LX7302

User Guide

LX7302 Evaluation Board

Preliminary

November 2018

Microsemi

a Microchip company

Contents

1 Revision History 1
1.1 Revision 2.0 1
1.2 Revision 1.0 1
2 Product Description 2
3 Evaluation Board Operation 3
4 PCB Layout Guidelines 4
5 Test Considerations 10
6 Evaluation Board Test Data 11
7 Evaluation Board Schematic 18
8 Bill of Materials 19

1 Revision History

1.1 Revision 2.0

Revision 2.0 was published in November 2018. In Revision 1.1, Table 3 (see page 19) was updated.

1.2 Revision 1.0

Revision 1.0 was published in 2012. It was the first publication of this document.

2 Product Description

The LX7302 is a single-phase, step-down, DC-DC controller IC designed to drive a high-side N-channel MOSFET and a low-side N-channel synchronous rectifier. The controller includes the following features:

- Inductor current sensing
- Voltage droop control
- Programmable VID control or external reference
- Over-current protection
- Over- and under-voltage protection
- Power saving mode
- Power OK indicator

The LX7302 device is housed in a 3 mm × 3 mm 20-pin plastic QFN package.

3 Evaluation Board Operation

The LX7302 evaluation board contains a single LX7302 device and components necessary to provide four output voltages at a maximum current of 30 A. Input voltages up to 25 V are supported. The input supply source should be voltage-limited to 25 V maximum to protect the input capacitors, which are rated at 25 V.

As configured, the evaluation board supports a user-programmable VID mode; however, the External Reference mode is supported by changing four component values. See Test Considerations (see page 10) for further details.

All input and output connections can be made using clip connections to on-board test points. In addition, through-hole connections to accommodate 16 AWG wires are provided for high-output current testing.

The following table describes the test point descriptions for the evaluation circuit. Please refer to this table for evaluation board setup.

Table 1 • Evaluation Board I/O Connector and Test Point Reference

Reference	Description
TP1	Switch node monitor point. Used to monitor switching output.
TP2	LX7302 UG pin monitor. Used to monitor upper FET gate signal.
TP3	LX7302 LG pin monitor. Used to monitor lower FET gate signal.
TP4	LX7302 POK pin monitor. Pulled up to VCC through a 10K resistor. Used to monitor Power OK indicator.
TP5	VOUT RTN. Connection for load return and monitor point for output voltage (–). Five 16 AWG through-hole connections provided for high-current load return.
TP6	VOUT (+). Output positive connect to load, and monitor point for output voltage (+). Five 16 AWG through-hole connections provided for high-current load return.
TP7	FCCM/PSM input. Control for LX7302 power saver mode. A voltage greater than 2.5 V on this pin places the LX7302 in forced continuous conduction mode (FCCM) operation. A voltage less than 0.5 V on this pin places the LX7302 in power saver mode (PSM) operation. See the LX7302 datasheet for details regarding these functions.
TP8	Enable input. Enable control for the LX7302. A voltage greater than 2.5 V on this pin will disable the LX7302.
TP9	External reference input. A 0 V to 2.2 V input to this pin controls the output voltage when in external reference mode. As configured, this mode is disabled, but it may be enabled by changing four components on the evaluation board. See Test Considerations (see page 10) for further details.
TP14	LX7302 VCC input. Connect a 5 V ±10% source capable of 200 mA to this test point.
TP15	LX7302 VCC return. Connect the 5 V supply return to this test point.
TP16	5 V to 25 V input. Connect a 5 V to 25 V supply source capable of a 10 A current. The supply source current is based on an as-configured maximum output voltage of 1.3 V; if higher output voltages are used, a supply of higher current capability may be needed.
TP17	5 V to 20 V input return.
TP18	LX7302 VID 1 input. One of two VID control inputs. See the LX7302 datasheet for details.
TP19	LX7302 VID 0 input. One of two VID control inputs. See the LX7302 datasheet for details.
TP20	Evaluation board power ground. Used for measurement reference.
TP21	Evaluation board power ground. Used for measurement reference.
JB1	Droop control enable/disable. With JB1 installed, the LX7302 voltage droop function is disabled. Removing JB1 jumper enables the droop function. See the LX7302 datasheet for details.

4 PCB Layout Guidelines

This section details the PCB layout guidelines for the LX7302 device and extensively references Figure 1 (see page 5). It is necessary to give due consideration to the high-current paths when laying out the PCB, particularly the following: the high switching current paths from the input filter capacitors (C12–C14) to the upper MOSFET (Q1); Q1's connection to the output inductor (L1); L1's connection to the output capacitors (C9–C11); the synchronous MOSFET (Q2 and Q3) connection to L1; C9–C11's return connection to Q2 and Q3; and C9–C11's return connection to C12–C14. These critical current paths should be on a single layer only and should not be established on multiple layers through vias. Establishing these traces with their associated parts on the top layer is preferable, both electrically and thermally.

The LX7302 uses the signal return (AGND) for differential sensing of the output, so it is critical that all connections unique to AGND be isolated from the power ground connections, and that the common ground connection point be established at the point of load only. If remote sensing is not used, establish the common ground at C2.

An R-C network consisting of R13 and C1 is used for sensing the voltage drop across L1. Both R13 and C1 should be mounted close to L1, and their respective connections to L1 should be Kelvin-connected as close to L1 as possible.

The signal developed across C1 should be routed back to the LX7302 IC using a differential pair.

The connections from the point of load to the LX7302's FB and AGND pins should also be routed as a differential pair.

Parasitic capacitance must be kept to a minimum on pins 4–7. Therefore, it is important that the RSx programming resistors (R4–R7) be mounted as close to their respective pins as possible. It is not recommended to use test point pads on pins 4–7.

Pins 4–8 are sensitive to noise coupling. It is recommended to not route traces carrying switching signals near these pins or their associated resistors.

Place components R10, R11, R14, C2, C4, and C5 as close to the IC as possible.

It is recommended to use 2 oz. copper due to its increased electrical and thermal performance.

A diagram indicating critical trace widths is shown in Figure 1 (see page 5). The EVB silkscreen, as well as top and bottom layers, are shown in Figure 2 (see page 5) through Figure 6 (see page 9). See Evaluation Board Schematic (see page 18) for a complete schematic of the EVB; see Bill of Materials (see page 19) for a complete list of materials used.

Figure 1 • PCB Critical Traces

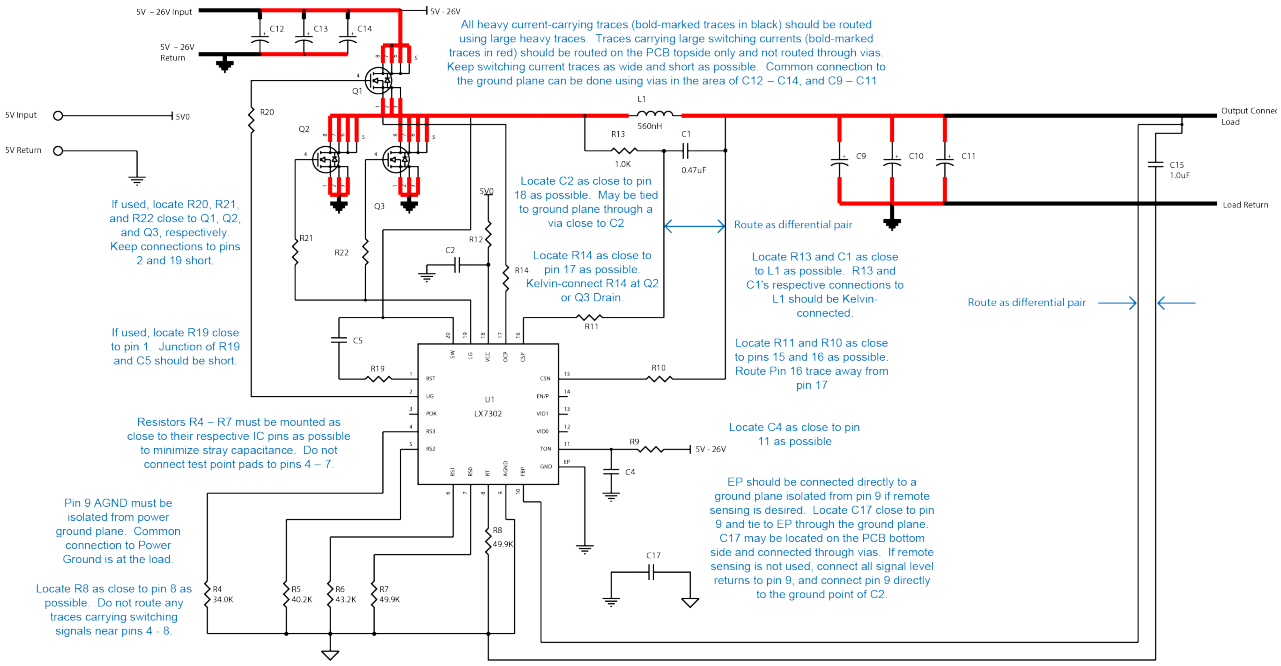


Figure 2 • Silkscreen Top

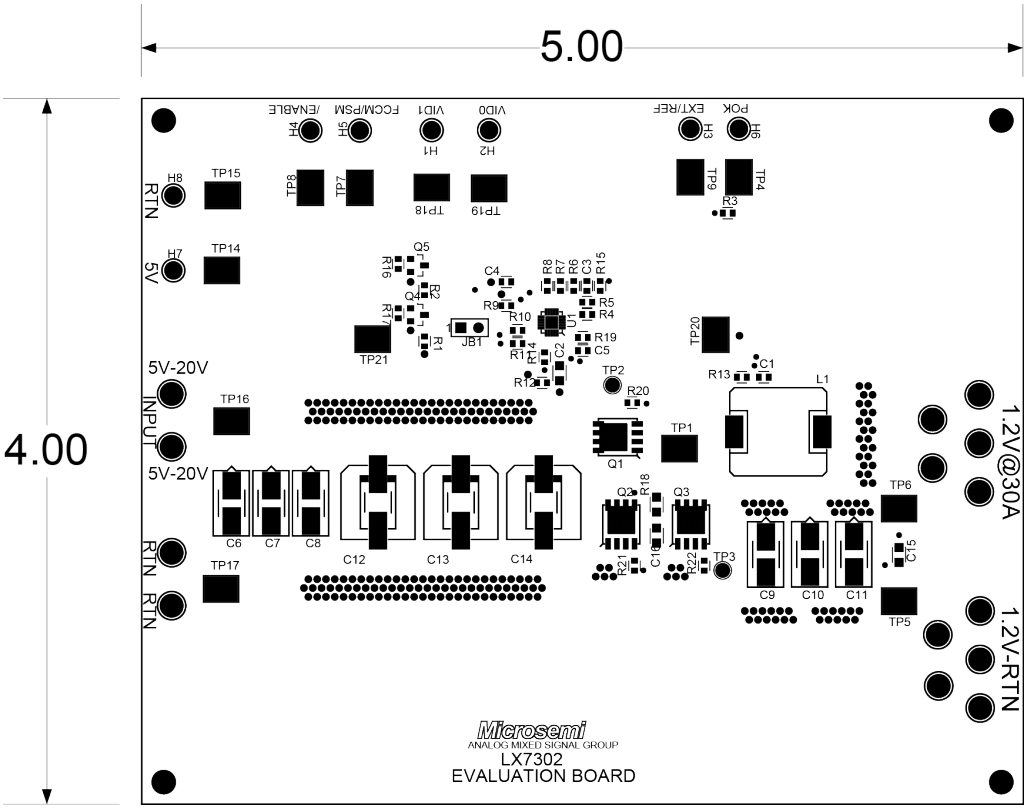


Figure 3 • Top Layer

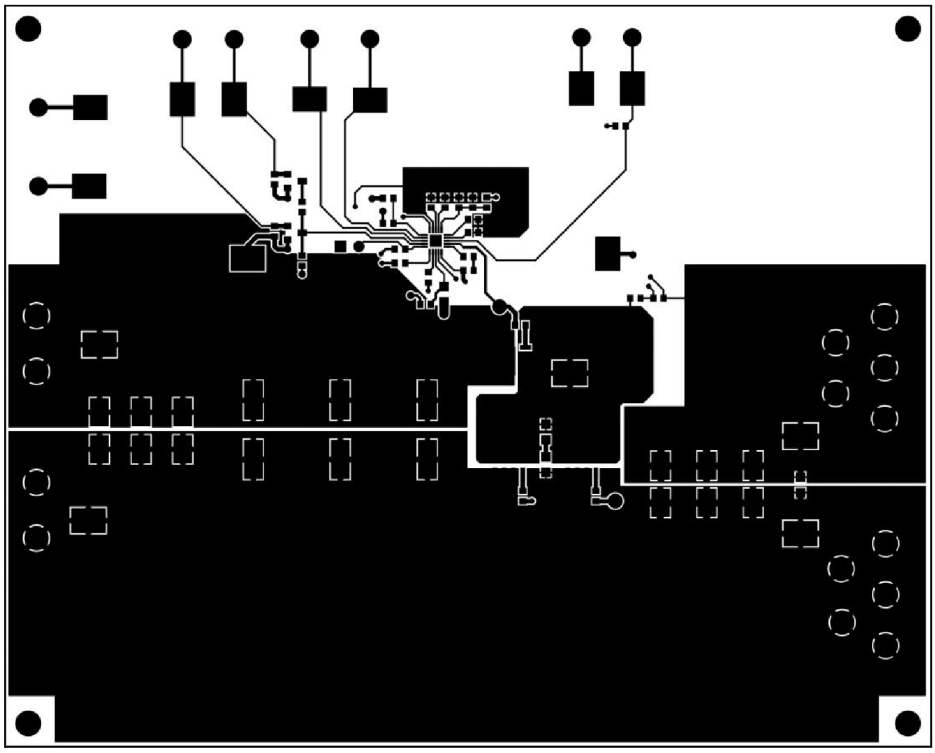


Figure 4 • Ground Layer

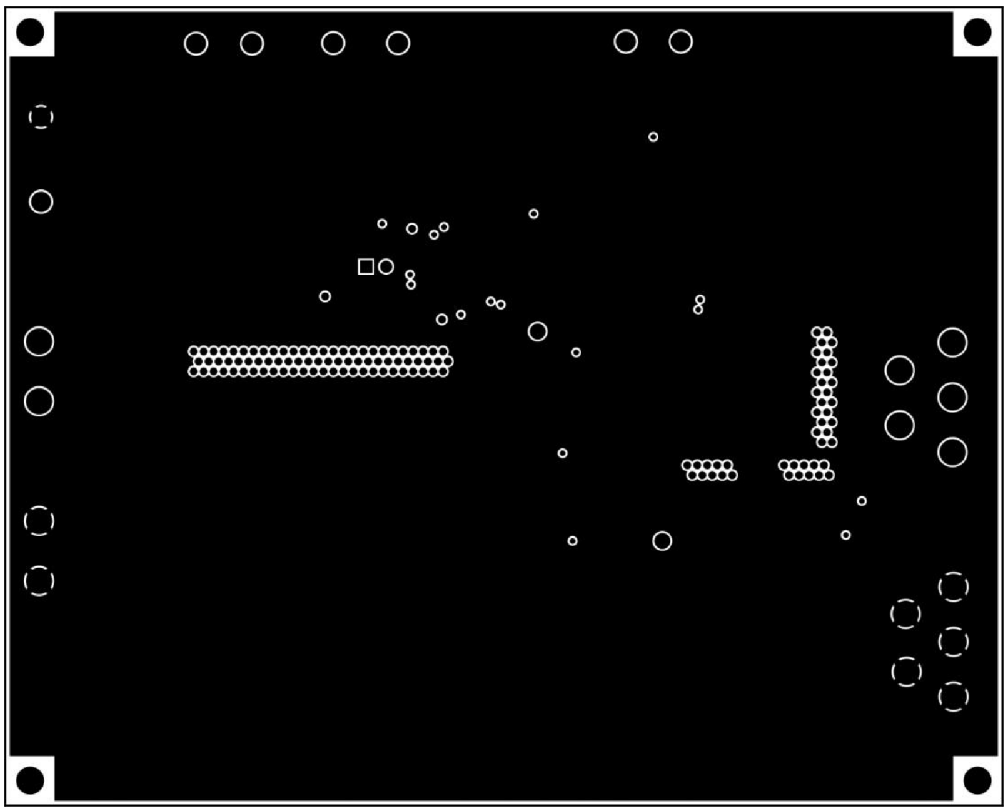


Figure 5 • Power Layer

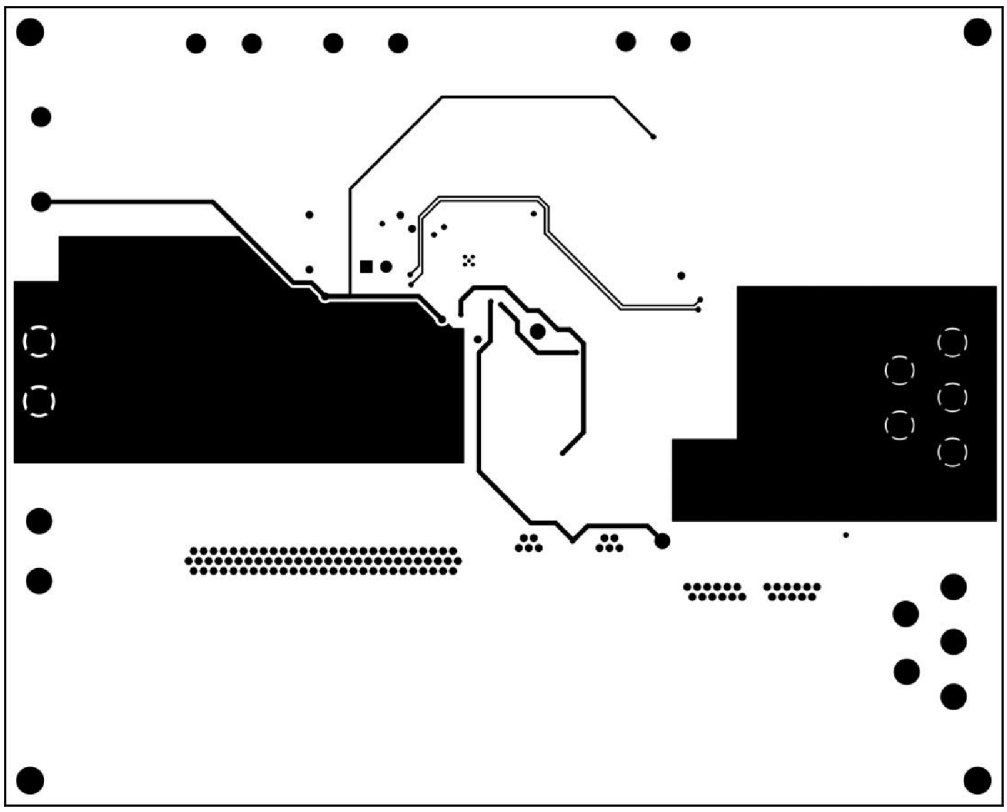
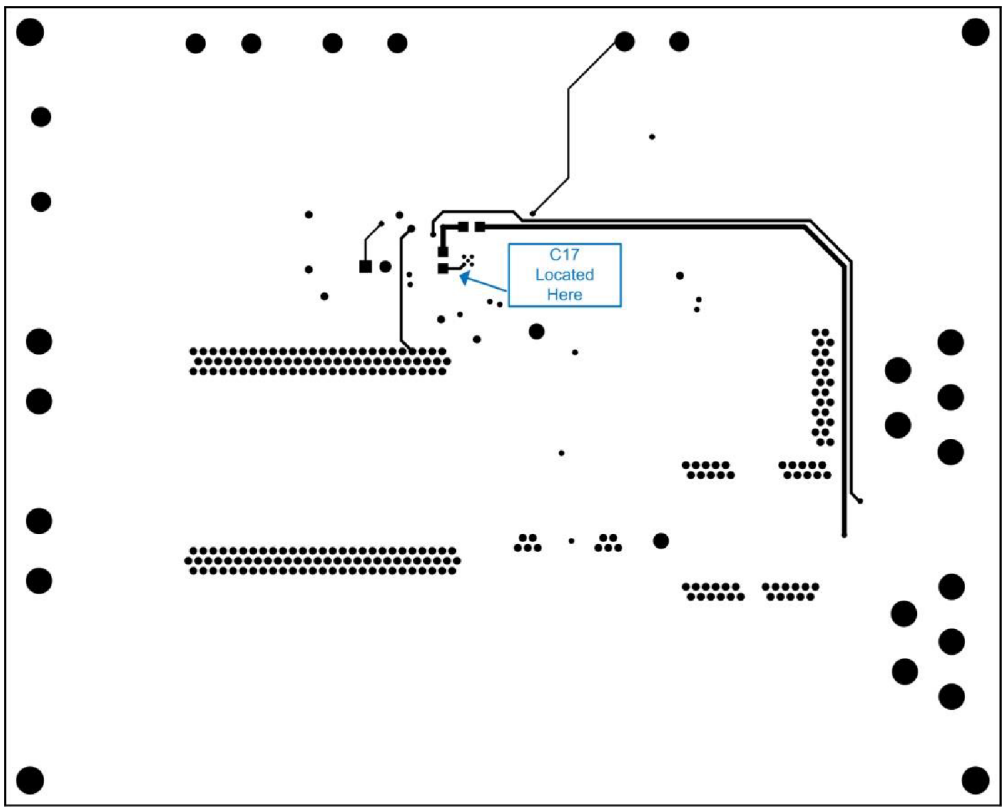


Figure 6 • Bottom Layer



5 Test Considerations

The following is a guideline for testing the LX7302 IC:

- The LX7302 evaluation board will provide up to 30 A of continuous load current. The board comes with through-hole pads to accommodate 16 AWG wire for high-current testing. It is recommended to use these pads when operating at load currents in excess of 5 A.
- The evaluation board is configured to operate in programmable VID mode. External Reference Mode can be supported by following these steps:
  1. Remove R6.
  2. Add an 80.6K, 0603 resistor to R15.
  3. Add a 1nF, 0603 capacitor to C3.
  4. Replace R5 with a 0 Ω resistor or wire jumper.
- Configuring the External Reference Mode will disable the VID Mode (they cannot be configured at the same time). See the LX7302 Datasheet for further information.
- The LX7302 evaluation board is configured to provide the following voltages under VID control:

Table 2 • Evaluation Board VID Settings

VID 1	VID 2	VOUT
0	0	1.250
0	1	1.082
1	0	1.007
1	1	0.852

Note: Actual output voltages will be within ±1% of the values listed in Table 2.

- The programmable output voltage settings can be adjusted by changing the values of R4–R7. See the LX7302 Datasheet for further information regarding VID control.
- The value of the RT resistor (R8) is set at 49.9K. It is recommended to leave this resistor at 49.9K for proper operation.
- The current limit is set at 35 A by R14. This limit will vary based on the temperature of the lower MOSFETs. The current limit may be adjusted by changing the value of R14.

6 Evaluation Board Test Data

This section features the evaluation board test data graphs for the LX7302.

Figure 7 • Load Regulation

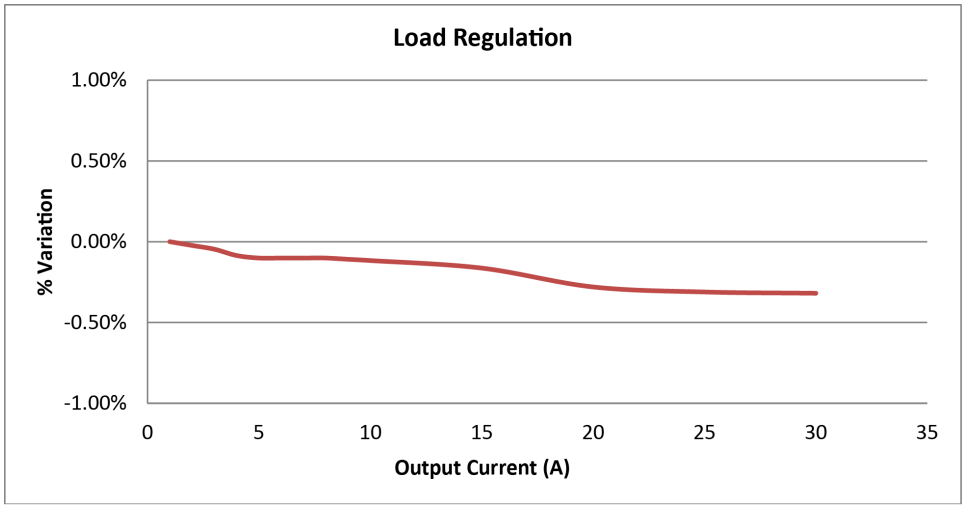


Figure 8 • Line Regulation

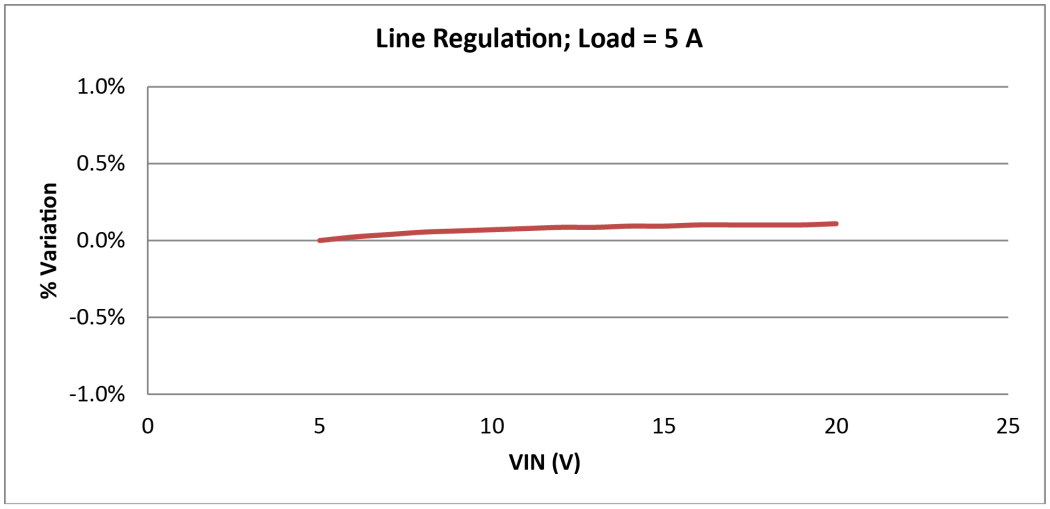


Figure 9 • Efficiency vs. Output Current

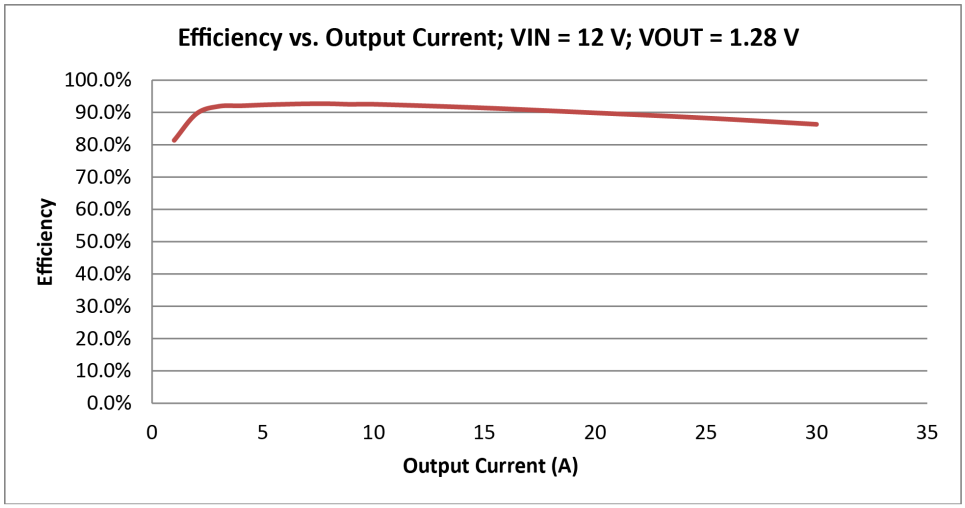
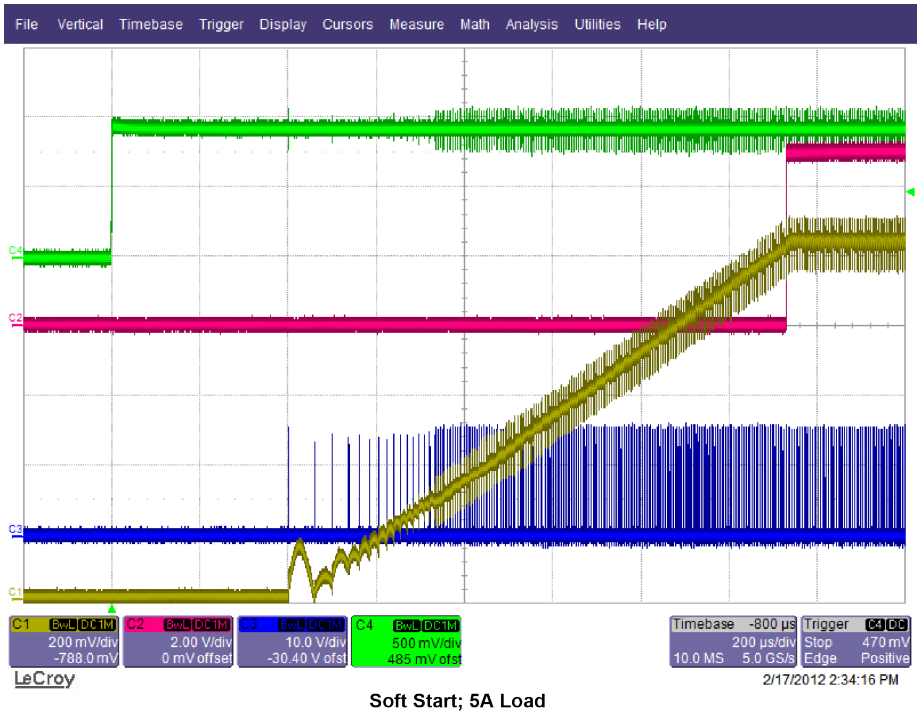
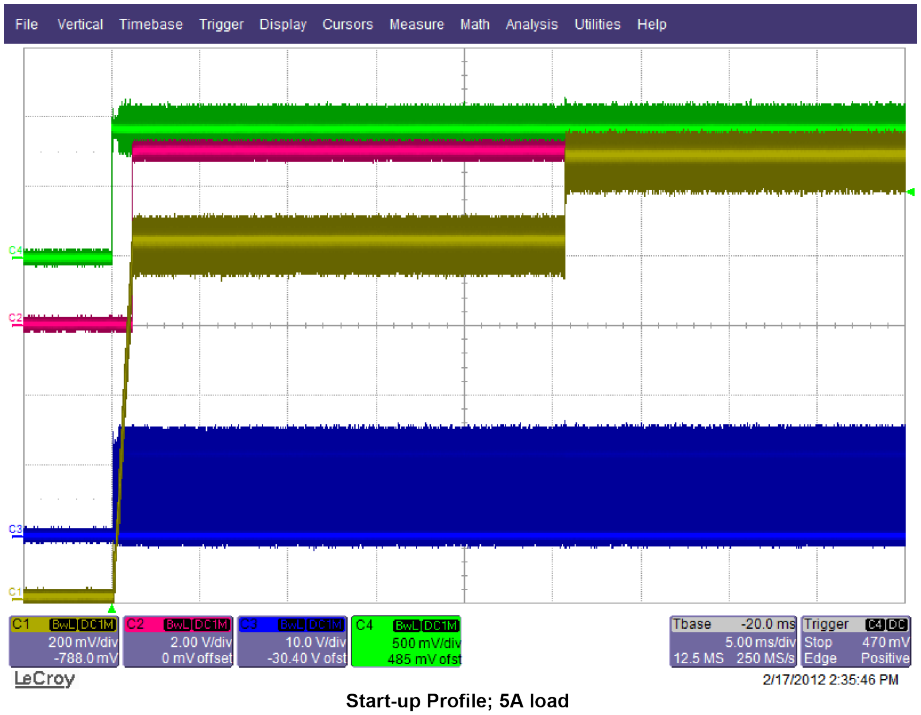


Figure 10 • Soft Start, 5 A Load



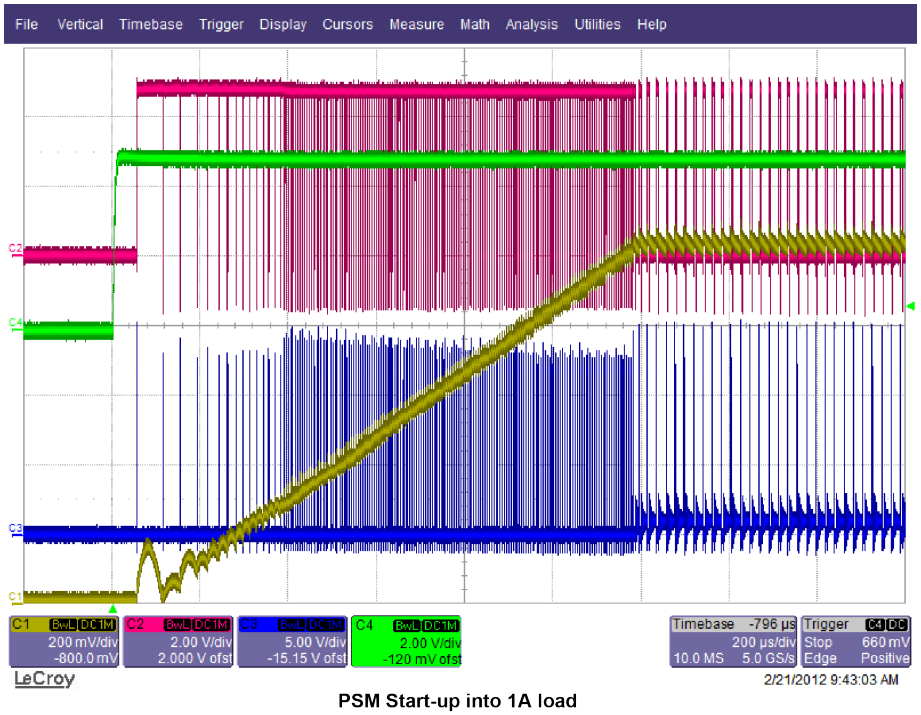
Soft Start; 5A Load
CH1: VOUT
CH2: POK
CH3: Switch Node
CH4: Enable Pin

Figure 11 • Start-Up Profile, 5 A Load



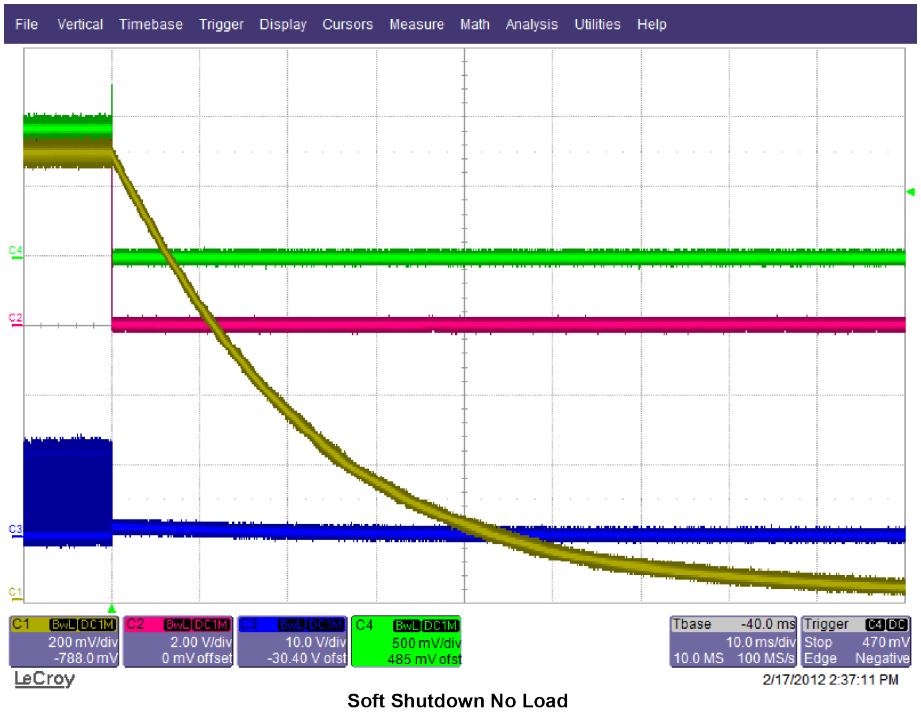
Start-up Profile; 5A load
CH1: VOUT
CH2: POK
CH3: Switch Node
CH4: Enable Pin

Figure 12 • PSM Start-Up into 1 A Load



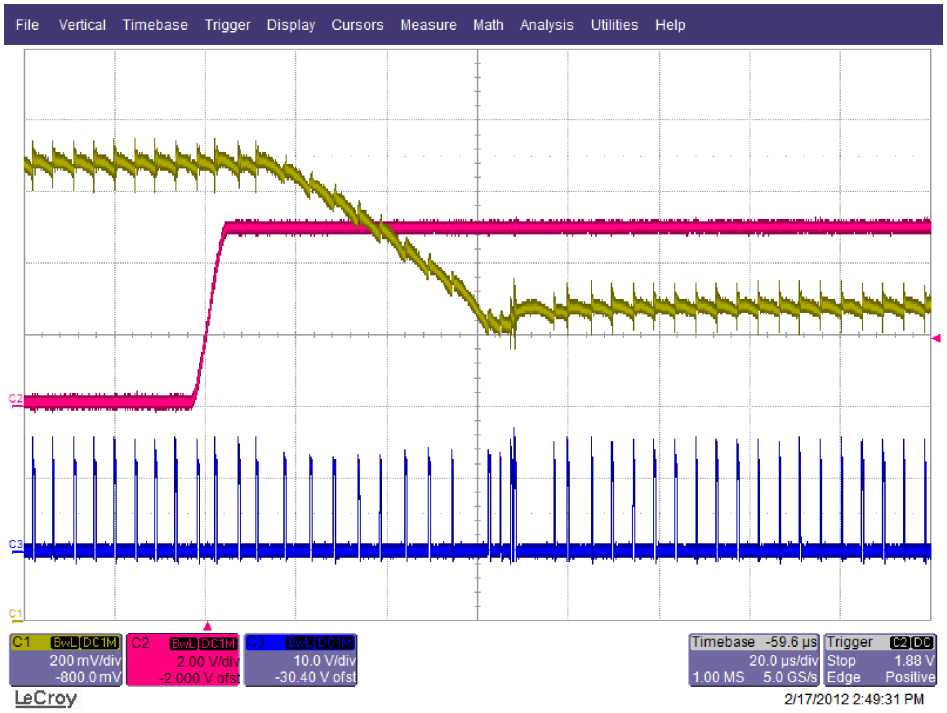
PSM Start-up into 1A load
CH1: VOUT
CH2: LG (Lower Gate Drive Signal)
CH3: Switch Node
CH4: Enable Pin

Figure 13 • Soft Shutdown No Load



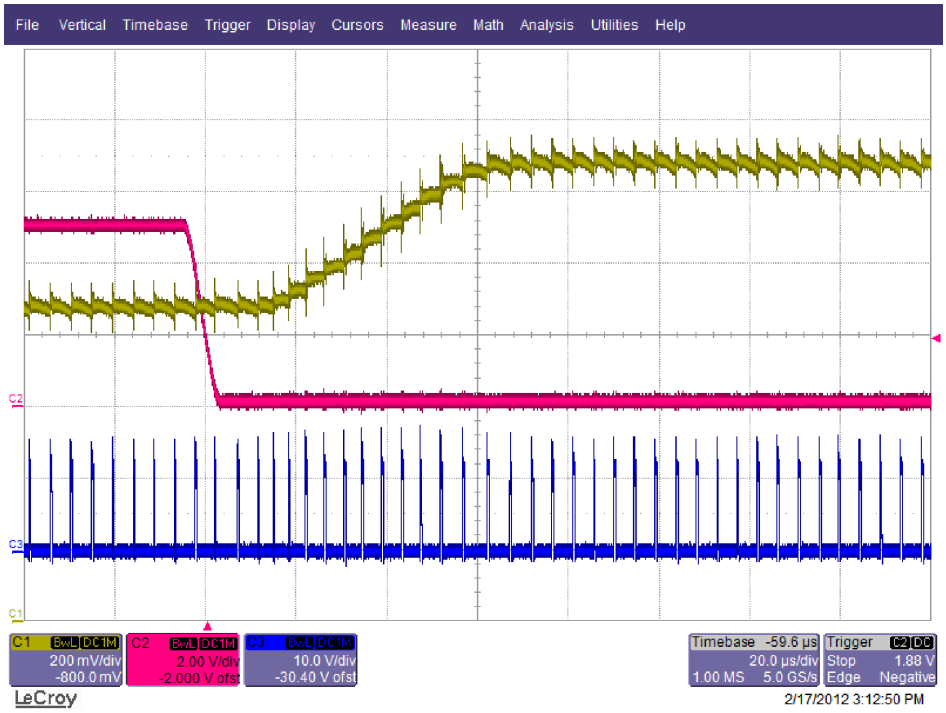
Soft Shutdown No Load
CH1: VOUT
CH2: POK
CH3: Switch Node
CH4: Enable Pin

Figure 14 • VID00 to VID11 Change; 0.2 Ω Load



VID00 to VID11 Change; 0.2 Ohm Load
CH1: VOUT
CH2: VID0 & VID1
CH3: Switch Node

Figure 15 • VID11 to VID00 Change; 0.2 Ω Load

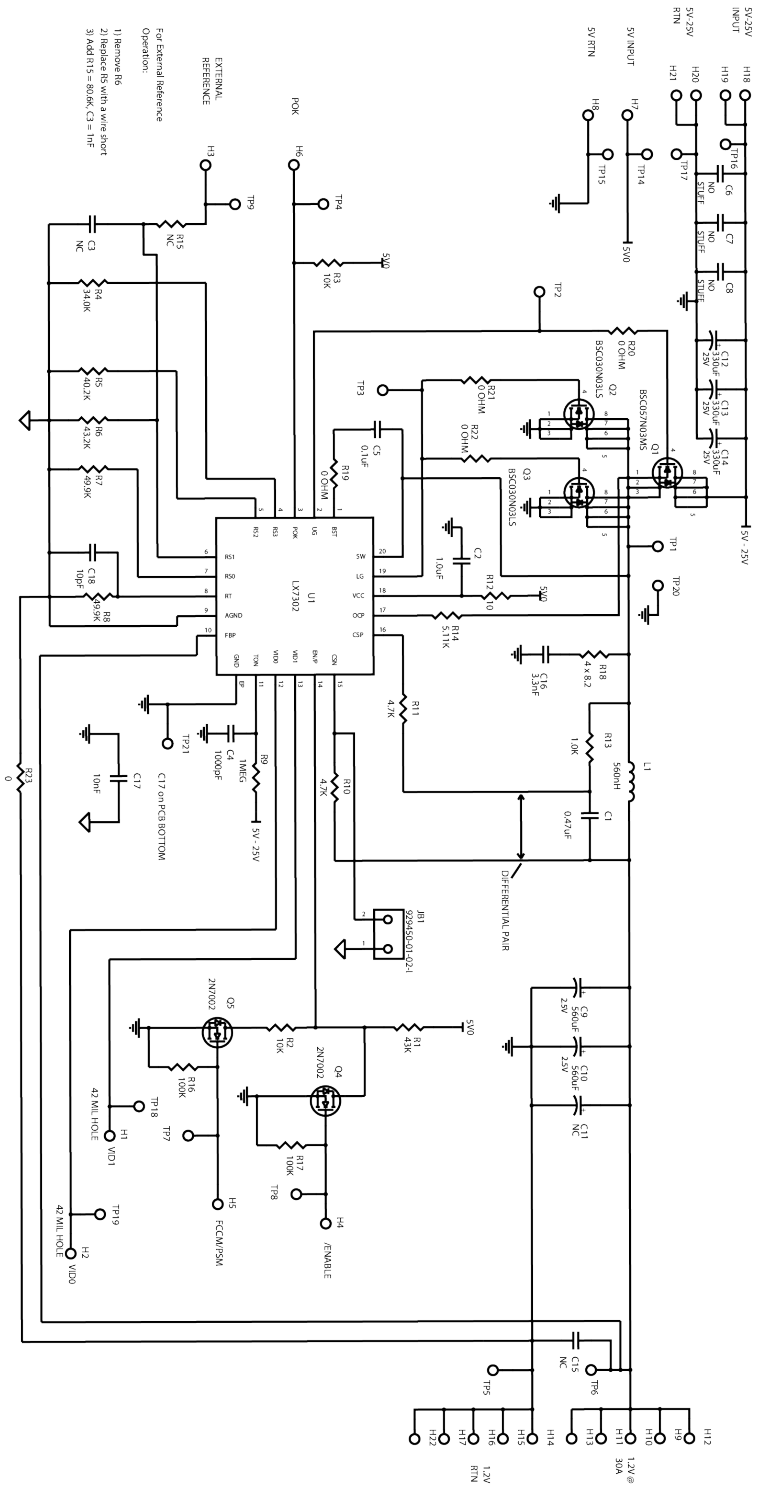


VID11 to VID00 Change; 0.2 Ohm Load
CH1: VOUT
CH2: VID0 & VID1
CH3: Switch Node

7 Evaluation Board Schematic

The section shows the schematic of the LX7302 evaluation board.

Figure 16 • Evaluation Board Schematic



8 Bill of Materials

The following table lists the bill of materials for the LX7302 device.

Table 3 • Bill of Materials

Item Number	Quantity	Part Reference	Description	Manufacturer	Manufacturer Part Number
1	1	C1	Capacitor, ceramic, 0.47 µF, 10 V, 10%, 0603 type SMD	Panasonic	ECJ-1VB1A474K
2	1	C2	Capacitor, ceramic, 1.0 µF, 10 V, 10%, 0805 type SMD	Panasonic	ECJ2YB1A105K
3	1	C4	Capacitor, ceramic, 1000 pF, 50 V, 10%, 0603 type SMD	Panasonic	ECJ-1VB1H102K
4	1	C5	Capacitor, ceramic, 0.1 µF, 16 V, 10%, 0603 type SMD	Panasonic	ECJ-1VB1C104K
5	5	C3,C6,C7, C8, C11, C15	Do not implement		
6	1	C16	Capacitor, ceramic, 3.3 nF, 50 V, 10%, 0805 type SMD	Panasonic	ECJ-2VB1H332K
7	1	C18	Capacitor, ceramic, 10 pF, 50 V, NPO, 0603 type SMD	Panasonic	ECJ-1VC1H100D
8	2	C9, C10	Capacitor, 560 µF, 2.5 V, polymer electrolytic, 13m Ω ESR, 6 mm × 7.7 mm SMD	United Chemi-Con	APXE2R5ARA561MF
9	3	C12, C13, C14	Capacitor, 330 µF, 25 V, polymer electrolytic, 5 A ripple, Oscon 4.3 mm × 13.1 mm SMT	Sanyo	25SVPF330M
10	1	C17	Capacitor, ceramic, 10 nF, 50 V, 20%, 0805 type SMD	Panasonic	ECJ2VB1H103K
11	1	JB1	Header, 2 position vertical	3M	929450-01-02-I
12	1	L1	Inductor, power, 560 nh, 36 A, 1.5 mΩ	Susumu	PCMC135T-R56MF
13	1	Q1	Transistor, FET, BSC057N03LS N channel FET, 30 V, 71 A, 5.7 mΩ, PG-TDSON-8	Infineon	BSC057N03MS
14	2	Q2, Q3	Transistor, FET, BSC030N03LS N channel FET, 30 V, 100 A, 3 mΩ, PG-TDSON-8	Infineon	BSC030N03LS
15	2	Q4, Q5	Transistor, FET, 2N7002 general purpose N-channel Mosfet SOT 23	Fairchild	2N7002
16	1	R1	Resistor, 43 kΩ, 1/10 W, 5% 0603 type SMD	Panasonic	ERJ3GSYJ433
17	2	R2, R3	Resistor, 10 kΩ, 1/10 W, 5% 0603 type SMD	Panasonic	ERJ3GSYJ103
18	1	R4	Resistor, 34.0 kΩ, 1/16 W, 1% 0603 type SMD	Panasonic	ERJ3EKF3402
19	1	R5	Resistor, 40.2 kΩ, 1/16 W, 1% 0603 type SMD	Panasonic	ERJ3EKF4022

Item Number	Quantity	Part Reference	Description	Manufacturer	Manufacturer Part Number
20	1	R6	Resistor, 43.2 kΩ, 1/16 W, 1% 0603 type SMD	Panasonic	ERJ3EKF4322
21	1	R7	Resistor, 49.9 kΩ, 1/16 W, 1% 0603 type SMD	Panasonic	ERJ3EKF4992
22	1	R8	Resistor, 49.9 kΩ, 1/16 W, 1% 0603 type SMD	Panasonic	ERJ3EKF4992
23	1	R9	Resistor, 1 MΩ, 1/10 W, 1% 0603 type SMD	Panasonic	ERJ3EKF1004
24	2	R10, R11	Resistor, 4.7 kΩ, 1/10 W, 5% 0603 type SMD	Panasonic	ERJ3GSYJ472
25	1	R12	Resistor, 10 Ω, 1/10 W, 5% 0603 type SMD	Panasonic	ERJ3GSYJ100
26	1	R13	Resistor, 1.0 kΩ, 1/10 W, 5% 0603 type SMD	Panasonic	ERJ3GSYJ102
27	1	R14	Resistor, 5.11 kΩ, 1/10 W, 1% 0603 type SMD	Panasonic	ERJ3EKF5111
28	2	R16, R17	Resistor, 100 kΩ, 1/10 W, 5% 0603 type SMD	Panasonic	ERJ3GSYJ104
29	4	R19, R20, R21, R22	Resistor, 0 Ω, 5%, 0603 type SMD	Panasonic	ERJ3GEY0R00V
30	4	R18a - R18d	RES 8.2 Ω, 1/8 W, 5%, 0805 SMD	Panasonic	ERJ-6GEYJ8R2V
31	1	R15	Do not implement		
32	17	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21	Terminal, miniature-style test point, SMT PCB mount	Keystone	5016
33	1	U1	IC, LX7302 step-down DC-DC controller, 3 mm × 3 mm 20-pin QFN	Microsemi	LX7302
	1	PCB	Printed circuit board	Microsemi	SGE3247 X3

Microsemi Headquarters
One Enterprise, Aliso Viejo,
CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
Email: sales.support@microsemi.com
www.microsemi.com

Microsemi, a wholly owned subsidiary of Microchip Technology Inc. (Nasdaq: MCHP), offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions; security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, California, and has approximately 4,800 employees globally. Learn more at www microsemi.com.

MSCC-0102-UG-01008-1.0-1118