LTM4663
Ultrathin 1.5A Thermoelectric Cooler (TEC) µModule Regulator

DESCRIPTION

Demonstration circuit 2902A is a thermoelectric cooler (TEC) regulator featuring the LTM®4663 µModule regulator. The demo board has a 2.7V to 5.5V input voltage range and can deliver up to 1.5A of sinking or sourcing current. Inside the LTM4663, a linear power stage works together with a PWM power stage to form an H-bridge configuration. The direction of the current fed through the TEC can be either positive (for cooling mode), or negative (for heating mode). The LTM4663 has two built-in zero drift, rail-to-rail chopper amplifiers which can serve as a thermistor input amplifier and form an analog temperature control loop. The LTM4663 provides a 1% accuracy 2.5V internal reference voltage to bias the thermistor temperature sensing circuit and to program the maximum TEC current and voltage limits for both the cooling and heating modes.

The demo board has a default 2MHz switching frequency and can be synchronized to an external clock from 1.85MHz to 3.25MHz applied to the EN/SY input pin (JP1: EN/SY). The clock high level must be above 2.1V and the clock low level must be below 0.8V. Maximum TEC current limit can be programmed with a resistor, R7 (default: 1.5A for cooling mode; –1.5A for heating mode). Maximum TEC voltage limit can be programmed with a resistor, R10 (default: 5V for cooling mode; –4.8V for heating mode). Other features include VTEC output for TEC voltage monitor and ITEC output for TEC current monitor.

The LTM4663 datasheet gives a complete description of the operation and application information. The datasheet must be read in conjunction with this demo manual.

Design files for this circuit board are available.

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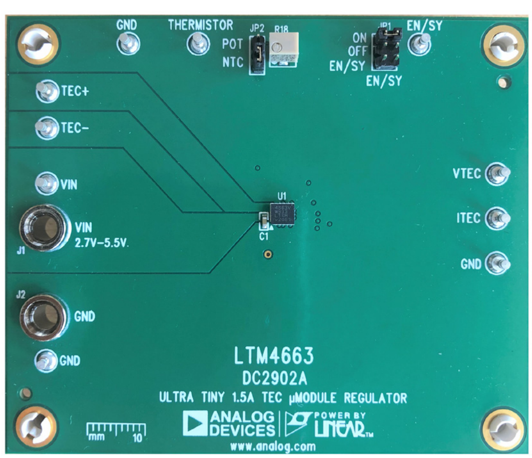
PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		2.7V to 5.5V
Maximum TEC Current	Cooling mode	1.5A
Maximum TEC Current	Heating mode	–1.5A
Typical Switching Frequency		2MHz
Typical Efficiency	Cooling mode, V_{IN} = 5V, I_{TEC} = 1.5A, 2Ω load	88.6%
Typical Efficiency	Heating mode, V_{IN} = 5V, I_{TEC} = –1.5A, 2Ω load	89.1%

BOARD PHOTO



QUICK START PROCEDURE

Demonstration circuit 2902A is easy to set up to evaluate the performance of the LTM4663. Refer to Figure 1 for the proper measurement setup and follow the procedure below:

1. With power off, connect the input power supply to V_{IN}(2.7V-5.5V) and GND (input return).
2. Many users do not have a real TEC, or do not want to use a real TEC for initial tests. In these cases, you may use a proper power resistor as a load to test the operation of the LTM4663, by connecting the resistor to TEC^+ and $TEC^–$ terminals. Set jumper JP1 to "on" position, and jumper JP2 to "POT" position.
3. Connect the DVMs to the input and outputs.
4. Turn on the input power supply (V_{IN} = 3.3V recommended) and check for the voltage across the TEC^+ and $TEC^–$ terminals, and the current through the load.
5. Use a small screwdriver to adjust the potentiometer (R18). check for the voltage across the TEC^+ and $TEC^–$ terminals, and the current through the load. Observe the changes of value and direction of the voltage across the TEC^+ and $TEC^–$ terminals, and the current through the load. (Positive TEC voltage: cooling mode; negative TEC voltage: heating mode).
6. Adjust the V_{IN} within the operating range (2.7V-5.5V) and repeat step 5. Observe the voltage across the TEC^+ and $TEC^–$ terminals, and the current through the load, efficiency, maximum TEC current limits, maximum TEC voltage limits and other features.

Notes:

a. To test the LTM4663 with a suitable TEC, connect the TEC to TEC^+ and $TEC^–$ terminals. Observe TEC polarity.

b. For real TEC thermal system, connect a thermistor (NTC) between the Thermistor terminal and ground terminal. Set jumper JP2 to "NTC".

c. When using a power resistor as a load for testing, make sure it has high enough power rating. Recommend a power resistor with 10W rating. Proper cooling may be needed for the power resistor.

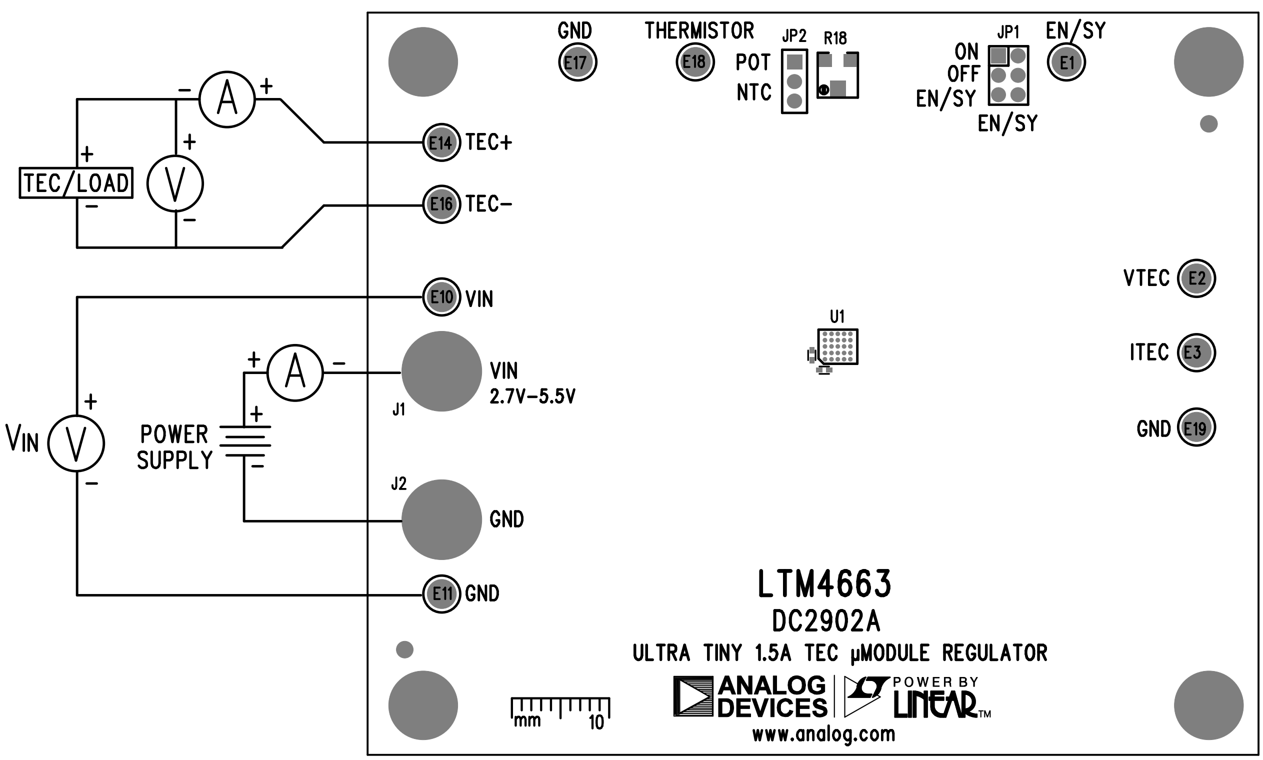


Figure 1. Proper Measurement Setup

QUICK START PROCEDURE

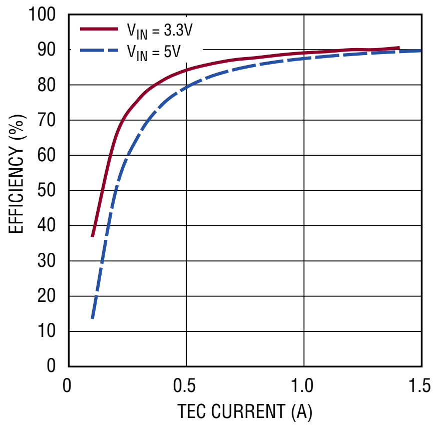


Figure 2. Efficiency vs TEC current (Cooling mode, 2Ω load)

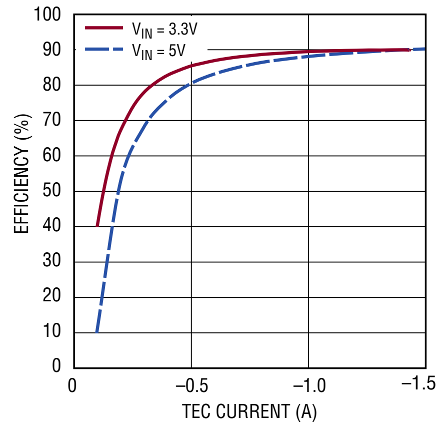


Figure 3. Efficiency vs TEC current (Heating mode, 2Ω load)

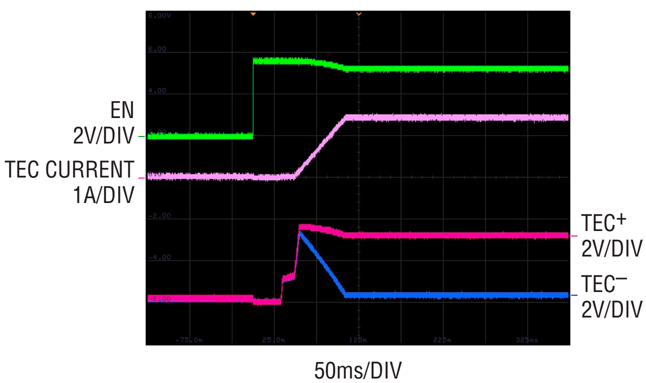


Figure 4. Typical Enable waveforms (Cooling mode, V_{IN} = 3.3V, 2Ω load, TEC current = 1.4A)

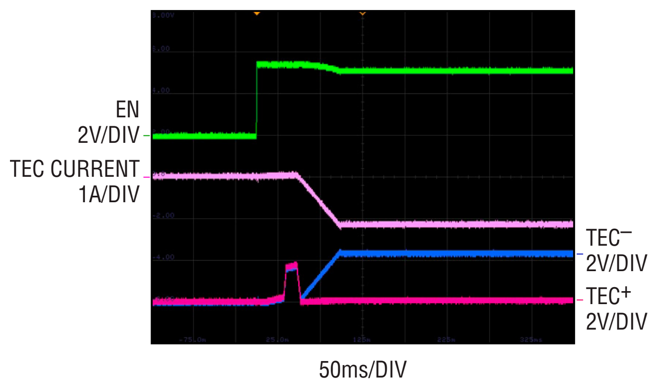
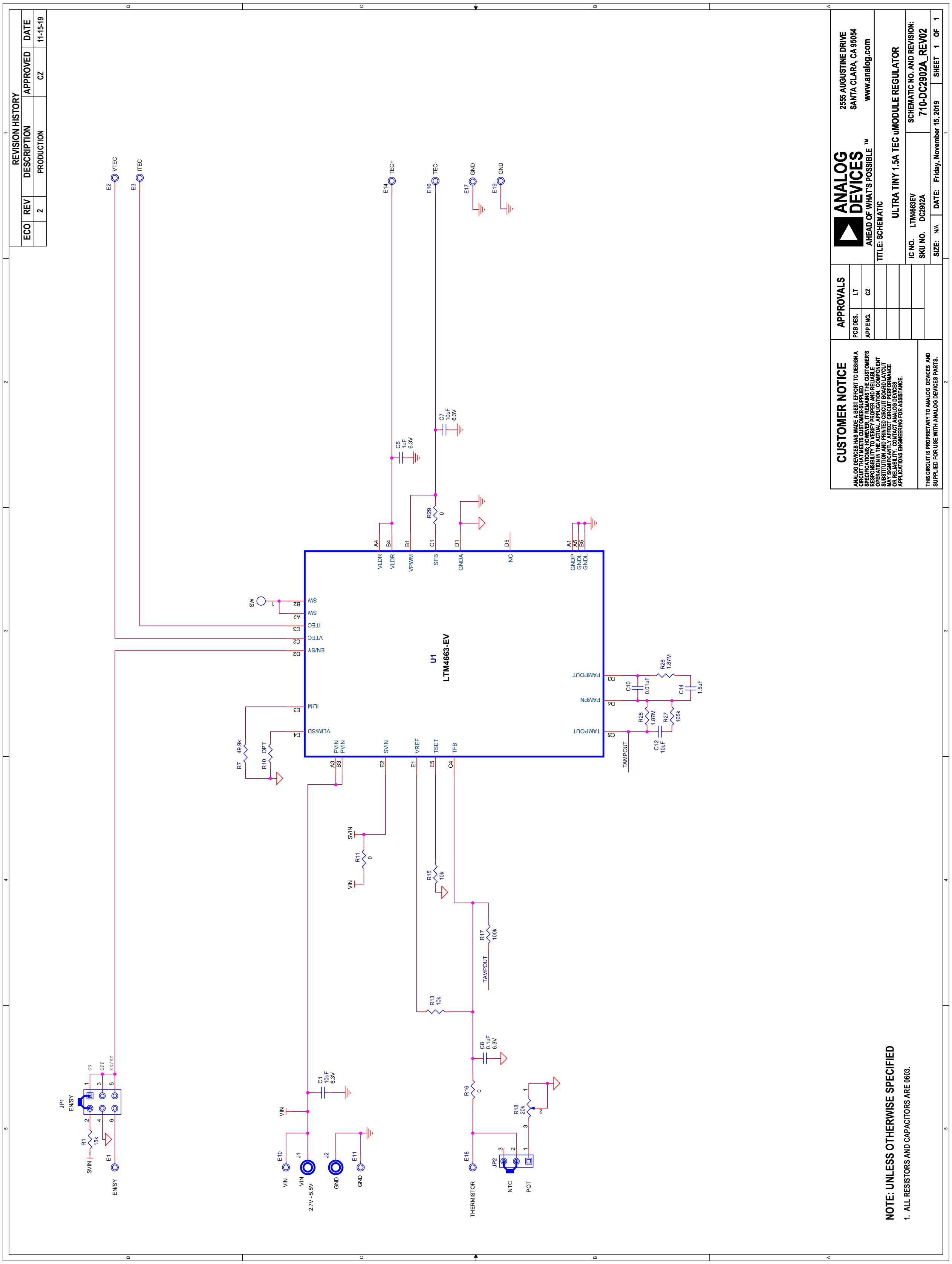


Figure 5. Typical Enable waveforms (Heating mode, V_{IN} = 3.3V, 2Ω load, TEC current = –1.2A)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C1, C7, C12	CAP., 10uF, X5R, 6.3V, 10%, 0603	MURATA, GRM188R60J106KE47D
2	1	C5	CAP., 1uF, X5R, 6.3V, 10%, 0603	MURATA, GRM188R60J105KA01D
3	1	C8	CAP., 0.1uF, X7R, 6.3V, 10%, 0603	KEMET, C0603C104K9RAC7867
4	1	C10	CAP., 0.01uF, X5R, 50V, 10%, 0603	MURATA, GRM188R61H103KA01D
5	1	C14	CAP., 1.5uF, X7R, 10V, 10%, 0603	TDK, C1608X7R1A155K080AC
6	1	R1	RES., 15k OHMS, 1%, 1/10W, 0603	YAGEO, RC0603FR-0715KL
7	1	R7	RES., 49.9k OHMS, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF4992V
8	3	R11, R16, R29	RES., 0 OHM, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
9	2	R13, R15	RES., 10k OHMS, 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTTD1002F
10	1	R17	RES., 100k OHMS, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1003TRF
11	1	R18	RES., 20K OHMS, 10%, 1/4W, SMD 4.8x3.9mm, 12 TURN, TOP ADJUST, TRIMPOT	BOURNS, 3224W-1-203E
12	2	R25, R28	RES., 1.87M OHMS, 1%, 1/10W, 0603	VISHAY, CRCW06031M87FKEA
13	1	R27	RES., 165k OHMS, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603165KFKEA
14	1	U1	IC, 1.5A TEC µMODULE REGULATOR, LGA	ANALOG DEVICES, LTM4663EV#PBF
Additional Demo Board Circuit Components				
15	0	R10	RES., OPTION, 0603	
Hardware: For Demo Board Only				
16	10	E1, E2, E3, E10, E11, E14, E16, E17, E18, E19	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2308-2-00-80-00-00-07-0
17	2	J1, J2	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
18	1	JP1	CONN., HDR., MALE, 2x3, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62000621121
19	1	JP2	CONN., HDR., MALE, 1x3, 2mm, VERT, STR, THT	SULLINS CONNECTOR SOLUTIONS, NRPN031PAEN-RC
20	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 2902A
21	2		STENCILS (TOP & BOTTOM)	STENCIL DC2902A
22	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE, 8833
23	2	XJP1, XJP2	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



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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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09/20

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