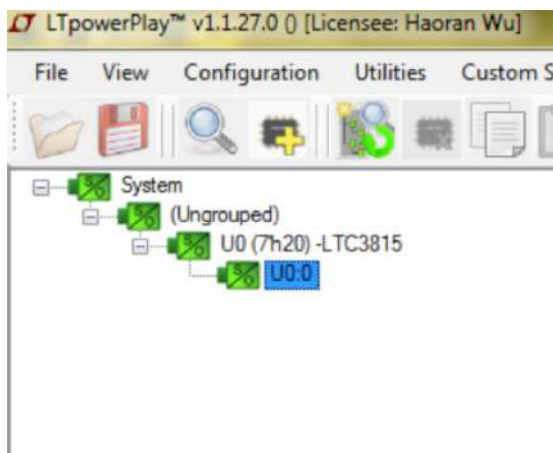
The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTC3815.

1. Download and install the LTpowerPlay GUI:

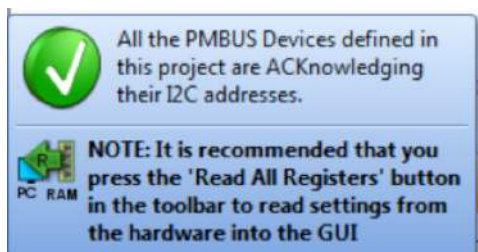
<http://linear.com/ltpowerplay>

2. Launch the LTpowerPlay GUI.

a. The GUI should automatically identify the DC2065A. The system tree on the left hand side should look like this:



b. A blue message box shows for a few seconds in the lower left hand corner, confirming that the LTC3815 is communicating:

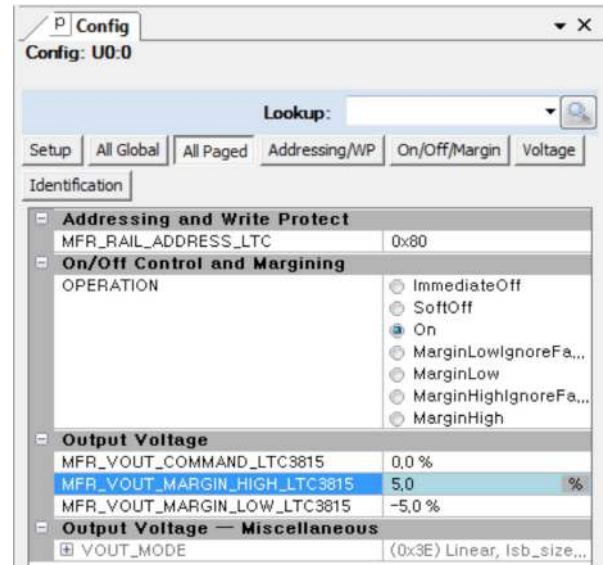


c. In the Toolbar, click the R (RAM to PC) icon to read the RAM from the LTC3815. This reads the configuration from the RAM of LTC3815 and loads it into the GUI.



d. If you want to change the MarginHigh and/or Margin/Low to different values (defaults are 0%), like +5% and/or -5%. In the Config tab, type 0.5 in the

MFR_VOUT_MARGIN_HIGH_LTC3815 (and/or -0.5 in the MFR_VOUT_MARGIN_HIGH_LTC3815 box), like this:



Then, click the W (PC to RAM) icon to write these register values to the LTC3815.



If the write is successful, you will see the following message:

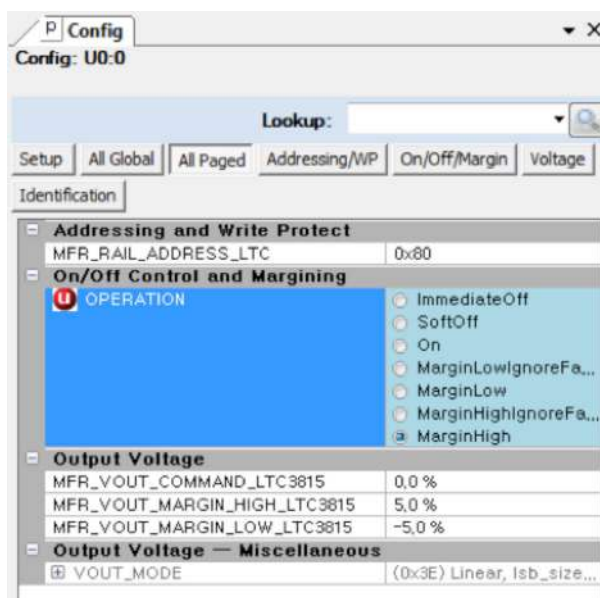


e. You can save the changes into the NVM. In the toolbar, click RAM to NVM button, as following:



LTpowerPlay QUICK START PROCEDURE

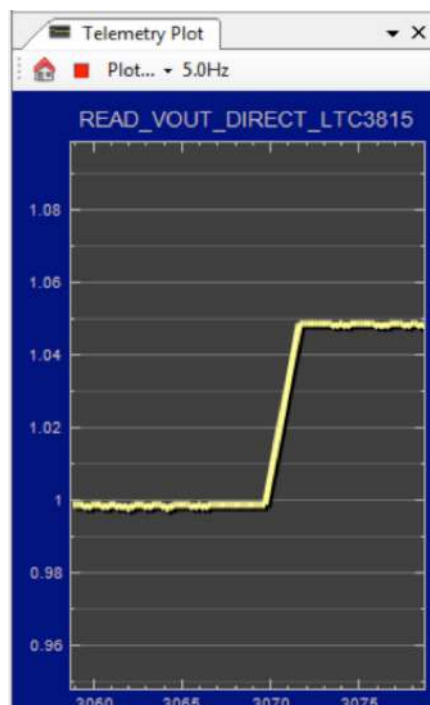
f. To margin VOUT to the set margin high value, you can either switch the MARGIN jumper on DC2065A board, or change OPERATION to be MarginHigh through LTpowerPlay, like this:



Then, click the W (PC to RAM) icon to write these register values to the LTC3815.



If the write is successful, you will see the output voltage jumps to 1.05V from the telemetry plot:



g. Save the demo board configuration to a (*.proj) file. Click the Save icon and save the file. Name it whatever you want.

DEMO MANUAL DC2065A

PARTS LIST

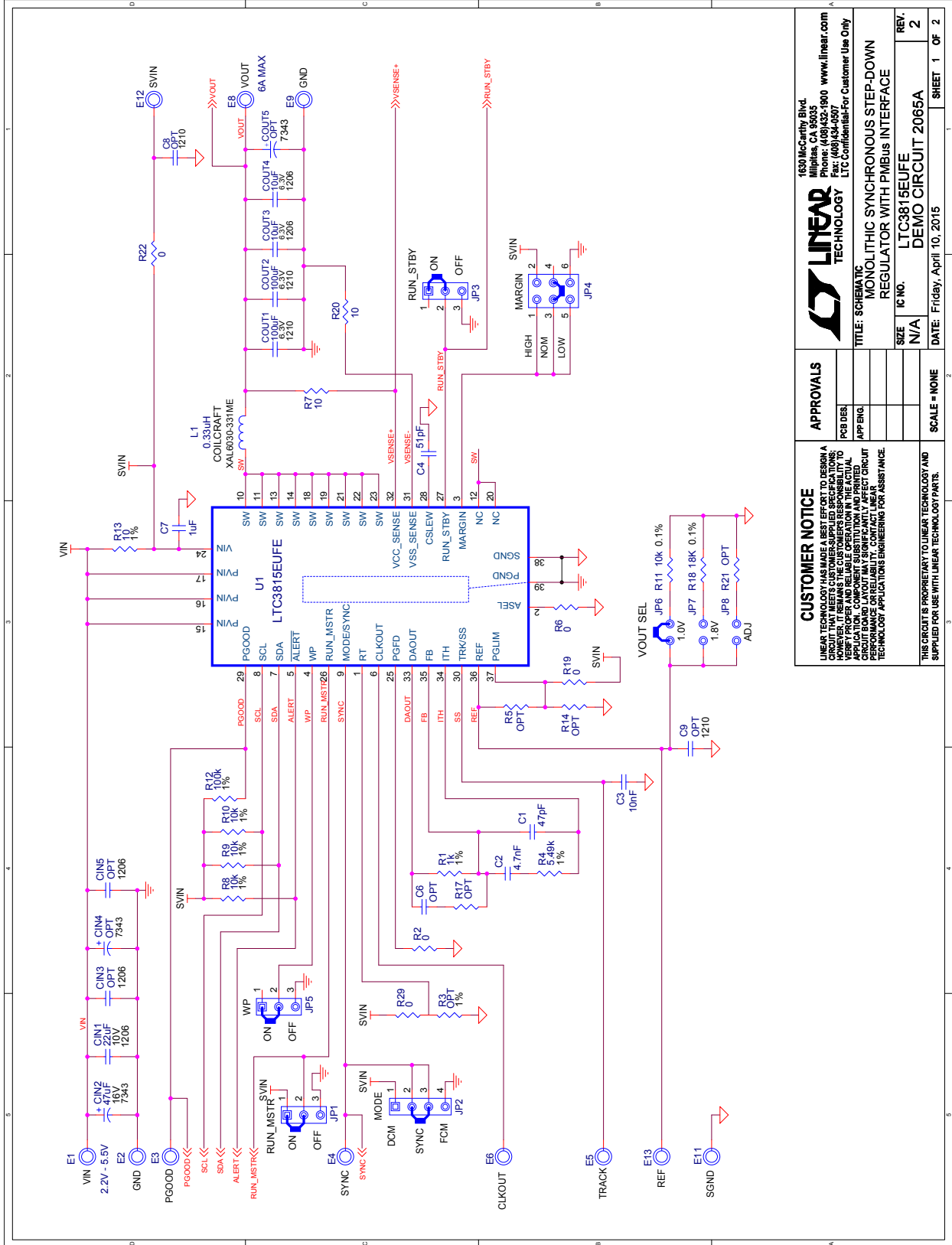
| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|-----|--|---|-----------------------------------|
| Required Circuit Components | | | | |
| 1 | 1 | CIN1 | CAP, 1206 22 μ F 20% 10V X5R | TDK C3216X5R1A226M |
| 2 | 1 | CIN2 | CAP, 7343 47 μ F 20% 16V POSCAP | PANASONIC 16TQC47MW |
| 3 | 2 | COUT1, COUT2 | CAP, 1210 100 μ F 20% 6.3V X5R | MURATA GRM32ER60J107ME20 |
| 4 | 2 | COUT3, COUT4 | CAP, 1206 10 μ F 10% 6.3V X5R | MURATA GRM31CR60J106K01L |
| 5 | 1 | C1 | CAP, 0603 47pF 5% 50V NPO | AVX 06035A470JAT2A |
| 6 | 1 | C2 | 0603 4.7nF 10% 50V X7R | AVX 06035C472KAT2A |
| 7 | 1 | C3 | CAP, 0603 10nF 10% 25V X7R | AVX 06033C103KAT2A |
| 8 | 1 | C4 | CAP, 0603 51pF 5% 50V NPO | AVX 06035A510JAT |
| 9 | 1 | C5 | CAP, 0603 100nF 10% 50V X7R | AVX 06035C104KAT2A |
| 10 | 1 | C7 | CAP, 0603 1 μ F 20% 25V X5R | AVX 06033D105KAT2A |
| 11 | 1 | D1 | LED, 0603 GREEN | OSRAM LG L29K-G2J1-24-Z |
| 12 | 1 | D2 | LED, 0603 RED | OSRAM LS L29K-H1J2-1-Z |
| 13 | 1 | L1 | IND, 0.33 μ H | COILCRAFT XAL6030-331ME |
| 14 | 1 | Q1 | XSTR, N-CHANNEL DMOS FET | VISHAY SI2365EDS1-GE3 |
| 15 | 1 | Q2 | XSTR, N-CHANNEL DMOS FET | FAIRCHILD 2N7002 |
| 16 | 1 | R1 | RES, 0603 1k Ω 1% 1/10W | VISHAY CRCW06031K00FKEA |
| 17 | 5 | R2, R6, R19, R22, R29 | RES, 0603 0 Ω JUMPER | VISHAY CRCW06030000Z0EA |
| 18 | 1 | R4 | RES, 0603 5.49k Ω 1% 1/10W | VISHAY CRCW06035K49FKEA |
| 19 | 3 | R7, R13, R20 | RES, 0603 10 Ω 1% 1/10W | VISHAY CRCW060310R0FKEA |
| 20 | 3 | R8, R9, R10 | RES, 0603 10k Ω 1% 1/10W | VISHAY CRCW060310K0FKEA |
| 21 | 1 | R11 | RES, 0603 10k Ω 0.1% 0.1W | PANASONIC ERA3AEB103V |
| 22 | 1 | R12 | RES, 0603 100k Ω 1% 1/10W | VISHAY CRCW0603100KFKEA |
| 23 | 2 | R15, R16 | RES, 0603 4.99k Ω 1% 1/10W | VISHAY CRCW06034K99FKEA |
| 24 | 1 | R18 | RES, 0603 18k Ω 0.1% 0.1W | PANASONIC ERA3AEB183V |
| 25 | 1 | R27 | RES, 0603 200 Ω 5% 1/10W | VISHAY CRCW0603200RJNEA |
| 26 | 1 | R28 | RES, 0603 127 Ω 1% 1/10W | VISHAY CRCW0603127RFKEA |
| 27 | 1 | U1 | IC, LTC3815EUFE | LINEAR TECHNOLOGY LTC3815EUFE#PBF |
| 28 | 1 | U2 | IC, 24LC025-I/ST | MICROCHIP 24LC025-I/ST |
| Additional Demo Board Circuit Components | | | | |
| 1 | 0 | CIN3, CIN5 | CAP, 1206 OPTION | OPTION |
| 2 | 0 | CIN4 | CAP, 7343 OPTION | OPTION |
| 3 | 0 | COUT5 | CAP, 7343 220 μ F 20% 10V POSCAP OPTION | PANASONIC 10TPE220ML OPTION |
| 4 | 0 | C6 | CAP, 0603 OPTION | OPTION |
| 5 | 0 | C8, C9 | CAP, 1210 OPTION | OPTION |
| 6 | 0 | R3, R5, R14, R17, R21, R23, R24, R25, R26, | RES, 0603 OPTION | OPTION |

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|--------------------------------------|-----|--|---------------------------------|----------------------------------|
| Hardware: For Demo Board Only | | | | |
| 1 | 15 | E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15 | TURRET | MILL-MAX 2501-2-00-80-00-00-07-0 |
| 2 | 3 | JP1, JP3, JP5 | HEADER, 3PIN, 2mm | SULLINS, NRPN031PAEN-RC |
| 3 | 1 | JP2 | HEADER, 4PIN, 2mm | SULLINS, NRPN041PAEN-RC |
| 4 | 1 | JP4 | HEADER, 3PIN, DBL ROW 2mm | SULLINS, NRPN032PAEN-M456RC |
| 5 | 3 | JP6, JP7, JP8 | HEADER, 2PIN, 2mm | SULLINS, NRPN021PAEN-RC |
| 6 | 1 | J1 | HEADER, 12PIN 2mm STR DL | FCI 98414-G06-12ULF |
| 7 | 1 | J3 | CONN, HEADER, 2X7, 2mm, R/A (M) | MOLEX 87760-1416 |
| 8 | 1 | J4 | CONN, HEADER, 2X7, 2mm, R/A (F) | SULLINSINC NPPN072FJFN-RC |
| 9 | 4 | MH1, MH2, MH3, MH4 | STANDOFF, SNAP ON | KEYSTONE_8831 |
| 10 | 6 | XJP1, XJP2, XJP3, XJP4, XJP5, | SHUNT, 2mm | SAMTEC 2SN-BK-G |

DEMO MANUAL DC2065A

SCHEMATIC DIAGRAM



| | | | |
|--|--|------------------|--|
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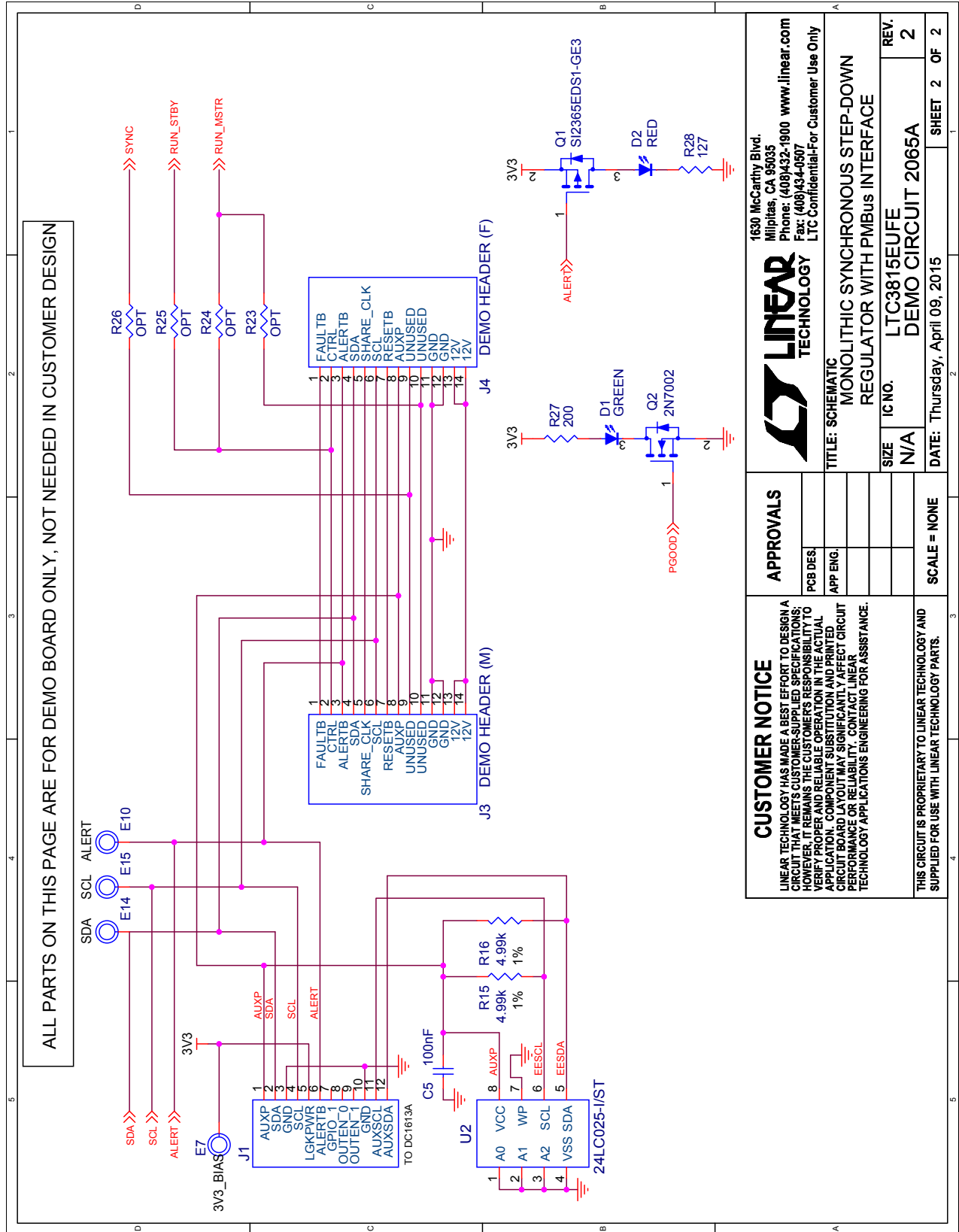
LINEAR TECHNOLOGY

TITLE: SCHEMATIC
 MONOLITHIC SYNCHRONOUS STEP-DOWN
 REGULATOR WITH PMBUS INTERFACE

SIZE: N/A
 IC NO.: LTC3815EUF1
 DEMO CIRCUIT 2065A

SCALE: NONE
 DATE: Friday, April 10, 2015
 SHEET 1 OF 2

SCHEMATIC DIAGRAM



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LINEAR TECHNOLOGY

TITLE: SCHEMATIC
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REGULATOR WITH PMBUS INTERFACE

| | |
|--------|--------------------------|
| REV. | 2 |
| IC NO. | LTC3815EUFE |
| SIZE | N/A |
| DATE: | Thursday, April 09, 2015 |
| SHEET | 2 OF 2 |

SCALE = NONE

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DEMO MANUAL DC2065A

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If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

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Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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