DEMO CIRCUIT 1479A QUICK START GUIDE

LTC3865EUH DUAL 15A SYNCHRONOUS BUCK CONVERTER with PIN SELECTABLE OUTPUTS

DESCRIPTION

Demonstration circuit 1479A is a dual output synchronous buck DC/DC converter featuring the LTC3865EUH. The input voltage range is from 4.5V to 14V. The outputs are 1.5V/15A and 1.2V/15A. Each output voltage can be precisely programmed to a preset value within 1% error with the VID pins. The demo board uses a high density, two sided drop-in layout. The package of LTC3865EUH is a small, low thermal impedance 5mm x 5mm 32-Lead QFN.

The light load operation mode of the converter is determined with the MODE/PLLIN pin. Use JP3 jumper to select burst mode, pulse skipping mode or forced continuous mode operation. Switching frequency is pre-set at about 500KHz. This frequency can be modified by changing R7 value at the FREQ pin. The converter can also be externally synchronized from 250kHz to 770kHz through MODE/PLLIN pin (SYNC terminal on the board). The maximum current sense threshold can be adjusted by connecting I_{LIM} pin to SGND, float or INTVcc (with optional R42 and R44). To shut down a channel, force its RUN pin below 1.2V (Jumper: OFF). The power good output (PGOOD terminal) is low when either channel output exceeds +/-10% regulation window.

Design files for this circuit board are available. Call the LTC factory.

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

PARAMETER	CONDITION	VALUE
Input Voltage Range		4.5V to 14V
Output Voltage, V_{OUT1}	V_{IN} = 4.5-14V, I_{OUT1} = 0A to 15A	1.5V ±1% (Note)
Output Voltage, V_{OUT2}	V_{IN} = 4.5-14V, I_{OUT2} = 0A to 15A	1.2V ±1% (Note)
Maximum Output Current, I_{OUT1}	V_{IN} = 4.5-14V, V_{OUT1} = 1.5V	15A
Maximum Output Current, I_{OUT2}	V_{IN} = 4.5-14V, V_{OUT2} = 1.2V	15A
Typical full load Efficiency, channel 1	V_{IN} = 12V, V_{OUT1} = 1.5V, I_{OUT1} = 15A	85%
Typical full load Efficiency, channel 2	V_{IN} = 12V, V_{OUT2} = 1.2V, I_{OUT2} = 15A	83.4%
Typical Switching Frequency		500kHz

Note: V_{OUT1}, V_{OUT2} are measured directly on output capacitors Cout1 and Cout4.

QUICK START PROCEDURE

Demonstration circuit 1479A is easy to set up to evaluate the performance of the LTC3865EUH. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

Jumper positions:

JP1,2 (RUN1/RUN2): ON

JP3 (MODE): CCM

1. With power off, connect the input power supply to Vin (4.5V-14V) and GND (input return).
2. Connect the load #1 between Vout1 and GND (Initial load: no load); connect the load #2 between Vout2 and GND (Initial load: no load).
3. Connect the DVMs to the input and outputs.
4. Turn on the input power supply and check for the proper output voltages. With current VID pin setting, Vout1 should be 1.5V+/-1%; Vout2 should be 1.2V+/-1%.
5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.
6. If necessary, change the resistor options on VID pins for another output voltage according to table 2.

Note: 1. When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 2 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (-) terminals of an output capacitor. The probe's ground ring needs to touch the (-) lead and the probe tip needs to touch the (+) lead.

Note: 2. Do not apply load from Vo1+ to Vo1- or from Vo2+ to Vo2- turrets. These are only intended to conveniently measure the output voltage. Heavy load currents may damage the sense traces.

To accurately measure the output voltages and efficiency, please directly measure Vout1 and Vout2 on output capacitors Cout1 and Cout4.

OUTPUT VOLTAGE PROGRAMMING

The output voltages of both channels can be programmed to preset values. There are two VID pins for each channel: VID11, VID12 for Vout1, and VID21, VID22 for Vout2. See Table 2 for details.

Table 2. Output voltage programming

VID11/VID21	VID12/VID22	VOUT1/VOUT2 (V)
INTVCC	INTVCC	5.0 (Vin > 5V)
INTVCC	FLOAT	3.3
INTVCC	GND	2.5
FLOAT	INTVCC	1.8
FLOAT	FLOAT	0.6 or external divider
FLOAT	GND	1.5
GND	INTVCC	1.2
GND	FLOAT	1.0
GND	GND	1.1

SINGLE OUTPUT / DUAL PHASE OPERATION

A single output / dual phase converter may be preferred for high output current applications. The benefits of single output / dual phase operation are lower ripple current through the input and output capacitors, improved load step response and simplified thermal design. To implement single output / dual phase operation, make the following modifications:

1. Tie VOUT1 to VOUT2. Use a piece of heavy copper foil if possible.
2. Tie ITH1 to ITH2 by stuffing 0Ω at R49.
3. Tie VFB1 to VFB2 by stuffing 0Ω at R50.
4. Tie TRK/SS1 to TRK/SS2 by stuffing 0Ω at R52.
5. Tie RUN1 to RUN2 by stuffing 0Ω at R55.
6. Remove channel 2 ITH compensation network (C44, R35) and float VID21, VID22 pins.

RAIL TRACKING

Demonstration circuit 1479A is configured for independent turn-on of VOUT1 and VOUT2. The ramp-rate for VOUT1 is determined by the TRK/SS1 cap at C2 and the ramp-rate for VOUT2 is determined by the TRK/SS2 cap at C47. This board can be modified on the bench to allow VOUT1 to track an external signal. It can also be modified to allow VOUT2 to track VOUT1 or to allow VOUT2 to track an external signal. Tables 3 and 4 cover the rail tracking options for each rail.

Table 3. V_{OUT1} Tracking Options (1.5V)

	TRACK1 DIVIDER		TRK/SS1 CAP
CONFIGURATION	**R3**	**R2**	**C2**
Soft Start Without Tracking (original board)	0 Ω	Not stuffed	0.1uF
External Coincident Tracking	17.8kΩ	20.0kΩ	Not Stuffed

Table 4. V_{OUT2} Tracking Options (1.2V)

	TRACK2 DIVIDER			TRK/SS2 CAP
CONFIGURATION	**R36**	**R34**	**R37**	**C47**
Soft Start Without Tracking (original board)	0 Ω	Not stuffed	Not stuffed	0.1uF
Coincident Tracking to V_{OUT1} (1.5V)	0 Ω	10.0kΩ	20.0kΩ	Not Stuffed
External Coincident Tracking	10.0kΩ	Not stuffed	20.0kΩ	Not Stuffed

INDUCTOR DCR SENSING

Demonstration circuit 1479A provides an optional circuit for DCR sensing. DCR sensing uses the DCR of the inductor to sense the inductor current instead of discrete sense resistors. The advantages of DCR sensing are lower cost, reduced board space and higher efficiency, but the disadvantage is a less accurate current limit. If DCR sensing is used, be sure to select an inductor current with a sufficiently high saturation current or use an iron powder type. Tables 5 and 6 show an example of how to modify the DC1479A for DCR sensing using these parameters:

V_{OUT1} = 1.5V / 15A
V_{OUT2} = 1.2V / 15A
V_{IN} = 4.5V to 14V
Fsw = 500kHz, typical
L1,2 = Vishay IHLP-4040DZERR47M11
(0.47uH, DCR = 1.53mΩ typ, 1.68mΩ max)
ILIM = FLOATING (R42,R44 = OPEN)

Table 5. V_{OUT1} Configured as a 1.5V/15A Converter Using DCR Sensing or a Discrete Sense Resistor

			RSENSE FILTER RESISTORS	SENSE FIILTER CAP	DCR FILTER/DIVIDER RESISTORS		SENSE1- TO L1- JUMPER
					TOP	BOTTOM	
CONFIGURATION	**RS1**	**L1**	**R29,R30**	**C14**	**R45**	**R47**	**R61**
DCR Sensing	Short with Cu strip or very short & thick piece of wire	IHLP-4040DZERR47M11	Open	0.22uF	1.40kΩ	15.4kΩ	0 Ω
Discrete RSENSE (original board)	2mΩ	IHLP-4040DZERR47M11	100Ω	1nF	Open	Open	Open

Table 6. V_{OUT2} Configured as a 1.2V/15A Converter Using DCR Sensing or a Discrete Sense Resistor

			RSENSE FILTER RESISTORS	SENSE FIILTER CAP	DCR FILTER/DIVIDER RESISTORS		SENSE1- TO L1- JUMPER
					TOP	BOTTOM	
CONFIGURATION	**RS2**	**L2**	**R39,R40**	**C15**	**R51**	**R53**	**R62**
DCR Sensing	Short with Cu strip or very short & thick piece of wire	IHLP-4040DZERR47M11	Open	0.22uF	1.40kΩ	15.4kΩ	0 Ω
Discrete RSENSE (original board)	2mΩ	IHLP-4040DZERR47M11	100Ω	1nF	Open	Open	Open

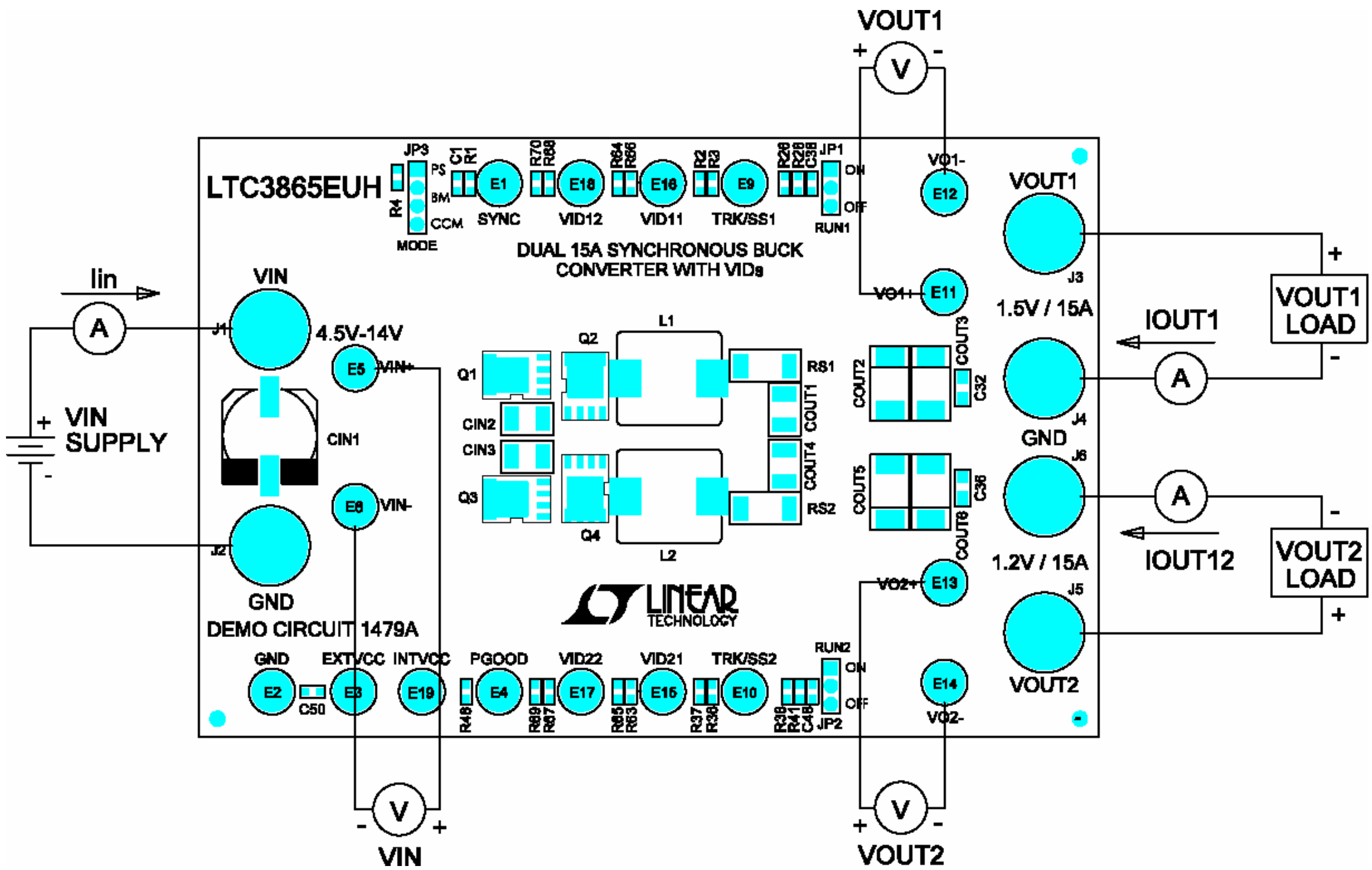


Figure 1. Proper Measurement Equipment Setup

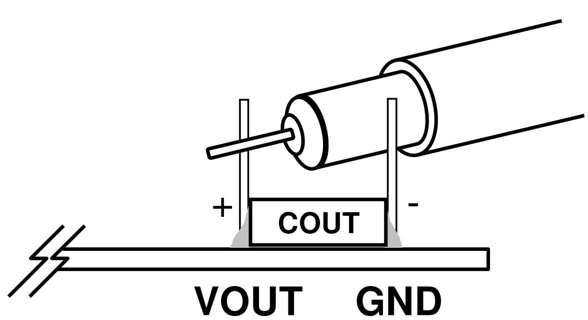


Figure 2. Measuring Output Voltage Ripple

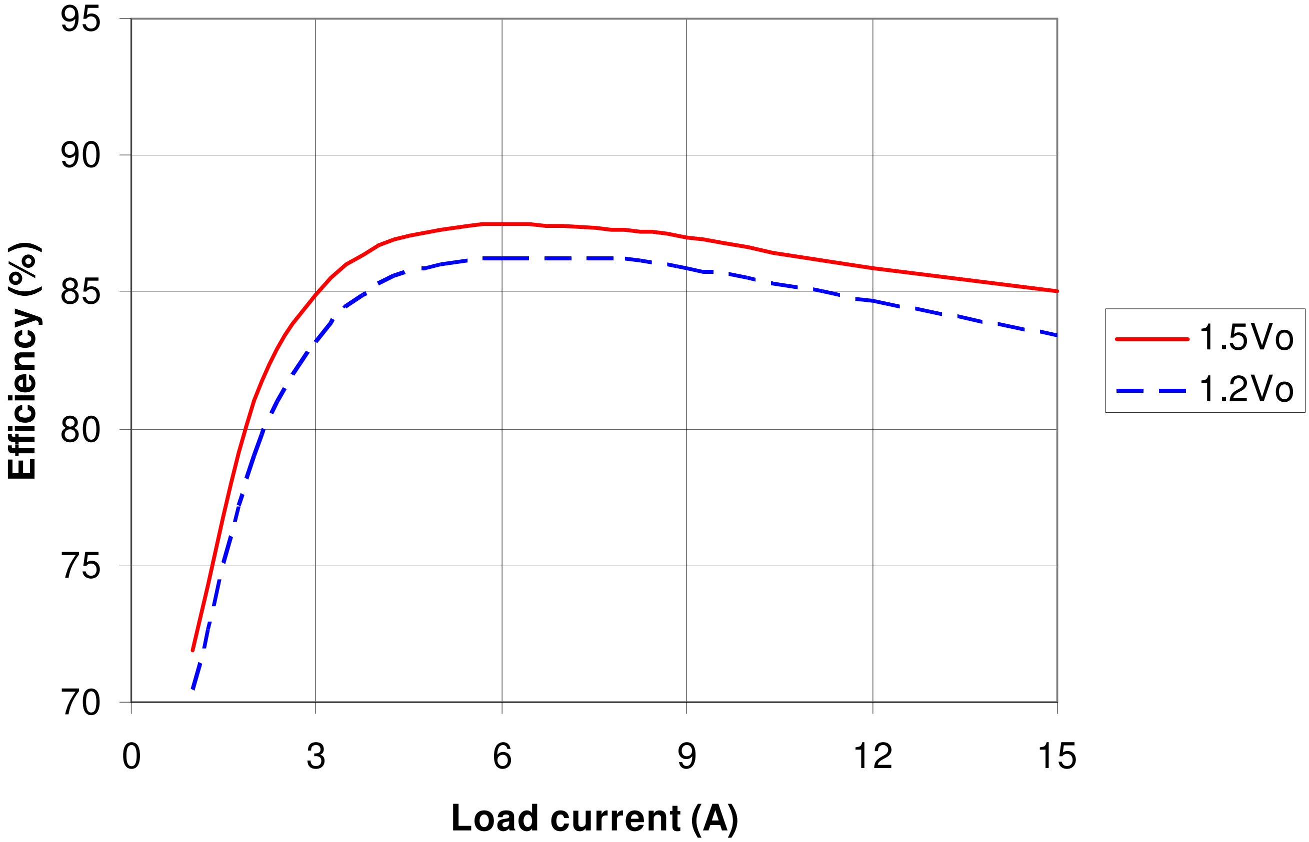
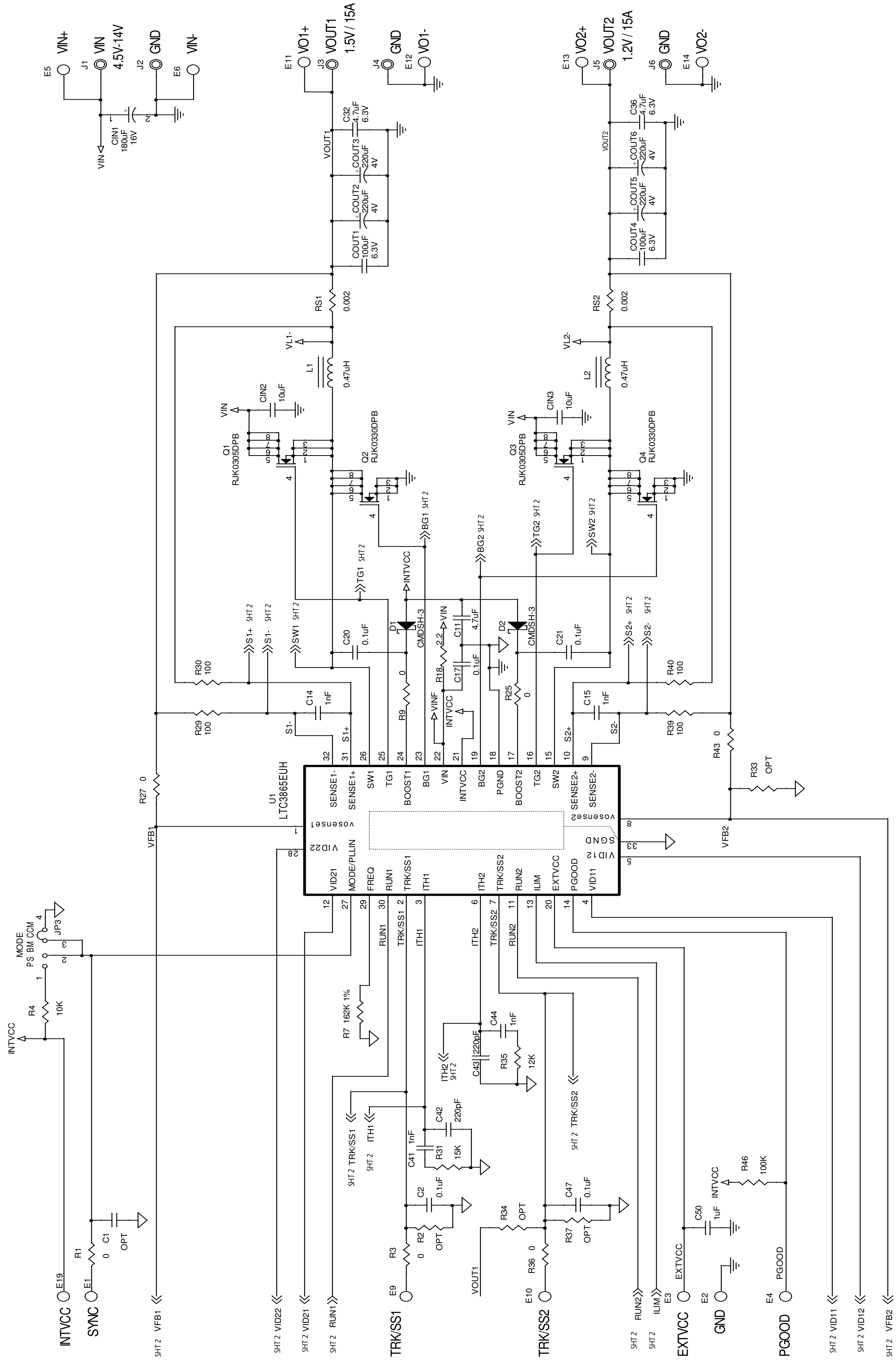
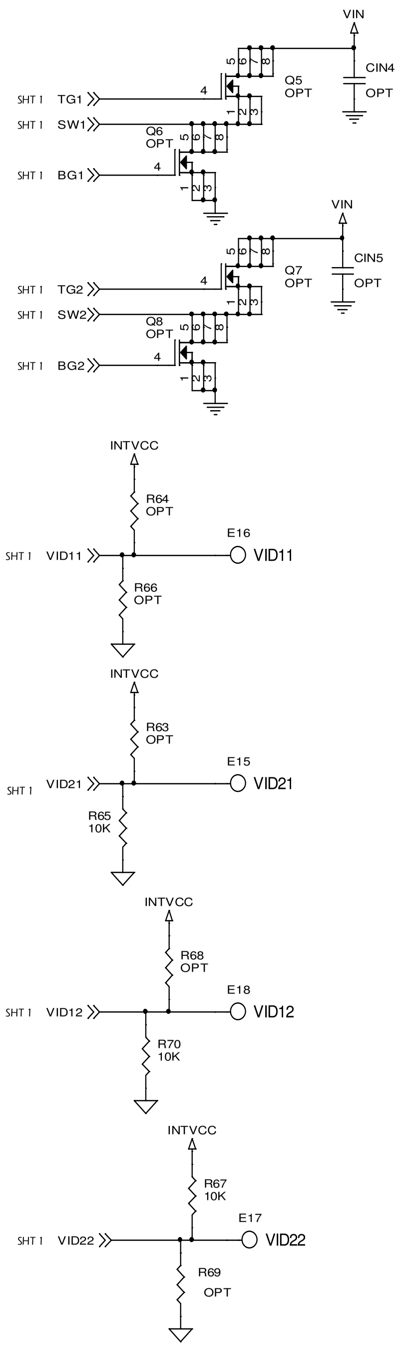


Figure 3. Efficiency vs load current (Vin=12V, 500kHz, CCM)



NOTES: UNLESS OTHERWISE SPECIFIED,

1. DO NOT APPLY LOAD FROM THE VO1+ TO VO1- OR FROM THE VO2+ TO VO2- TURRETS. THESE ARE ONLY INTENDED TO KELVIN SENSE THE OUTPUT VOLTAGE ACROSS COUT1 AND COUT4.



VID11/VID21	VID12/VID22	VOUT1/VOUT2 (V)
INTVCC	INTVCC	5.0 (Vin > 5V)
INTVCC	FLOAT	3.3
INTVCC	GND	2.5
FLOAT	INTVCC	1.8
FLOAT	FLOAT	0.6 or external divider
FLOAT	GND	1.5
GND	INTVCC	1.2
GND	FLOAT	1.0
GND	GND	1.1