



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): | 0.58g |
| 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 |

| 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* | <ul style="list-style-type: none"> • Module on • Module off • Nominal input voltage, input current when off | | Ctrl pin open or pulled high (TTL 1.6~5VDC) Ctrl pin pulled low to GND (-Vo) (0~0.6VDC) 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:

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

| Output specifications | | | | | | |
|------------------------------|---|-----|--------------------|--------------------|-------|----------|
| Item | Test conditions | Min | Typ | Max | Units | |
| Voltage accuracy | Input voltage range at full load | | | | | |
| | • 3.3VDC • Others | | ± 2 ± 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 | | 50 100 | 150 300 | | mV 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;

| 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

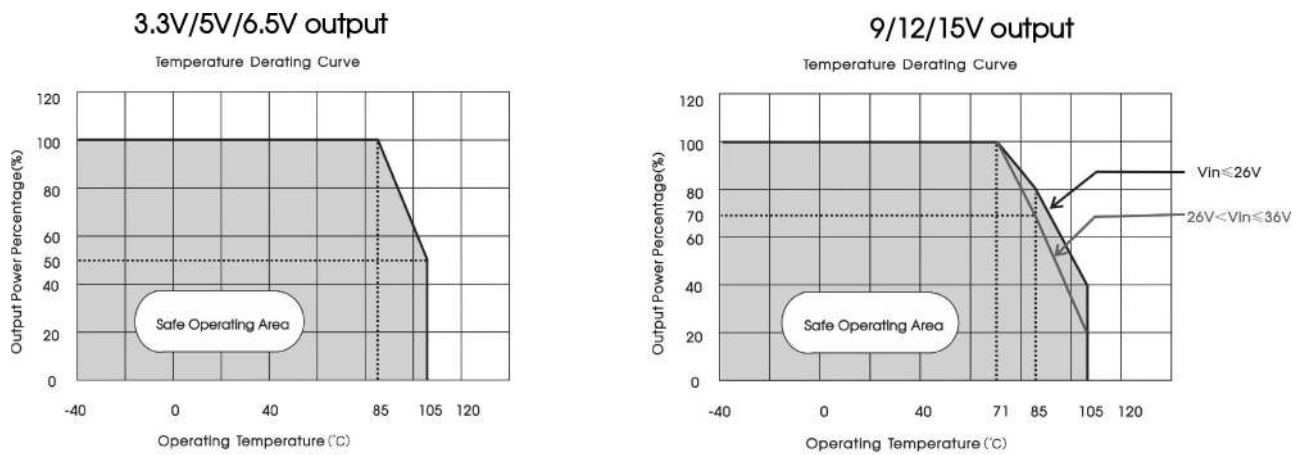


Fig. 1

Typical application circuit

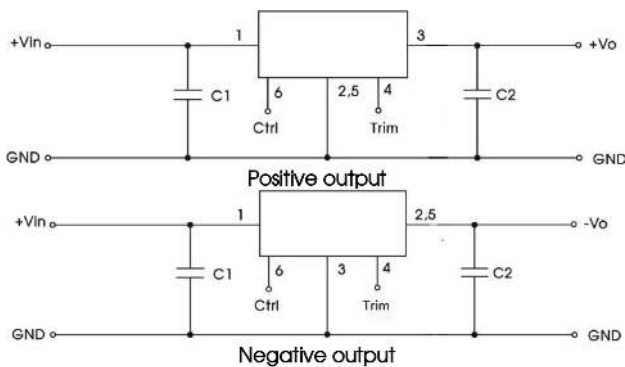


Fig. 2 Typical application circuit

| 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

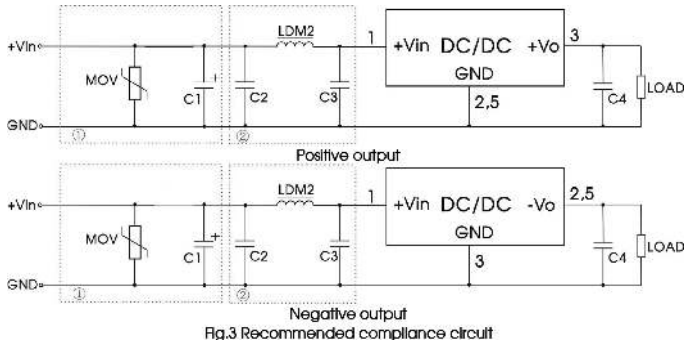
Note:

- 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 | |

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

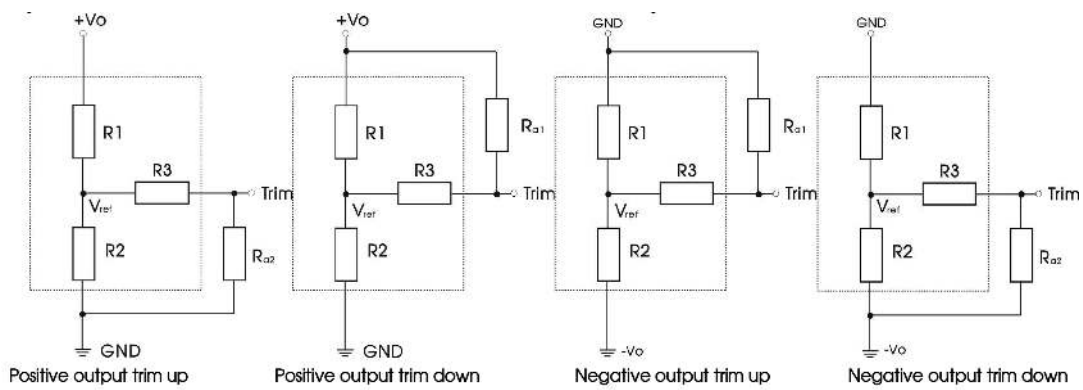


Fig.4 Circuit diagram of Trim up and down (dashed line shows internal part of module)

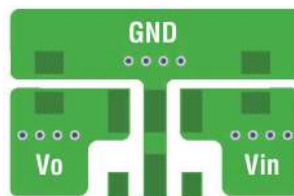
Calculating Trim resistor values:

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

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

| 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

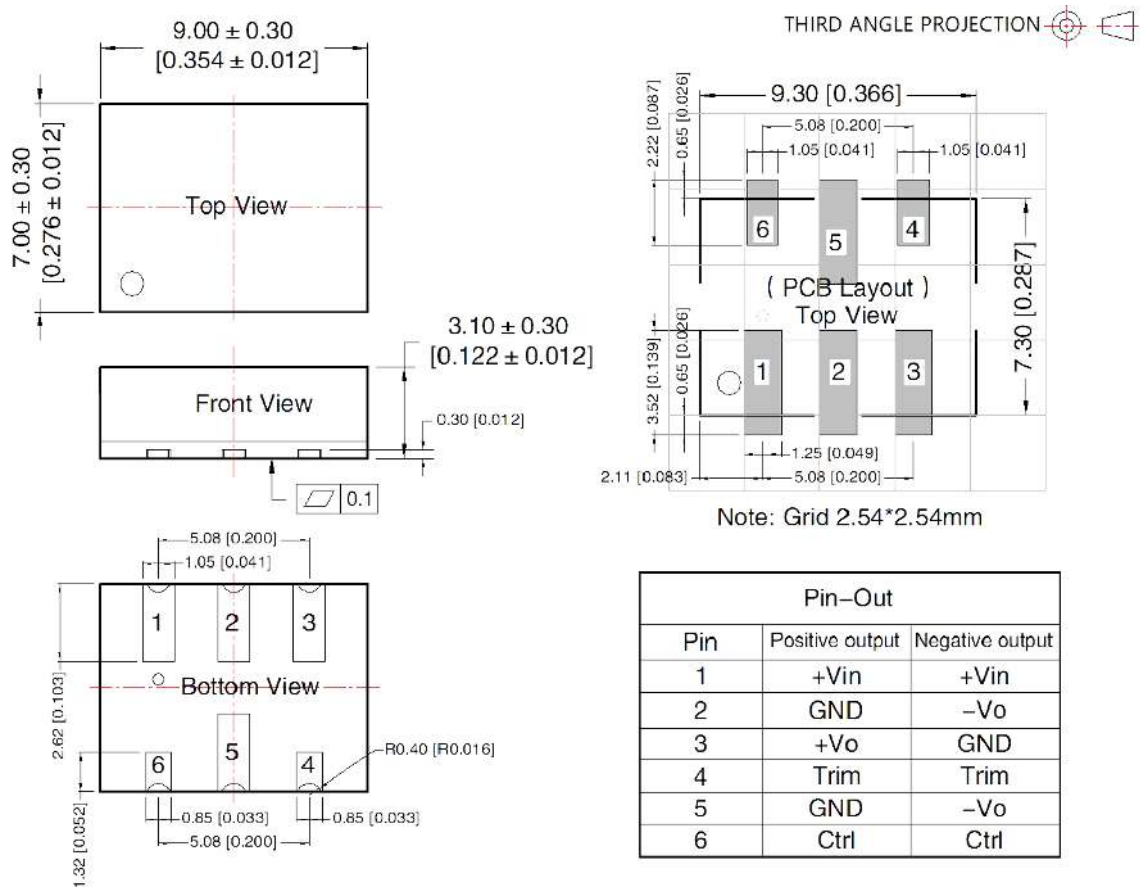


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| Vout nom. | ±3.3VDC | | ±5.0VDC | | ±6.5VDC | | ±9.0VDC | | ±12VDC | | ±15VDC | |
|------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Vout Trim. | R1 (KΩ) | R2 (KΩ) | 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



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Tape/Reel packaging

