# HV MFM™ Filter

## MFM1714xD2KD2F4yzz

## High-Voltage MIL-COTS Input Filter Module

### Features & Benefits

- 270V nominal input
- 99% efficiency
- EMI filtering
  - MIL-STD-461E/F/G, selected CE and CS tests
- Input transient protection
  - MIL-STD-704F
    normal and abnormal transients
- Envronmental qualification
  - MIL-STD-810
  - MIL-STD-202
- Low M-Grade temperature rating,
  providing operation down to –55°C
- Output power up to 640W
- Available in chassis and PCB mount
- Small size
  - 1.76 x 1.40 x 0.36in
    [44.6 x 35.5 x 9.2mm]

### Typical Applications

- Defense
- Aerospace

### Compatible Products

- High input voltage DCM3714 VIA™
- High input voltage ChiP[a] DCM

### Product Description

The MFM DCM™ Filter is a DC front-end module that provides EMI filtering and transient protection. The MFM DCM Filter enables designers using Vicor 270V nominal input voltage VIA™ or ChiP™[a] modules to meet conducted emission/conducted susceptibility per MIL-STD-461E/F/G; and input transients per MIL-STD-704F. The MFM DCM Filter accepts an input voltage of 160 – 420$V_{DC}$ (270V nominal input ) and delivers output power up to 640W.



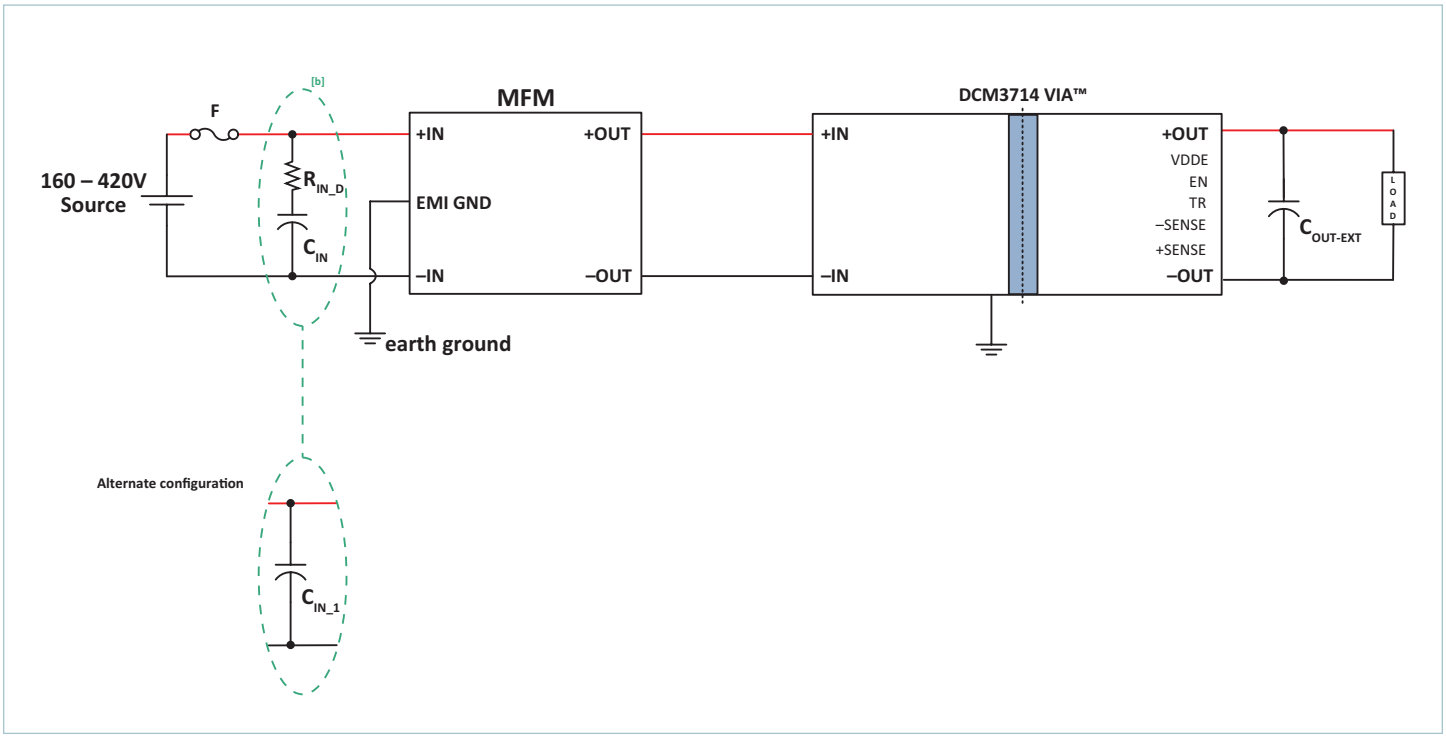
Size:
1.76 x 1.40 x 0.36in
[44.6 x 35.5 x 9.2mm]

[a] Additional components are required for EMI filtering and transient suppression, when used with ChiP™ package modules.

### Part Ordering Information

| Part Number | Package Type | Product Grade | Option Field |
|---|---|---|---|
| MFM1714**B**D2KD2F4**M04** | **B** = Board VIA | **M** = –55 to 100°C | **04** = Short Pin |
| MFM1714**B**D2KD2F4**M08** | | | **08** = Long Pin |
| MFM1714**V**D2KD2F4**M00** | **V** = Chassis VIA | | **00** = Chassis |

## Typical Application



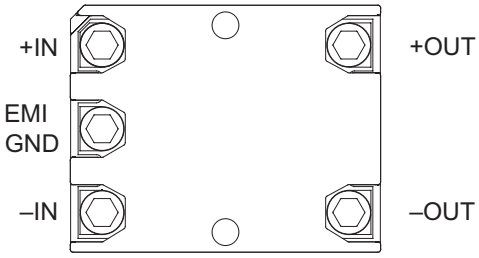

*DCM3714 VIA™ with a MFM input filter, to meet the MIL-STD-461E/F/G requirements*

| Parts List for Typical Application | |
|---|---|
| F | **Littelfuse** 0487 Series rated 8A<br>**Cooper/Bussman** PC-Tron Series, fast acting fuses rated 5A |
| $R_{IN_D}$ | **Vishay Dale** CRCW25123R30FKEG, 3.3Ω, 1W |
| $C_{IN}$ [b] | **TDK Corporation** C5750X6S2W225K250KA, 5 x 2.2µF (11µF) |
| **Parts List for Alternate Configuration** | |
| $C_{IN_1}$ [c] | **Rubycon** 450QXW100MEFC16X35, 100µF, 450V |

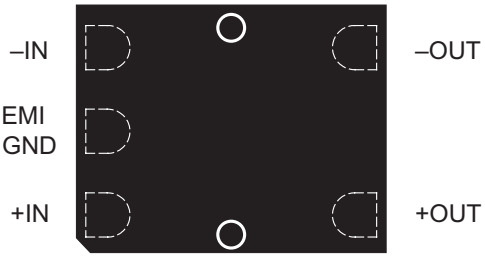
[b] A minimum load of 10% is required to meet the conducted emissions CE102 for input voltages in the range of 270 – 420$V_{DC}$. For EMI test report, contact Vicor Applications.

[c] No minimum load is required to meet CE102 with $C_{IN_1}$ = 100µF.

## Pin Configuration




**MFM1714 Filter – Chassis (Lug) Mount – Terminals Up**




**MFM1714 Filter – PCB Mount – Pins Down**

**Note:** These pin drawings are not to scale.

## Pin Descriptions

| Signal Name | Type | Function |
|---|---|---|
| +IN | INPUT POWER | Positive input power terminal |
| –IN | INPUT POWER RETURN | Negative input power terminal |
| EMI GND | EMI GROUND | EMI ground terminal |
| +OUT | OUTPUT POWER | Positive output power terminal |
| –OUT | OUTPUT POWER RETURN | Negative output power terminal |

## Absolute Maximum Ratings

The absolute maximum ratings below are stress ratings only. Operation at or beyond these maximum ratings can cause permanent damage to the device. Electrical specifications do not apply when operating beyond rated operating conditions.

| Parameter | Comments | Min | Max | Unit |
|---|---|---|---|---|
| Input Voltage (+IN to –IN) | Continuous | –0.5 | 460.0 | V |
| Output Voltage (+OUT to –OUT) | Continuous | –0.5 | 460.0 | V |
| Dielectric Withstand (Input/Output to EMI GND/Case) | | | 2121 | $V_{DC}$ |
| Storage Temperature | M-Grade | –65 | 125 | °C |
| Internal Operating Temperature | M-Grade | –55 | 125 | °C |
| Average Output Current | | | 4 | A |
| Input/Output Pin Torque and Mounting Torque | | | 4 [0.45] | in·lbs [N·m] |

## Electrical Specifications

Specifications apply over all line and load conditions, unless otherwise noted; **boldface** specifications apply over the temperature range of –55°C ≤ $T_{CASE}$ ≤100°C (M-Grade); all other specifications are at $T_{CASE}$ = 25°C unless otherwise noted.

| Attribute | Symbol | Conditions / Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Power Input / Output Specification** | | | | | | |
| Input Voltage Range | $V_{IN}$ | Continuous operation | 160 | 270 | 420 | V |
| Maximum Output Current [d] | $I_{OUT_MAX}$ | Continuous, at $V_{OUT}$ = 160V ($I_{OUT} = P_{OUT}/V_{IN}$) | | | 4 | A |
| Rated Output Power [d] | $P_{OUT}$ | Continuous, over all line conditions | | | 640 | W |
| Internal Voltage Drop | | @270V, 2.37A, 100°C baseplate | | | **0.80** | $V_{DC}$ |
| Efficiency | η | Full load, low line, high temperature | **99.4** | 99.6 | 99 | % |
| | | Full load, nominal line, high temperature | **99.7** | 99.8 | | % |
| | | Full load, high line, high temperature | **99.8** | 99.9 | | % |

[d] One MFM for each DCM™ even if the total power of the DCM is below $P_{OUT}$ maximum value.

## EMI/EMC

| Standard | Test Procedure | Notes |
|---|---|---|
| | | |
| **MIL-STD-461E/F/G** | | |
| Conducted Emmisions | CE101 | Figure CE101-4, Navy ASW & Army Aircraft, Curve #1 (above 28$V_{DC}$) |
| | CE102 | Figure CE102-1, Basic curve + 10dB limit relaxation for all applications |
| Conducted Susceptibility | CS101 | Figure CS101, Curve #1, for all applications (above 28$V_{DC}$) |
| | | |
| **MIL-HDBK-704-7** | | |
| Transient Immunity | MIL-STD-704F normal transients | From table HDC105-III: overvoltage 330$V_{DC}$ for 20ms duration, undervoltage 200$V_{DC}$ for 50ms duration |
| | MIL-STD-704F abnormal transients | From table HDC302-III: overvoltage 350$V_{DC}$ for 50ms duration, undervoltage 180$V_{DC}$ for 50ms duration |

## Typical Characteristics

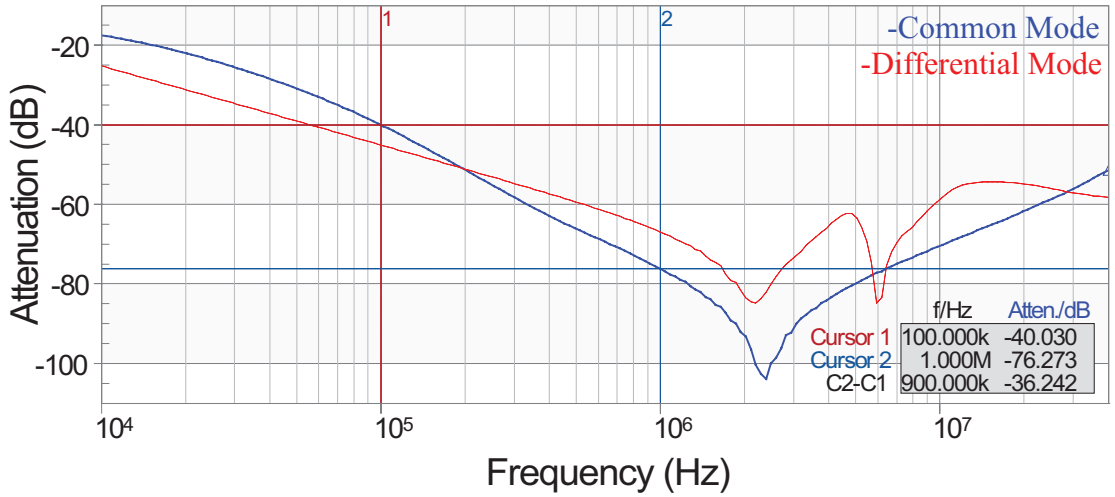



***Figure 1 —*** *Attenuation (dB) vs. frequency (Hz), input leads are terminated with LISN impedances 25Ω for common mode, 100Ω for differential mode*

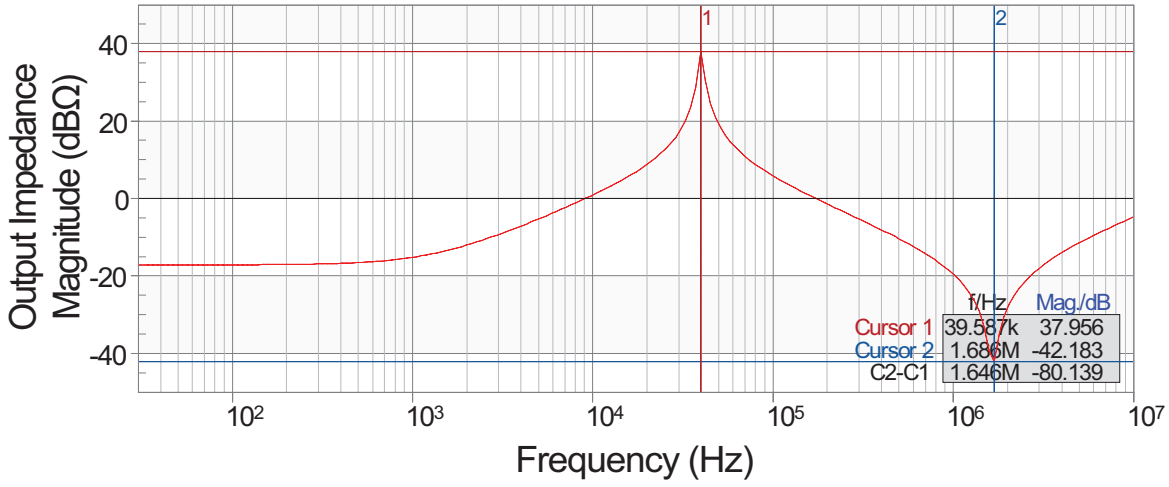



***Figure 2 —*** *Output Impedance (dBΩ) vs. frequency (Hz) plot looking back into the output terminals of the MFM with shorted input terminals*

## Typical Conducted Emissions

CE101 peak scans with MFM1714VD2KD2F4M00 and DCM3714VD2K26E0M01 or DCM3714VD2K31E0T01, in either condition: –OUT connected to GND or –OUT floating.

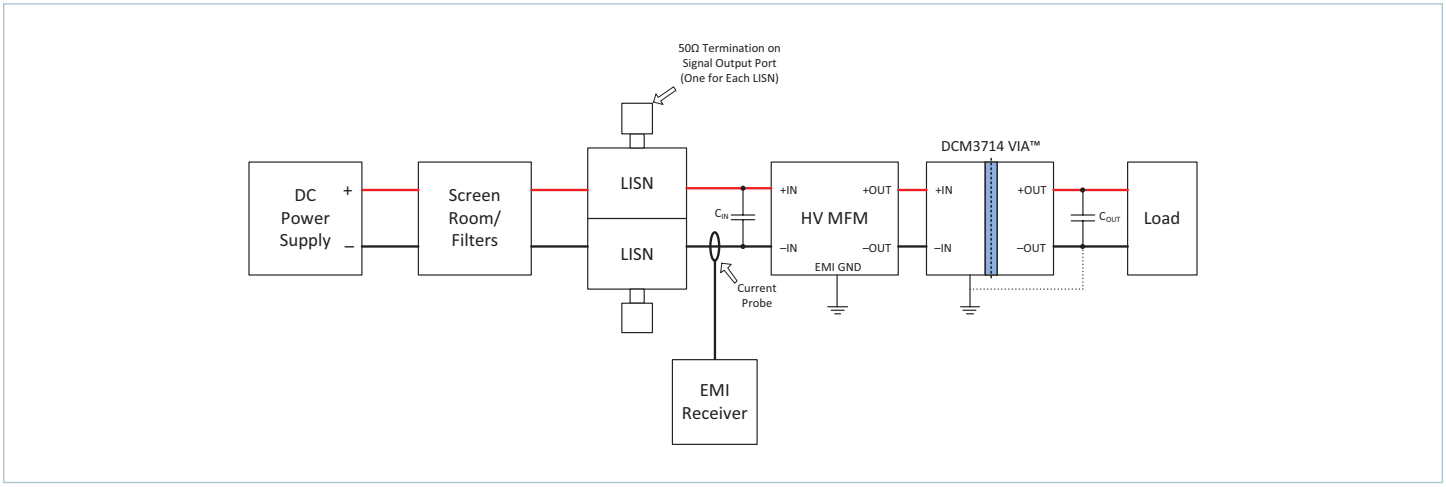



***Figure 3 —*** *A typical test setup for conducted emissions CE101 is shown above. A current probe is used to measure and plot the variations in the current through the RED and BLACK leads at various load conditions.*

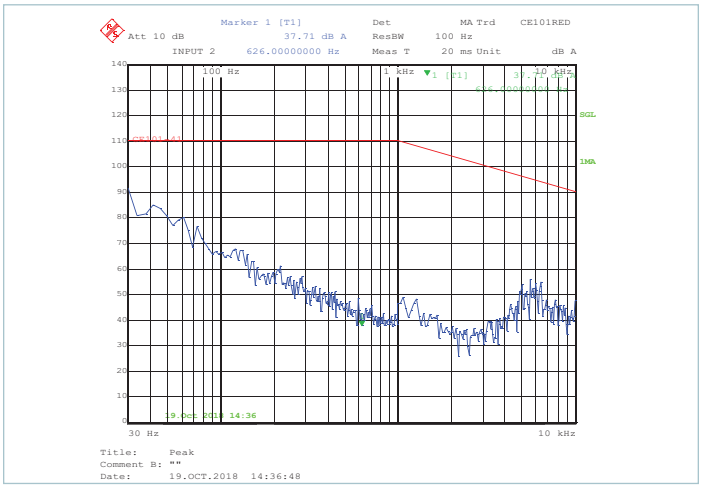



***Figure 4 —*** *Peak scan for the RED lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 0% load, $V_{IN}$ = 160V*

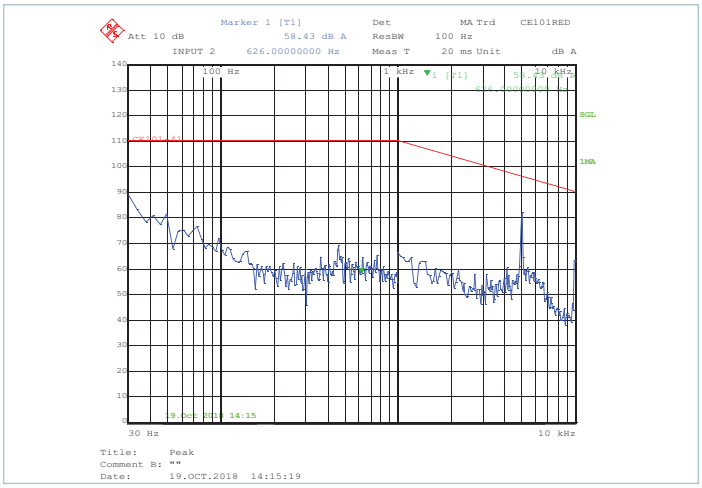



***Figure 5 —*** *Peak scan for the RED lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 100% load, $V_{IN}$ = 160V*

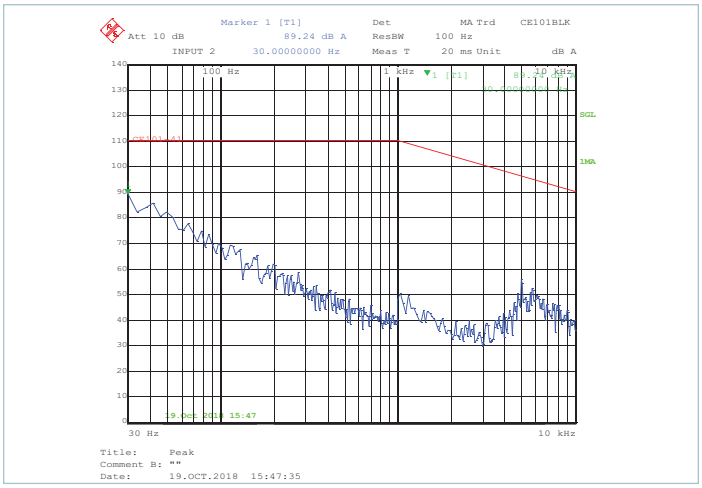



***Figure 6 —*** *Peak scan for the BLACK lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 0% load, $V_{IN}$ = 160V*

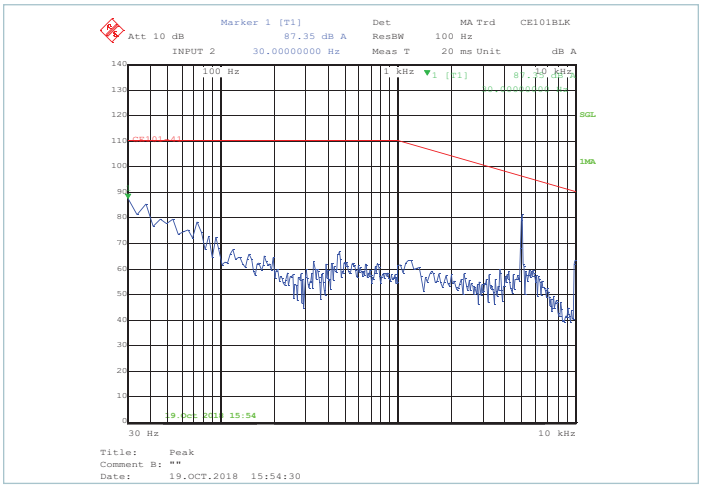



***Figure 7 —*** *Peak scan for the BLACK lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 100% load, $V_{IN}$ = 160V*

## Typical Conducted Emissions (Cont.)

CE101 peak scans with MFM1714VD2KD2F4M00 and DCM3714VD2K26E0M01 or DCM3714VD2K31E0T01, in either condition:
–OUT connected to GND or –OUT floating.

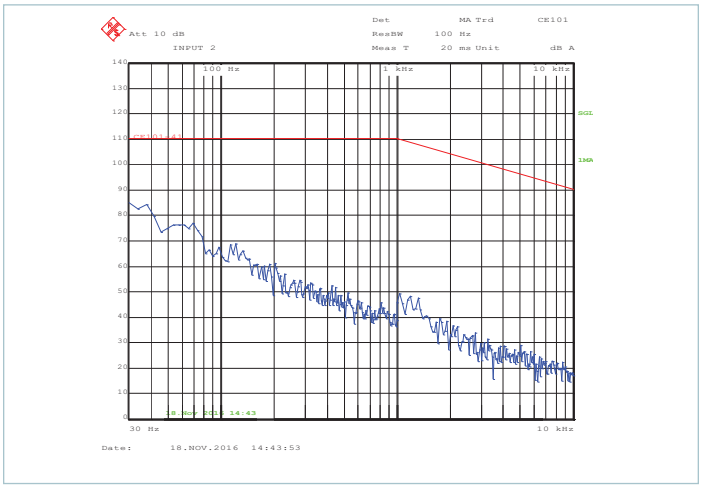



***Figure 8 —*** *Peak scan for the RED lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 0% load*

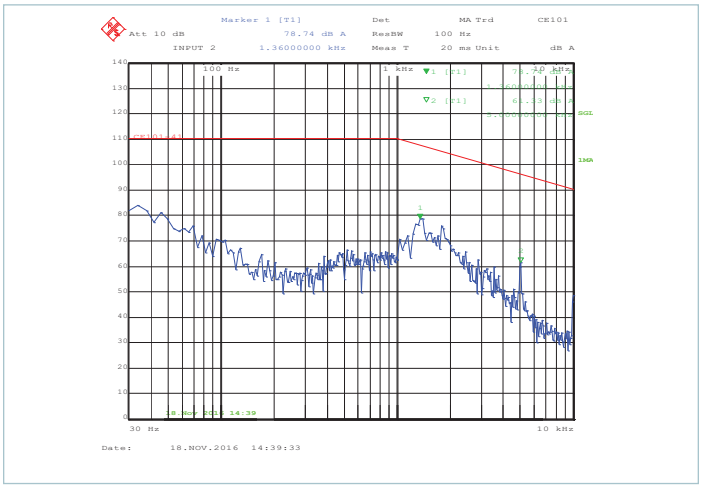



***Figure 9 —*** *Peak scan for the RED lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 100% load*

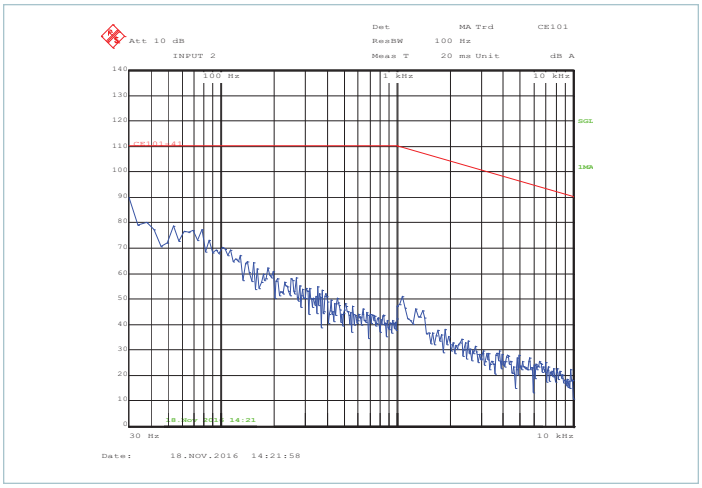



***Figure 10 —*** *Peak scan for the BLACK lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 0% load*

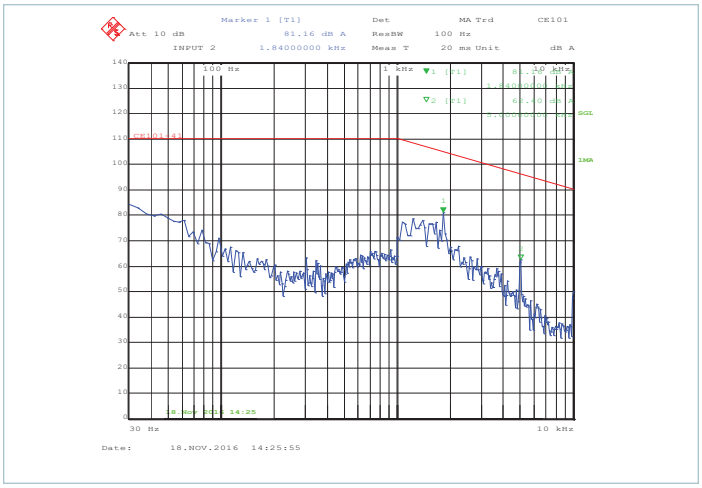



***Figure 11 —*** *Peak scan for the BLACK lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 100% load*

## Typical Conducted Emissions (Cont.)

CE102 peak scans with MFM1714VD2KD2F4M00 and DCM3714VD2K26E0M01 or DCM3714VD2K31E0T01, –OUT connected to GND, –OUT is floating.

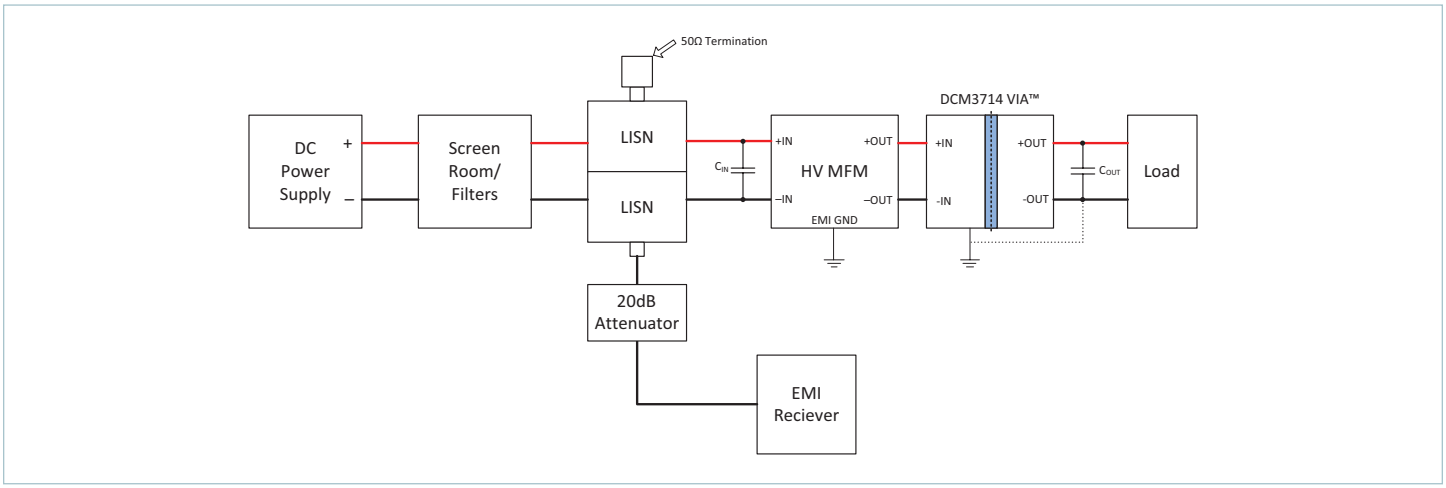



***Figure 12 —*** *A typical test setup for conducted emissions CE102 is shown above. A 50Ω termination is used for LISN and voltage across the RED and BLACK leads are measured at various load conditions.*

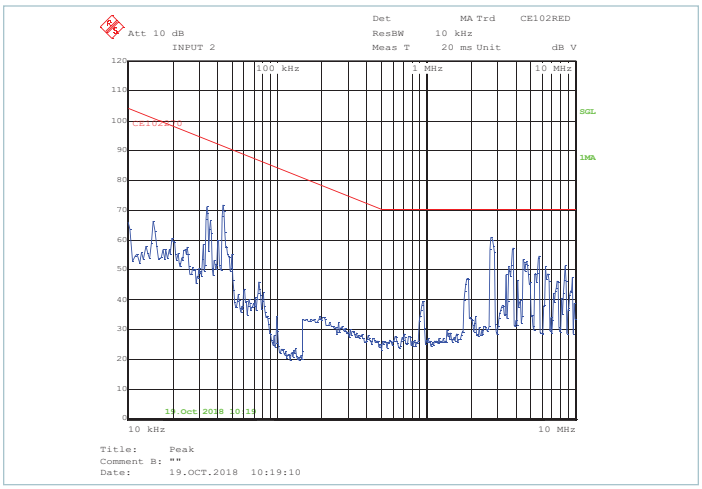



***Figure 13 —*** *Peak scan for the RED lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 0% load, $V_{IN}$ = 160V*

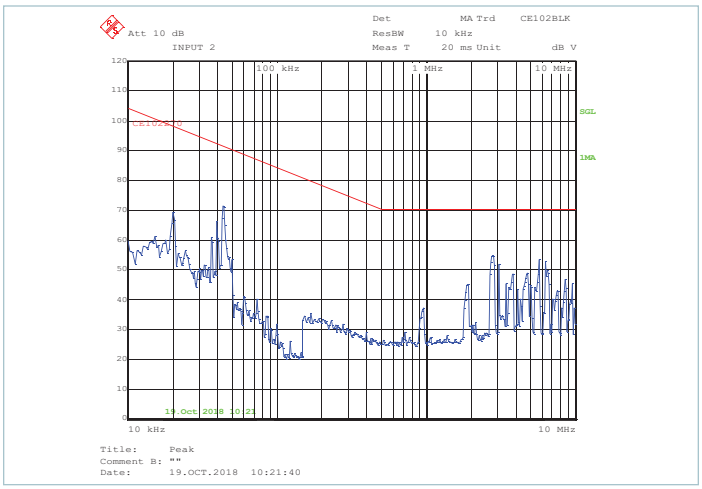



***Figure 14 —*** *Peak scan for the RED lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 100% load, $V_{IN}$ = 160V*

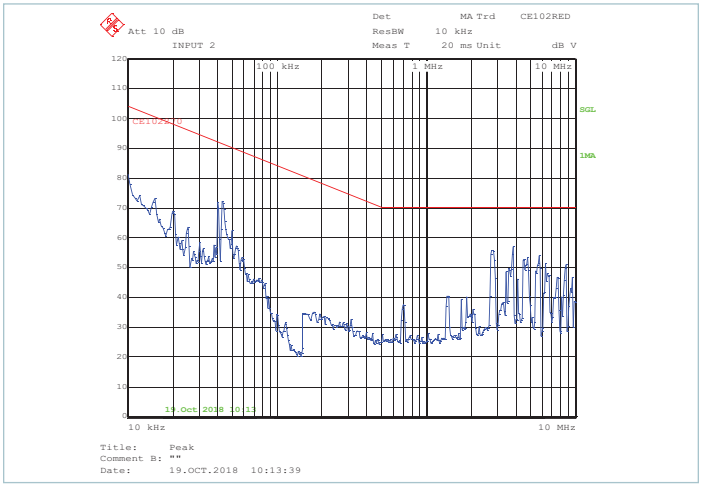



***Figure 15 —*** *Peak scan for the BLACK lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 0% load, $V_{IN}$ = 160V*

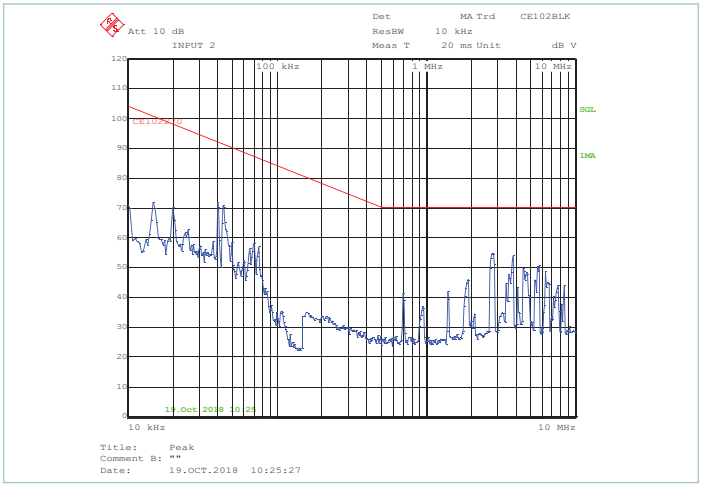



***Figure 16 —*** *Peak scan for the BLACK lead with $C_{IN}$ = 11µF, $R_{IN_D}$ = 3.3Ω $C_{OUT}$ = 2200µF, 100% load, $V_{IN}$ = 160V*

**Note:** A minimum load of 10% is required to meet the conducted emissions CE102 for input voltages in the range of 270 – 420$V_{DC}$. For EMI test report, contact Vicor Applications.

## Typical Conducted Emissions (Cont.)

CE102 peak scans with MFM1714VD2KD2F4M00 and DCM3714VD2K26E0M01 or DCM3714VD2K31E0T01, –OUT connected to GND, –OUT is floating.

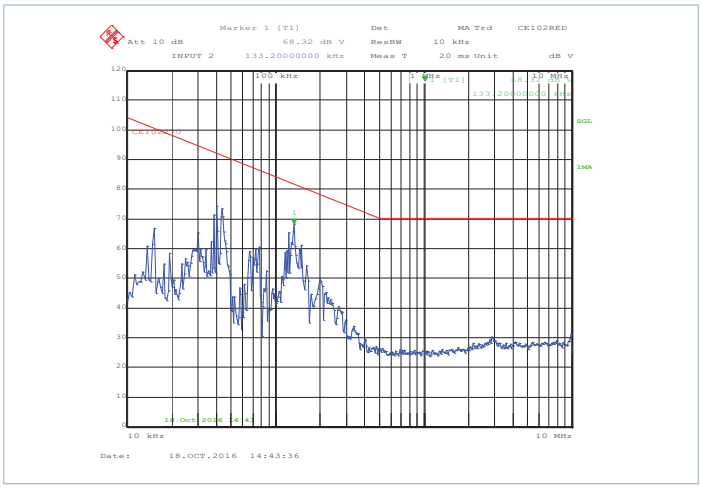



***Figure 17 —*** *Peak scan for the RED lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 0% load*

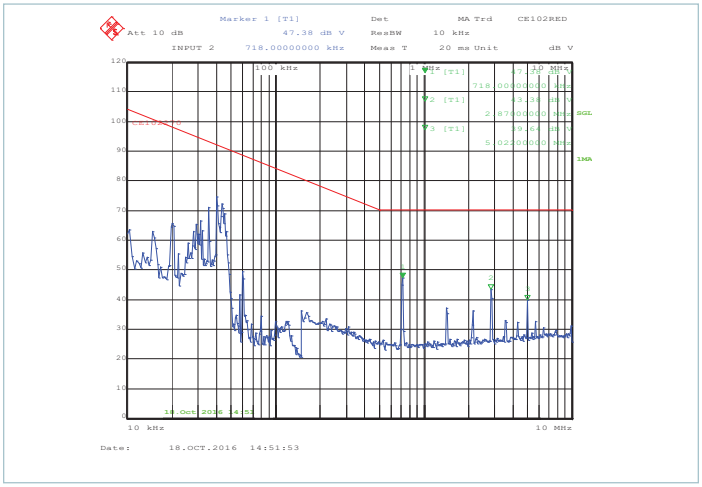



***Figure 18 —*** *Peak scan for the RED lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 100% load*

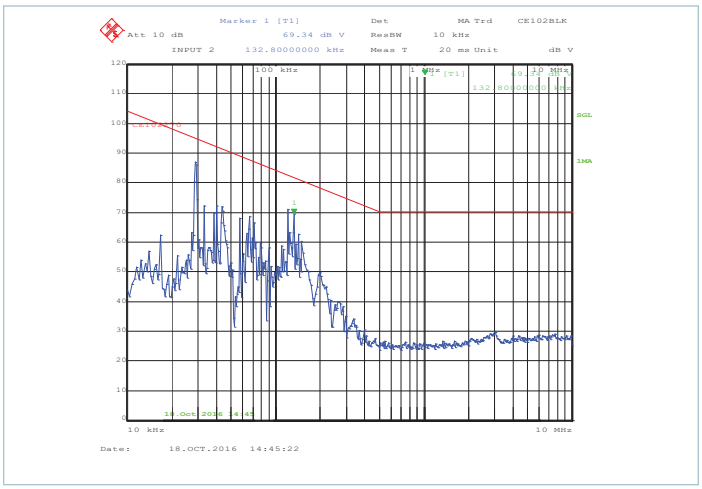



***Figure 19 —*** *Peak scan for the BLACK lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 0% load*

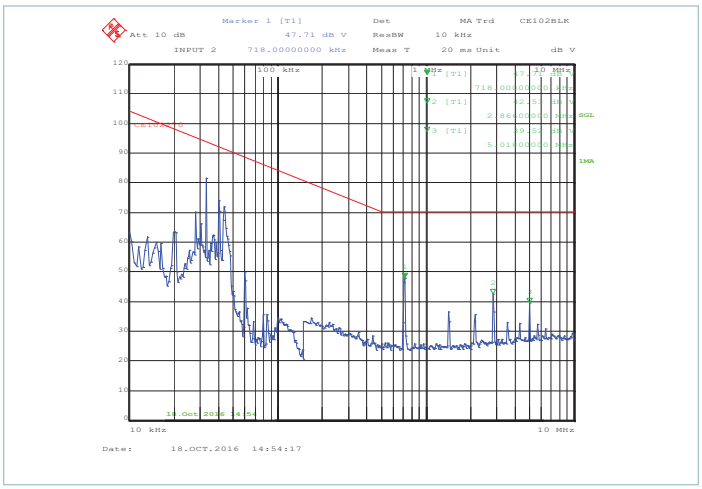



***Figure 20 —*** *Peak scan for the BLACK lead with $C_{IN_1}$ = 100µF, $C_{OUT}$ = 2000µF, 100% load*

**Note:** No minimum load is required to meet CE102 with $C_{IN_1}$ = 100µF.

## General Characteristics

Specifications apply over all line and load conditions, $T_{INT}$ = 25°C, unless otherwise noted; **boldface** specifications apply over the temperature range of the specified product grade.

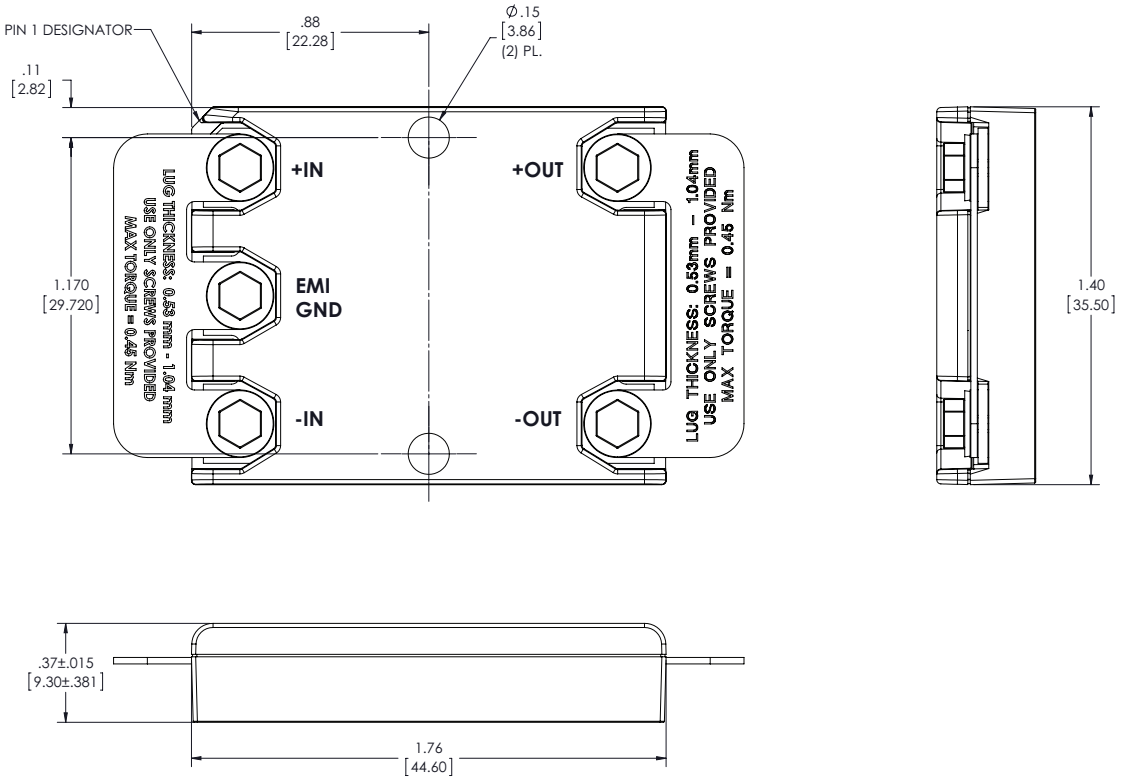
| Attribute | Symbol | Conditions / Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Mechanical** | | | | | | |
| Length | L | | | 44.6 [1.76] | | mm [in] |
| Width | W | | | 35.5 [1.39] | | mm [in] |
| Height | H | | | 9.22 [0.36] | | mm [in] |
| Volume | Vol | | | 14.5 [0.88] | | $cm^3$ [$in^3$] |
| Mass (Weight) | M | | | 30 [1.06] | | g [oz] |
| Pin Material | | C145 copper, 1/2 hard | | | | |
| Underplate | | Low-stress ductile Nickel | 50 | | 100 | µin |
| Pin Finish | | Palladium | 0.8 | | 6 | µin |
| | | Soft Gold | 0.12 | | 2 | |
| Flatness | | | | | <0.25 [0.010] | mm [in] |
| | | | | | | |
| **Thermal** | | | | | | |
| Internal Operating Temperature[e] | | M-Grade | –55 | | 125 | °C |
| Case Temperature | | M-Grade | –55 | | 100 | |
| Thermal Resistance, Internal to Case Non-Pin Side | $\theta_{INT_NON_PIN_SIDE}$ | | | 6.5 | | °C/W |
| | | | | | | |
| **Soldering** | | | | | | |
| Temperature | | See: AN:401 PCB Mount VIA Soldering Guidelines | | | | |
| | | | | | | |
| **Reliability** | | | | | | |
| MTBF | | MIL-HDBK-217FN2 Parts Count - 25°C Ground Benign, Stationary, Indoors / Computer | 60 | | | MHrs |
| | | | | | | |
| **Safety** | | | | | | |
| Dielectric Withstand | | Input / Output to EMI GND/Case | 2121 | | | $V_{DC}$ |
| Agency Approvals / Standards | | | | | | |
| | | | | | | |
| | | CE marked for Low Voltage Directive (LVD) 2014/35/EU, EN60950-1 | | | | |

[e] Internal operating temperatures will be kept to acceptable limits if the lower housing of the unit is mounted to a metal plate (coldplate or heat sink) with thermal grease that is kept to 100°C or less. If the unit is not mounted to a metal plate, then a thermocouple on the non-pin-side housing located midway between the two mounting holes needs to be kept to 100°C or less.

## Environmental Qualification

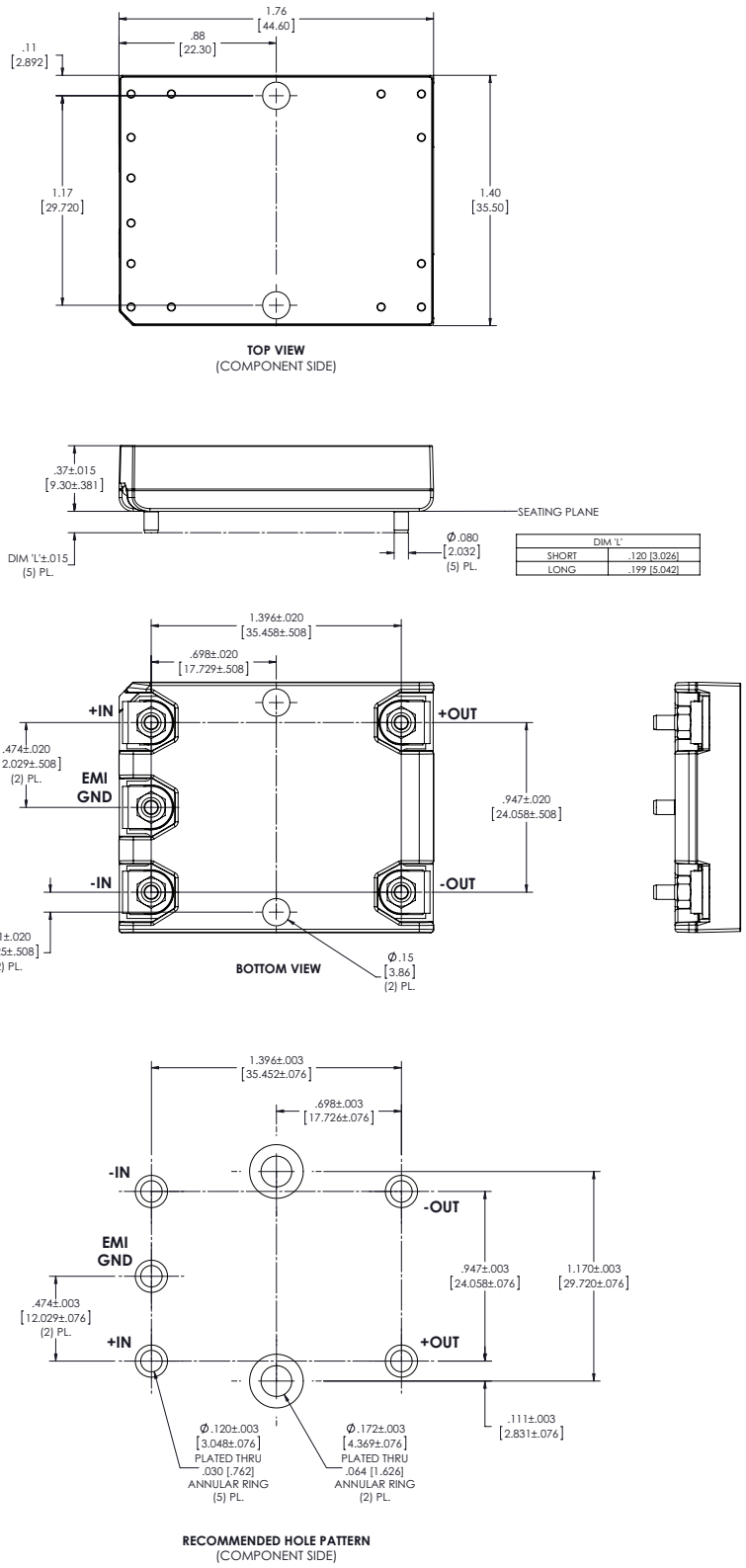
| Testing Activity | Reference Standard | Test Details |
|---|---|---|
| HTOB-HTOL High-Temperature Operating Bias/Life | JESD22-A110-B | Duration of 1000hrs, high Line, full load, max operating temperature, power cycled per IPC9592 |
| TC (Temperature Cycling) | JESD22-A104D | 1000 cycles –55 to 125°C |
| HALT (Highly Accelerated Life Test) | DP-0266 | Low temp, high temp, rapid thermal cycling, random vibration test, combined stress test |
| THB (Temperature Humidity Bias) | JEDSD22-A101C | Duration of 1000hrs, biased, 85°C, 85%RH |
| HTS (High Temperature Storage) | JESD 22-A103-D | Duration 1000hrs, no bias. Maximum storage temperature (125°C) |
| LTS (Low Temperature Storage) | JESD22–A119 | Duration 1000hrs, no bias. Minimum storage temperature (–65°C) |
| Random Vibration | MIL-STD-810G | Method 514.6, Procedure I, Category 24, mounted on QA |
| Mechanical Shock | MIL-STD-810G | Method 516.5, Procedure I, Environment: functional shock 40G, mounted on QA |
| Electro Static Discharge Human Body Model | JEDEC JS-001-2012 | Table 2B, Class 2, ±2000V minimum |
| Electro Static Discharge Device Charge Model | JESD22-C101-E | Class III ±500V minimum |
| Free Fall | IPC9592B | IEC 60068-2-32, freefall procedure 1 |
| Term Strength | MIL-STD-202G | Method 211A, Test Condition A, Environment: Ambient temperature & %Rh. |
| Through-Hole Solderability | IPC-9592B | IPC/ECA J-STD-002 Test A (dip and look) |
| Salt Fog | MIL-STD-810G | Method 509.5 |
| Fungus | MIL-STD-810G | Method 508.6 |
| Resistance to Solvents | MIL-STD-202G | Method 215K |
| Acceleration | MIL-STD-810G | Method 513.6 Procedure II |
| Altitude | MIL-STD-810G | Method 500.5 Procedure I & II |
| Explosive Atmosphere | MIL-STD-810G | Method 511.5 Procedure I, operational |

## Chassis-Mount Outline Drawing




UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE: INCH [MM]

## Board-Mount Outline Drawing




UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE: INCH [MM]

## Revision History

| Revision | Date | Description | Page Number(s) |
|---|---|---|---|
| 1.0 | 02/13/17 | Initial release | n/a |
| 1.1 | 06/15/17 | Updated product image | 7, 8 |
| 1.2 | 07/26/17 | Added fuse recommendation for typical application & remvoed MOV<br>Updated internal operting temperature<br>Updated note on CE scans for –OUT floating<br>Updated MTBF rating | 2<br>4<br>7, 8<br>9 |
| 1.3 | 07/24/18 | Updated mechanical drawings | 11, 12 |
| 1.4 | 10/26/18 | Updated typical application<br>Updated typical conducted emissions | 2<br>7 – 10 |
| 1.5 | 03/31/20 | Updated MIL-STD-461 to the latest revision | 1, 2, 5 |

**Note:** pages added in Rev 1.4

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