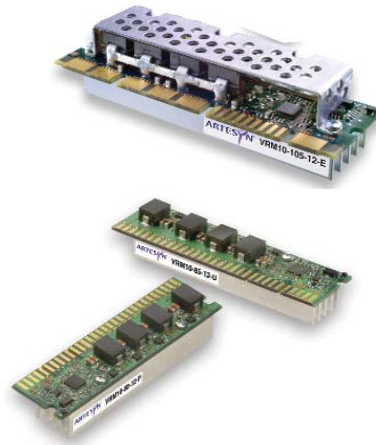


VRM10 Series Single Output

Input Voltage: 12VDC
of Outputs: Single



Special Features

- Designed for use in low profile applications where VRM10.0 or 10.1 specifications are required
- Output current up to 105 A continuous
- Open-collector power good (PWRGD) output
- 6-bit microprocessor voltage identification input (VID)
 - 0.8375 Vdc to 1.6000 Vdc in 12.5mV steps
 - Allows dynamic VID code changes
- Differential remote sense for improved load regulation
- Vertical plug-in to standard motherboard connector
- Selectable output load line impedances, via LL0 and LL1
- Output over-voltage signal (OVP)
- Monotonic output turn-on and turn-off with no overshoot or undershoot
- RoHS compliant
- 2 Year Warranty

Safety

VDE Certificate
No. 2487000-3336-0016

The VRM10 non-isolated DC-DC converters are designed to meet the exceptionally fast transient response requirements of today's microprocessors and fast switching logic in a compact size at a very affordable price. Advanced circuit techniques, component selection and placement optimization, state-of-the-art thermal packaging, and surface-mount technologies provide a high power density, highly reliable, and very precise voltage regulation system for advanced microprocessors.



Specifications

Unless otherwise stated, all specifications are typical at nominal input, maximum continuous rated load at 25 °C and voltages are referenced to Vin-.

| OUTPUT SPECIFICATIONS | | |
|--|---|---|
| Voltage adjustability | (See VID codes, Table 3) | 0.8375-1.6000 Vdc |
| Output current (Iout) | | 0 A min. 85 A max. |
| VRM10-85-12-UY | Continuous | 85 A max. |
| | Peak non-sustained | 100 A max. |
| VRM10-80-12-PY | Continuous | 80 A max. |
| | Peak non-sustained | 91 A max. |
| VRM10-105-12-EJ | Continuous | 105 A max. |
| | Peak non-sustained | 120 A max. |
| Load line (LL) adjustability (See LL codes, Table 1) | | 0.91-1.25 mW |
| Output voltage (Vout) (Vo sen+ minus Vo sen-) (See Notes 3, B) | Vo max Vo min Vo min Where Rout Iout | VID - Rout * Iout V VID - Rout * Iout - 0.040V (-U/-E) VID - Rout * Iout - 0.038V (-P) VID = programmed voltage (V) Fixed or programmable output impedance (W) Output current (A) |
| Ripple and noise (See Notes 1, 2) | 20 MHz bandwidth | 8 mV pk-pk |
| Short circuit protection | | Continuous current limit, brickwall automatic recovery |
| Remote sensing compensating voltage | | Up to 300 mV max. |

| INPUT SPECIFICATIONS | | |
|--------------------------------|--|---------------|
| Input voltage range | 12 Vin nominal | 11.0-12.6 Vdc |
| Input current | | |
| VRM10-85-12-UY | 11Vin, VID=1.325 V, Iout=100 A | 15.3 A |
| VRM10-80-12-PY | 11Vin, VID=1.400 V, Iout=91 A | 14.2 A |
| VRM10-105-12-EJ | 11VIN, VID=1.325V, Iout=120 A | 18.5 A |
| No load | 25 0 mA typ., 300 mA max. | |
| OUTEN OFF | | 50 mA max. |
| UVLO turn ON voltage | 0 °C <tamb <60 °C | 9.5 V ± 2.6% |
| UVLO turn OFF voltage | 0 °C <tamb <60 °C | 8.7 V ± 4.5% |
| Hysteresis | | 0.8 V typ |
| Start-up time (using OUTEN) | 11.0 V < Vin <12.6 V (PWRGD transitioning high) | 10 ms max. |

| INPUT SPECIFICATIONS CONTD. | | |
|---|--|---|
| OUTEN, VID and LL signal valid states: ON or Logic '1' OFF or Logic '0' | | 0.8 Vdc min., 5.5 Vdc max. -0.3 Vdc min., 0.4 Vdc max. |

| GENERAL CHARACTERISTICS | | |
|---------------------------|-----------------------|------------------------------------|
| Efficiency | See table 2 on page 2 | VID = 1.325 V |
| Switching frequency | 80 A/85 A 105 A | 2.2 MHz 1.1 MHz |
| Approvals and standards | (See Note 5) | IEC/EN60950 VDE |
| Material flammability | | UL94V-0 |
| Weight | 80 A/85 A 105 A | 38 g (1.34 oz) 70 g (2.47 oz) |
| MTBF Telecordia SR-332 | 80 A/85 A 105 A | 2,000,000 hours 1,648,000 hours |
| Mating connector | 80 A/85 A 105 A | See Figure 7 See Figure 8 |
| Connector fingers | | Gold plated, 30 μ-inches |

| ENVIRONMENTAL SPECIFICATIONS | | |
|-------------------------------------|------------------------------------|--------------------------------------|
| Temperature shock | Operating non-operating | 10 °C/hour 20 °C/hour |
| Humidity (Non-condensing) | Operating storage | 85% RH 95% RH |
| Altitude | Operating storage | 10,000 feet max. 50,000 feet max. |
| Shock | Operational and non-operational | 30 G 11ms Half sine wave |
| Vibration (See Note 6) | Operational and non-operational | 0.02 G ² /Hz max. |
| Thermal performance (See Note 7) | Operating ambient temperature | 0 °C to +60 °C |
| Storage temperature | (Non-condensing) | -40 °C to + 100 °C |

Specifications

| INPUT VOLTAGE | OUTPUT VOLTAGE | OVP ⁽⁹⁾ | OUTPUT CURRENT | OUTPUT CURRENT | OUTPUT CURRENT | EFFICIENCY (TYP.) | REGULATION LOAD | MODEL NUMBER |
|---------------|-------------------|--------------------|----------------|-------------------|----------------------|-------------------|-----------------|---------------------------------|
| | | | (MIN) | (MAX.) CONTINUOUS | (MAX.) NON-SUSTAINED | | | |
| 12 Vdc | 0.8375-1.6000 Vdc | 1.8 V | 0 A | 80 A | 91 A | 85% | 1.24 mV/A | VRM10-80-12-PY ⁽¹¹⁾ |
| 12 Vdc | 0.8375-1.6000 Vdc | 1.8 V | 0 A | 85 A | 100 A | 85% | See Table 1 | VRM10-85-12-UY ⁽¹¹⁾ |
| 12 Vdc | 0.8375-1.6000 Vdc | 1.8 V | 0 A | 105 A | 120 A | 84% | See table 1 | VRM10-105-12-EY ⁽¹¹⁾ |

| MODEL | LL0 | LL1 | LOAD LINE SLOPE, Rout | UNITS |
|-----------------|-----|-----|-----------------------|-------|
| VRM10-85-12-UY | 0 | 0 | 1.25 | mW |
| VRM10-85-12-UY | 0 | 1 | 1.25 | mW |
| VRM10-85-12-UY | 1 | 0 | 1.25 | mW |
| VRM10-85-12-UY | 1 | 1 | Reserved | mW |
| VRM10-80-12-PY | N/A | N/A | 1.24 | mW |
| VRM10-105-12-EJ | 0 | 0 | 1.25 | mW |
| VRM10-105-12-EJ | 0 | 1 | 1.25 | mW |
| VRM10-105-12-EJ | 1 | 0 | 1.25 | mW |
| VRM10-105-12-EJ | 1 | 1 | Reserved | mW |

Table 1: LL0, LL1 Load Line Codes

| EFFICIENCY TABLE | |
|-----------------------|-------------------|
| OUTPUT VOLTAGE | EFFICIENCY (typ.) |
| VID = 1.325 V @ 85 A | 85% |
| VID = 1.325 V @ 80 A | 85% |
| VID = 1.325 V @ 105 A | 84% |

Table 2: Efficiency Values

Notes

- Recommended output capacitance, 12 x 560 μ F aluminium polymer and 44 x 10 μ F MLCC for slew rates up to 430 A/ μ s, 14 x 560 μ F aluminum polymer and 45 x 10 μ F MLCC for slew rates up to 930 A/ μ s.
- 8 mV pk-pk ripple. Vin = 12 V, Vout = 1.35 V, Iout = 85 A.
- With the recommended capacitors (See Note 1) across the output, the output voltage stays within the load regulation window for all loads and transient events, up to 100 A for the VRM10-85-12-UY (91 A for the VRM10-80-12-PY) over a 20MHz bandwidth, 0 °C < T_{amb} < 60 °C.
- VRM10 uses a four phase buck topology. Each phase switches at 550 KHz for the VRM10-85-12-UY and VRM10-80-12-PY. This gives an equivalent switching frequency of 2.2 MHz. For the VRM10-105-12-EJ, each phase switches at 275 KHz. This gives an equivalent switching frequency of 1.1 MHz
- Recommended input fusing: one 20 A (or two 10 A in parallel) very fast acting fuse(s). The VRM10 is a high current device. Use appropriate care in handling and installation of this device, which is intended only for use within enclosed equipment.
- 0.01 G²/Hz from 5 Hz to 20 Hz, maintaining 0.02 G²/Hz from 20 Hz to 500 Hz, all axes.
- Maximum current requires adequate forced air over the converter. Please consult Figures 2 and 3 for thermal de-rating.
- When the VRM detects an output over-voltage event, the OVP pin transitions to logic high. This signal can be used to shut down the supply to the VRM, or drive a crowbar device.
- Pins 12 and 51 are not connected on VRM10-80-12-PY. On VRM10-85-12-UY, do not leave these pins floating.
- When included in the users system ESD event shall cause no out-of-regulation conditions.
- The 'Y' suffix indicates that these parts are TSE RoHS 5/6 (non Pb-free) compliant.

Specifications

| VOLTAGE IDENTIFICATION (VID) CODES | | | | | | | VOLTAGE IDENTIFICATION (VID) CODES (CONTD.) | | | | | | |
|------------------------------------|------|------|------|------|------|---------|---|------|------|------|------|------|---------|
| VID4 | VID3 | VID2 | VID1 | VID0 | VID5 | VID (V) | VID4 | VID3 | VID2 | VID1 | VID0 | VID5 | VID (V) |
| 0 | 1 | 0 | 1 | 0 | 0 | 0.8375 | 1 | 1 | 0 | 1 | 0 | 0 | 1.2125 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0.8500 | 1 | 1 | 0 | 0 | 1 | 1 | 1.2250 |
| 0 | 1 | 0 | 0 | 1 | 0 | 0.8625 | 1 | 1 | 0 | 0 | 1 | 0 | 1.2375 |
| 0 | 1 | 0 | 0 | 0 | 1 | 0.8750 | 1 | 1 | 0 | 0 | 0 | 1 | 1.2500 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0.8875 | 1 | 1 | 0 | 0 | 0 | 0 | 1.2625 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0.9000 | 1 | 0 | 1 | 1 | 1 | 1 | 1.2750 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0.9125 | 1 | 0 | 1 | 1 | 1 | 0 | 1.2875 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0.9250 | 1 | 0 | 1 | 1 | 0 | 1 | 1.3000 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0.9375 | 1 | 0 | 1 | 1 | 0 | 0 | 1.3125 |
| 0 | 0 | 1 | 0 | 1 | 1 | 0.9500 | 1 | 0 | 1 | 0 | 1 | 1 | 1.3250 |
| 0 | 0 | 1 | 0 | 1 | 0 | 0.9625 | 1 | 0 | 1 | 0 | 1 | 0 | 1.3375 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0.9750 | 1 | 0 | 1 | 0 | 0 | 1 | 1.3500 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0.9875 | 1 | 0 | 1 | 0 | 0 | 0 | 1.3625 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1.0000 | 1 | 0 | 0 | 1 | 1 | 1 | 1.3750 |
| 0 | 0 | 0 | 1 | 1 | 0 | 1.0125 | 1 | 0 | 0 | 1 | 1 | 0 | 1.3875 |
| 0 | 0 | 0 | 1 | 0 | 1 | 1.0250 | 1 | 0 | 0 | 1 | 0 | 1 | 1.4000 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1.0375 | 1 | 0 | 0 | 1 | 0 | 0 | 1.4125 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1.0500 | 1 | 0 | 0 | 0 | 1 | 1 | 1.4250 |
| 0 | 0 | 0 | 0 | 1 | 0 | 1.0625 | 1 | 0 | 0 | 0 | 1 | 0 | 1.4375 |
| 0 | 0 | 0 | 0 | 0 | 1 | 1.0750 | 1 | 0 | 0 | 0 | 0 | 1 | 1.4500 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1.0875 | 1 | 0 | 0 | 0 | 0 | 0 | 1.4625 |
| 1 | 1 | 1 | 1 | 1 | 1 | OFF | 0 | 1 | 1 | 1 | 1 | 1 | 1.4750 |
| 1 | 1 | 1 | 1 | 1 | 0 | OFF | 0 | 1 | 1 | 1 | 1 | 0 | 1.4875 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1.1000 | 0 | 1 | 1 | 1 | 0 | 1 | 1.5000 |
| 1 | 1 | 1 | 1 | 0 | 0 | 1.1125 | 0 | 1 | 1 | 1 | 0 | 0 | 1.5125 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1.1250 | 0 | 1 | 1 | 0 | 1 | 1 | 1.5250 |
| 1 | 1 | 1 | 0 | 1 | 0 | 1.1375 | 0 | 1 | 1 | 0 | 1 | 0 | 1.5375 |
| 1 | 1 | 1 | 0 | 0 | 1 | 1.1500 | 0 | 1 | 1 | 0 | 0 | 1 | 1.5500 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1.1625 | 0 | 1 | 1 | 0 | 0 | 0 | 1.5625 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1.1750 | 0 | 1 | 0 | 1 | 1 | 1 | 1.5750 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1.1875 | 0 | 1 | 0 | 1 | 1 | 0 | 1.5875 |
| 1 | 1 | 0 | 1 | 0 | 1 | 1.2000 | 0 | 1 | 0 | 1 | 0 | 1 | 1.6000 |

Table 3: Voltage Identification Codes

Specifications

| SIGNAL ELECTRICAL INTERFACE | | | | | | |
|--|-----------------------|------|-----------|-----------|------------|--|
| CHARACTERISTIC - SIGNAL NAME | SYMBOL | MIN | TYP | MAX | UNITS | NOTES AND CONDITIONS |
| OUTEN - on | $V_{OUTEN(on)}$ | 0.8 | | 5.5 | V | No pull up resistor provided by the VRM |
| OUTEN - off | $V_{OUTEN(off)}$ | -0.3 | | 0.4 | V | No pull up resistor provided by the VRM |
| OUTEN - leakage current | | -1 | | 1 | μ A | |
| PWRGD - low | $V_{PWRGD(low)}$ | | | 0.4 | V | Sink current 4 mA |
| PWRGD - sink current | $I_{PWRGD(sink)}$ | | | 4 | mA | Open-collector output to not more than 5.5 V |
| PWRGD - low threshold | | 72 | 74 | 76 | % | Percentage of VID code setting |
| PWRGD - turn-on response to OUTEN going high | T_{rise} | 0 | 4 | 10 | ms | For waveforms, refer to Application Note 171 |
| VID - high | $V_{ih(VID)}$ | 0.8 | | 5.5 | V | |
| VID - low | $V_{il(VID)}$ | -0.3 | | 0.4 | V | |
| VID - pull up current | $I_{(VID)}$ | 35 | 50 | 65 | μ A | |
| OVP signal trip point | $R_{(VID)}$ | 1.7 | | VID + 0.2 | V | |
| OVP drive voltage | | | 1.9 (5.5) | V | | $I_{ovp} = -100$ mA ($I_{ovp} = -1$ mA) |
| LL - high | $V_{ih(LL)}$ | 0.8 | | 5.5 | V | VRM10-85-12-UY only |
| LL - low | $V_{il(LL)}$ | -0.3 | | 0.4 | V | VRM10-85-12-UY only |
| LL - input impedance | $Z_{i(LL)}$ | 2.18 | 2.21 | | k Ω | VRM10-85-12-UY only |
| VR_Hot# - low | $V_{VR_HOT\#(low)}$ | 0 | | 0.4 | V | Sink current 30 mA. VR_HOT# is pulled as a thermal event is present in the VRM |
| VR_Hot# - sink current | $I_{VR_HOT\#(sink)}$ | 0 | | 30mA | | Open-collector output to not more than V_{in} . Sinks current as long as thermal event is present in the VRM |

| ELECTROMAGNETIC COMPATIBILITY | | | | | | |
|---|-------------|-----|------|-----|---------|---|
| CHARACTERISTIC - SIGNAL NAME | SYMBOL | MIN | TYP | MAX | UNITS | NOTES AND CONDITIONS |
| ESD - operating (See Note 10) | | 15 | kV | | | IEC61000-4-2. In end user equipment |
| ESD - non-operating | | | | 25 | kV | IEC61000-4-2. In end user equipment |
| Radiated emissions | | B | | | Class | FCC and EN55022. In end user equipment |
| Input characteristics: Input current - operating | I_{IN} | | 10.7 | | A | $V_{in} = V_{in}(typ.)$, $I_{out(cont.)} = 85A$, VID = 1.325 V |
| Input capacitance - external bypass | C_{INext} | 680 | 1000 | | μ F | |

Specifications

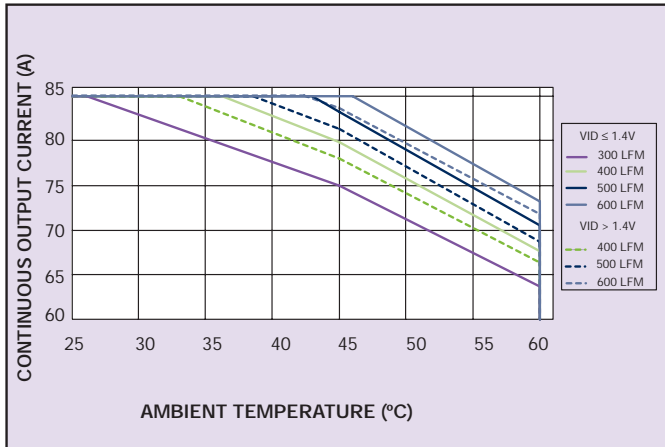


Figure 1: Thermal Derating Curve for VRM10-85-12-UY
(See Note A)

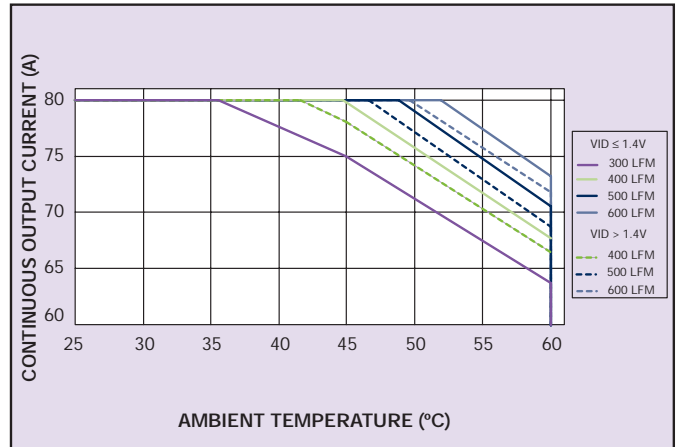


Figure 2: Thermal Derating Curve for VRM10-80-12-PY
(See Note A)

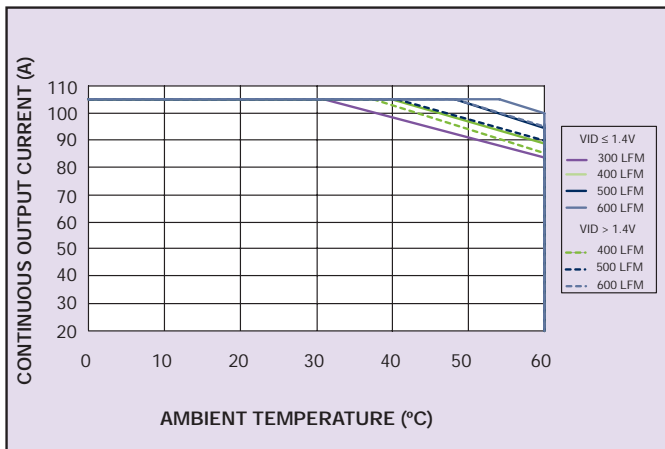


Figure 3: Thermal Derating Curve for VRM10-105-12-EY
(See Note A)

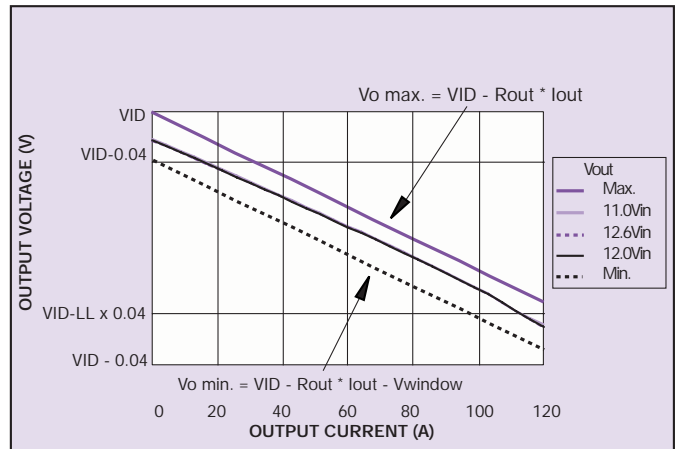


Figure 4: Load Regulation (See Notes 3 and B)

Notes

- A For the LFM and VID conditions graphed, there is no derating between 0 °C and 25 °C.
- B For load regulation equations: VID is in Volts, programmed by the VID bits (refer to Table 3); Rout is in W's, programmed by the LL bits (refer to Table 1); and the output current, Iout is in amps. V_{Window} is 0.040 for VRM10-85-12-UY and 0.038 for VRM10-80-12-PY.
- C Efficiency Vs load plotted is representative of a typical VRM10-85-12-UY with VID = 1.4 V, LL0 = 0, LL1 = 1.
- D Shown for a VRM10-80-12-P with VID = 1.4 V.

Specifications

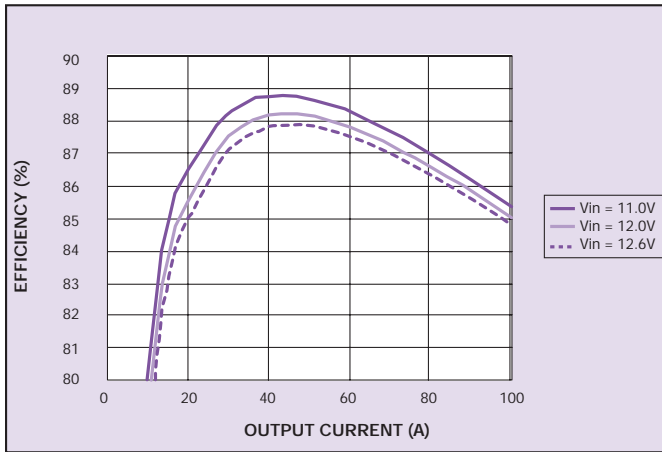


Figure 5: Typical Efficiency Vs Load (See Note C)
For VRM10-85-12-UY and VRM10-80-12-PY

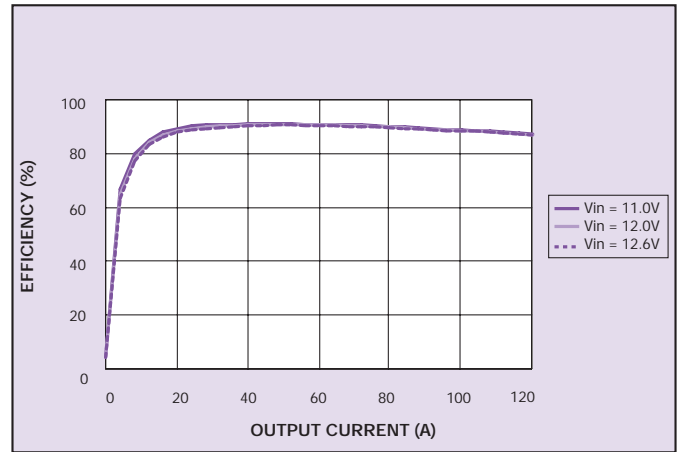


Figure 5a: Typical Efficiency Vs Load (See Note C)
For VRM10-105-12-EJ

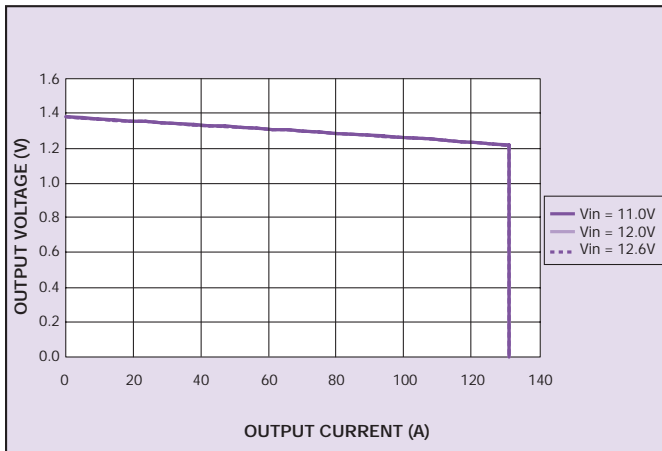
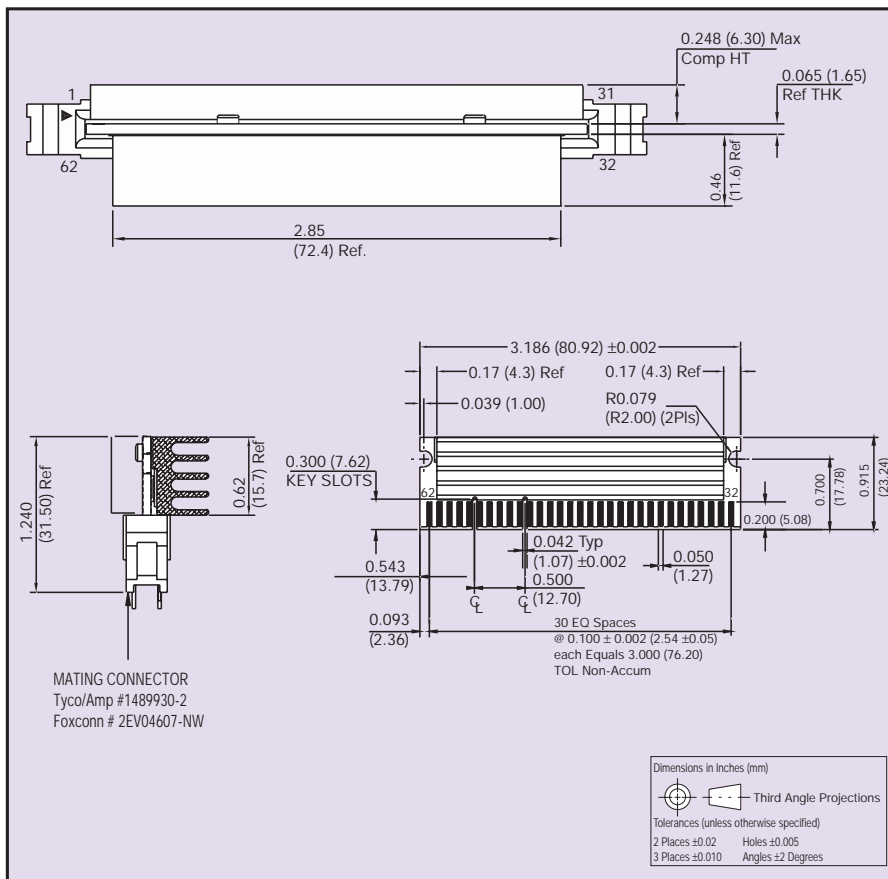


Figure 6: Short Circuit and Over Current Protection (See Note D)
For VRM10-85-12-UY and VRM10-80-12-PY

Specifications

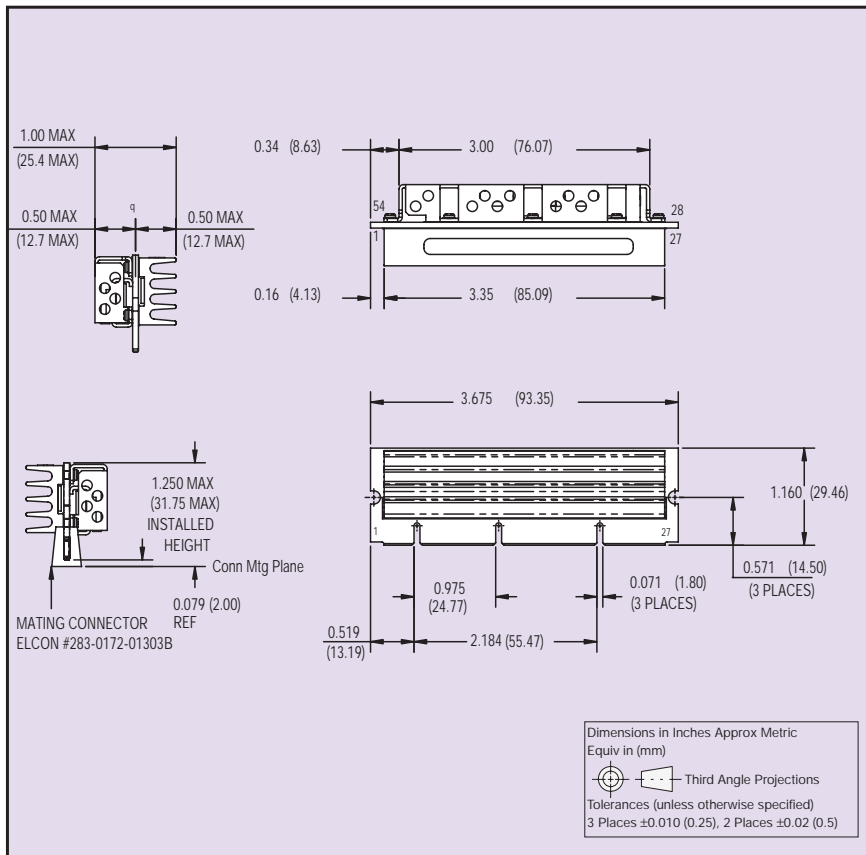
Rev.07.20.07
vrml0 series
8 of 10



| PIN CONNECTIONS | | | |
|-----------------|--------------------|---------|--------------------|
| PIN NO. | FUNCTION | PIN NO. | FUNCTION |
| 1 | Vin+ | 62 | Vin- |
| 2 | Vin+ | 61 | Vin- |
| 3 | Vin+ | 60 | Vin- |
| 4 | Vin+ | 59 | Vin- |
| 5 | N/U | 58 | VRM_pres# |
| 6 | VID4 | 57 | Key |
| 7 | VID3 | 56 | VID2 |
| 8 | VID1 | 55 | VID0 |
| 9 | OVP | 54 | VID5 |
| 10 | PWRGD | 53 | Outen |
| 11 | Vo sen- | 52 | Vo sen+ |
| 12 | LL0 ⁽⁹⁾ | 51 | LL1 ⁽⁹⁾ |
| 13 | Vo- | 50 | Vo+ |
| 14 | Vo+ | 49 | Vo+ |
| 15 | Vo- | 48 | Vo- |
| 16 | Vo+ | 47 | Vo+ |
| 17 | Vo- | 46 | Vo- |
| 18 | Vo+ | 45 | Vo+ |
| 19 | Vo- | 44 | Vo- |
| 20 | Vo+ | 43 | Vo+ |
| 21 | Vo- | 42 | Vo- |
| 22 | Vo+ | 41 | Vo+ |
| 23 | Vo- | 40 | Vo- |
| 24 | Vo+ | 39 | Vo+ |
| 25 | Vo- | 38 | Vo- |
| 26 | Vo+ | 37 | Vo+ |
| 27 | Vo- | 36 | Vo- |
| 28 | Vo+ | 35 | Vo+ |
| 29 | Vo- | 34 | Vo- |
| 30 | Vo+ | 33 | Vo+ |
| 31 | Vo- | 32 | Vo- |

Figure 7: 80/85 A Mechanical Drawing and Pinout Table

Specifications



| PIN CONNECTIONS | | | |
|-----------------|-----------------------|---------|--------------------|
| PIN NO. | FUNCTION | PIN NO. | FUNCTION |
| 1 | Vin- | 54 | Vin+ |
| 2 | Vin- | 53 | Vin+ |
| 3 | Vin- | 52 | Vin+ |
| 4 | VID4 | 51 | VID3 |
| 5 | VID2 | 50 | VID1 |
| 6 | VID0 | 49 | VID5 |
| 7 | Vo sen+ | 48 | Vo sen- |
| 8 | V _{CC} PWRGD | 47 | VR_HOT# |
| 9 | Outen | 46 | LL0 ⁽⁹⁾ |
| 10 | OVP | 45 | LL1 ⁽⁹⁾ |
| 11 | NA | 44 | NA |
| 12 | VRM_pres# | 43 | NA |
| 13 | Vo+ | 42 | Vo+ |
| 14 | Vo+ | 41 | Vo+ |
| 15 | Vo+ | 40 | Vo+ |
| 16 | Vo- | 39 | Vo- |
| 17 | Vo- | 38 | Vo- |
| 18 | Vo- | 37 | Vo- |
| 19 | Vo+ | 36 | Vo+ |
| 20 | Vo+ | 35 | Vo+ |
| 21 | Vo+ | 34 | Vo+ |
| 22 | Vo- | 33 | Vo- |
| 23 | Vo- | 32 | Vo- |
| 24 | Vo- | 31 | Vo- |
| 25 | Vo+ | 30 | Vo+ |
| 26 | Vo+ | 29 | Vo+ |
| 27 | Vo+ | 28 | Vo+ |

Figure 8: 105 A Mechanical Drawing and Pinout Table

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