LTM4653
EN55022B Compliant 58V, 4A Step-Down DC/DC µModule Regulator

DESCRIPTION

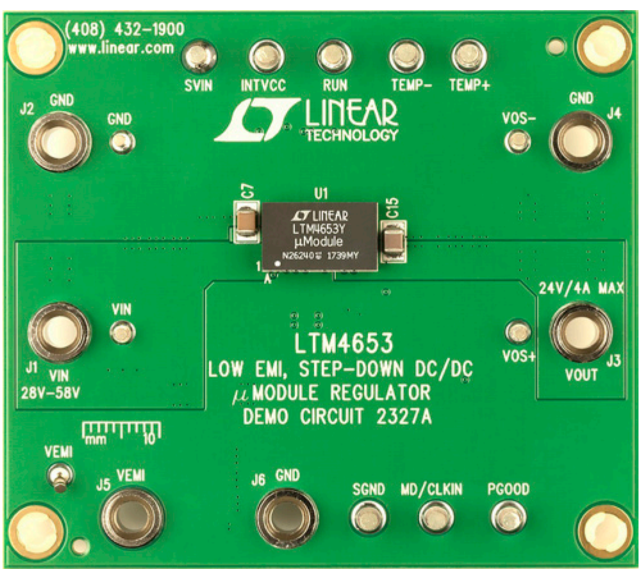
Demonstration circuit 2327A is a step-down DC/DC converter with 28V to 58V input voltage, 24V output voltage and max 4A output featuring the LTM4653Y. The LTM®4653 is an ultralow noise, 58V, 4A step-down DC/DC µModule regulator. It is designed to meet the radiated emissions requirement of EN55022B. A switching frequency range of 250kHz to 3MHz is supported and the module can synchronize to an external clock. The LTM4653 data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit DC2327A.

Design files for this circuit board are available at http://www.analog.com/demo/DC2327A

PERFORMANCE SUMMARY

PARAMETER	CONDITION	VALUE
Input Voltage Range		28V to 58V
Output Voltage, V_{OUT}		24V ±2%
Maximum Output Current, I_{OUT}	Derating for Certain Thermal Conditions	4A
Default Operating Frequency		1.2MHz
Efficiency	$48V_{IN}$, $24V_{OUT}$, 4A	93.9%

BOARD PHOTO



QUICK START PROCEDURE

Demonstration circuit 2327A is easy to set up to evaluate the performance of the LTM4653Y. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below.

1. With power off, connect the input power supply to V_{IN} (28V to 58V) and GND (input return).
2. Connect the 24V output load between V_{OUT} (+) and GND (–) (Initial load: no load).
3. Connect the DVMs to the input and output.
4. Turn on the input power supply and check for the proper output voltages. V_{OUT} should be 24V ±2%.
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.

   Note: 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.

WARNING: The voltage at the V_{IN} pin of the LTM4653 during a hot-plugging condition can ring to twice the nominal input voltage, possibly exceeding the LTM4653's rating and damaging the part. See the Hot-Plugging Safety section in the LTM4653 data sheet for proper implementation.

Optional $12V_{OUT}$

Besides the default 24V output voltage which shows the full capacity of LTM4653, it is very easy to customize the DC2327A demo board to make other output voltages available. As an example, to implement $12V_{OUT}$ with 14V to 58V V_{IN}.

1. Change R4 from 14k to 30k. This sets the minimum operation input voltage, 14V for this case.
2. Change R1 and R8 from 240k to 121k. This sets the output voltage, 12V for this case.

Check the input and output capacitor voltage rating. And then it is done.

However, to maximize the efficiency of the regulator for different input voltage, the switching frequency can be adjusted by changing R13. For the recommended switching frequency for given input voltage and given output voltage, please refer to the LTM4653 data sheet.

QUICK START PROCEDURE

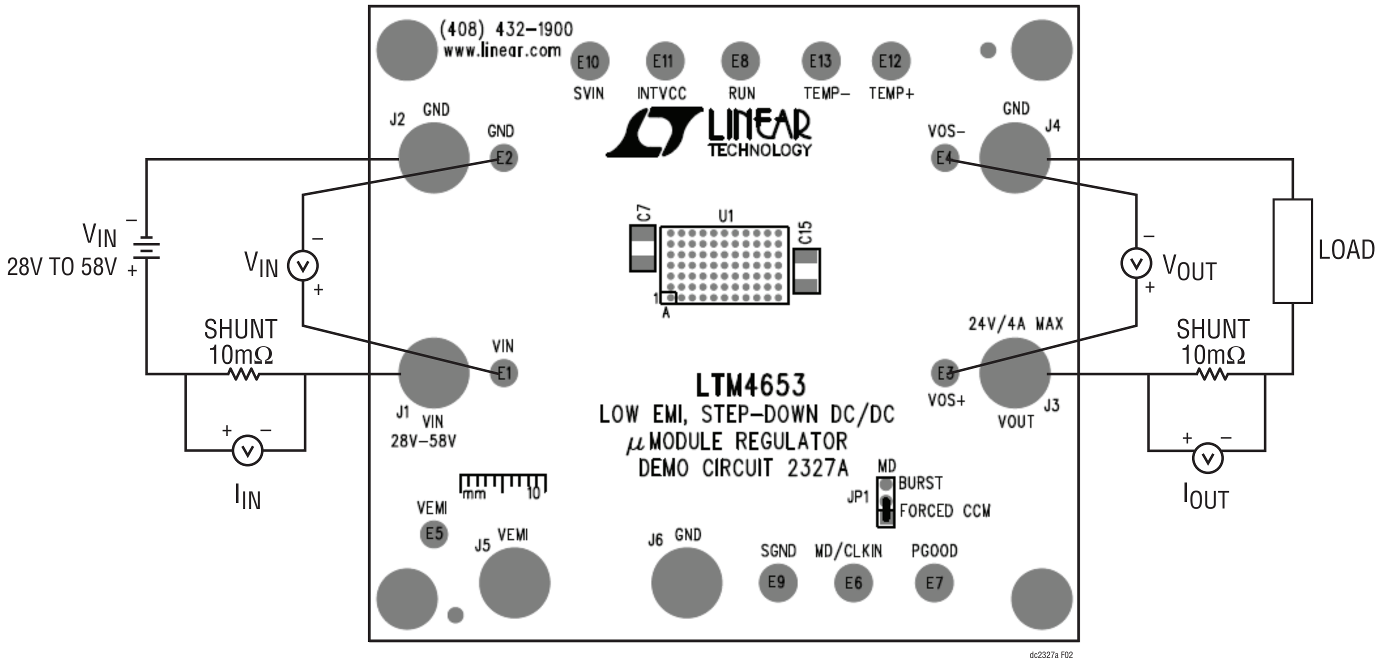


Figure 1. Proper Measurement Equipment Setup

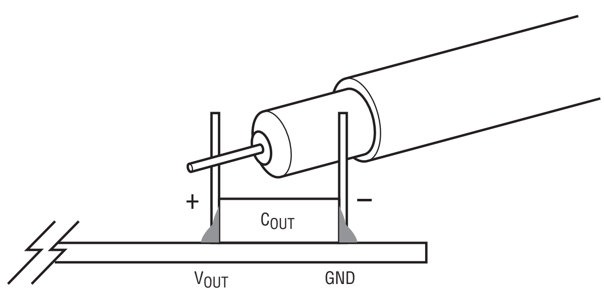


Figure 2. Measuring Output Voltage Ripple

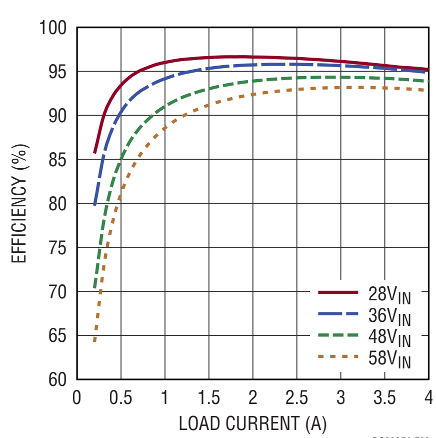


Figure 3. Efficiency vs Load Current (V_{OUT} = 24V)

QUICK START PROCEDURE

Figure 4. 0A to 4A Load Transients (V_{IN} = 28V, V_{OUT} = 24V)

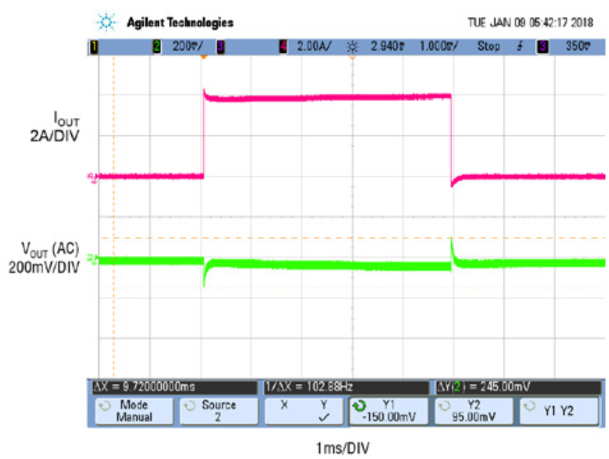


Figure 5. 0A to 4A Load Transients (V_{IN} = 48V, V_{OUT} = 24V)

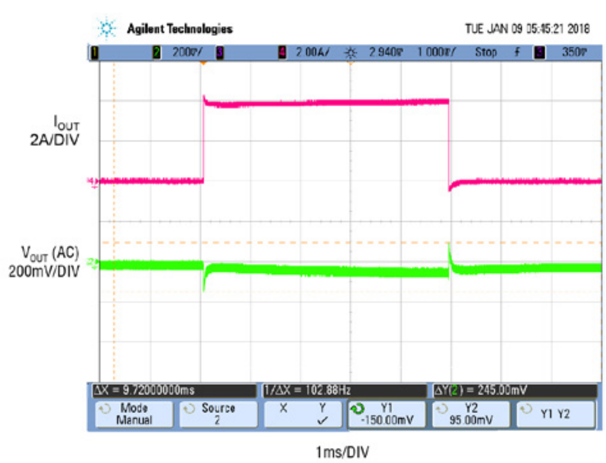


Figure 6. 0A to 4A Load Transients (V_{IN} = 58V, V_{OUT} = 24V)

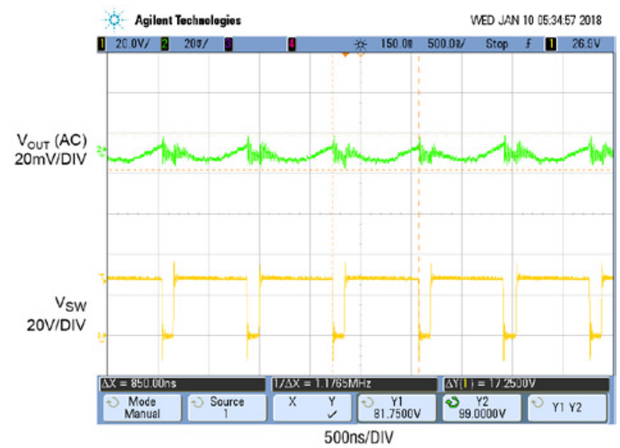


Figure 7. Output Voltage Ripple (V_{IN} = 28V, V_{OUT} = 24V, 4A Load)

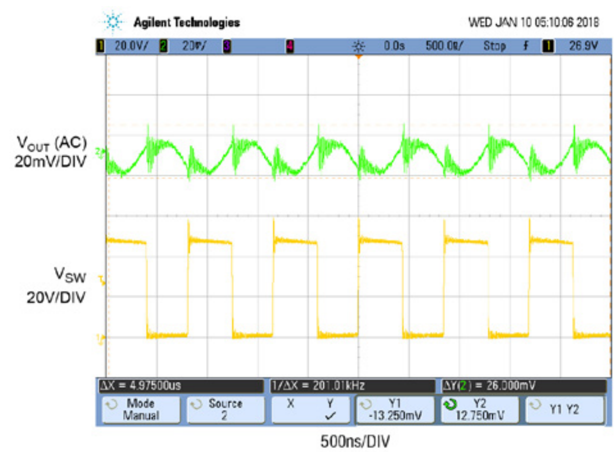


Figure 8. Output Voltage Ripple (V_{IN} = 48V, V_{OUT} = 24V, 4A Load)

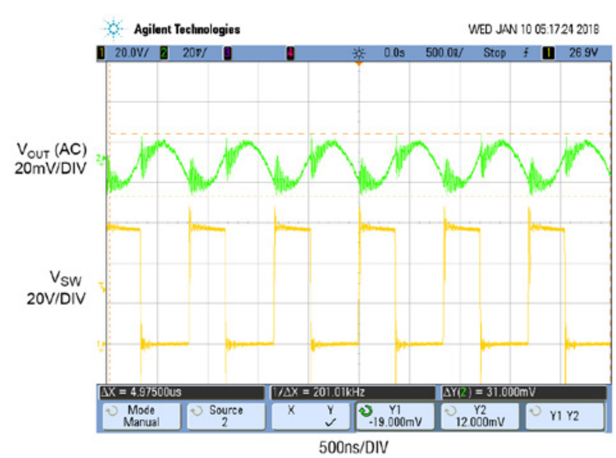


Figure 9. Output Voltage Ripple (V_{IN} = 58V, V_{OUT} = 24V, 4A Load)

QUICK START PROCEDURE

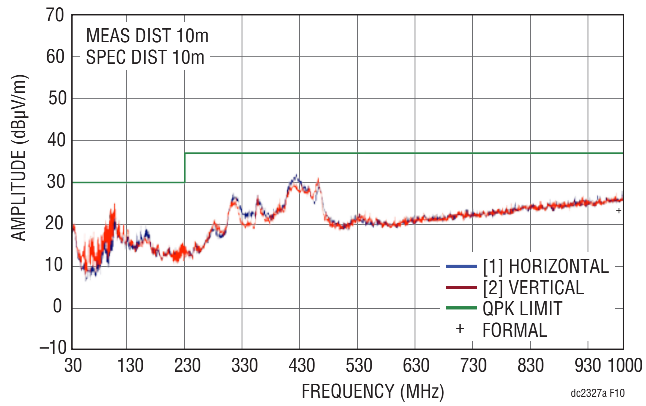


Figure 10. Radiated Emissions Scan of the LTM4653. Producing 24V_{OUT} at 4A, from 29.5V_{IN}. DC2327A Hardware. f_{SW} = 1.2MHz. Measured in a 10m Chamber. Peak Detect Method

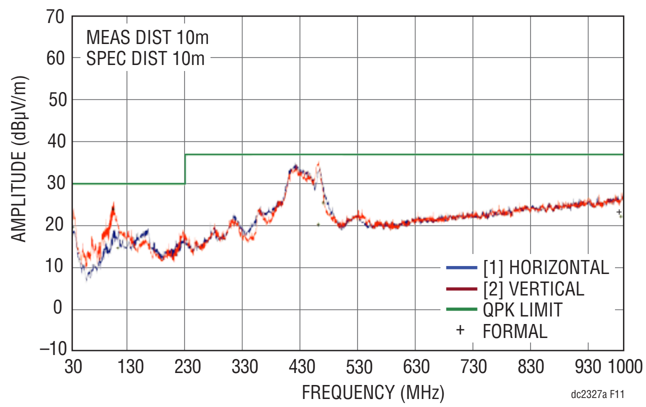


Figure 11. Radiated Emissions Scan of the LTM4653 Producing 24V_{OUT} at 3.5A, from 48V_{IN}. DC2327A Hardware. f_{SW} = 1.2MHz. Measured in a 10m Chamber. Peak Detect Method

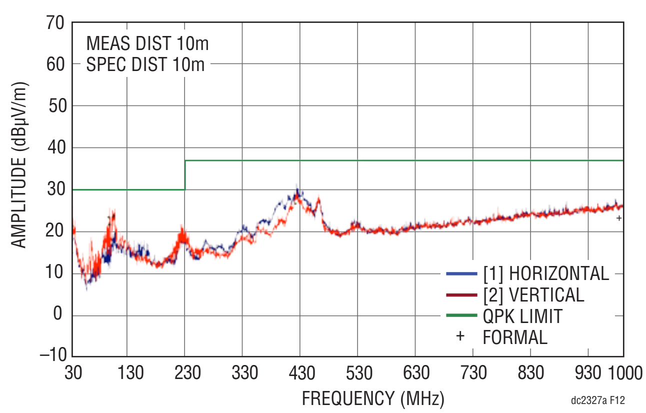
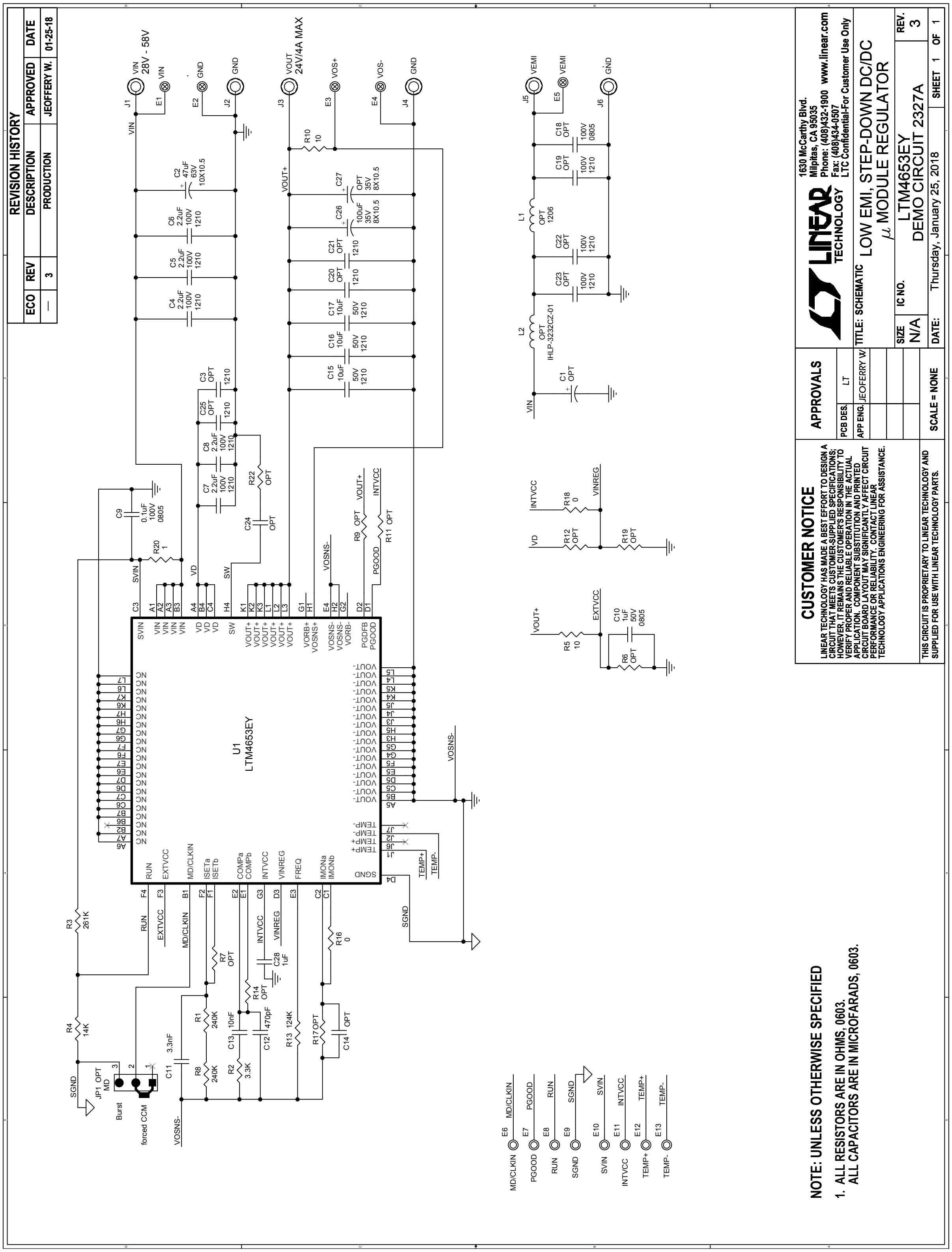


Figure 12. Radiated Emissions Scan of the LTM4653. Producing 12V_{OUT} at 3A, from 58V_{IN}. DC2327A Hardware. f_{SW} = 1.2MHz. Measured in a 10m Chamber. Peak Detect Method

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	0	C1	CAP., OPT, 10×10.2	OPT
2	1	C2	CAP., ALUM., 47µF, 63V, 10×10.5	SUN ELECTRONIC, 63HVP47M
3	0	C3, C19, C20, C21, C22, C23, C25	CAP., OPT, 1210	OPT
4	5	C4, C5, C6, C7, C8	CAP., X7R, 2.2µF, 100V, 10%, 1210	MURATA, GRM32ER72A225KA35L
5	1	C9	CAP., X7R, 0.1µF, 100V, 10%, 0805	MURATA, GRM21BR72A104KAC4K
6	1	C10	CAP., X7R, 1µF, 50V, 10%, 0805	MURATA, GRM21BR71H105KA12L
7	1	C11	CAP., X7R, 3.3nF, 50V, 10%, 0603	MURATA, GRM188R71H332KA01D
8	1	C12	CAP., X7R, 470pF, 50V, 10%, 0603	MURATA GRM188R71H471KA01D
9	1	C13	CAP., X7R, 10nF, 50V, 10%, 0603	MURATA, GRM188R71H103KA01D
10	0	C14, C24	CAP., OPT, 0603	OPT
11	1	C28	CAP., X7R, 1µF, 25V, 10%, 0603	TDK, C1608X7R1E105M080AB
12	3	C15, C16, C17	CAP., X7R, 10µF, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
13	0	C18	CAP., OPT, 0805	OPT
14	1	C26	CAP., ALUM., 100µF, 35V, 8×10.5	SUN ELECTRONIC, 35HVP100M
15	0	C27	CAP., OPT, 8×10.5	OPT
16	5	E1-E5	TESTPOINT, TURRET, 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0
17	8	E6-E13	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
18	0	JP1	HEADER, OPT, 1×3, 0.079	OPT
19	6	J1, J2, J3, J4, J5, J6	JACK, BANANA	KEYSTONE, 575-4
20	0	L1	IND, OPT, 1206	OPT
21	0	L2	IND, OPT, IHLP3232CZ-01	OPT
22	2	R1, R8	RES., CHIP, 240k, 0.1%, 0603	VISHAY, CRCW0603240KFKEA
23	1	R2	RES., 3.3k, 1%, 0603	VISHAY, CRCW06033K3FKEA
24	1	R3	RES., 261k, 1%, 0603	VISHAY, CRCW0603261KFKEA
25	1	R4	RES., 14k, 1%, 0603	VISHAY, CRCW060314K0FKEA
26	2	R5, R10	RES., 10Ω, 1%, 0603	VISHAY, CRCW060310R0FKEA
27	0	R6, R7, R9, R11, R12, R14, R17, R19, R22	RES., OPT, 0603	OPT
28	1	R13	RES., 124k, 1%, 0603	VISHAY, CRCW0603124KFKEA
29	2	R16, R18	RES., 0Ω, 1%, 0603	VISHAY, CRCW06030000Z0EA
30	1	R20	RES., 1Ω, 5%, 0603	VISHAY, CRCW06031R00JNEA
31	1	U1	I.C., LTM4653EY, BGA77-15×9×5.01	ANALOG DEVICES, LTM4653EY#PBF
32	0	XJP1	SHUNT, OPT, 0.079" CENTER	OPT
33	4	(STAND-OFF)	STAND-OFF, NYLON 0.50"	WURTH ELEKTRONIK, 702935000
34	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT, 2327A
35	2		STENCILS TOP AND BOTTOM	STENCIL DC2327A

SCHEMATIC DIAGRAM



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