

LTM4636-1 40A DC/DC μ Module Regulator with Overvoltage/Overtemperature Protection

DESCRIPTION

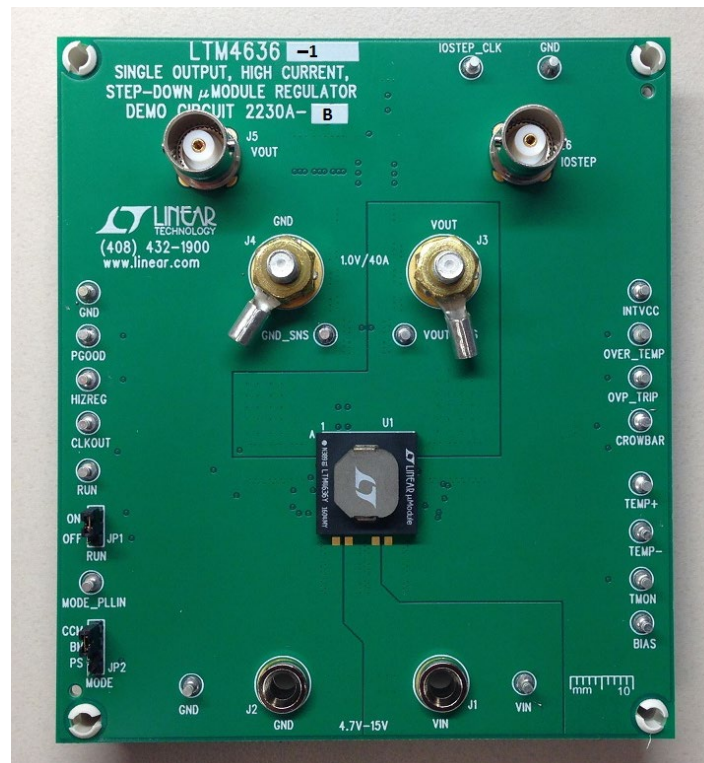
Demonstration circuit 2230A-B features the [LTM[®]4636-1EY](#), a 40A high efficiency, switch mode step-down power μ Module[®] regulator with overtemperature and input/output overvoltage protection. The input voltage range is from 4.7V to 15V. For input voltage range from 4.7V to 5.5V, short PV_{CC} pin to V_{IN} pin with R8 = R21 = 0 Ω and remove R17. The output voltage range is 0.6V to 3.3V. Derating is necessary for certain V_{IN}, V_{OUT}, frequency and thermal conditions. The board operates in continuous conduction mode in heavy load conditions. For high efficiency at low load currents, the MODE_PLLIN jumper selects pulse-skipping mode for noise sensitive applications or Burst Mode[®] operation in less noise sensitive applica-

tions. The MODE_PLLIN pin also allows the LTM4636 to synchronize to an external clock signal. DC2230A-B has the option of choosing both internal and external compensation circuit for LTM4636-1. Tying the PHASMD pin to different voltage generates certain phase difference between MODE_PLLIN and CLKOUT. The LTM4636-1 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC2230A-B.

Design files for this circuit board are available at <http://www.linear.com/demo/DC2230A-B>

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BOARD PHOTO



PERFORMANCE SUMMARY

| PARAMETER | CONDITIONS/NOTES | VALUE |
|-----------------------------------|---|----------------------|
| Input Voltage Range | | 4.7V to 15V |
| Output Voltages | | 1.0V ± 1.3% |
| Maximum Continuous Output Current | Derating is Necessary for Certain Operating Conditions. See Data Sheet for Details. | 40ADC |
| Operating Frequency | | 350kHz |
| Efficiency | $V_{IN} = 12V, V_{OUT} = 1.0V, I_{OUT} = 40A, Q2$ Not Included | 87.7% (see Figure 2) |
| Load Transient | $V_{IN} = 12V, V_{OUT} = 1.0V, I_{STEP} = 0A$ to 10A | 81mV (see Figure 3) |
| Overtemperature Trip Point | $R_{OTP} = R_{56} = 66.5k\Omega$ | 130°C |
| Overvoltage Trip Point | $R_{OVP} = R_{10} = 86.6k\Omega$ | 1.18V |

QUICK START PROCEDURE

Demonstration circuit 2230A-B is an easy way to evaluate the performance of the LTM4636-1EY. Please refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

- Place jumpers in the following positions for a typical application:

| MODE | RUN |
|------|-----|
| CCM | ON |

- With power off, connect the input power supply, load and meters as shown in Figure 1. Preset the load to 0A and V_{IN} supply to 12V.
- Turn on the power supply at the input. The output voltage should be 1.0V ± 1.3% (0.987V to 1.013V).

- Vary the input voltage from 6V to 15V and adjust the load current from 0A – 40A. Observe the output voltage regulation, ripple voltage, efficiency, and other parameters.
- (Optional) For optional load transient test, apply an adjustable pulse signal between IOSTEP_CLK and GND test points. The pulse amplitude sets the load step current amplitude. Keep the pulse width short (<1ms) and pulse duty cycle low (<5%) to limit the thermal stress on the load transient circuit.
- (Optional) LTM4636 can be synchronized to an external clock signal. Place the JP1 jumper on EXT_CLK and apply a clock signal (0V to 5V, square wave) on the MODE_PLLIN test point.

QUICK START PROCEDURE

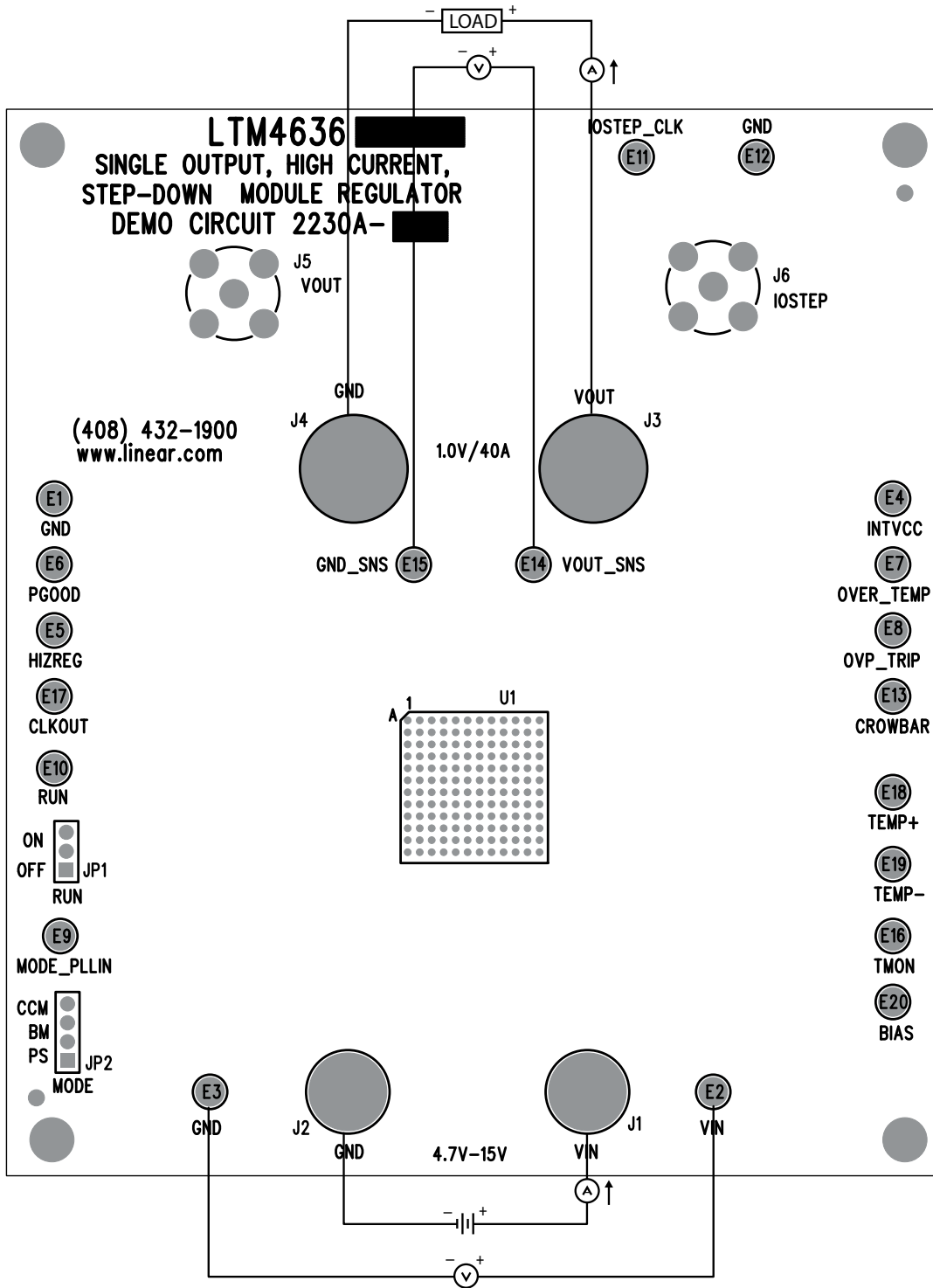


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

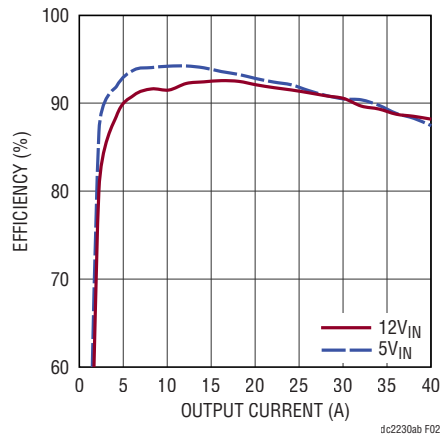


Figure 2. Measured Efficiency at V_{IN} = 5V/12V, V_{OUT} = 1V, f_{SW} = 350kHz, CCM, Q2 Not Included

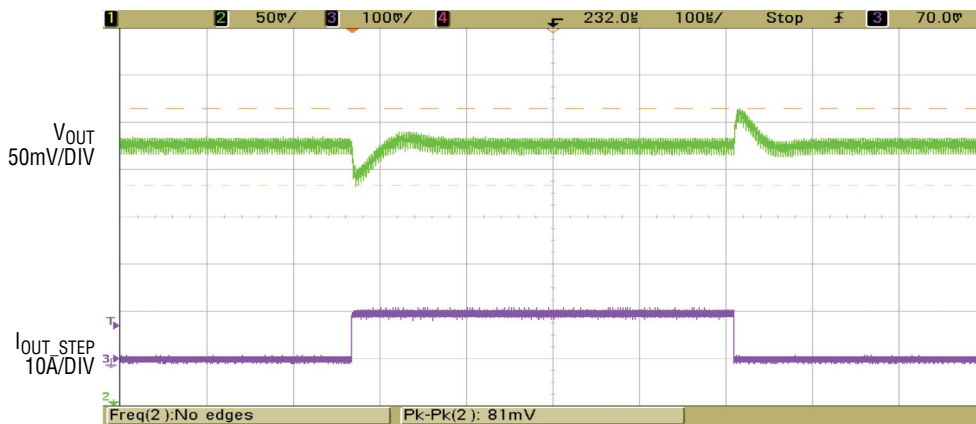


Figure 3. Measured Load Transient, V_{IN} = 12V, V_{OUT} = 1.0V, I_{STEP} = 0A to 10A



Figure 4. Thermal Image, V_{IN} = 12V, V_{OUT} = 1.0V, I_{LOAD} = 40A, Ambient Temperature = 23.0°C, No Forced Airflow

dc2230abf

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART # |
|---|-----|--|--|------------------------------------|
| Required Circuit Components | | | | |
| 1 | 1 | CIN1 | CAP, ALUM ELECT, 150µF, 25V, CE SERIES | SUN ELECT, 25CE150AX |
| 2 | 6 | CIN4, CIN5, CIN6, CIN7, CIN8, CIN9 | CAP, 22µF, X5R, 16V, 20%, 1210 | MURATA, GRM32ER61C226ME20 |
| 3 | 8 | COUT1, COUT2, COUT3, COUT4, COUT6, COUT7, COUT11, COUT12 | CAP, 100µF, X5R, 6.3V, 20%, 1210 | MURATA, GRM32ER60J107ME20L |
| 4 | 3 | COUT8, COUT13, COUT14 | CAP, POSCAP, 470µF, 2.5V, 20%, D3L | PANASONIC, 2R5TPE470M9 |
| 5 | 1 | C15 | CAP, 100pF, NPO, 50V, 5%, 0603 | MURATA, GRM1885C1H101JA01D |
| 6 | 1 | C17 | CAP, 0.01µF, X7R, 25V, 10%, 0603 | AVX, 06033C103KAT2A |
| 7 | 1 | C18 | CAP, 2200pF, X7R, 25V, 10%, 0603 | MURATA, GRM188R71E222KA01D |
| 8 | 2 | C19, C25 | CAP, 0.1µF, X5R, 16V, 10%, 0603 | MURATA, GRM188R61C104KA01D |
| 9 | 1 | C22 | CAP, 4.7µF, X5R, 10V, 10%, 0603 | TDK, C1608X5R1A475K080AC |
| 10 | 1 | C23 | CAP, 1µF, X5R, 25V, 10%, 0603 | MURATA, GRM188R61E105KA12D |
| 11 | 1 | C24 | CAP, 22µF, X5R, 6.3V, 20%, 0805 | KEMET, C0805C226M9PACTU |
| 12 | 1 | C26 | CAP, 1µF, X5R, 25V, 10%, 0603 | MURATA, GRM188R61E105KA12D |
| 13 | 1 | Q1 | XSTR, MOSFET, N-CH, 40V, 50A, TO-252 | VISHAY, SUD50N04-8M8P-4GE3 |
| 14 | 1 | R9 | RES, 7.5k, 0.5%, 0603 | VISHAY, CRCW06037K5FKEA |
| 15 | 1 | R10 | RES, 86.6k, 1/10W, 1%, 0603 | VISHAY, CRCW060386K6FKEA |
| 16 | 4 | R11, R12, R16, R54 | RES, 10k, 1/10W, 1%, 0603 | VISHAY, CRCW060310K0FKEA |
| 17 | 2 | R13, R14 | RES, 10k, 1/10W, 1%, 0603 | VISHAY, CRCW060310K0FKEA |
| 18 | 1 | R18 | RES, 15k, 1/10W, 1%, 0603 | VISHAY, CRCW060315K0FKEA |
| 19 | 1 | R20 | RES, 100k, 1/10W, 1%, 0603 | VISHAY, CRCW0603100K0FKEA |
| 20 | 2 | R25, R32 | RES, 10Ω, 1/10W, 1%, 0603 | VISHAY, CRCW060310R0FKEA |
| 21 | 1 | R35 | RES, 2.2, 1/8W, 5%, 0805 | VISHAY, CRCW08052R20JNEA |
| 22 | 1 | R40 | RES, 34.8k, 1/10W, 1%, 0603 | VISHAY, CRCW060334K8FKEA |
| 23 | 1 | R55 | RES, SENSE, 0.01Ω, 1/2W, 1%, 2010 | VISHAY, WSL2010R0100FEA |
| 24 | 1 | R56 | RES, 66.5k, 1/10W, 1%, 0603 | VISHAY, CRCW060366K5FKEA |
| 25 | 1 | U1 | LTM4636-1EY#PBF, 16X16X5.01 BGA | LINEAR TECHNOLOGY, LTM4636-1EY#PBF |
| Additional Demo Board Circuit Components | | | | |
| 1 | 0 | COUT9 (OPT) | CAP, OPTION, D3L | OPT |
| 2 | 0 | COUT10, COUT15, COUT16 (OPT) | CAP, OPTION, 1210 | OPT |
| 3 | 0 | C14, C16 (OPT) | CAP, OPTION, 0603 | OPT |
| 4 | 0 | R8, R15, R19, R21, R22, R38 (OPT) | RES, OPTION, 0603 | OPT |
| 5 | 4 | R17, R23, R24, R33 | RES, 0Ω, 1/10W, 0603 | VISHAY, CRCW06030000Z0EA |
| 6 | 0 | Q2 | XSTR, OPT, TO-252 | OPT |

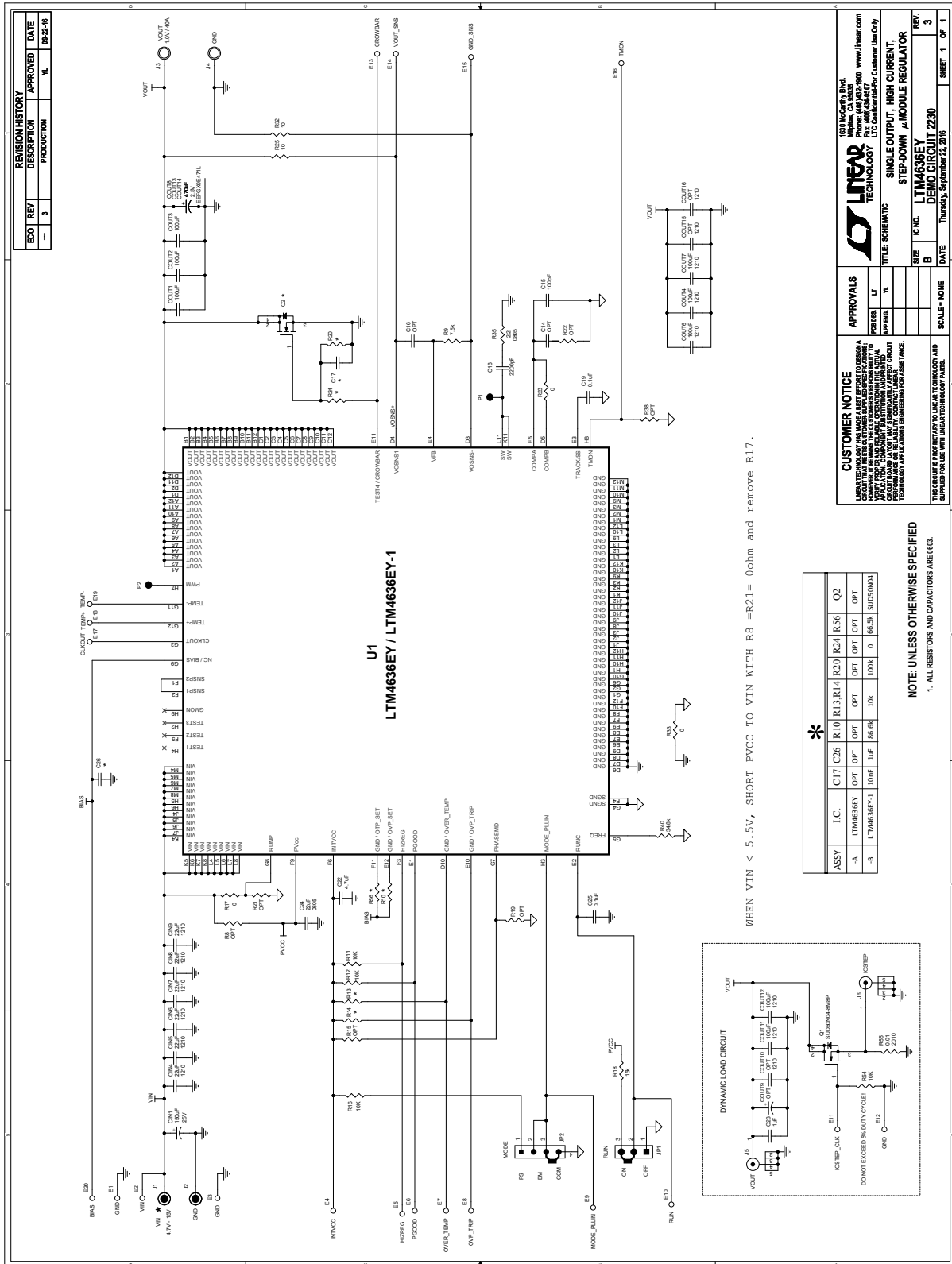
DEMO MANUAL DC2230A-B

PARTS LIST

Hardware

| | | | | |
|----|----|-------------|---|-----------------------------------|
| 1 | 20 | E1 TO E20 | TEST POINT, TURRET, 0.064" MTG. HOLE | MILL-MAX, 2308-2-00-80-00-00-07-0 |
| 2 | 1 | JP1 | CONN, HEADER, 1 x 3, 2mm | SULLINS, NRPN031PAEN-RC |
| 3 | 1 | JP2 | CONN, HEADER, 1 x 4, 2mm | SULLINS, NRPN041PAEN-RC |
| 4 | 2 | J1, J2 | CONN, JACK, BANANA, NON-INSULATED, 0.218" | KEYSTONE, 575-4 |
| 5 | 2 | J3, J4 | STUD, TEST PIN | PEM, KFH-032-10 |
| 6 | 4 | J3, J4 x 2 | NUT, BRASS 10-32 | ANY, #10-32M/S BR PL |
| 7 | 2 | J3, J4 | RING, LUG #10 | KEYSTONE, 8205 |
| 8 | 2 | J3, J4 | WASHER, TIN PLATED BRASS | ANY, #10 EXT BZ TN |
| 9 | 2 | J5, J6 | CONN, BNC, 5PINS | CONNEX, 112404 |
| 10 | 2 | XJP1, XJP2 | SHUNT, 2mm | SAMTEC 2SN-BK-G |
| 11 | 4 | (STAND-OFF) | STANDOFF, NYLON, SNAP-ON, 0.500" | KEYSTONE, 8833 (SNAP ON) |

SCHEMATIC DIAGRAM



DEMO MANUAL DC2230A-B

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