

## LTM8065 40V, 2.5A Silent Switcher $\mu$ Module Regulator

### DESCRIPTION

Demonstration circuit 2251A is a 40V, 3.5A peak, 2.5A continuous step-down  $\mu$ Module<sup>®</sup> regulator featuring the LTM<sup>®</sup>8065. The demo board is designed for 5V output from a 6V to 40V input. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The user adjustable features of the LTM8065 such as output voltage, switching frequency, soft-start and power good can be changed on DC2251A simply by modifying the appropriate resistors and/or capacitors.

The LTM8065 can be programmed to different operation modes. The SYNC pin on the demo board is grounded (JP1 at BURST position) by default for low ripple Burst Mode<sup>®</sup> operation. Pulse-skipping mode, spread spectrum mode or synchronization mode can be selected respectively by moving JP1 shunt to SYNC position and adding different signals to SYNC terminal. See Quick Start Procedure section for more details.

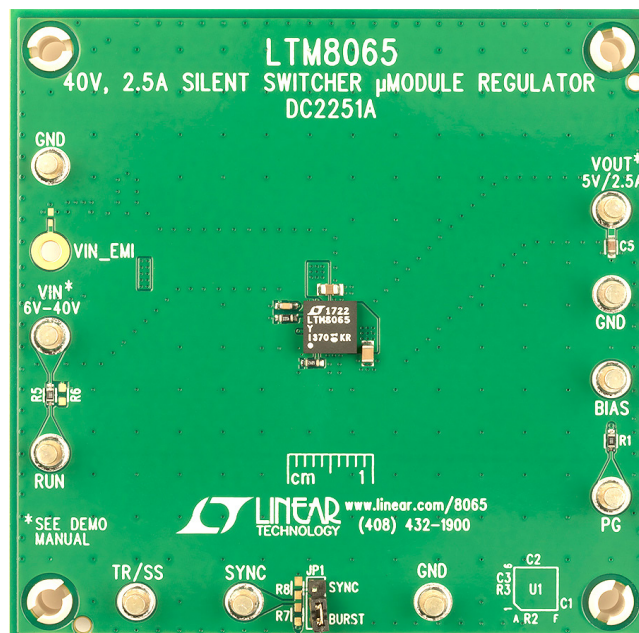
Figure 1 shows the efficiency of the circuit under different input voltages in Burst Mode operation. The rated maximum continuous load current is 2.5A, while derating is necessary for certain input voltage and thermal conditions. Figure 2 shows the LTM8065 derating curve on DC2251A demo board. The demo board has an optional EMI filter. To achieve high EMI/EMC performance, the input EMI filter is required and the input voltage should be applied at VIN\_EMI terminal.

The LTM8065 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this demo manual for demo circuit 2251A.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2251A>**

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### BOARD PHOTO



# DEMO MANUAL DC2251A

## PERFORMANCE SUMMARY

Specifications are at  $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{IN}^*$	Input Supply Range		6		40	V
$V_{OUT}$	Output Voltage		4.85	5	5.15	V
$I_{OUT}^{**}$	Maximum Continuous Output Current		2.5			A
$f_{SW}$	Switching Frequency	$V_{IN} = 12\text{V}$ , $I_{OUT} = 2.5\text{A}$		1		MHz
EFE	Efficiency at DC	$V_{IN} = 12\text{V}$ , $I_{OUT} = 2.5\text{A}$		91.5		%

\* When  $V_{IN}$  voltage is low, the LTM8065 may skip switching cycles.

\*\* Derating is necessary for certain  $V_{IN}$  and thermal conditions.

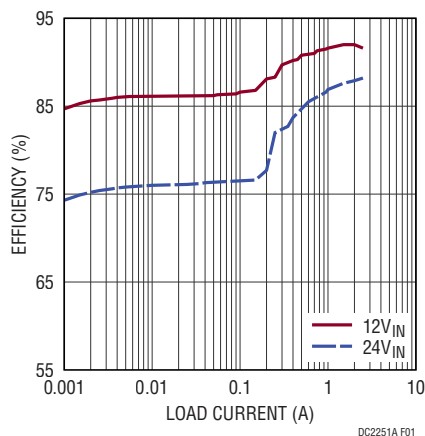


Figure 1. LTM8065 Demo Circuit DC2251A Efficiency vs. Load Current ( $f_{SW} = 1\text{MHz}$ ,  $V_{OUT} = 5\text{V}$ , Burst Mode Operation)

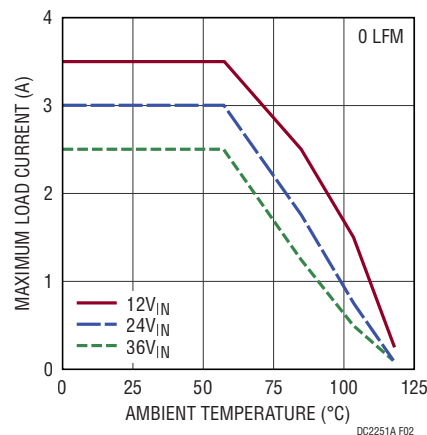


Figure 2. LTM8065 Demo Circuit DC2251A Maximum Load Current Derating

## QUICK START PROCEDURE

Demonstration circuit 2251A is easy to set up to evaluate the performance of the LTM8065. Refer to Figure 3 for proper measurement equipment setup and follow the procedure below:

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 output voltage ripple by touching the probe tip directly across the output capacitor. See Figure 4 for the proper scope technique.

1. Place JP1 on BURST position.
2. With power off, connect the input power supply to  $V_{IN}$  and GND. If the input EMI filter is desired, install the filter and connect the input power supply to  $V_{IN\_EMI}$  and GND.

3. With power off, connect the load from  $V_{OUT}$  to GND.
4. Turn on the power at the input.

NOTE. Make sure that the input voltage does not exceed 40V.

5. Check for the proper output voltage ( $V_{OUT} = 5\text{V}$ ).  
NOTE. If there is no output, temporarily disconnect the load to make sure that the load is not set too high or is shorted.
6. Once the proper output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

## QUICK START PROCEDURE

7. JP1 is placed on BURST position by default, for the low ripple Burst Mode operation. When JP1 is placed on SYNC position, LTM8065 can operate in pulse-skipping mode, spread spectrum mode or synchronization mode respectively, based on the different SYNC terminal inputs. If SYNC terminal is floating, LTM8065 is in pulse-skipping mode. If an external clock is driving the SYNC terminal, LTM8065 is in synchronization mode.

Please make sure that RT should be chosen to set the LTM8065 switching frequency equal to or below the lowest SYNC frequency. If a 2.9V to 4.2V DC voltage is tied to the SYNC terminal, LTM8065 is in spread spectrum mode. This DC voltage can also be added through a voltage divider (R7 and R8) from the output. The recommended divider bottom resistor (R8) is 200k.

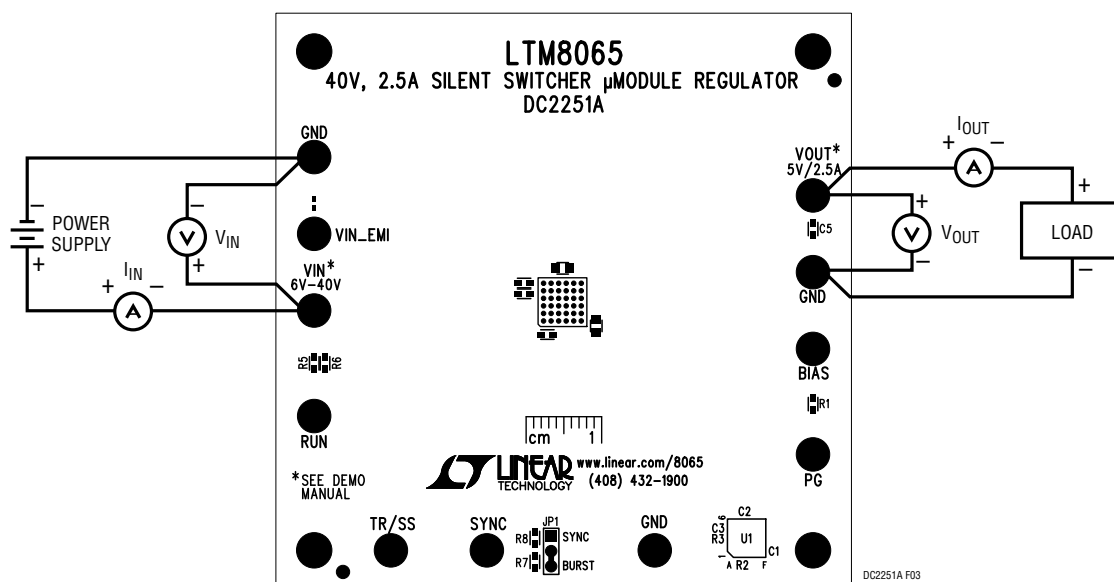


Figure 4. Proper Measurement Equipment Setup

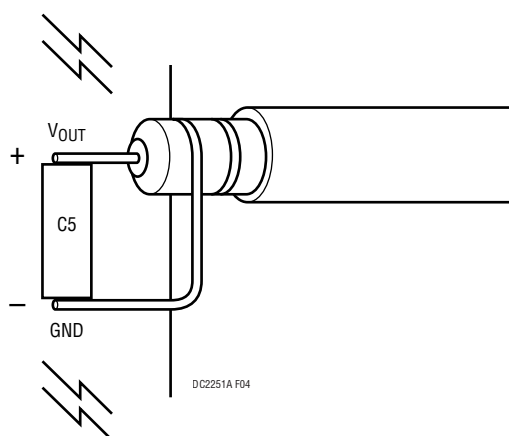


Figure 3. Measuring Output Ripple

# DEMO MANUAL DC2251A

## QUICK START PROCEDURE

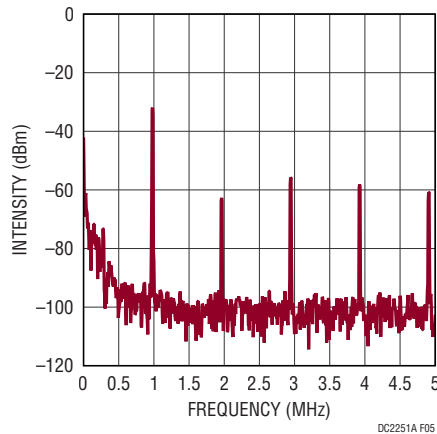
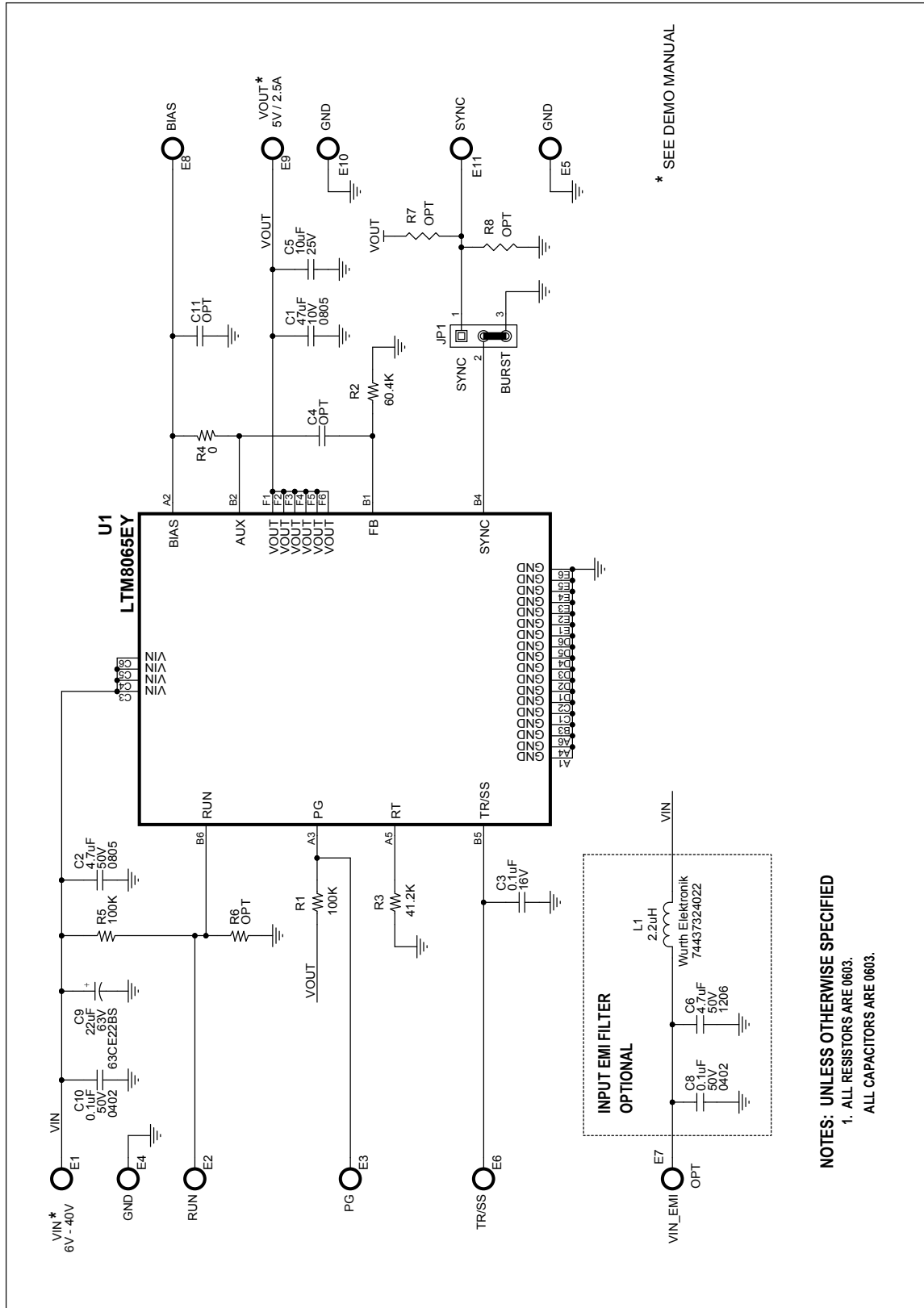


Figure 5. DC2251A Output Noise Spectrum,  $V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 2.5A$ ,  $f_{sw} = 1MHz$

## PARTS LIST

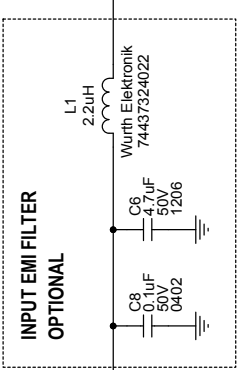
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C1	CAP, X5R, 47 $\mu$ F, 10V, 20%, 0805	MURATA, GRM21BR61A476ME15L
2	1	C2	CAP, X5R, 4.7 $\mu$ F, 50V, 10%, 0805	MURATA, GRM21BR61H475KE51L
3	1	C3	CAP, X7R, 0.1 $\mu$ F, 16V, 10%, 0603	MURATA, GRM188R71C104KA01D
4	1	C5	CAP, X5R, 10 $\mu$ F, 25V, 20%, 0603	MURATA, GRM188R61E106MA73D
5	1	C10	CAP, X7R, 0.1 $\mu$ F, 50V, 10%, 0402	TDK, CGA2B3X7R1H104K050BB
6	2	R1, R5	RES., CHIP, 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
7	1	R2	RES., CHIP, 60.4k, 1/10W, 1%, 0603	VISHAY, CRCW060360K4FKEA
8	1	R3	RES., CHIP, 41.2k, 1/10W, 1%, 0603	VISHAY, CRCW060341K2FKEA
9	1	U1	IC., BGA, 36L, 6.25mm $\times$ 6.25mm $\times$ 2.32mm	LINEAR TECH., LTM8065EY#PBF
<b>Additional Demo Board Circuit Components</b>				
1	0	C4, C11 (OPT)	CAP, 0603	
2	0	C6 (OPT)	CAP, X7R, 4.7 $\mu$ F, 50V, 10%, 1206	
3	0	C8 (OPT)	CAP, X7R, 0.1 $\mu$ F, 50V, 10%, 0402	
4	1	C9	CAP, ALUM, 22 $\mu$ F, 63V, 20%	SUN ELECTRONIC INDUSTRIES CORP, 63CE22BS
5	0	L1 (OPT)	IND, 2.2 $\mu$ H, 4.45mm $\times$ 4.06mm	WURTH ELEKTRONIK, 74437324022
6	1	R4	RES., CHIP, 0, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
7	0	R6, R7, R8 (OPT)	RES., 0603	
<b>Hardware: For Demo Board Only</b>				
1	10	E1-E6, E8-E11	TESTPOINT, TURRET, 0.094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
2	0	E7 (OPT)	TESTPOINT, TURRET, 0.094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
3	1	JP1	HEADER 3 PIN 0.079 SINGLE ROW	WURTH ELEKTRONIK, 62000311121
4	1	XJP1	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421
5	4	MH1-MH4	STAND-OFF, NYLON, 0.375" SNAP ON	KEYSTONE, 8832

**SCHEMATIC DIAGRAM**



\* SEE DEMO MANUAL

**NOTES: UNLESS OTHERWISE SPECIFIED**  
 1. ALL RESISTORS ARE 0603.  
 ALL CAPACITORS ARE 0603.



# DEMO MANUAL DC2251A

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