

UL TEST REPORT AND PROCEDURE

| | |
|------------------------------------|---|
| Standard: | UL 60950-1, 2nd Edition, 2011-12-19 (Information Technology Equipment - Safety - Part 1: General Requirements) CSA C22.2 No. 60950-1-07, 2nd Edition, 2011-12 (Information Technology Equipment - Safety - Part 1: General Requirements) |
| Certification Type: | Component Recognition |
| CCN: | QQGQ2, QQGQ8 (Power Supplies for Information Technology Equipment Including Electrical Business Equipment) |
| Product: | DC/DC Converter |
| Model: | VTM Series VTM2 Series |
| Rating: | See Miscellaneous Enclosure for model nomenclature. Input: 36V or 48V Output: 48V Max Power: 300W Max. See Miscellaneous Enclosure for model nomenclature. |
| Applicant Name and Address: | VICOR CORP 25 FRONTAGE RD ANDOVER MA 01810-5499 UNITED STATES |

This is to certify that representative samples of the products covered by this Test Report have been investigated in accordance with the above referenced Standards. The products have been found to comply with the requirements covering the category and the products are judged to be eligible for Follow-Up Service under the indicated Test Procedure. The manufacturer is authorized to use the UL Mark on such products which comply with this Test Report and any other applicable requirements of UL LLC ('UL') in accordance with the Follow-Up Service Agreement. Only those products which properly bear the UL Mark are considered as being covered by UL's Follow-Up Service under the indicated Test Procedure.

The applicant is authorized to reproduce the referenced Test Report provided it is reproduced in its entirety.

UL authorizes the applicant to reproduce the latest pages of the referenced Test Report consisting of the first page of the Specific Technical Criteria through to the end of the Conditions of Acceptability.

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

Prepared by: Gerard Soprych

Reviewed by: Daniel Pirozzi

Supporting Documentation

The following documents located at the beginning of this Procedure supplement the requirements of this Test Report:

- A. Authorization - The Authorization page may include additional Factory Identification Code markings.
- B. Generic Inspection Instructions -
 - i. Part AC details important information which may be applicable to products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of this Test Report.
 - ii. Part AE details any requirements which may be applicable to all products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of each Test Report.
 - iii. Part AF details the requirements for the UL Certification Mark which is not controlled by the technical standard used to investigate these products. Products are permitted to bear only the Certification Mark(s) corresponding to the countries for which it is certified, as indicated in each Test Report.

Product Description

The full size VI Chip VTM is an isolating DC-DC back end voltage Transformation module that is designed to be used with a VI Chip PRM to make a complete regulated DC-DC converter but may be used as a standalone device. the VTM DC-DC converters are designed for building-in and the input is intended to be derived from the output of a VI chip PRM, a TNV-2, SELV, or other non-hazardous secondary circuit. The VTM is a current rated device. The VTM output is rated for a max current as opposed to a max power. The max current rating is valid for the entire output voltage range for each model.

Model Differences

See Miscellaneous Enclosure for model nomenclature.

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : N/A
- Operating condition : continuous
- Access location : building-in
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : No direct connection
- Tested for IT power systems : No
- IT testing, phase-phase voltage (V) : -
- Class of equipment : Class II (double insulated)
- Considered current rating of protective device as part of the building installation (A) : -
- Pollution degree (PD) : PD 2
- IP protection class : IP X0
- Altitude of operation (m) : 2000
- Altitude of test laboratory (m) : 150
- Mass of equipment (kg) : 0.0125
- The product was submitted and evaluated for use at the maximum ambient temperature (T_{ma}) permitted by the manufacturer's specification of: semiconductor junction temperature of the VI Chip not exceeding 125°C

Engineering Conditions of Acceptability

For use only in or with complete equipment where the acceptability of the combination is determined by UL LLC. When installed in an end-product, consideration must be given to the following:

- The input to the VTM is intended to be supplied from the output of a VI chip PRM, a TNV-2 circuit, or other non-hazardous secondary circuit
- The VTM provides 2250 Vdc of isolation from input to output.
- The output of the VTM is considered SELV.
- A standalone VTM used without a PRM should be protected by Littelfuse Nano²Fuse rated 10A or less.
- The following Production-Line tests are conducted for this product: Electric Strength
- The end-product Electric Strength Test is to be based upon a maximum working voltage of: Primary-SELV: 57.6 Vrms, 88 Vpk
- The following secondary output circuits are SELV: All
- The following secondary output circuits are at non-hazardous energy levels: All
- The power supply terminals and/or connectors are: Not investigated for field wiring
- The investigated Pollution Degree is: 2
- The following end-product enclosures are required: Mechanical , Fire , Electrical
- Max Temperature: Keep the maximum semiconductor junction temperature of the VI Chip at 125°C or less. There are two three methods to demonstrate compliance. Method 1: Keep T casemax < 100°C under all conditions where T casemax is the maximum case temp of the VI chip. Method 2: Keep T casemax < 125°C - (P dissmax X 1.5) under all conditions where P dissmax = P inputmax - P outputmax. P dissmax is the amount of power in Watts dissipated within the device. The thermal resistance of the full size VI Chip from the internal semiconductor junction to the case is 1.5°C/Watts. Method Three: Maintain the internal semiconductor junction temperature at Tj = 125°C or less. This can be achieved by measuring the dc voltage at the TM (temperature monitor) lead and converting the voltage to temperature The TM has a nominal +27C set point of 3.0 Vdc and a nominal gain of 10mV / °C. Example; TM = 3.4Vdc, Tj = (27 + 40) 67°C
- The VTM is designed to be used with the VI Chip PRM. The PRM/VTM combination should be protected by Littelfuse Nano²Fuse rated 15A or less when the PRM is rated 400W or less.
- The VTM is designed to be used with the VI Chip PRM. The PRM/VTM combination should be protected by Littelfuse Nano²Fuse rated 10A or less in front of when the PRM is rated 320W or less.

VI CHIP VTM Model Number: Vbbbcdddefffx

Sample model number: V048F480T006A

V = Constant

| VTM Family (Voltage Transformation Module) | |
|--|--------------|
| V | Standard VTM |

bbb = 048

| Input Voltage | Nominal (range) |
|---------------|-----------------|
| 036 | 36 Vdc (26-50) |
| 048 | 48 Vdc (26-55) |

c = F

| Package Size | In Board BGA | On Board J-Lead | Through Hole |
|--------------|--------------|-----------------|--------------|
| Full VIC | K | F | T |

ddd = 480

| Output Voltage Designator (Vdc) | | | |
|---------------------------------|-----|-----|------|
| 010 | 1.0 | 072 | 7.2 |
| 011 | 1.1 | 080 | 8.0 |
| 015 | 1.5 | 090 | 9.0 |
| 020 | 2.0 | 096 | 9.6 |
| 022 | 2.2 | 120 | 12.0 |
| 024 | 2.4 | 160 | 16.0 |
| 030 | 3.0 | 180 | 18.0 |
| 033 | 3.3 | 240 | 24.0 |
| 040 | 4.0 | 320 | 32.0 |
| 045 | 4.5 | 360 | 36.0 |
| 060 | 6.0 | 480 | 48.0 |

e = T

| Product Grade | |
|---------------|---------------|
| T | -40 to 125° C |
| M | -55 to 125° C |

fff = 006

| Output Current Designator (Amps) | | | | | |
|----------------------------------|------|-----|------|-----|-------|
| 003 | 3 A | 013 | 13 A | 040 | 40 A |
| 005 | 5 A | 015 | 15 A | 050 | 50 A |
| 006 | 6 A | 017 | 17 A | 055 | 55 A |
| 007 | 7 A | 020 | 20 A | 060 | 60 A |
| 009 | 9 A | 025 | 25 A | 070 | 70 A |
| 010 | 10 A | 027 | 27 A | 080 | 80 A |
| 012 | 12 A | 030 | 30 A | 100 | 100 A |

x = A

| Revision (optional non-safety related) | |
|--|----------------------------|
| x | Any alphanumeric character |

Customer Special Models:

| Customer Special Model Numbers | Equivalent Standard Model Numbers |
|--|--|
| MV036F011M100x | V036F011M100 |
| MV036F015M080x | V036F015M080 |
| MV036F022M055x | V036F022M055 |
| MV036F030M040x | V036F030M040 |
| MV036F045M027x | V036F045M027 |
| MV036F060M020x | V036F060M020 |
| MV036F072M017x | V036F072M017 |
| MV036F090M013x | V036F090M013 |
| MV036F120M010x | V036F120M010 |
| MV036F180M007x | V036F180M007 |
| MV036F240M005x | V036F240M005 |
| MV036F360M003x | V036F360M003 |
| VIZ0033, VIZ0033x | V048F120T025 |
| VIZ0034, VIZ0034x | V048F040T050 |
| VIZ0039, VIZ0039x | V048F020T080 |
| VIZ0040, VIZ0040x | V048F030T070 |
| VIZ0041, VIZ0041x | V048F040T050 |
| VIZ0042, VIZ0042x | V048F120T025 |
| VIZ0052, VIZ0052x | V048F120T025 |
| VIZ0068, VIZ0068x | V048F080T030 |
| VIZ0069, VIZ0069x | V048F060T040 |
| VIZ0077, VIZ0077x | V048F020T080 |
| VIZ0078, VIZ0078x | V048F096T025 |
| F = J Lead, F may be replace by T for thru-hole | |
| x = revision, optional, any letter A through Z, non-safety related | |

VI CHIP VTM2 Model Number: VTMbbbccddefffxzz

Example: VTM48EF240T009A00

VTM = Constant

| VTM Family (Voltage Transformation Module) | |
|--|------------------|
| VTM | Standard version |
| MVTM | Mil-COTS version |

bbb = 48E

| Input Voltage | Nominal (range) | | |
|---------------|-----------------|------------|----------------|
| 36B | 36 Vdc (26-50) | 48G | 48 Vdc (26-53) |
| 48E | 48 Vdc (26-55) | 48H | 48 Vdc (32-55) |
| 48F | 48 Vdc (26-48) | | |

c = F

| Package Size and Lead Designator | |
|----------------------------------|--------------------------|
| F | Full VI Chip J-Lead |
| T | Full VI Chip Though-hole |

ddd = 240

| Output Voltage Designator (can be any three digits from 010 to 480) Vout = (designator / 10), non-inclusive list of examples below | | | | | |
|---|---------|------------|---------|------------|----------|
| 010 | 1.0 Vdc | 030 | 3.0 Vdc | 096 | 9.6 Vdc |
| 011 | 1.1 Vdc | 033 | 3.3 Vdc | 120 | 12.0 Vdc |
| 012 | 1.2 Vdc | 040 | 4.0 Vdc | 160 | 16.0 Vdc |
| 015 | 1.5 Vdc | 045 | 4.5 Vdc | 240 | 24.0 Vdc |
| 020 | 2.0 Vdc | 072 | 7.2 Vdc | 320 | 32.0 Vdc |
| 022 | 2.2 Vdc | 080 | 8.0 Vdc | 360 | 36.0 Vdc |
| 024 | 2.4 Vdc | 090 | 9.0 Vdc | 480 | 48.0 Vdc |

e = T

| Product Grade | |
|---------------|-------------|
| T | -40 to 125C |
| M | -55 to 125C |

fff = 009

| Output Current Designator (can be any three digits from 001 to 100) non-inclusive list of examples below | | | | | | | | | |
|---|-----|------------|------|------------|------|------------|------|------------|-------|
| 003 | 3 A | 010 | 10 A | 020 | 20 A | 050 | 50 A | 100 | 100 A |
| 005 | 5 A | 012 | 12 A | 025 | 25 A | 055 | 55 A | | |
| 006 | 6 A | 013 | 13 A | 027 | 27 A | 060 | 60 A | | |
| 007 | 7 A | 015 | 15 A | 030 | 30 A | 070 | 70 A | | |
| 009 | 9 A | 017 | 17 A | 040 | 40 A | 080 | 80 A | | |

x = A

| Revision (non-safety related) | |
|-------------------------------|----------------------------|
| x | Any alphanumeric character |

zz = 00

| Customer reference (non-safety related) | |
|--|-------------------------------------|
| zz | Any alphanumeric character or Blank |

VTM2 Customer Special Models:

| Customer Special Model Numbers | Equivalent Standard Model Numbers |
|--|--|
| VIZ0080, VIZ0080x | VTM48EF020T070A00 |
| VIZ0084, VIZ0084x | VTM48EF060T040A00 |
| VIZ0085, VIZ0085x | VTM48EF080T030A00 |
| VIZ0086, VIZ0086x | VTM48EF120T025A01 |
| VIZ0087, VIZ0087x | VTM48EF040T050B00 |
| x = revision, optional, any letter A through Z, non-safety related | |