LTC3865EUH-1
Dual 5A Synchronous Buck Converter with Pin Selectable Outputs

DESCRIPTION

Demonstration circuit 1480A is a dual output synchronous buck DC/DC converter featuring the LTC®3865EUH-1. The input voltage range is from 4.5V to 14V. The outputs are 3.3V/5A and 1.8V/5A. 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-1 is a small, low thermal impedance 5mm × 5mm 32-Lead QFN.

The light load operation mode of the converter is determined with the MODE/PLLIN pin. Use JP1 jumper to select Burst Mode® operation, pulse-skipping mode or forced continuous mode operation. Switching frequency is preset at about 500kHz. This frequency can be modified by changing R5 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). To shut down a channel, force its RUN pin below 1.2V (Jumper: OFF). The power good output (PGOOD1 or PGOOG2 terminal) is low when that channel output exceeds ±10% regulation window.

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

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PERFORMANCE SUMMARY (T_A = 25°C)

PARAMETER	CONDITION	VALUE
Input Voltage Range		4.5V to 14V
Output Voltage, V_{OUT1}	V_{IN} = 4.5V to 14V, I_{OUT1} = 0A to 5A	3.3V ±1%
Output Voltage, V_{OUT2}	V_{IN} = 4.5V to 14V, I_{OUT2} = 0A to 5A	1.8V ±1%
Maximum Output Current, I_{OUT1}	V_{IN} = 4.5V to 14V, V_{OUT1} = 3.3V	5A
Maximum Output Current, I_{OUT2}	V_{IN} = 4.5V to 14V, V_{OUT2} = 1.8V	5A
Typical Full Load Efficiency, Channel 1	V_{IN} = 12V, V_{OUT1} = 3.3V, I_{OUT1} = 5A	91.6%
Typical Full Load Efficiency, Channel 2	V_{IN} = 12V, V_{OUT2} = 1.8V, I_{OUT2} = 5A	86.6%
Typical Switching Frequency		500kHz

QUICK START PROCEDURE

Demonstration circuit 1480A is easy to set up to evaluate the performance of the LTC3865EUH-1. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

Jumper positions:

JP1 (MODE): PS

JP2, JP3 (RUN1/RUN2): ON

1. With power off, connect the input power supply to V_{IN} (4.5V to 14V) and GND (input return).
2. Connect the load #1 between V_{OUT1} and GND (Initial load: no load); connect the load #2 between V_{OUT2} 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, V_{OUT1} should be 3.3V ±1%; V_{OUT2} should be 1.8V ±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 other output voltages according to Table 1.

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. To accurately measure the output voltages and efficiency, measure V_{OUT1} and V_{OUT2} on output capacitors C_{OUT2} and C_{OUT4} directly.

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 V_{OUT1}, and VID21, VID22 for V_{OUT2}. See Table 1 for details.

Table 1. Output Voltage Programming

VID11/VID21	VID12/VID22	V_{OUT1}/V_{OUT2} (V)
$INTV_{CC}$	$INTV_{CC}$	5V ($V_{IN} \geq 5V$)
$INTV_{CC}$	FLOAT	3.3V
$INTV_{CC}$	GND	2.5V
FLOAT	$INTV_{CC}$	1.8V
FLOAT	FLOAT	0.6 or External Divider
FLOAT	GND	1.5V
GND	$INTV_{CC}$	1.2V
GND	FLOAT	1V
GND	GND	1.1V

QUICK START PROCEDURE

Rail Tracking

Demonstration circuit 1480A is configured for independent turn-on of V_{OUT1} and V_{OUT2}. The ramp rate for V_{OUT1} is determined by the TRK/SS1 cap at C6 and the ramp rate for V_{OUT2} is determined by the TRK/SS2 capacitor at C14. This board can be modified on the bench to allow V_{OUT1} to track an external signal. It can also be modified to allow V_{OUT2} to track V_{OUT1} or to allow V_{OUT2} to track an external signal. Tables 2 and 3 cover the rail tracking options for each rail.

Table 2. V_{OUT1} Tracking Options (3.3V)

	TRACK1 DIVIDER		TRK/SS1 CAPACITOR
CONFIGURATION	**R7**	**R9**	**C6**
Soft-Start without Tracking (Original Board)	0Ω	Not Stuffed	0.1µF
External Coincident Tracking	45.3kΩ	10kΩ	Not Stuffed

Table 3. V_{OUT2} Tracking Options (1.8V)

	TRACK2 DIVIDER			TRK/SS2 CAPACITOR
CONFIGURATION	**R15**	**R14**	**R17**	**C14**
Soft-Start without Tracking (Original Board)	0Ω	Not Stuffed	Not Stuffed	0.1µF
Coincident Tracking to V_{OUT1} (3.3V)	0Ω	20kΩ	10kΩ	Not Stuffed
External Coincident Tracking	20kΩ	Not Stuffed	10kΩ	Not Stuffed

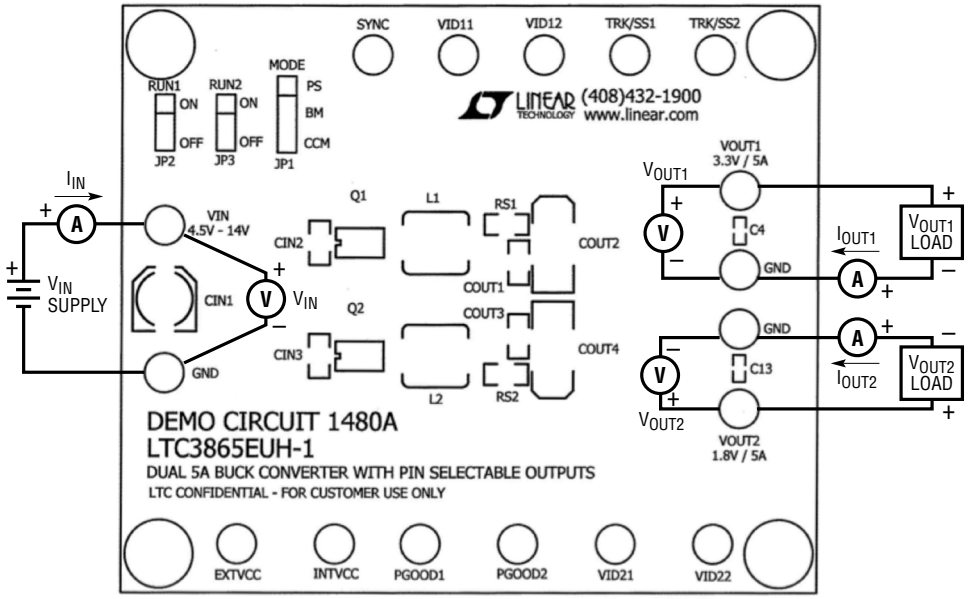


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

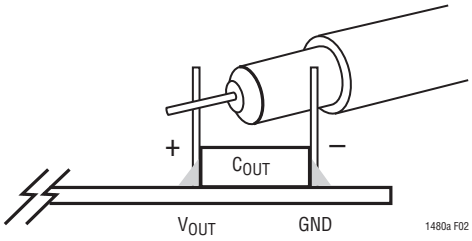


Figure 2. Measuring Output Voltage Ripple

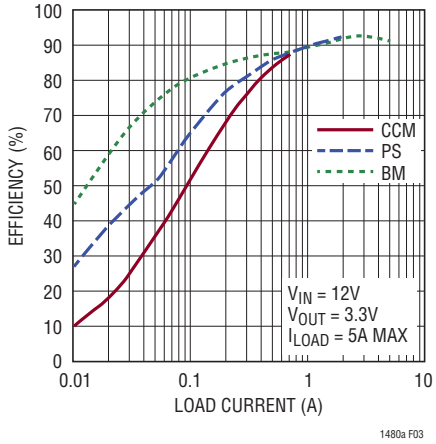


Figure 3. Efficiency vs Load Current (V_{IN} = 12V, V_{OUT1} = 3.3V, 500kHz)

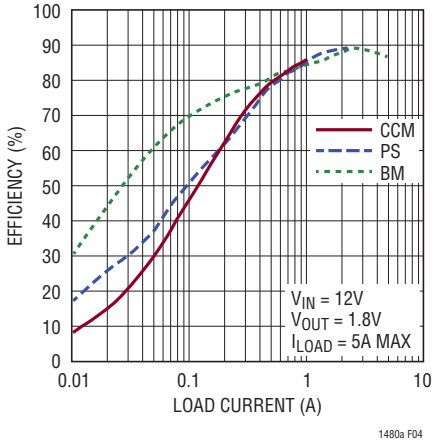
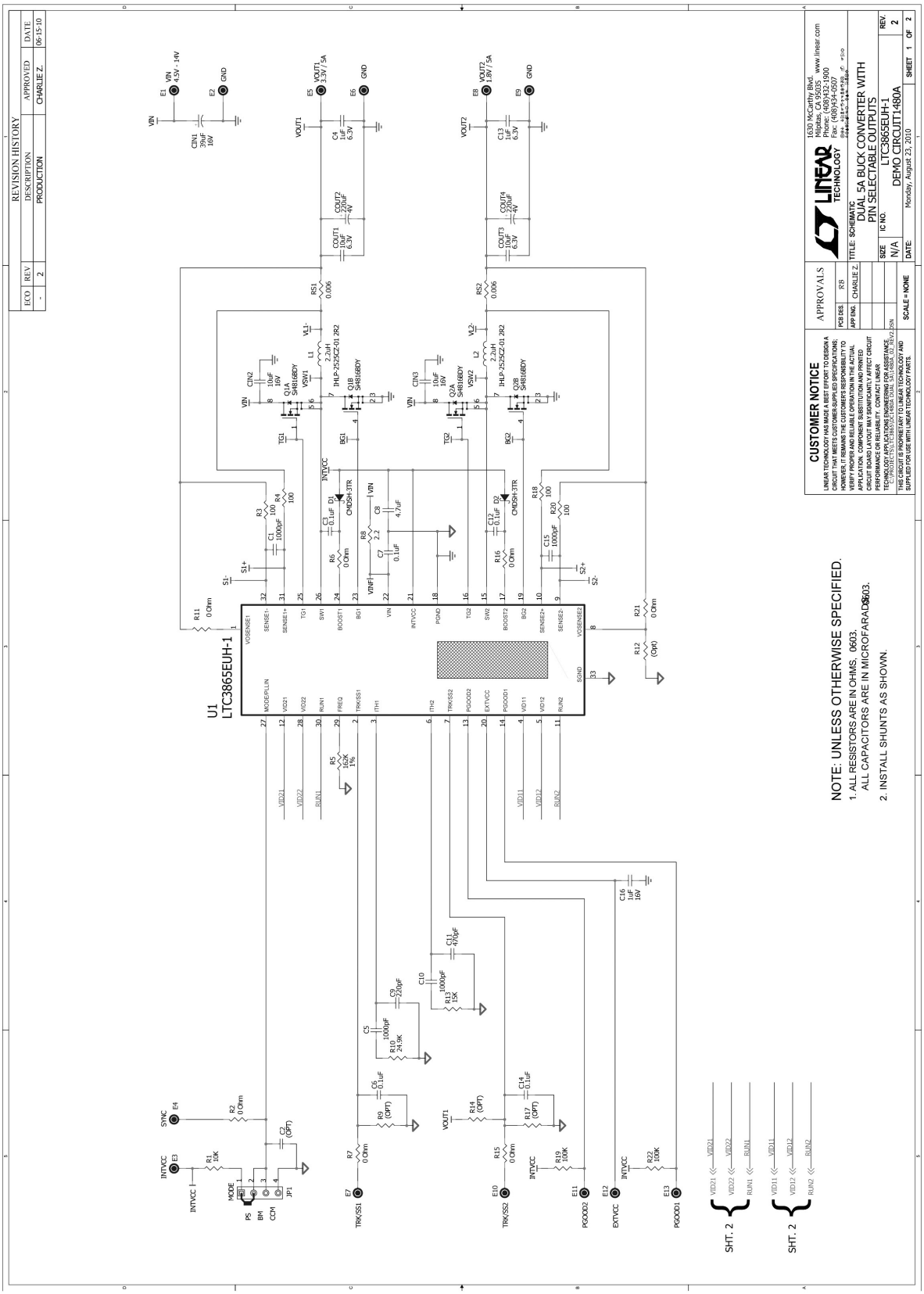


Figure 4. Efficiency vs Load Current (V_{IN} = 12V, V_{OUT2} = 1.8V, 500kHz)

PARTS LIST

ITEM	QUANTITY	REFERENCE-DESCRIPTION	DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	Cap, Alum 39µF 16V 20% OSCON-C6	OSCON 16SVP39M
2	2	CIN3, CIN2	Cap, X5R 10µF 16V 20% 1206	Taiyo Yuden EMK316BJ106ML
3	2	COUT1, COUT3	Cap, X5R 10µF 6.3V 10% 1206	Taiyo Yuden JMK316BJ106KL-T
4	2	COUT2, COUT4	Cap, POSCAP 220µF 4V 20%	Sanyo 4TPE220MF
5	4	C1, C5, C10, C15	Cap, X7R 1000pF 50V 10% 0603	AVX 06035C102KAT1A
6	5	C3, C6, C7, C12, C14	Cap, X7R 0.1µF 25V 10% 0603	AVX 06033C104KAT2A
7	2	C4,C13	Cap, X5R 1µF 6.3V 10% 0603	Taiyo Yuden JMK107BJ105KA-T
8	1	C8	Cap, X5R 4.7µF 16V 20% 0805	Taiyo Yuden EMK212BJ475MG
9	1	C9	Cap, NPO 220pF 25V 10% 0603	AVX 06033A221KAT2A
10	1	C11	Cap, X7R 470pF 50V 5% 0603	AVX 06035C471JAT1A
11	1	C16	Cap, X5R 1µF 16V 20% 0805	Taiyo Yuden EMK212BJ105MG
12	2	D1, D2	Schottky Diode, 30V CMDSH-3	Central Semi. CMDSH-3TR
13	2	L1, L2	Inductor, 2.2µH IHLP-2525CZ-01	Vishay IHLP-2525CZERM01 2R2uH
14	2	Q2, Q1	Dual MOSFET N-Channel, 30V	Siliconix Vishay Si4816BDY
15	2	RS1, RS2	Res, LRC 0.006 0.25W 5% 1206	IRC LRF1206-01-R006-J
16	3	R1, R33, R38	Res, Chip 10k 0.06W 5% 0603	Vishay CRCW060310K0JNEA
17	7	R2, R6, R7, R11, R15, R16, R21	Res, Chip 0Ω 1/16W 1A 0603	Vishay CRCW06030000Z0EA
18	4	R3, R4, R18, R20	Res, Chip 100 0.06W 5% 0603	Vishay CRCW0603100RJNEA
19	1	R5	Res, Chip 162k 0.06W 1% 0603	Vishay CRCW0603162KFKEA
20	1	R8	Res, Chip 2.2 0.06W 5% 0603	Vishay CRCW06032R20JNEA
21	1	R10	Res, Chip 24.9k 0.06W 1% 0603	Vishay CRCW060324K9FKEA
22	1	R13	Res, Chip 15k 0.06W 5% 0603	Vishay CRCW060315K0JNEA
23	2	R19, R22	Res, Chip 100k 0.06W 5% 0603	Vishay CRCW0603100KJNEA
24	1	U1	IC, Voltage Regulator QFN (32) (UH) 5mm × 5mm	Linear Technology LTC3865EUH-1
Additional Circuit Components				
1	2	CIN5,CIN4	Cap, 0805	
2	1	C2	Cap, 0603	
3	2	Q3, Q4	(SyncFet) N-Channel, Dual	Fairchild FDS6982AS
4	20	R9, R12, R14, R17, R23, R24 R25, R26, R27, R28, R29, R30, R31 R32, R34, R35, R36, R37, R39, R40	Res, 0603	
Hardware Demo Board Only				
1	17	E1, E2, E3 ,E4, E5, E6, E7, E8, E9, E10	Turret, Testpoint 0.094”	Mill Max 2501-2-00-80-00-00-07-0
2		E11, E12, E13, E14, E15, E16, E17		
3	1	JP1	Headers, 4 Pins 2mm Ctrs.	Samtec TMM-104-02-L-S
4	2	JP2, JP3	Headers, 3 Pins 2mm Ctrs.	Samtec TMM-103-02-L-S
5	3	XJP1, XJP2, XJP3	Shunt, 2mm Ctrs.	Samtec 2SN-BK-G
6	4	MH1 to MH4	Stand-Off, Nylon 0.25” Tall	Keystone, 8831(Snap On)
7	1		FAB, 1480A_ Rev0	Demo Circuit 1480A
8	2		Stencil 1480A	Stencil #1480A

SCHEMATIC DIAGRAM



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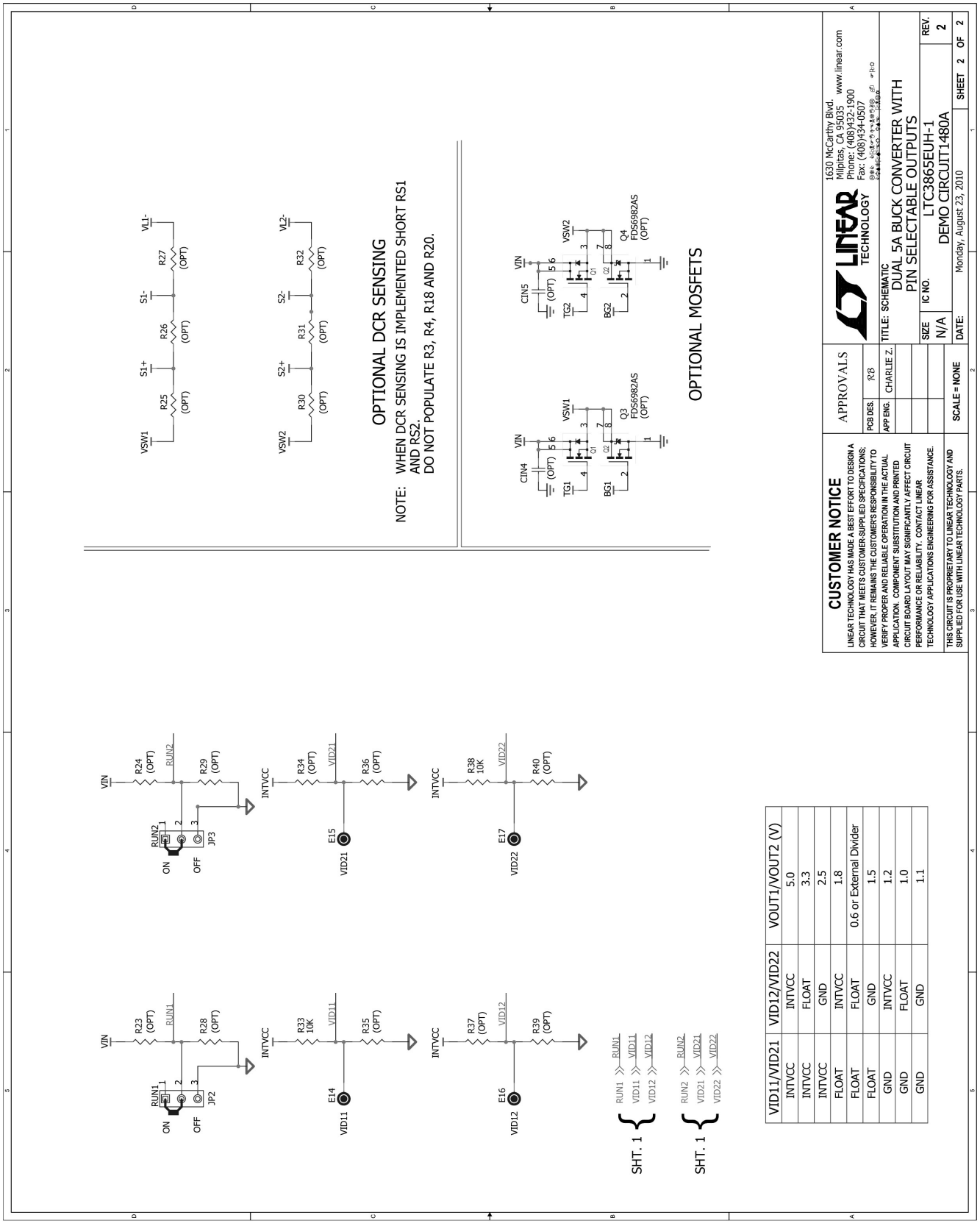

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