LV MFM™ Filter

MFM1714x50M50C5yzz

Low Voltage MIL-COTS Input Filter Module

Features & Benefits

- 28V Nominal input
- 99% efficiency
- EMI filtering
  - MIL-STD-461E/F, selected CE and CS tests
- Input Transient protection
  - MIL-STD-1275A/B/D/E
  - MIL-STD-704A/F (MIL-HDBK-704-8) 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 350W
- Available in chassis and PCB mount
- Small size
  - 1.76" x 1.40" x 0.36" (44.6mm x 35.5mm x 9.2mm)

Typical Applications

- Defense
- Aerospace

Compatible Products

- Low input voltage DCM in a VIA Package
- Low input voltage ChiP[1] 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's 28V nominal input voltage VIA or ChiP[1] modules to meet conducted emission/conducted susceptibility per MIL-STD-461E/F; and input transients per MIL-STD-704A/F, MIL-STD-1275A/B/D/E and DO-160E. The MFM DCM Filter accepts an input voltage of 16 – 50V_{DC} (28V nominal input) and delivers output power up to 350W.

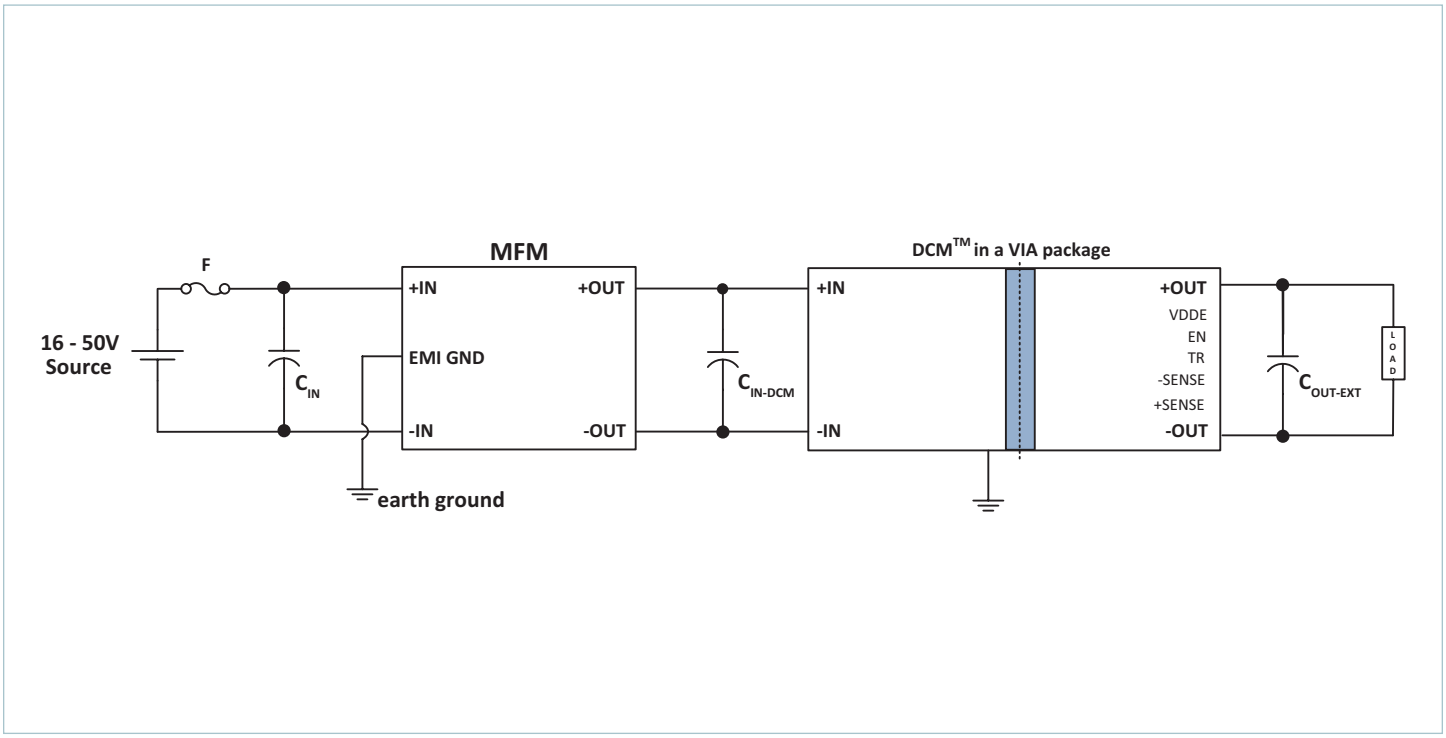
Size:
1.76 x 1.40 x 0.36in
44.6 x 35.5 x 9.2mm

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

Part Ordering Information

Product Function	Package Length	Package Width	Package Type	Max High Side Voltage	High Side Voltage Range Ratio	Max Low Side Voltage	Max Low Side Current	Product Grade (Case Temperature)	Option Field
MFM	17	14	x	50	M	50	C5	y	zz
MFM = MIL-COTS Input Filter Module	Length in Inches x 10	Width in Inches x 10	B = Board VIA V = Chassis VIA	Internal Reference				M = -55 to 100°C	00 = Chassis 04 = Short Pin 08 = Long Pin

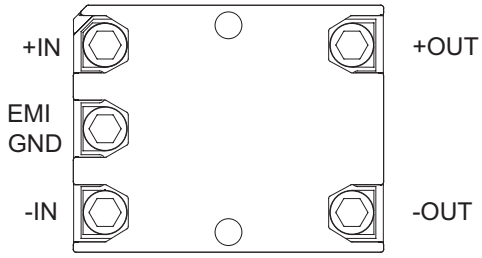
Typical Application



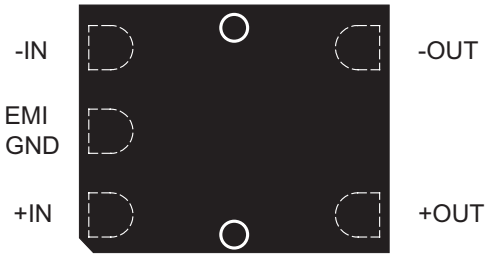
M-Grade DCM in a VIA package with a MFM input filter, to meet the EMI and transient requirements

Parts List for Typical Applications	
F	**EATON (Cooper/Bussman)** ABC series, fast acting tube fuses rated 30A **Littlefuse NANO2** 456 Series, surface mount fuses rated 30A

Pin Configuration



MFM Filter in a VIA Package - Chassis (Lug) Mount - Terminals Up



MFM Filter in a VIA Package - 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	65.0	V_{DC}
	Transient per MIL-STD-1275D/E, 50ms		100	
	Transient per MIL-STD-1275A/B/D, 70µs		250	
	Transient per DO-160E, 100ms		80	
Output Voltage (+OUT to –OUT)		-0.5	65.0	V_{DC}
Dielectric Withstand (Input/Output to EMI GND/Case)			1500	V_{DC}
Storage Temperature	M-Grade	-65	125	°C
Internal Operating Temperature	M-Grade	-55	125	°C
Average Output Current			22	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[2]	V_{IN}	Continuous operation	16	28	50	V
		Transient per MIL-STD-1275D/E, 50ms			100	
		Transient per MIL-STD-1275A/B/D, 70µs			250	
		Transient per DO-160E, 100ms			80	
Maximum Output Current[3]	I_{OUT_MAX}	Continuous, at V_{OUT} = 16V ($I_{OUT} = P_{OUT}/V_{IN}$)			22	A
Rated Output Power[3]	P_{OUT}	Continuous, over all line conditions			350	W
Internal Voltage Drop		@16V, 22A, 100°C baseplate			**0.65**	V_{DC}
Efficiency	η	Full load, low line, high temperature	**97.7**	98	98.2	%
		Full load, nominal line, high temperature	**99.2**	99.4		%
		Full load, high line, high temperature	**99.7**	99.8		%

[2] Transient immunity specifications are met only when LV MFM is used with M-grade 16-50V_{IN} DCM in a VIA package.
[3] 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		
Conducted Emmisions	CE101	Figure CE101-4, Navy ASW & Army Aircraft, Curve #2 ($28V_{DC}$ or below)
	CE102	Figure CE102-1, Basic curve for all applications
Conducted Susceptibility	CS101	Figure CS101, Curve #2, for all applications ($28V_{DC}$ or below)
MIL-STD-1275		
Transient Immunity[4]	MIL-STD-1275A/B/D/E	$100V_{DC}$ for 50ms duration
		$250V_{DC}$ for 70µs
MIL-STD-704		
Transient Immunity[4]	MIL-STD-704A (MIL-HDBK-704-8) Normal Voltage Transients	From table LDC 105-II (A-J) overvoltage $70V_{DC}$ for 20ms duration; within the MIL-STD-1275 (100V for 50ms) transient condition
	MIL-STD-704B/C/D/E/F (MIL-HDBK-704-8) Normal Voltage Transients	From table LDC 105-III (AA-RR) overvoltage $50V_{DC}$ for 12.5ms duration, undervoltage $18V_{DC}$ for 15ms duration; within the normal operating input voltage range
	MIL-STD-704A (MIL-HDBK-704-8) Abnormal Voltage Transients	From table LDC 302-II (A-J) overvoltage $80V_{DC}$ for 50ms duration; within the MIL-STD-1275 (100V for 50ms) transient condition
	MIL-STD-704E/F (MIL-HDBK-704-8) Abnormal Voltage Transients	From Table LDC 302-IV (AAA-FFF), overvoltage test conditions; within the normal operating input voltage range
DO-160E		
Transient Immunity[4]	DO-160E sec. 16, cat. z	$80V_{DC}$ for 100ms

[4] Transient immunity specifications are met only when LV MFM is used with M-grade 16-$50V_{IN}$ DCM in a VIA package.

Typical Characteristics

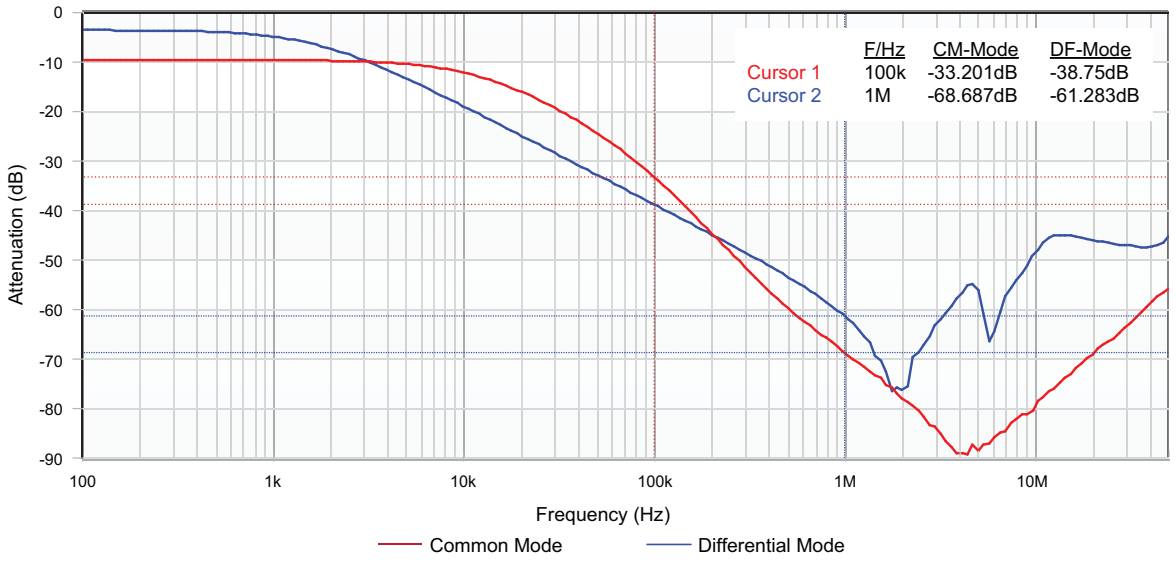


Figure 1 — *Attenuation (dB) vs. Frequency (Hz), input leads are terminated with LISN impedances 25Ω for common mode, 100Ω for differential mode*

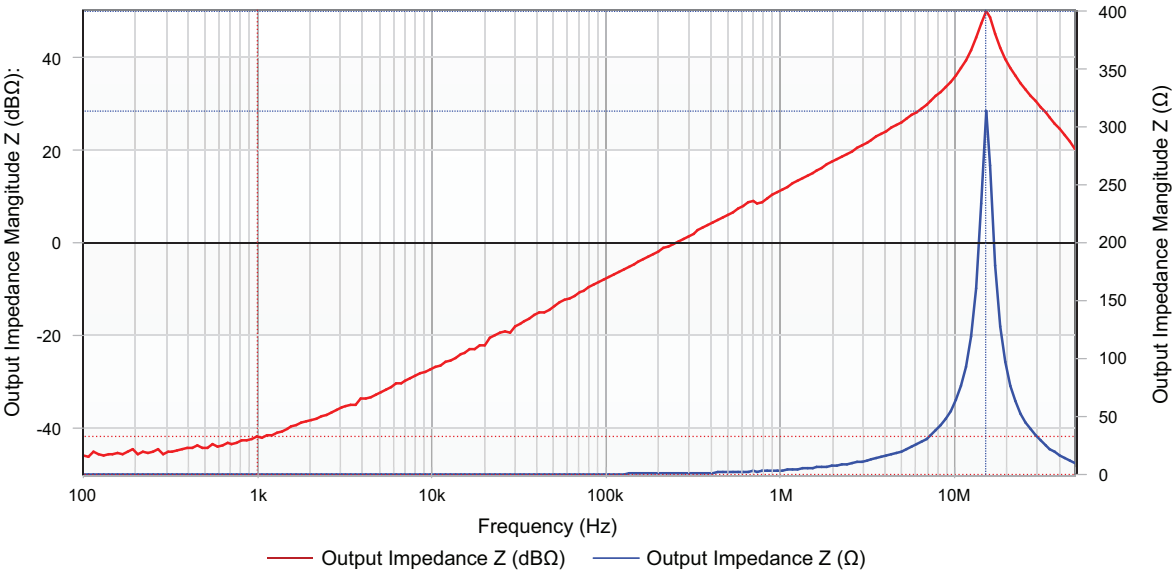


Figure 2 — *Output Impedance vs. Frequency (Hz) plot looking back into the output terminals of the MFM with shorted input terminals*

Typical Conducted Emissions

CE101 peak scans with MFM1714V50M50C5M00 and DCM3414V50M31C2T01, –OUT connected to GND, –OUT floating.

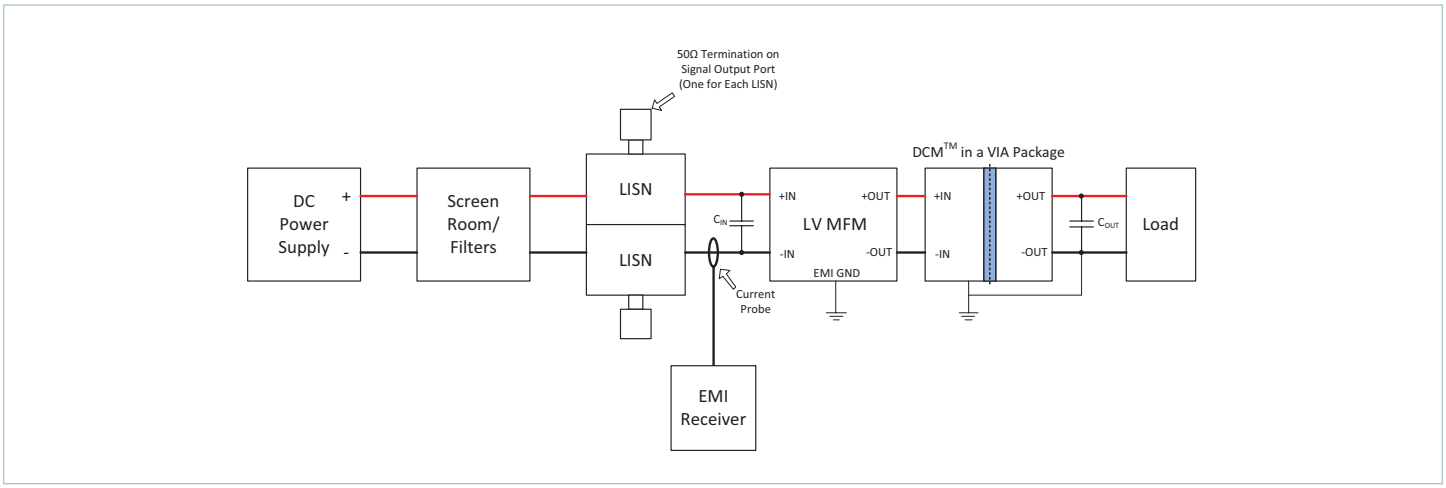


Figure 3 — *A typical test setup for conducted emissions CE101 is shown above. A current probe is used to measure and plot the variations in the current through the RED and BLACK leads at various load conditions.*

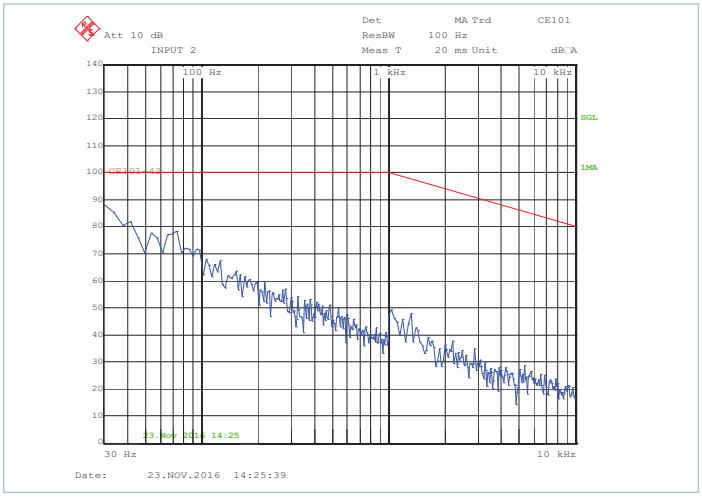


Figure 4 — *Peak scan for the RED lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

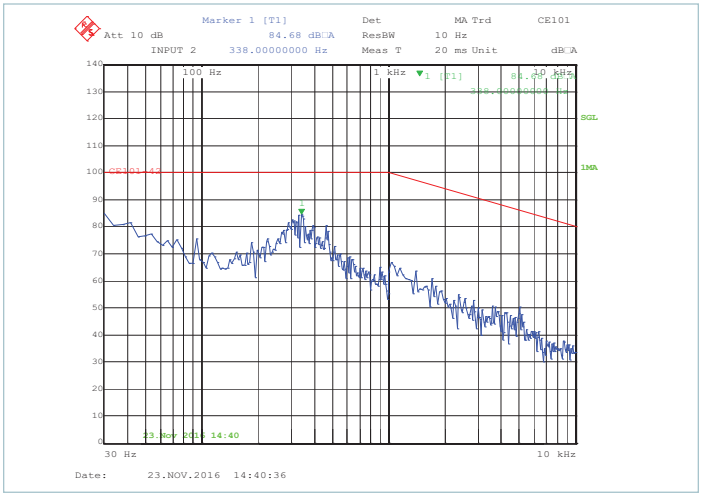


Figure 5 — *Peak scan for the RED lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

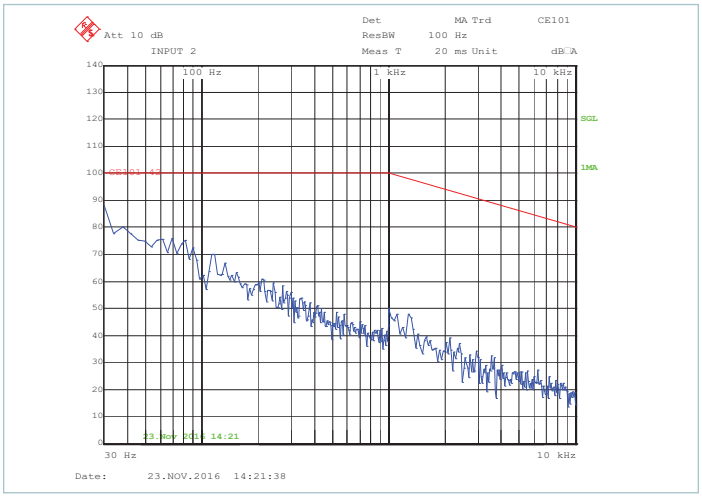


Figure 6 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

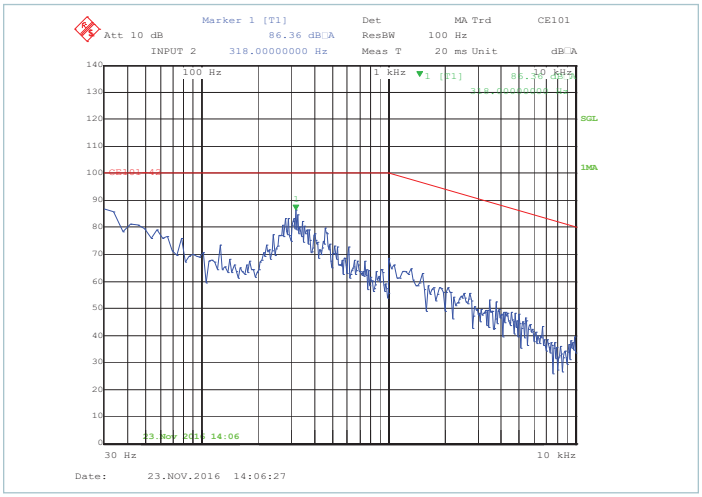


Figure 7 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

Typical Conducted Emissions (Cont.)

CE102 peak scans with MFM1714V50M50C5M00 and DCM3414V50M31C2T01, –OUT connected to GND, –OUT floating.

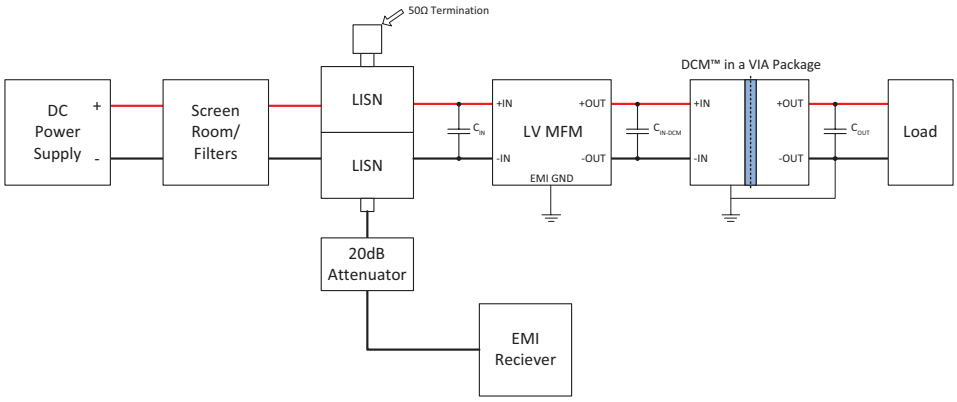


Figure 8 — *A typical test setup for conducted emissions CE102 is shown above. A 50Ω termination is used for LISN and voltage across the RED and BLACK leads are measured at various load conditions.*

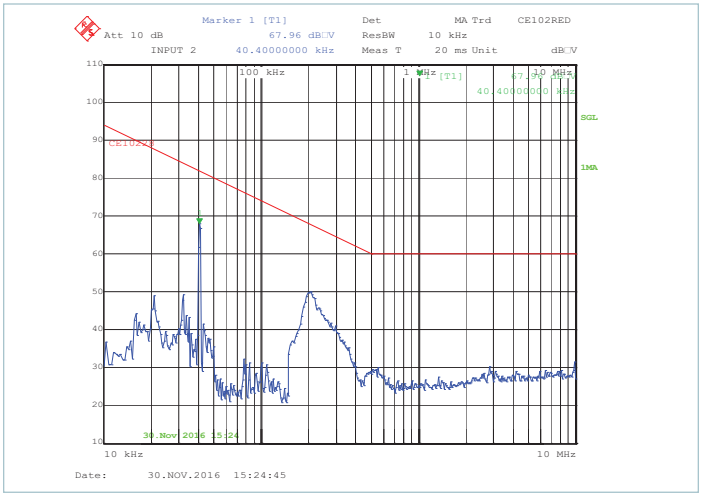


Figure 9— *Peak scan for the RED lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

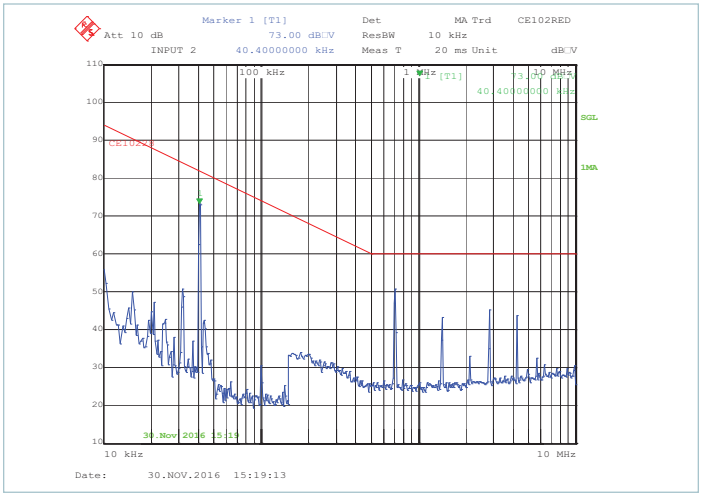


Figure 10 — *Peak scan for the RED lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

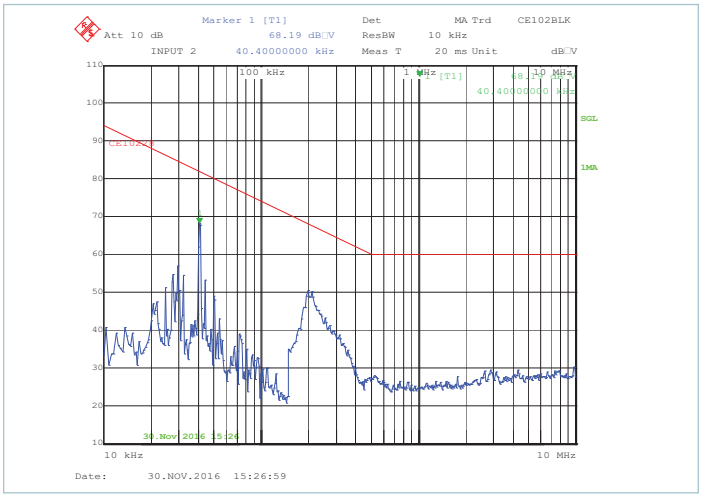


Figure 11 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

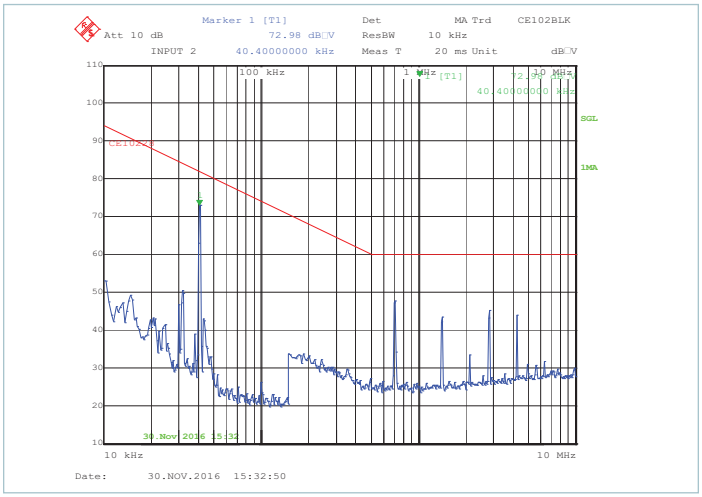


Figure 12 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

Electrical Power Characteristics

Transient immunity with MFM1714V50M50C5M00 and DCM3414V50M13C2M01 per MIL-STD-1275D/E.

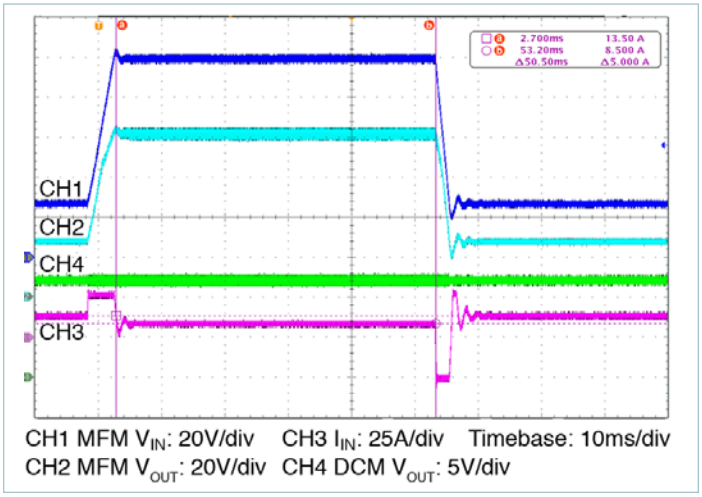


Figure 13 — *Transient immunity; LV MFM and DCM 3414 VIA output response to an 100V, 50ms input transient*

General Characteristics

Specifications apply over all line and load conditions, T_J = 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	Without heatsink		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		M-Grade	-55		125	°C
Case Temperature		M-Grade	-55		100	
Thermal Resistance, Junction to Case Bottom	θ_{INT_BOT}			14.29		°C/W
Thermal Resistance, Junction to Output Terminals	$\theta_{INT\_OUT\_TERMINALS}$			4.68		°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	6.6			MHrs
Safety						
Dielectric Withstand		Input / Output to EMI GND/Case	1500			V_{DC}
Agency Approvals / Standards						
		CE marked to the Low Voltage Directive (LVD) 2014/35/EU				

Environmental Qualification

Testing Activity	Reference Standard	Test Details
HTOB-HTOL High Temperature Operating Bias/Life	JESD22-A110-B	Duration of 1000 hrs, High Line, full load, max operating temperature, Power cycled per IPC9592
TC (Temperature Cycling)	JESD22-A104D	1000 cycles -55°C 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

Thermal Considerations

The customer needs to insure that the LV MFM is operated such that the internal components are kept within the maximum of the operating temperature range by monitoring/controlling the temperature of both the bottom plastic housing and the output terminals. To assist the customer, Vicor provides the simplified thermal circuit model of the LV MFM shown below in Figure 14. In this thermal circuit model, thermal resistance in units of °C/W is analogous to electrical resistance, temperature in °C is analogous to voltage, and the rate of heat transferred in W is analogous to current. The maximum internal temperature of the LV MFM can be estimated by the customer based on total power dissipated by the MFM, the temperature maintained on the bottom of the housing, and the temperature of the output terminals.

In the example shown in Figure 14, the bottom of the plastic housing is maintained by the customer at 70°C, the output terminals are measured to be about 100°C, and the LV MFM is dissipating 9W of heat. The resultant maximum internal temperature of the LV MFM can then be estimated at 124°C, which is close to the maximum in the operating temperature range. 4W of power is conducted through the lower housing, and the balance of 5W is conducted through the output terminals.

The LV MFM is best attached to a material with a high thermal conductivity (e.g., aluminum or copper) to maintain temperature uniformity across the bottom plastic housing.

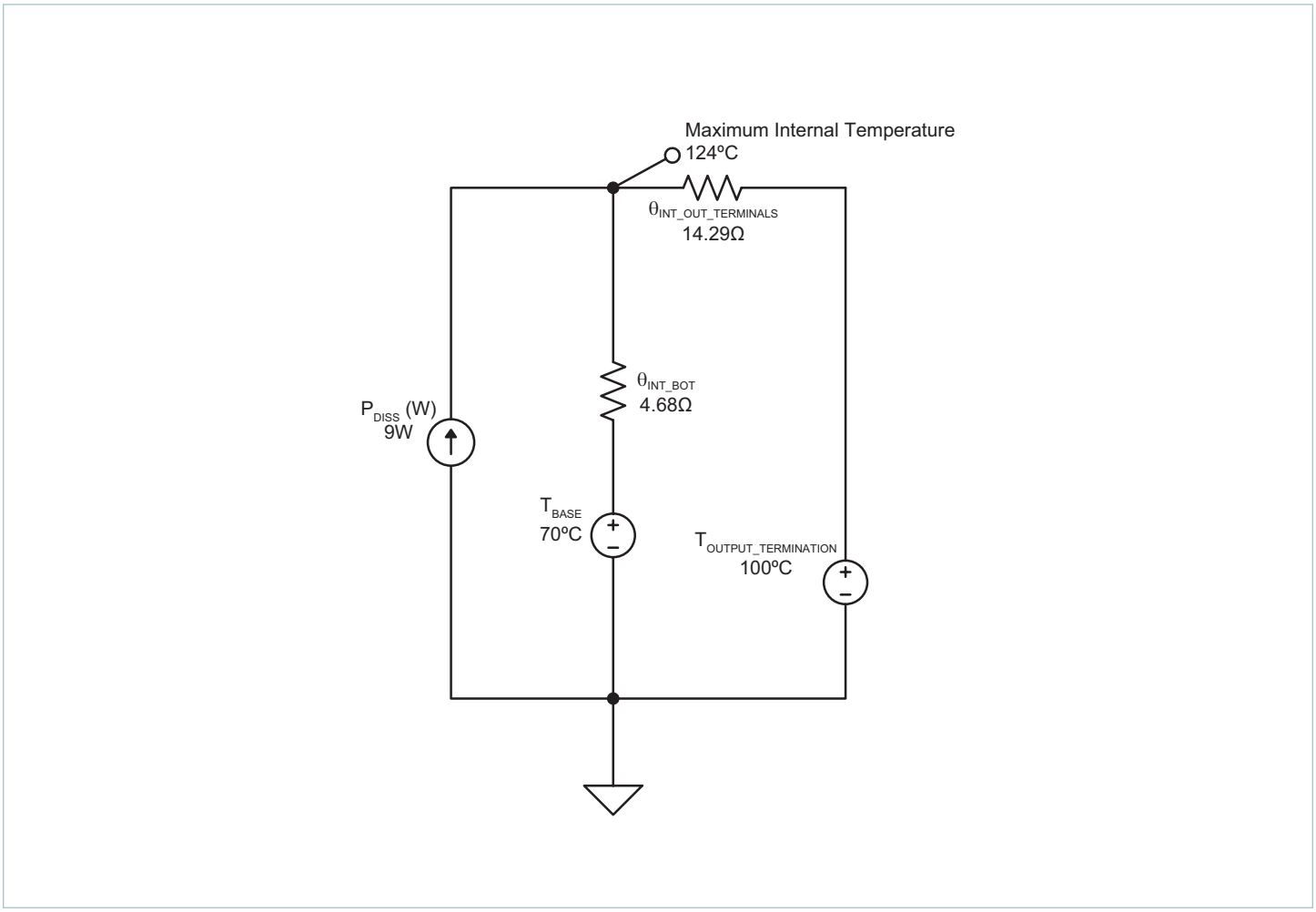
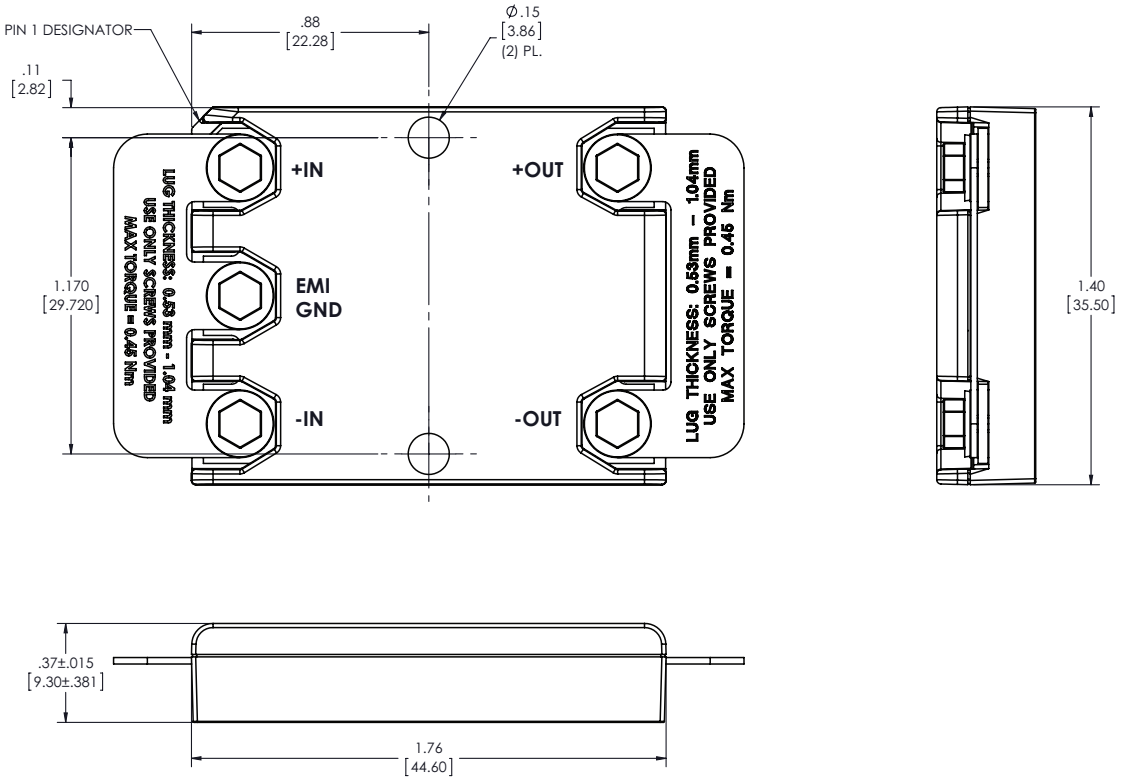


Figure 14 — *LV MFM thermal model*

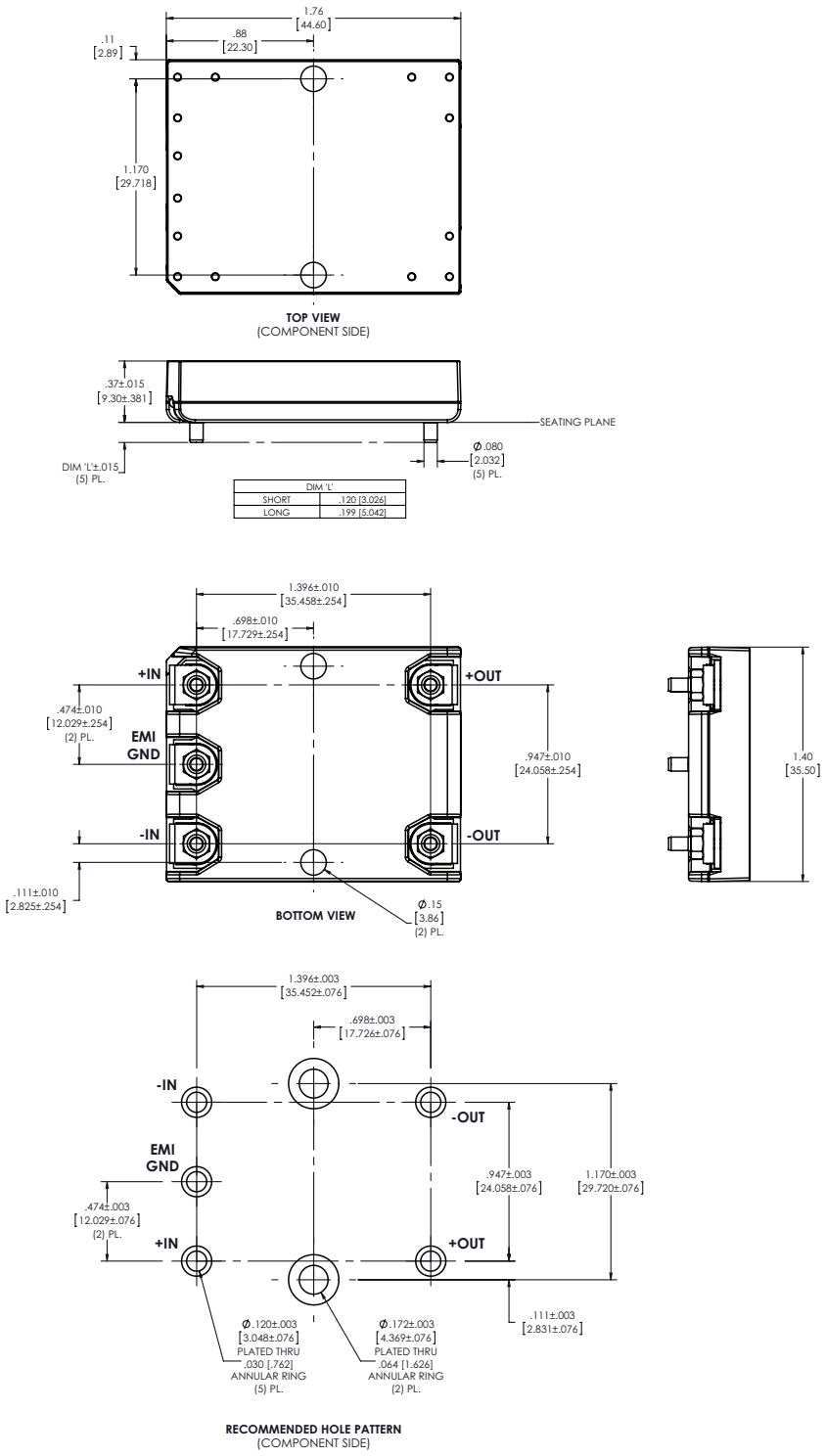
Chassis Mount Outline Drawing



NOTE:

1. RoHS COMPLIANT PER CST-0001 LATEST REVISION

Board Mount Outline Drawing



NOTE:
1. RoHS COMPLIANT PER CST-0001 LATEST REVISION

Revision History

Revision	Date	Description	Page Number(s)
1.0	06/07/17	Initial Release	n/a
1.1	07/26/17	Added fuse recommendation for typical application & remvoed MOV Updated internal operting temperature Updated note on CE scans for –OUT floating Updated MTBF rating	2 4 7, 8 10

Vicor's comprehensive line of power solutions includes high density AC-DC and DC-DC modules and accessory components, fully configurable AC-DC and DC-DC power supplies, and complete custom power systems.

Information furnished by Vicor is believed to be accurate and reliable. However, no responsibility is assumed by Vicor for its use. Vicor makes no representations or warranties with respect to the accuracy or completeness of the contents of this publication. Vicor reserves the right to make changes to any products, specifications, and product descriptions at any time without notice. Information published by Vicor has been checked and is believed to be accurate at the time it was printed; however, Vicor assumes no responsibility for inaccuracies. Testing and other quality controls are used to the extent Vicor deems necessary to support Vicor's product warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

Specifications are subject to change without notice.

Visit http://www.vicorpower.com/mil-cots-dc-dc/mfm-filter-module for the latest product information.

Vicor's Standard Terms and Conditions and Product Warranty

All sales are subject to Vicor's Standard Terms and Conditions of Sale, and Product Warranty which are available on Vicor's webpage (http://www.vicorpower.com/termsconditionswarranty) or upon request.

Life Support Policy

VICOR'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF VICOR CORPORATION. As used herein, life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness. Per Vicor Terms and Conditions of Sale, the user of Vicor products and components in life support applications assumes all risks of such use and indemnifies Vicor against all liability and damages.

Intellectual Property Notice

Vicor and its subsidiaries own Intellectual Property (including issued U.S. and Foreign Patents and pending patent applications) relating to the products described in this data sheet. No license, whether express, implied, or arising by estoppel or otherwise, to any intellectual property rights is granted by this document. Interested parties should contact Vicor's Intellectual Property Department.

The products described on this data sheet are protected by the following U.S. Patents Numbers:
Patents Pending.

Contact Us: http://www.vicorpower.com/contact-us

Vicor Corporation
25 Frontage Road
Andover, MA, USA 01810
Tel: 800-735-6200
Fax: 978-475-6715
www.vicorpower.com

email
Customer Service: custserv@vicorpower.com
Technical Support: apps@vicorpower.com