DEMO MANUAL DC2659A

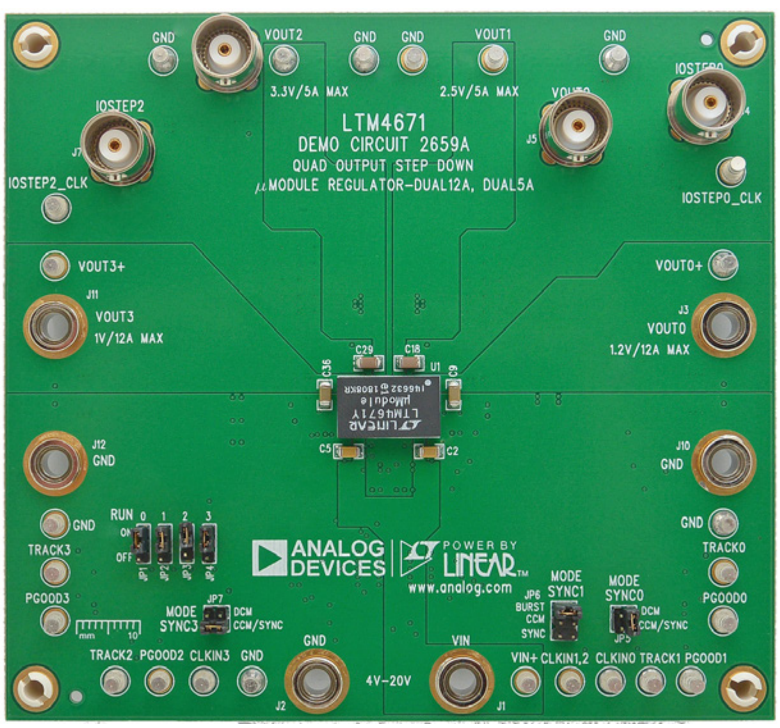
LTM4671
Quad Output (Dual 12A, Dual 5A) Step-Down µModule Regulator

DESCRIPTION

Demonstration circuit 2659A features the LTM®4671 µModule® regulator, a high performance high efficiency four output step-down regulator. The LTM4671EY has an operating input voltage range of 3.6V to 20V providing up to 12A from each of its two higher current rails and up to 5A from each of its two lower current rails. The two higher current rails' output voltage is programmable from 0.6V to 3.3V while the two lower current rails' output voltage is programmable from 0.6V to 5.5V. High current rails can be paralleled together, and lower current rails can be paralleled together to satisfy higher rail current requirements. The LTM4671EY is a complete multi-output DC-DC point-of-load regulator in a thermally enhanced 16mm × 9.5mm × 4.82mm BGA package requiring only a few input and output capacitors. Output voltage tracking is made available by the TRACK/SS pins for supply rail sequencing. Temperature sensing options are included via the TSENSE and TMON pins. External clock synchronization is available through the CLKIN pins, CLKOUT pins provide for optional synchronization of additional module phases. The LTM4671 data sheet must be read in conjunction with this demo manual for working on or modifying demo circuit 2659A

Design files for this circuit board are available.

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS/NOTES	VALUE
Input Voltage Range		3.6V – 20V
Output Voltage V_{OUT}	Jumper Selectable	V_{OUT0} = 1.2V_{DC}, V_{OUT1} = 2.5V_{DC}, V_{OUT2} = 3.3V_{DC}, V_{OUT4} = 1V_{DC}
Maximum Continuous Output Current per Phase	De-Rating is Necessary for Certain Operating Conditions. See Data Sheet for Details	$I_{OUT0MAX}$, $I_{OUT3MAX}$ = 12A_{DC} $I_{OUT1MAX}$, $I_{OUT2MAX}$ = 5A_{DC}
Default Operating Frequency		600kHz (for V_{OUT0}, V_{OUT3}) 1MHz (for V_{OUT1}, V_{OUT2})
Efficiency	V_{IN} = 12V V_{OUT0} = 1.2V, I_{OUT} = 12A V_{OUT0} = 3.3V, I_{OUT} = 5A	See Figure 2 87.4% 91.6%

QUICK START PROCEDURE

Demonstration circuit 2659A is an easy way to evaluate the performance of the LTM4671EY. Please refer to Figure 1 for test setup connections and follow the procedure below.

1. With power off, place the jumpers in the following positions:

JP1	JP2	JP3	JP4	JP5	JP6	JP7
RUN0	RUN1	RUN2	RUN3	MODE0	MODE1	MODE3
ON	ON	ON	ON	CCM	CCM	CCM

2. Before connecting input supply, loads and meters, preset the input voltage supply to be between 4V to 20V. Preset the load currents to 0A.
3. With power off, connect the loads, input voltage supply and meters as shown in Figure 1.
4. Turn on input power supply. The output voltage meters for each phase should display the programmed output voltage ±2%.
5. Once the proper output voltages are established, adjust the load currents for each phase within the 0A–12A range for V_{OUT0} and V_{OUT3} outputs and within 0A–5A for V_{OUT1} and V_{OUT2} outputs. Observe each output's load regulation, efficiency, and other parameters. Output voltage ripples for each output should be measured across the furthest output capacitor with a BNC cable and oscilloscope. BNCs J5 and J9 are available for V_{OUT0} and V_{OUT2} ripple measurements, respectively.
6. To observe increased light load efficiency, for V_{OUT0} and V_{OUT3} place the MODE pin jumpers (JP5, JP7) in the DCM position, for V_{OUT1} and V_{OUT2} place the MODE pin jumper (JP6) in the BURST position.
7. For optional load transient testing on-board transient circuits are provided to measure transient responses on V_{OUT0} and V_{OUT2} outputs. Place a positive pulse signal between the IOSTEPx_CLK pin and GND pins. The pulse amplitude sets the load step current amplitude. The pulse width should be short (<1ms) and pulse duty cycle should be low (<15%) to limit the thermal stress on the load transient circuit. The load step response for V_{OUT0} and V_{OUT2} can be monitored with a BNC connected to J4 (10mV/A) and J7 (20mV/A), respectively.

QUICK START PROCEDURE

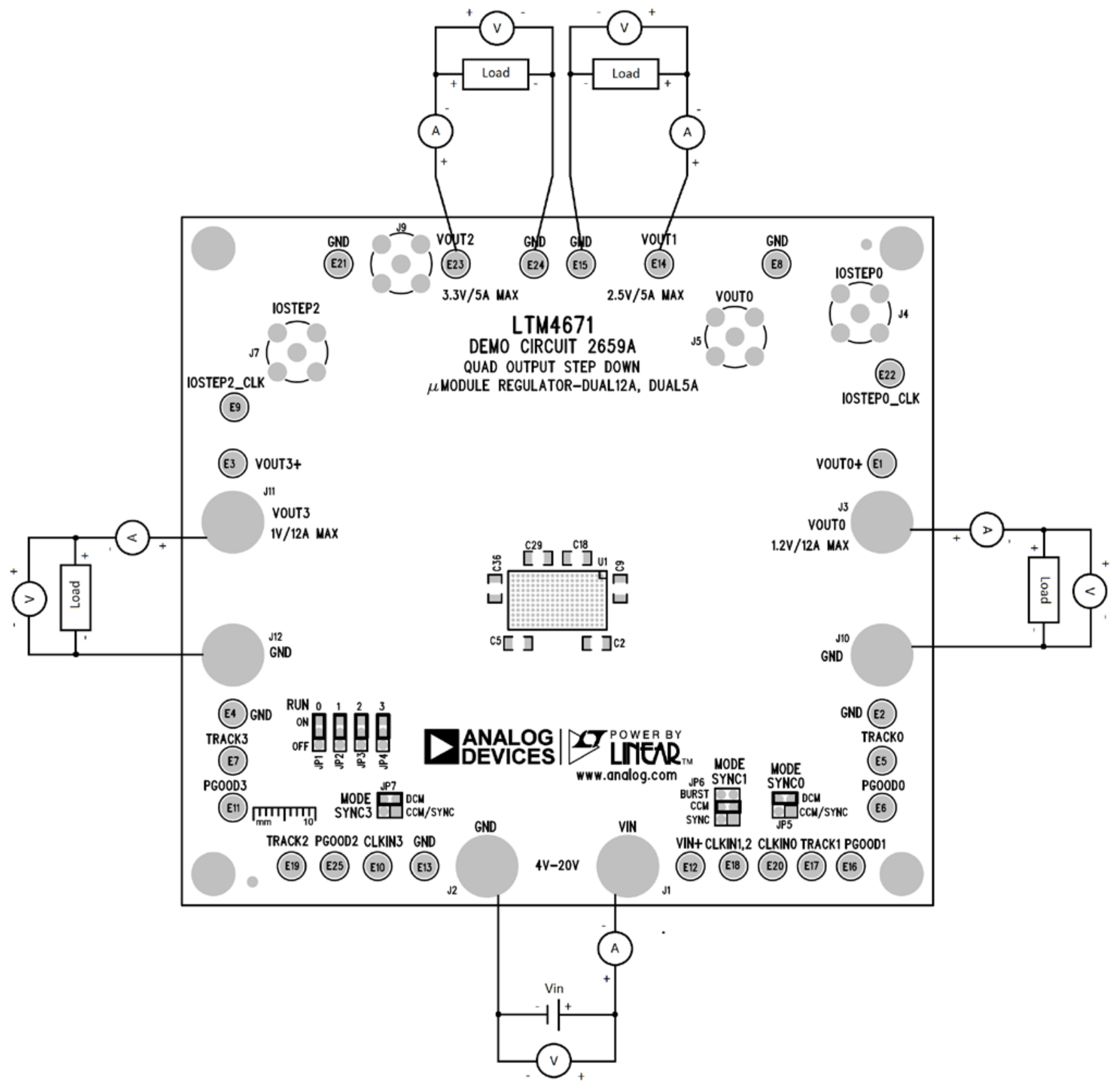
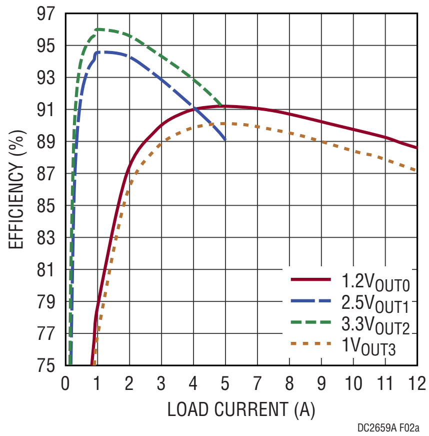
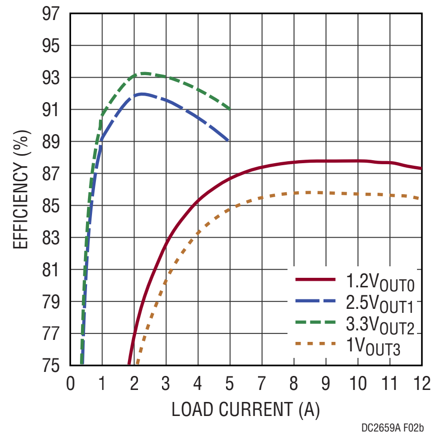


Figure 1. Test Setup of DC2659A

QUICK START PROCEDURE

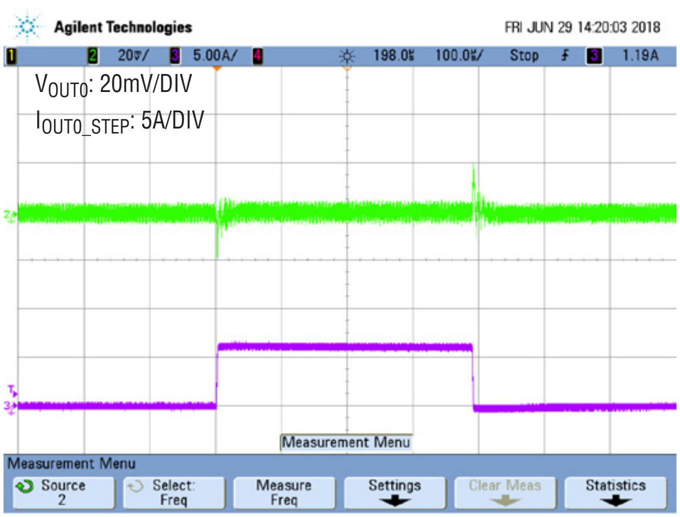


(a) $5V_{IN}$ CCM Efficiency

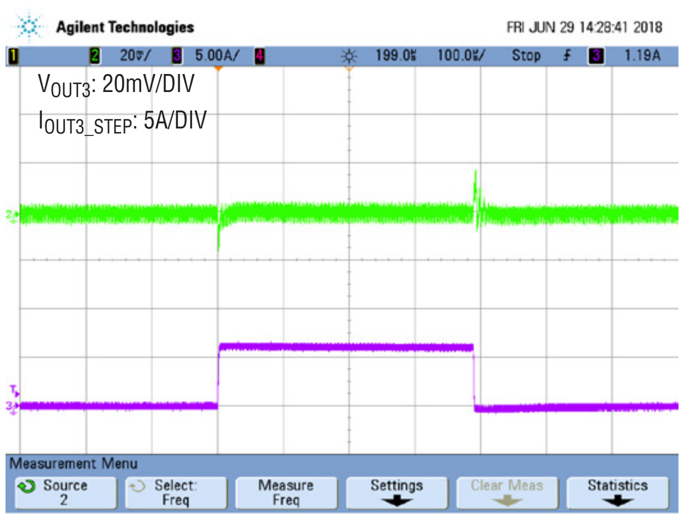


(b) $12V_{IN}$ CCM Efficiency

Figure 2. Measured Supply Efficiency at $5V_{IN}$ and $12V_{IN}$



V_{IN} (V)	V_{OUT0} (V)	C_{OUT} CERAMIC
12	1.2	2 × 100µF/6.3V/Ceramic +1 × 330µF/6.3V/Bulk



V_{IN} (V)	V_{OUT3} (V)	C_{OUT} CERAMIC
12	1	2 × 100µF/6.3V/Ceramic +1 × 330µF/6.3V/Bulk

Figure 3. Measured V_{OUT0} = 1.2V and V_{OUT3} = 1V Load Transient Responses (6A Load Step)

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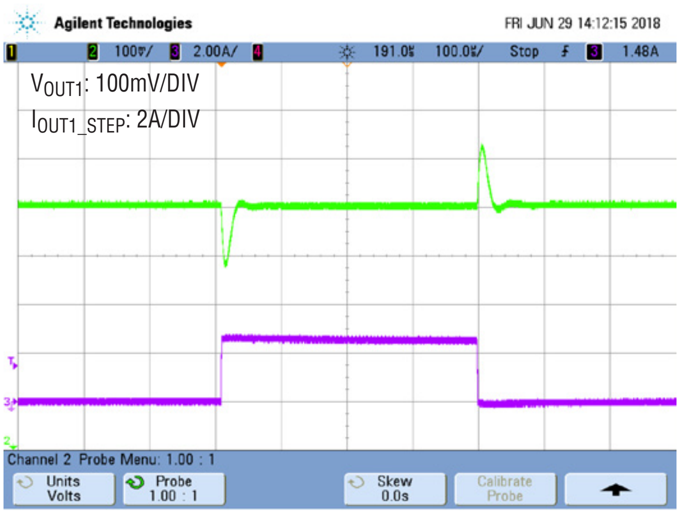
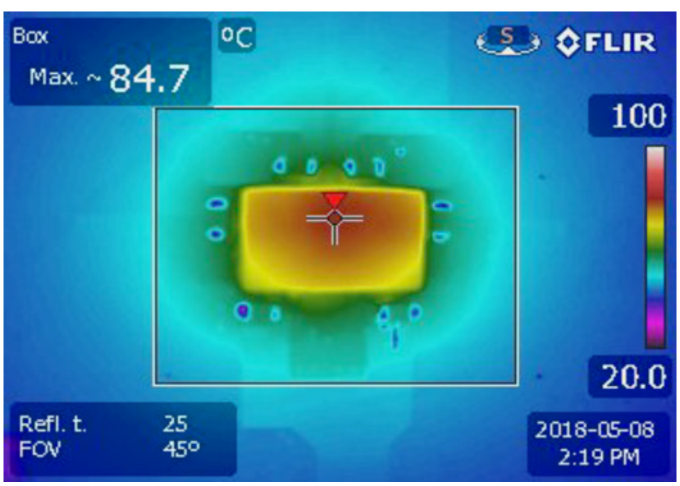
QUICK START PROCEDURE

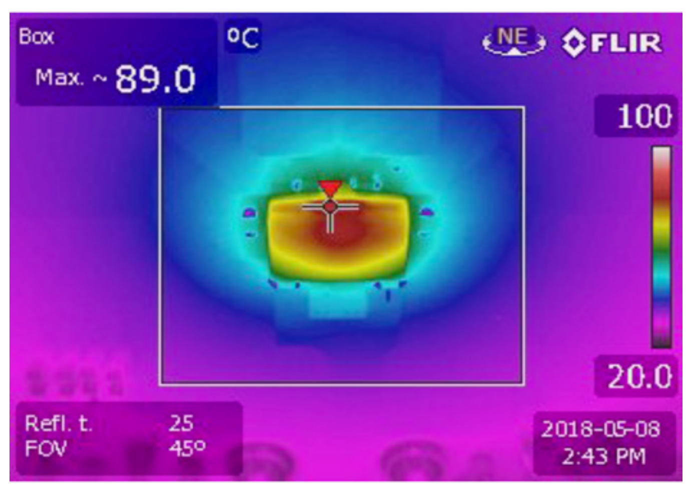


V_{IN} (V)	V_{OUT1} (V)	C_{OUT} CERAMIC
12	2.5	2 × 47µF/6.3V/Ceramic +1 × 10µF/6.3V/Ceramic

V_{IN} (V)	V_{OUT2} (V)	C_{OUT} CERAMIC
12	3.3	2 × 47µF/6.3V/Ceramic +1 × 10µF/6.3V/Ceramic

Figure 4. Measured V_{OUT1} = 2.5V and V_{OUT2} =3.3V Load Transient Responses (2.5A Load Step)





V_{IN} (V)	AIRFLOW	HEATSINK	AMBIENT (°C)
12	Natural Convection	None	23

CHANNEL	V_{OUT0}	V_{OUT1}	V_{OUT2}	V_{OUT3}
V_{OUT} (V)	1.2	2.5	3.3	1
I_{OUT} (A)	10	4	4	10

V_{IN} (V)	AIRFLOW	HEATSINK	AMBIENT (°C)
12	Forced Air 200LFM	None	23

CHANNEL	V_{OUT0}	V_{OUT1}	V_{OUT2}	V_{OUT3}
V_{OUT} (V)	1.2	2.5	3.3	1
I_{OUT} (A)	12	5	5	12

Figure 5. Measured Thermal Captures

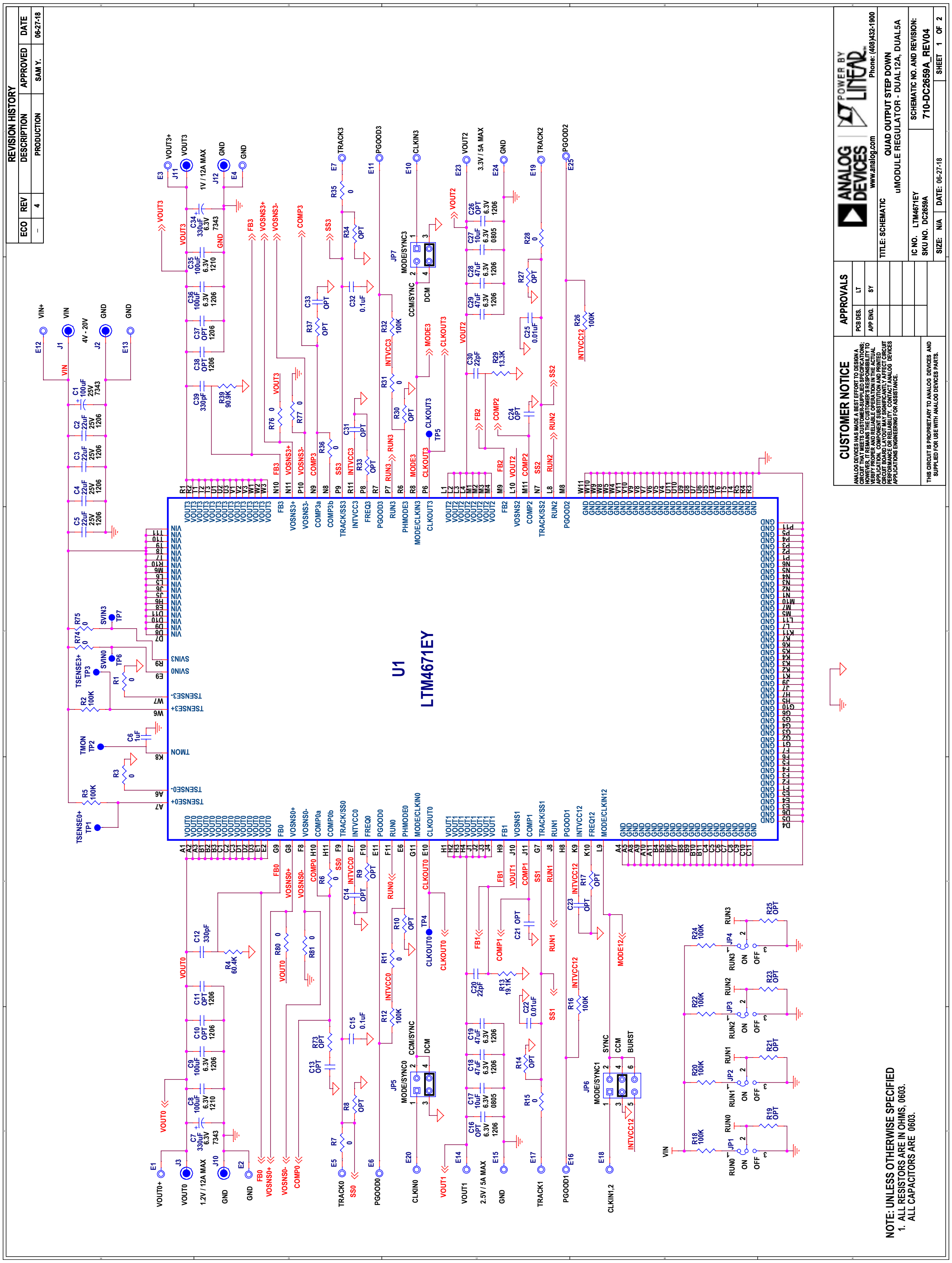
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C2, C3, C4, C5	CAP., 22µF, X5R, 25V, 20%, 1206	MURATA, GRM31CR61E226ME15L
2	2	C8, C35	CAP., 100µF, X5R, 6.3V, 20%, 1210	TDK, C3225X5R0J107M250AC
3	2	C18, C28	CAP., 47µF, X5R, 16V, 20%, 1206	TDK, C3216X5R1C476M160AB
4	1	R4	RES., 60.4k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060360K4FKEA
5	1	R13	RES., 19.1k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060319K1FKEA
6	1	R29	RES., 13.3k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060313K3FKEA
7	1	R39	RES., 90.9k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060390K9FKEA
8	1	U1	IC, QUAD HIGH EFFICIENCY MODULE, BGA-16mm × 9.5mm × 4.72mm	ANALOG DEVICES., LTM4671EY#PBF
Additional Demo Board Circuit Components				
1	2	C7, C34	CAP., 330µF, ALUM. ELECT., 2.5V, 20%, 7343, 9mΩ, 6.3A	PANASONIC, EEFSX0E331ER
2	2	C9, C36	CAP., 100µF, X5R, 6.3V, 20%, 1206	TDK, C3216X5R0J107M160AB
3	2	C17, C27	CAP., 10µF, X5R, 16V, 10%, 0805	MURATA, GRM21BR61C106KE15L
4	2	C19, C29	CAP., 47µF, X5R, 16V, 20%, 1206	TDK, C3216X5R1C476M160AB
5	2	C20, C30	CAP., 22pF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H220JA01J
6	2	C12, C39	CAP., 330pF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H331JA01J
7	2	C15, C32	CAP., 0.1µF, X7R, 50V, 10%, 0603	TDK, C1608X7R1H104K080AA
8	1	C1	CAP., 100µF, TANT. POLY., 25V, 20%, 7343	KEMET, T521X107M025ATE060
9	1	C6	CAP., 1µF, X5R, 16V, 10%, 0603	MURATA, GRM188R61C105KA93D
10	2	C22, C25	CAP., 0.01µF, X7R, 50V, 10%, 0603	KEMET, C0603C103K5RACTU
11	4	C40, C43, C45, C47	CAP., 1µF, X7R, 16V, 20%, 0603	TDK, C1608X7R1C105M080AC
12	2	C42, C46	CAP., 1µF, X7R, 50V, 10%, 0805	MURATA, GRM21BR71H105KA12L
13	2	Q1, Q2	XSTR., MOSFET, N-CH, 40V, TO-252 (DPAK)	VISHAY, SUD50N04-8M8P-4GE3
14	16	R1, R3, R6, R7, R11, R15, R28, R31, R35, R36, R74, R75, R76, R77, R80, R81	RES., 0Ω, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
15	10	R2, R5, R12, R16, R26, R32, R18, R20, R22, R24	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603100KFKEA
16	4	R50, R51, R82, R83	RES., 1k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06031K00FKEA
17	2	R54, R69	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060310K0FKEA
18	1	R55	RES., 0.01, 1%, 1/2W, 2010, SENSE, AEC-Q200	VISHAY, WSL2010R0100FEA
19	1	R70	RES., 0.02, 1%, 1/2W, 2010, SENSE, AEC-Q200	VISHAY, WSL2010R0200FEA

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware				
1	25	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21, E22, E23, E24, E25	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	6	J1, J2, J3, J10, J11, J12	CONN.,BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE	KEYSTONE, 575-4
3	4	JP1, JP2, JP3, JP4	CONN., HDR, MALE, 1mm ×3mm × 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000311121
4	4	J4, J5, J7, J9	CONN., RF, BNC, RCPT JACK, 5-PIN, STR, THT, 50Ω	AMPHENOL RF, 112404
5	2	JP5, JP7	CONN., HDR, MALE, 2mm × 2mm × 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000421121
6	1	JP6	CONN., HDR, MALE, 2mm × 3mm × 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
7	4	MH1, MH2, MH3, MH4	STANDOFF, NYLON, SNAP-ON, 0.375"	KEYSTONE, 8832
8	7	XJP1, XJP2, XJP3, XJP4, XJP5, XJP6, XJP7	CONN., SHUNT, FEMALE, 2-POS,2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



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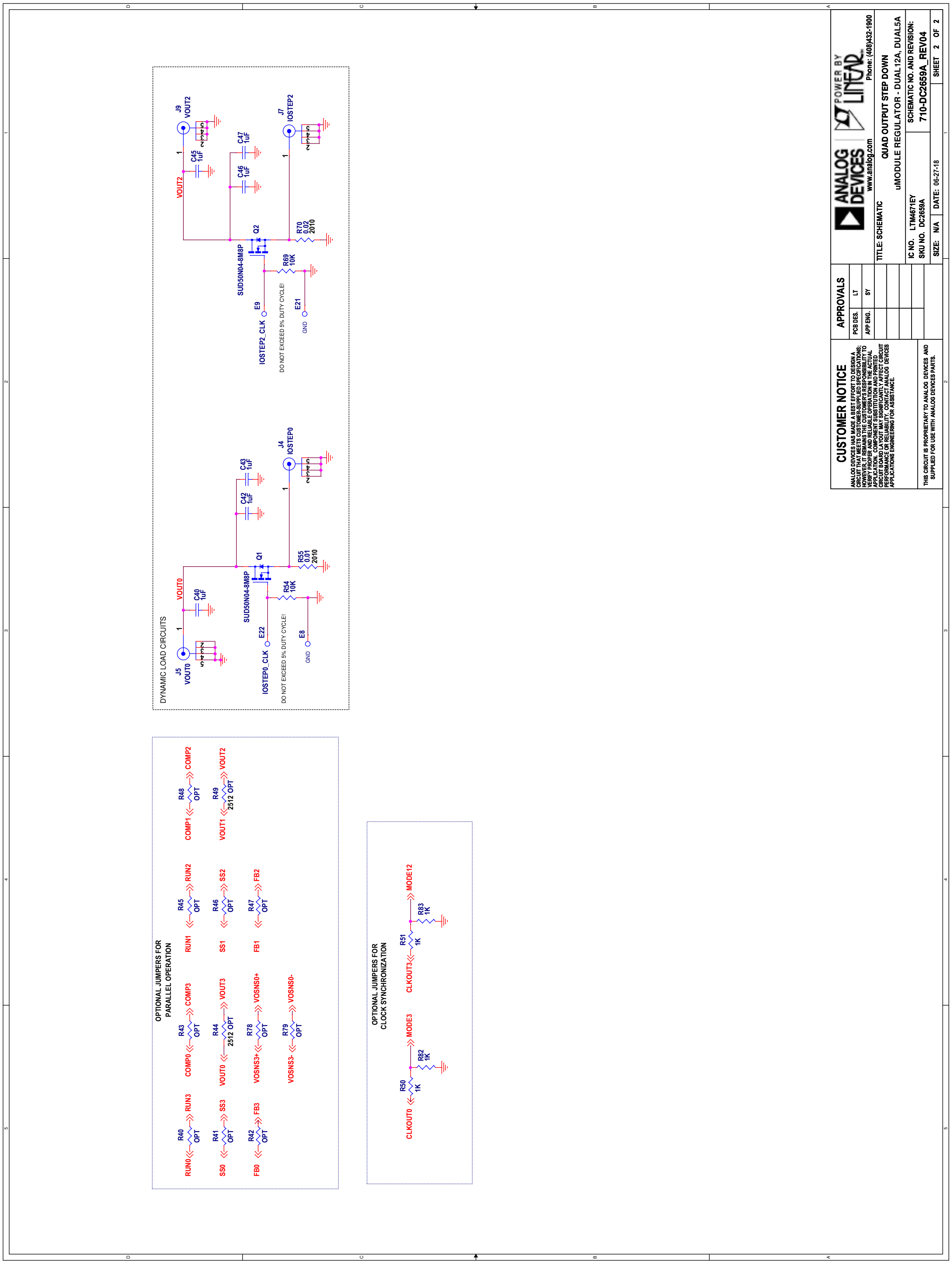
SCHEMATIC DIAGRAM



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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