LTM4655
Low EMI Dual 13V–28V$_{IN}$, –12V/2.2A$_{OUT}$ Negative µModule Regulator

DESCRIPTION

Demonstration circuit 2899A is a dual inverting DC/DC converter with a 13V to 28V input voltage range, two 12V outputs at up to 2.5A each featuring the LTM®4655. The LTM4655 is a EN55022B compliant 40V, dual 4A or single 8A step-down or 50W inverting DC/DC µModule® regulator.

The switching frequencies of both channels are set at 1.2MHz on DC2899A. If the output voltage collapses sufficiently due to an overload or short-circuit condition, the internal oscillator will foldback to one-fifth of the LTM4655's programmed switching frequency, protecting the power switch from damage.

Key features of this board include:

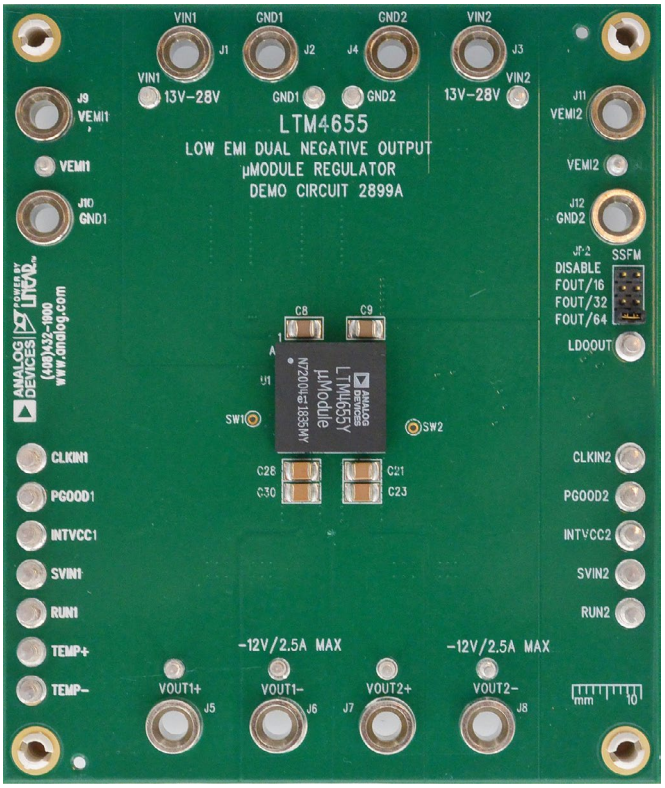
- SSFM Jumper for Spread Spectrum Options
- CLKIN Inputs for External Sync
- PGOOD Signals for Each Output

The two channels can be paralleled for higher output current. See the data sheet for more information on setting-up the board for paralleling the two outputs.

The LTM4655 data sheet gives a complete description of the device, its operation and application information. The data sheet must be read in conjunction with this demo manual prior to working on or modifying DC2899A.

Design files for this circuit board are available.

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		13		28	V
f_{SW}	Switching Frequency			1.2		MHz
V_{OUT}	Output Voltage		–11.75	–12	–12.25	V
I_{OUT}	Output Current	V_{IN} = 13V	0		–2.2	A
I_{OUT}	Output Current	V_{IN} = 28V	0		–2.5	A
$V_{OUT(AC)}$	Output Ripple (across C23/C30)	V_{IN} = 28V, I_{OUT} = 2.5A, 20MHz		30		mV_{P-P}
η	Efficiency	V_{IN} = 28V, I_{OUT} = 2.5A		88		%

QUICK START PROCEDURE

Demo circuit 2899A is an easy way to evaluate the performance of the LTM4655. Refer to Figure 1 for proper measurement equipment setup, and follow the procedure below:

1. With power off, connect the input power supply "+" to V_{IN1} and V_{IN2} and "–" to GND1 and GND2. Connect the loads from V_{OUT1}^+ to V_{OUT1}^-, and V_{OUT2}^+ to V_{OUT2}^-.
2. Set voltage of the DC power supply at 14V. Turn on the power at the input.

   NOTE: Make sure that the input voltage does not exceed 28V.
3. Check for the proper output voltage between V_{OUT1}^+ and V_{OUT1}^- (V_{OUT1}^- = –12V). Check for the proper output voltage between V_{OUT2}^+ and V_{OUT2}^- (V_{OUT2}^- = –12V).

   NOTE: If there is no output, or output voltage value is out of the spec, temporarily disconnect the load to make sure that the load is not set too high.

   NOTE: The circuit features frequency foldback to protect the power switches during a fault or output current overload.
4. Once the proper output voltage at each channel is established, adjust the load within the operating range and measure the output voltage regulation, ripple voltage, efficiency and other parameters.

   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 input or output voltage ripple by touching the probe tip directly across the V_{IN1} or V_{IN2} and GND terminals, V_{OUT1}^+ and V_{OUT1}^- terminals, or V_{OUT2}^+ and V_{OUT2}^- terminals. See Figure 2 for proper scope probe technique.

QUICK START PROCEDURE

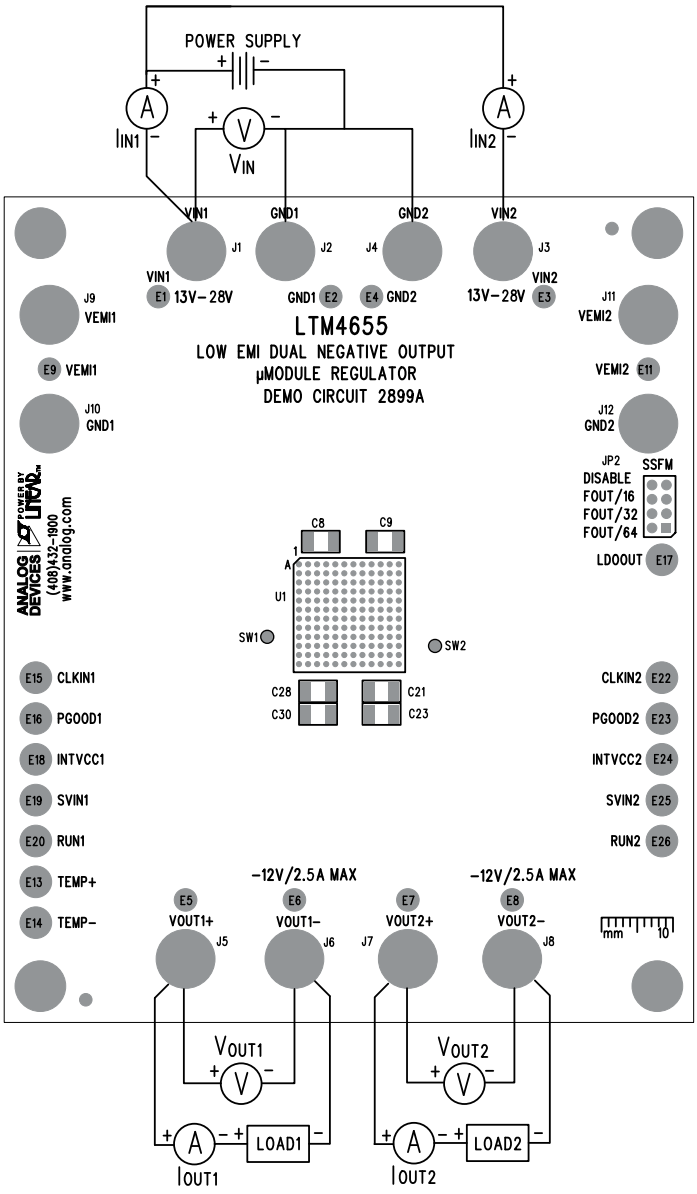


Figure 1. DC2899A Proper Equipment Setup

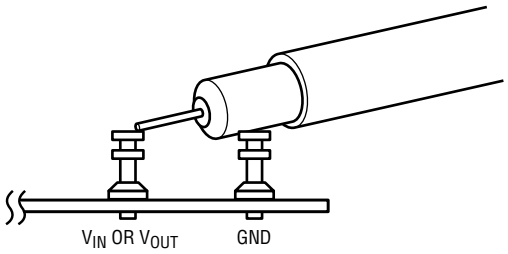


Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE

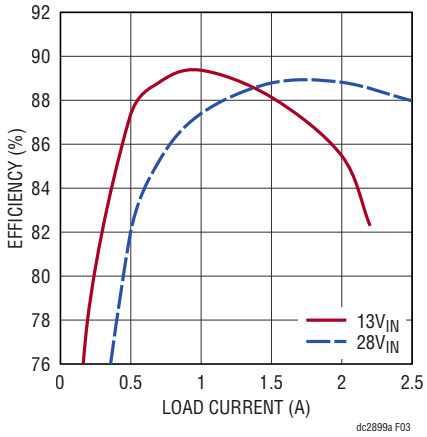


Figure 3. DC2899A Output Efficiency vs Load Current (T_A = 25°C)

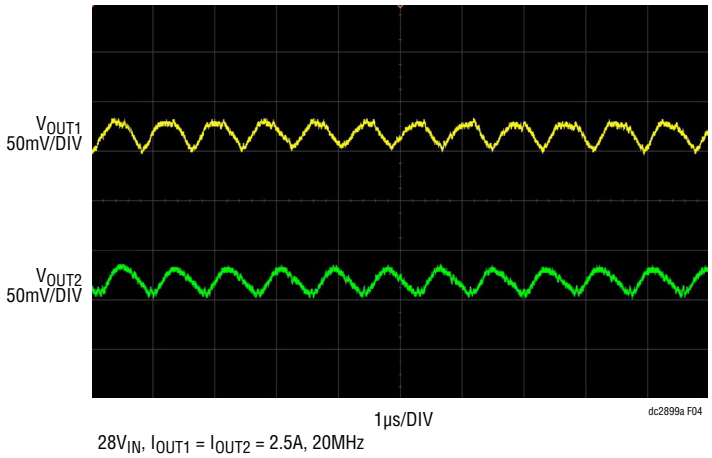


Figure 4. DC2899A Output Ripple

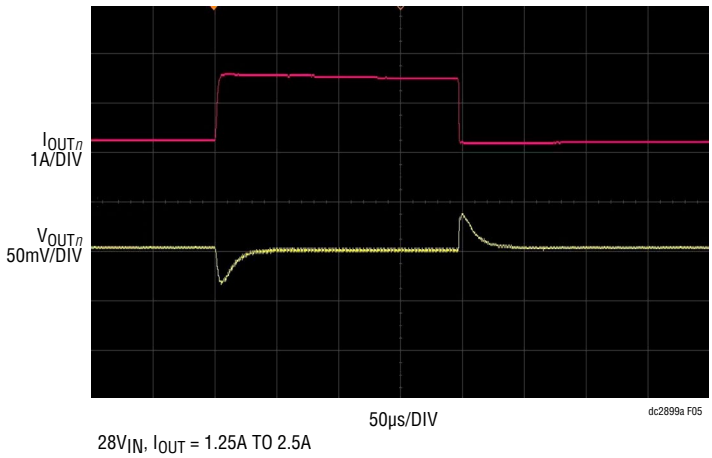


Figure 5. DC2899A Transient Response

QUICK START PROCEDURE

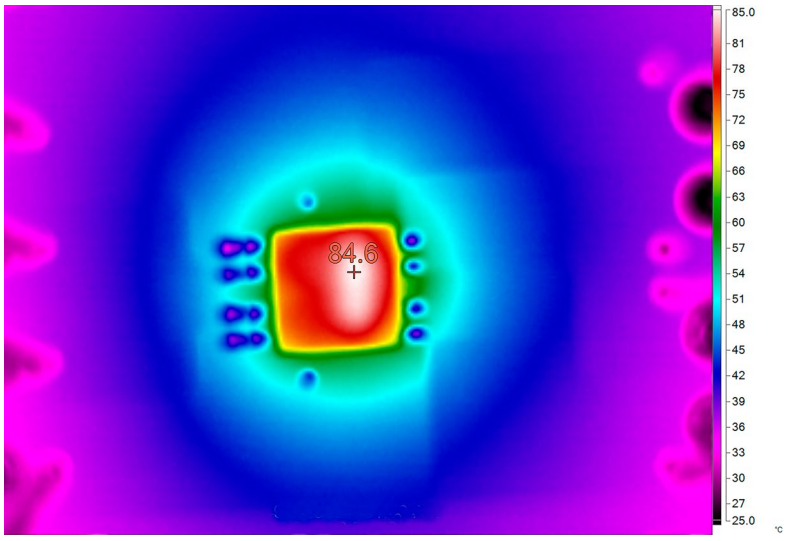


Figure 6. DC2899A Thermal Performance ($14V_{IN}$, $I_{OUT1} = I_{OUT2} = 1.8A$, $T_A = 25°C$, Free Air)

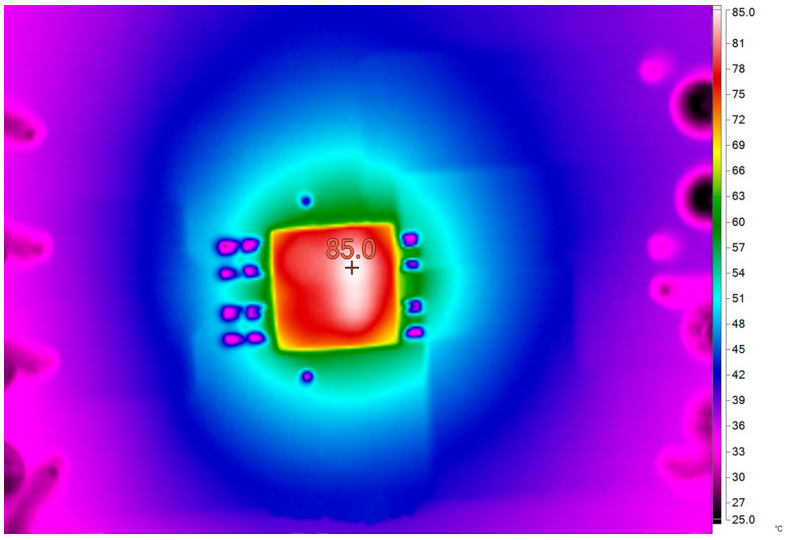


Figure 7. DC2899A Thermal Performance ($24V_{IN}$, $I_{OUT1} = I_{OUT2} = 2.1A$, $T_A = 25°C$, Free Air)

QUICK START PROCEDURE

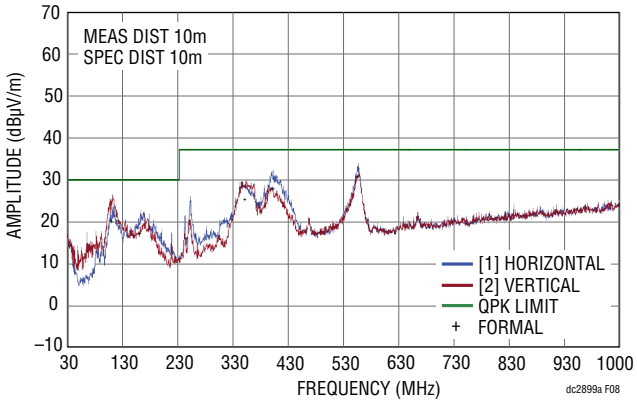
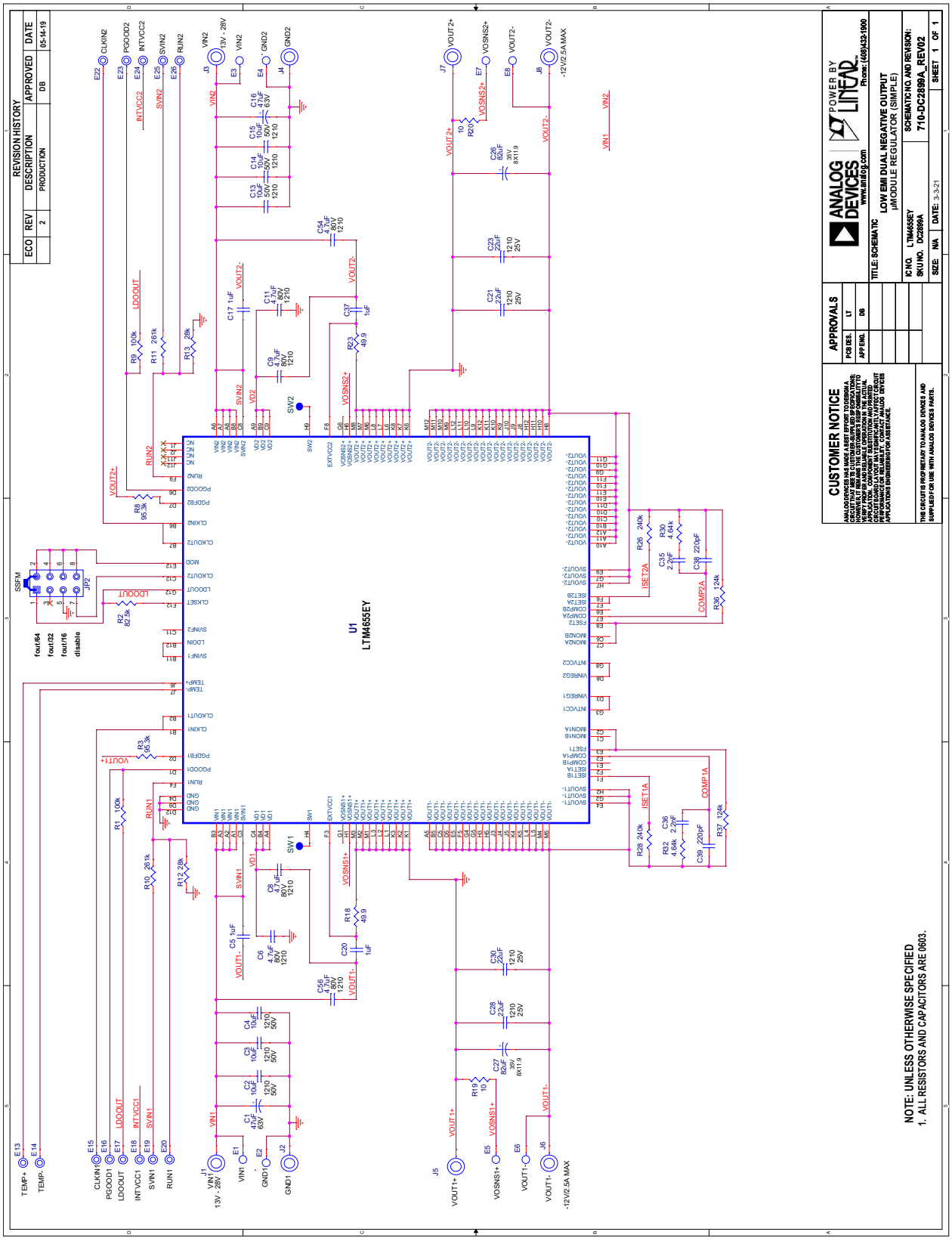


Figure 8. Radiated Emissions Scan of the LTM4655. Producing $-12V_{OUT}$ at 4A (2 Channels), from $12V_{IN}$. DC2899A Hardware. f_{SW} = 700kHz. Measured in a 10m Chamber. Peak Detect Method

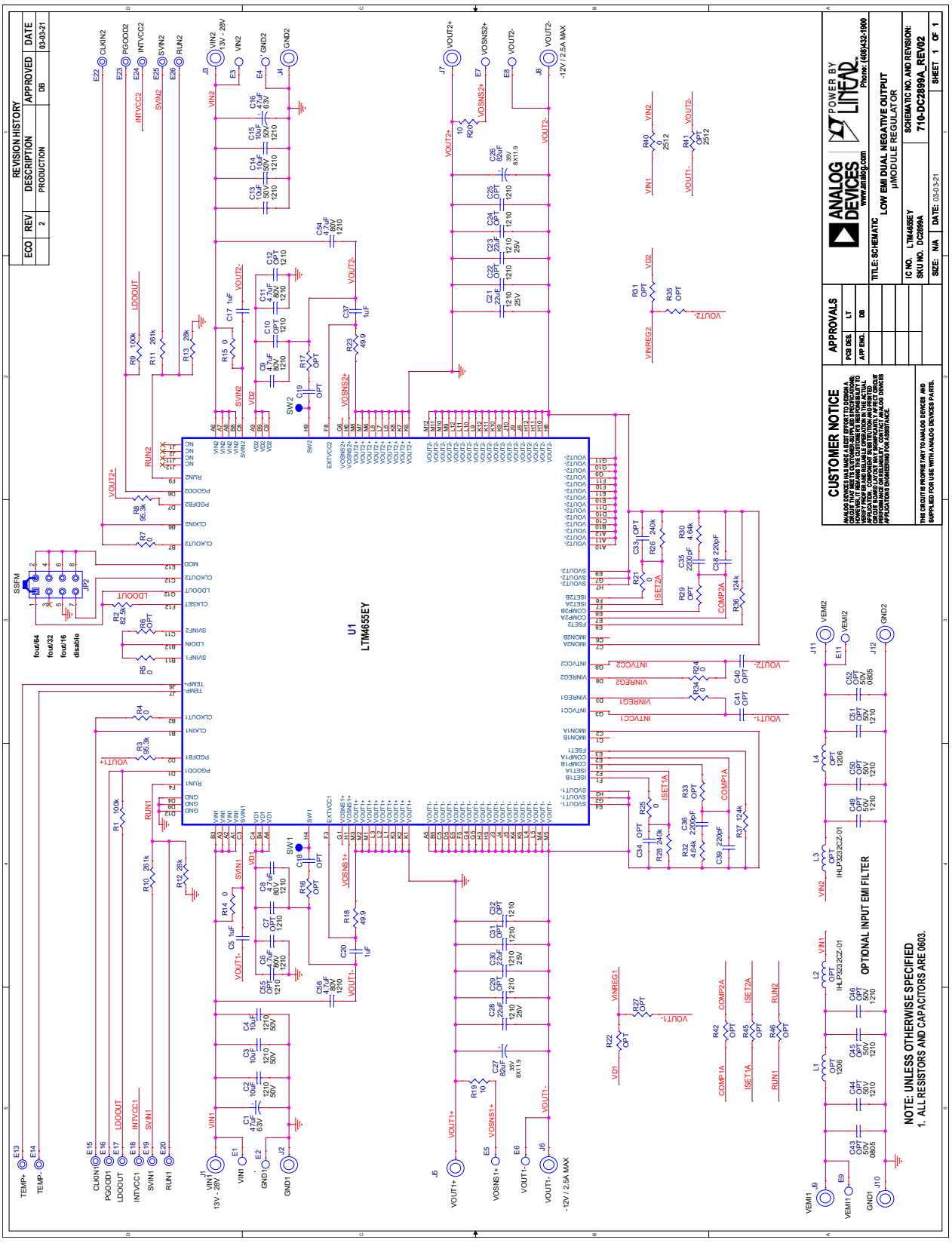
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C16	CAP., 47µF, ALUM POLY HYB, 63V, 20%, SMD 10mm × 10.5mm, AEC-Q200, HVP SERIES	SUN ELECTRONIC INDUSTRIES CORP, 63HVP47M+P
2	6	C2-C4, C13-C15	CAP., 10µF, X7R, 50V, 10%, 1210, NO SUBS. ALLOWED	MURATA, GRM32ER71H106KA12L
3	4	C5, C17, C20, C37	CAP., 1µF, X5R, 50V, 10%, 0603	AVX, 06035D105KAT2A
4	6	C6, C8, C9, C11, C54, C56	CAP., 4.7µF, X7R, 80V, 10%, 1210	MURATA, GRM32ER71K475KE14L
5	4	C21, C23, C28, C30	CAP., 22µF, X7R, 25V, 10%, 1210	AVX, 12103C226KAT2A
6	2	C26, C27	CAP., 82µF, ALUM, OS-CON, 35V, 20%, SMD 8mm × 11.9mm, E12, SVPF SERIES	PANASONIC, 35SVPF82M
7	2	C35, C36	CAP., 2200pF, X7R, 50V, 10%, 0603	AVX, 06035C222KAT2A
8	2	C38, C39	CAP., 220pF, X7R, 50V, 10%, 0603	AVX, 06035C221KAT2A
9	2	R1, R9	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603100KFKEA
10	1	R2	RES., 82.5k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF8252V
11	2	R3, R8	RES., 95.3k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF9532V
12	2	R10, R11	RES., 261k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F2613TRF
13	2	R12, R13	RES., 28k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF2802V
14	2	R18, R23	RES., 49.9Ω, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060349R9FKEA
15	2	R19, R20	RES., 10Ω, 1%, 1/10W, 0603	VISHAY, CRCW060310R0FKEA
16	2	R26, R28	RES., 240k, 1%, 1/10W, 0603	VISHAY, CRCW0603240KFKEA
17	2	R30, R32	RES., 4.64k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF4641V
18	2	R36, R37	RES., 124k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1243V
19	1	R40	RES., 0Ω, 1W, 2512, 7A, AEC-Q200	VISHAY, CRCW25120000Z0EG
20	1	U1	IC, DC/DC REGULATOR, BGA-144 (16mm × 16mm × 5.01mm)	ANALOG DEVICES, LTM4655EY#PBF
Additional Demo Board Circuit Components				
1	0	C7, C10, C12, C22, C24, C25, C29, C31, C32, C44-C46, C49-C51, C55	CAP., OPTION, 1210	
2	0	C18, C19, C33, C34, C40, C41	CAP., OPTION, 0603	
3	0	C43, C52	CAP., OPTION, 0805	
4	0	L1, L4	IND., OPTION, 1206	
5	0	L2, L3	IND., OPTION	
6	9	R4, R5, R7, R14, R15, R21, R24, R25, R34	RES., 0Ω, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
7	0	R6, R16, R17, R22, R27, R29, R31, R33, R35, R42, R45, R46	RES., OPTION, 0603	
8	0	R41	RES., OPTION, 2512	
Hardware				
1	10	E1-E9, E11	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2308-2-00-80-00-00-07-0
2	13	E13-E20, E22-E26	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
3	12	J1-J12	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
4	1	JP2	CONN., HDR, MALE, 2×4, 2mm, VERT, STR, THT	SAMTEC, TMM-104-02-L-D
5	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE, 8833
6	1	XJP2	CONN., SHUNT, FEMALE, 2-POS, 2mm	SAMTEC, 2SN-BK-G

SIMPLIFIED SCHEMATIC DIAGRAM



FULL SCHEMATIC DIAGRAM



ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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