



LMTM78_1.0 series

Wide input, non-isolated & regulated, single output

Switching Regulator

- ⊕ Ultra-small, ultra-thin DFN package (9.0 x 7.0 x 3.1mm)
- ⊕ Operating ambient temperature range: -40°C to +105°C
- ⊕ High efficiency up to 94%
- ⊕ No-load input current as low as 0.1mA
- ⊕ Continuous short circuit protection
- ⊕ EN62368 approved
- ⊕ Meets AEC-Q100

The LMTM78_1.0 Series series are high efficiency switching regulators. The converters feature high efficiency, low loss and short-circuit protection in a compact DFN package. These products are widely used in applications such as industrial control, instrumentation and electric power.



Common specifications	
Short circuit protection:	Continuous, self-recovery
Operating temperature range:	-40°C ~ +105°C (See Fig. 1)
Storage temperature range:	-55°C ~ +125°C
Storage humidity range:	5 - 95 %RH
Reflow Soldering Temperature:	Peak temperature $\leq 245^{\circ}\text{C}$, duration $\leq 60\text{s}$ max. over 217°C . Also refer to IPC/JEDEC J-STD-020D.1.
MTBF (MIL-HDBK-217F, +25°C):	> 8552 Khours
Moisture Sensitivity Level (MSL):	3
Pollution Degree:	PD3
Case material:	Black epoxy resin; flame-retardant and heat-resistant(UL94 V-0)
Dimensions:	9.00 × 7.00 × 3.10mm
Weight:	0.58g (Typ.)
Cooling:	Free air convection

Output specifications						
Item	Test conditions	Min	Typ	Max	Units	
Voltage accuracy	Input voltage range at full load					
	• 3.3VDC • Others		± 2	± 4	± 3	%
Line regulation	Input voltage range at full load		± 0.2			%
Load regulation	Nominal input, 10% to 100% load		± 1.0			%
Ripple + Noise*	20MHz bandwidth, nominal input voltage, • full load • full load, external capacitor 22 μF		75	150		mVp-p
			20	75		mVp-p
Temperature coefficient	Operating temp. -40°C to +105°C		± 0.02			%/°C
Transient response deviation	Nominal input voltage, 25% load step change • 3.3 V/5V/6.5V/9VDC output • 12V/15VDC output		50	150		mV
			100	300		mV
Transient recovery time	Nominal input voltage, 25% load step change		0.1	0.8		ms
Switching Frequency	Full load, nominal input voltage		1.0			MHz
Trim	input voltage range		± 10			%Vo

* The "parallel cable" method is used for ripple and noise test, please refer to DC-DC Converter Application Notes for specific information;

Input specifications					
Item	Test conditions	Min	Typ	Max	Units
No load input current	Nominal input voltage		0.1		mA
Reverse Polarity at Input	Avoid/not protected				
Input filter	Capacitance filter				
Ctrl*	• Module on		Ctrl pin open or pulled high (TTL 1.6~5VDC)		
	• Module off		Ctrl pin pulled low to GND (-Vo) (0~0.6VDC)		
	• Nominal input voltage, input current when off		240		μA

* The positive output ctrl pin voltage is referenced to input GND; Negative output ctrl pin voltage is referenced to -Vo.

Example:
LMTM78_05-1.0
 LM = Series; T = SMT case; M = Micro size; 05 = 5Vout; 1.0 = 1.0A

Note:

- All specifications measured at $T_a = 25^{\circ}\text{C}$, humidity <75%, nominal input voltage and rated output load unless otherwise specified.
- In this datasheet, all the test methods of indications are based on corporate standards.

EMC specifications				
Emissions	CE	CISPR32/EN55032	CLASS B	(see EMC recommended circuit, ②)
Emissions	RE	CISPR32/EN55032	CLASS B	(see EMC recommended circuit, ②)
Immunity	ESD*	IEC/EN61000-4-2	Contact $\pm 6\text{kV}$	perf. Criteria B
Immunity	RS	IEC/EN61000-4-3	10V/m	perf. Criteria A
Immunity	CS	IEC/EN61000-4-6	3 Vr.m.s	perf. Criteria A
Immunity	EFT	IEC/EN61000-4-4	$\pm 1\text{kV}$	(see EMC recommended circuit, ③) perf. Criteria B
Immunity	Surge	IEC/EN61000-4-5	$\pm 1\text{kV}$	(see EMC recommended circuit, ③) perf. Criteria B

* The static level of the Ctrl & Trim pin is $\pm 2\text{kV}$ when they are not connected to external devices; It is suggested to connect an external capacitor (225K/50V) from Ctrl to GND/-Vo to meet ESD ($\pm 6\text{kV}$) of the Ctrl pin, and to connect a varistor (22V/30A) from Trim to GND/-Vo to meet ESD ($\pm 6\text{kV}$) of the Trim pin.

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Product Selection Guide

Part Number	Input Voltage [VDC]		Output Voltage [VDC]	Output Current [mA, Max]	Capacitive load [μ F, max]	Efficiency Full load [max]
	Nominal	Range				
LMTM78_03-1.0	24	4.75-36	3.3	1000	680	89
	12	8-27	-3.3	-500	330	85
LMTM78_05-1.0	24	6.5-36	5	1000	680	92
	12	8-27	-5	-500	330	85
LMTM78_6.5-1.0	24	8-36	6.5	1000	680	92
	12	8-24	-6.5	-500	330	85
LMTM78_09-1.0	24	12-36	9	1000	680	92
	12	8-24	-9	-500	330	85
LMTM78_12-1.0	24	15-36	12	1000	680	94
	12	8-20	-12	-300	330	85
LMTM78_15-1.0	24	18-36	15	1000	680	94
	12	8-18	-15	-300	330	84

Note: For input voltage higher than 30VDC, a 22 μ F/50V input capacitor is required.

Typical characteristics

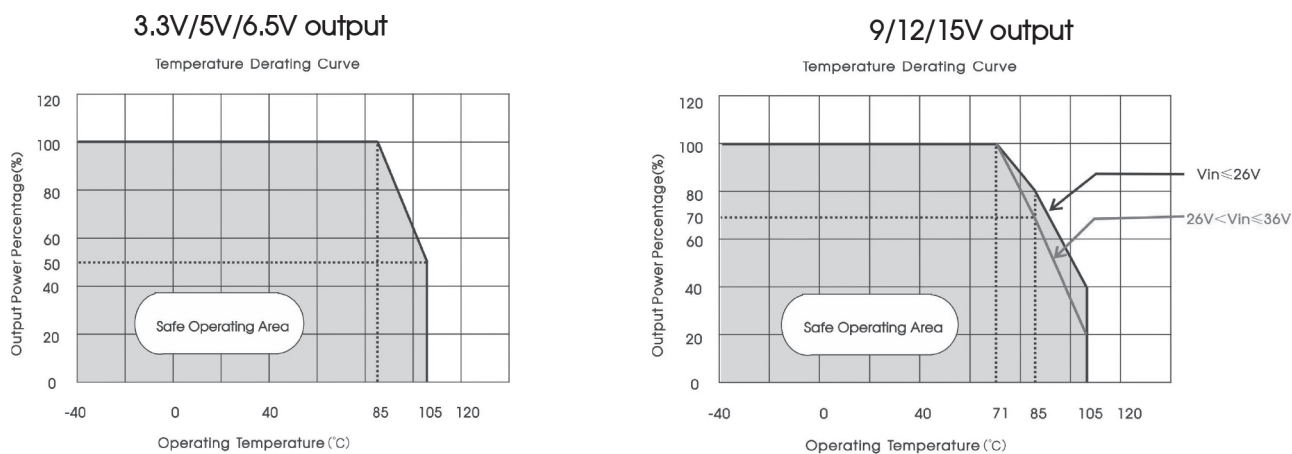


Fig. 1

Typical application circuit

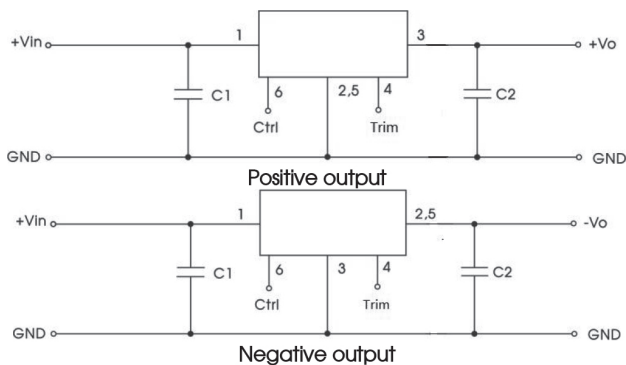


Fig. 2 Typical application circuit

Part number	C1 (ceramic capacitor)	C2 (ceramic capacitor)	Ra1/Ra2 (Vadj resistance)
LMTM78_03-1.0	10 μ F/50V	22 μ F/10V	Refer to Trim resistance calculation
LMTM78_05-1.0	10 μ F/50V	22 μ F/10V	
LMTM78_6.5-1.0	10 μ F/50V	22 μ F/16V	
LMTM78_09-1.0	10 μ F/50V	22 μ F/16V	
LMTM78_12-1.0	10 μ F/50V	22 μ F/25V	
LMTM78_15-1.0	10 μ F/50V	22 μ F/25V	

Table 1

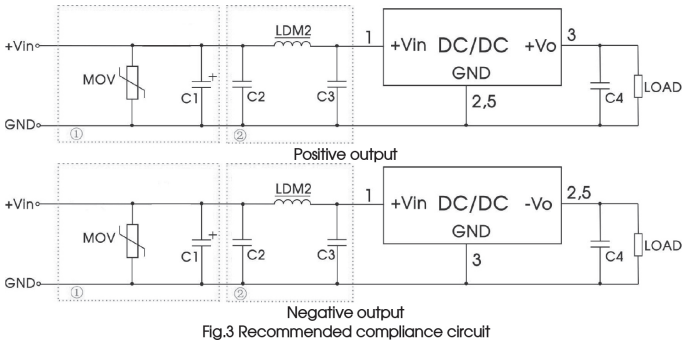
Note:

- The required C1 and C2 capacitors must be connected as close as possible to the terminals of the module;
- Refer to Table 1 for C1 and C2 capacitor values. For certain applications, increased values and/or tantalum or low ESR electrolytic capacitors may also be used instead;
- Converter cannot be used for hot swap and with output in parallel.

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EMC compliance circuit



Part No.	MOV	C1	C2	LDM2	C3	C4
LMTM78_03-1.0, LMTM78_05-1.0 (positive output)	S20K30	680μF /50V	10μF/ 50V	68μH	-	22μF/ 25V
Others					10μF/ 50V	

Fig.3 Recommended compliance circuit

Note:
For EMC tests we use Part ① for immunity and part ② for emissions test. Selecting based on needs.

Trim Function for Output Voltage Adjustment (open if unused)

- 1.Positive output application: connect trim resistor to GND/Vo respectively for adjusting up/down.
- 2.Negative output application: connect trim resistor to GND/Vo- respectively for adjusting up/down

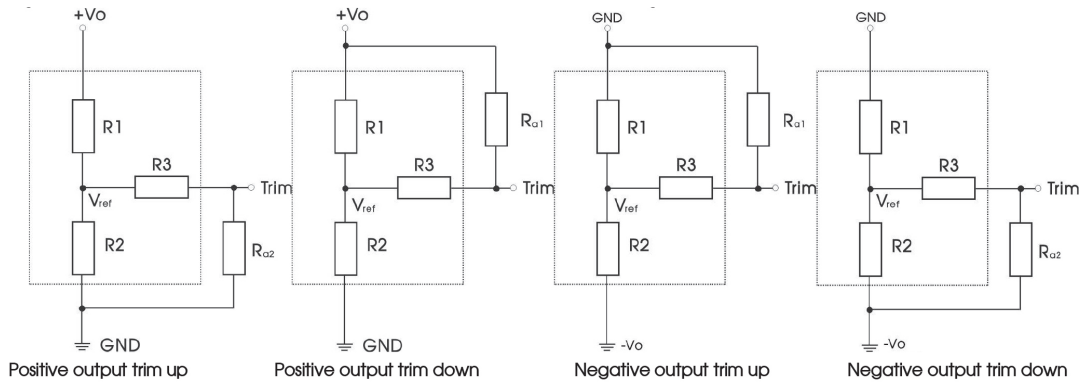


Fig.4 Circuit diagram of Trim up and down (dashed line shows internal part of module)

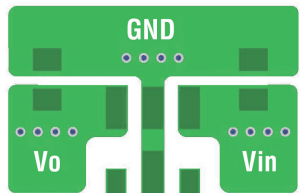
Calculating Trim resistor values:

$$\text{Trim up : } R_{a2} = \frac{aR_2}{R_2 - a} - R_3, \quad a = R_2 // (R_3 + R_{a2}) = \frac{V_{ref}}{V_o - V_{ref}} R_1$$

$$\text{Trim down : } R_{a1} = \frac{aR_1}{R_1 - a} - R_3, \quad a = R_1 // (R_3 + R_{a1}) = \frac{V_o - V_{ref}}{V_{ref}} R_2$$

Vout (V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Vref (V)
3.3	150	33	180	0.6
5	100	13.66	82	0.6
6.5	32.4	3.3	20	0.6
9	100	7.14	47	0.6
12	100	5.28	43	0.6
15	180	7.5	51	0.6

Temperature Rise Test PCB Layout

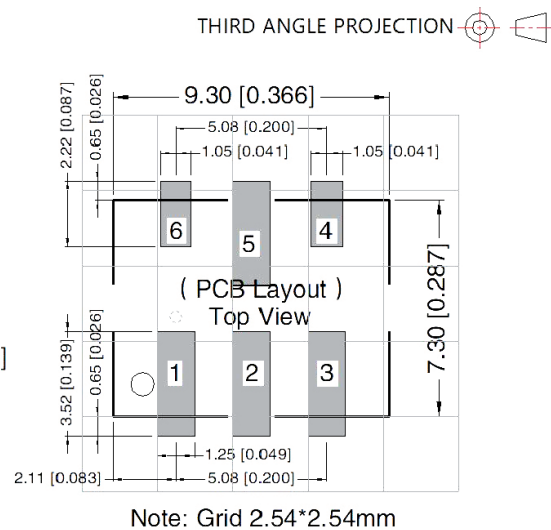
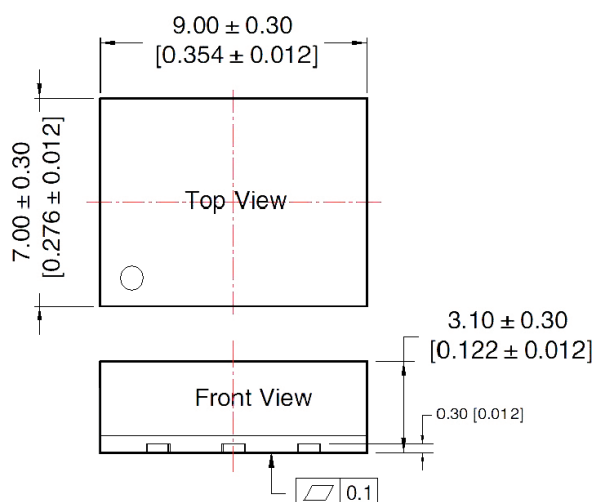


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Vout nom.	±3.3VDC		±5.0VDC		±6.5VDC		±9.0VDC		±12VDC		±15VDC	
Vout Trim.	R1 (KΩ)	R2 (KΩ)	R1 (KΩ)	R2 (KΩ)	R1 (KΩ)	R2 (KΩ)	R1 (KΩ)	R2 (KΩ)	R1 (KΩ)	R2 (KΩ)	R1 (KΩ)	R2 (KΩ)
2.97	815	-	-	-	-	-	-	-	-	-	-	-
3.63	-	-117.3	-	-	-	-	-	-	-	-	-	-
4.5	-	-	710	-	-	-	-	-	-	-	-	-
5.5	-	-	-	36.2	-	-	-	-	-	-	-	-
5.85	-	-	-	-	245.4	-	-	-	-	-	-	-
7.15	-	-	-	-	-	9.5	-	-	-	-	-	-
8.1	-	-	-	-	-	-	783.2	-	-	-	-	-
9.9	-	-	-	-	-	-	-	19.9	-	-	-	-
10.8	-	-	-	-	-	-	-	-	833.5	-	-	-
13.2	-	-	-	-	-	-	-	-	-	5.5	-	-
13.5	-	-	-	-	-	-	-	-	-	-	1497	-
16.5	-	-	-	-	-	-	-	-	-	-	-	21

Mechanical dimensions



Pin-Out		
Pin	Positive output	Negative output
1	+Vin	+Vin
2	GND	-Vo
3	+Vo	GND
4	Trim	Trim
5	GND	-Vo
6	Ctrl	Ctrl

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Tape/Reel packaging

