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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 0.36in [44.6 x 35.5 x 9.2mm]

Typical Applications

- Defense
- Aerospace

Compatible Products

- Low input voltage DCM3414 VIA™
- Low 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 28V nominal input voltage VIA™ or ChiP™[a] 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.

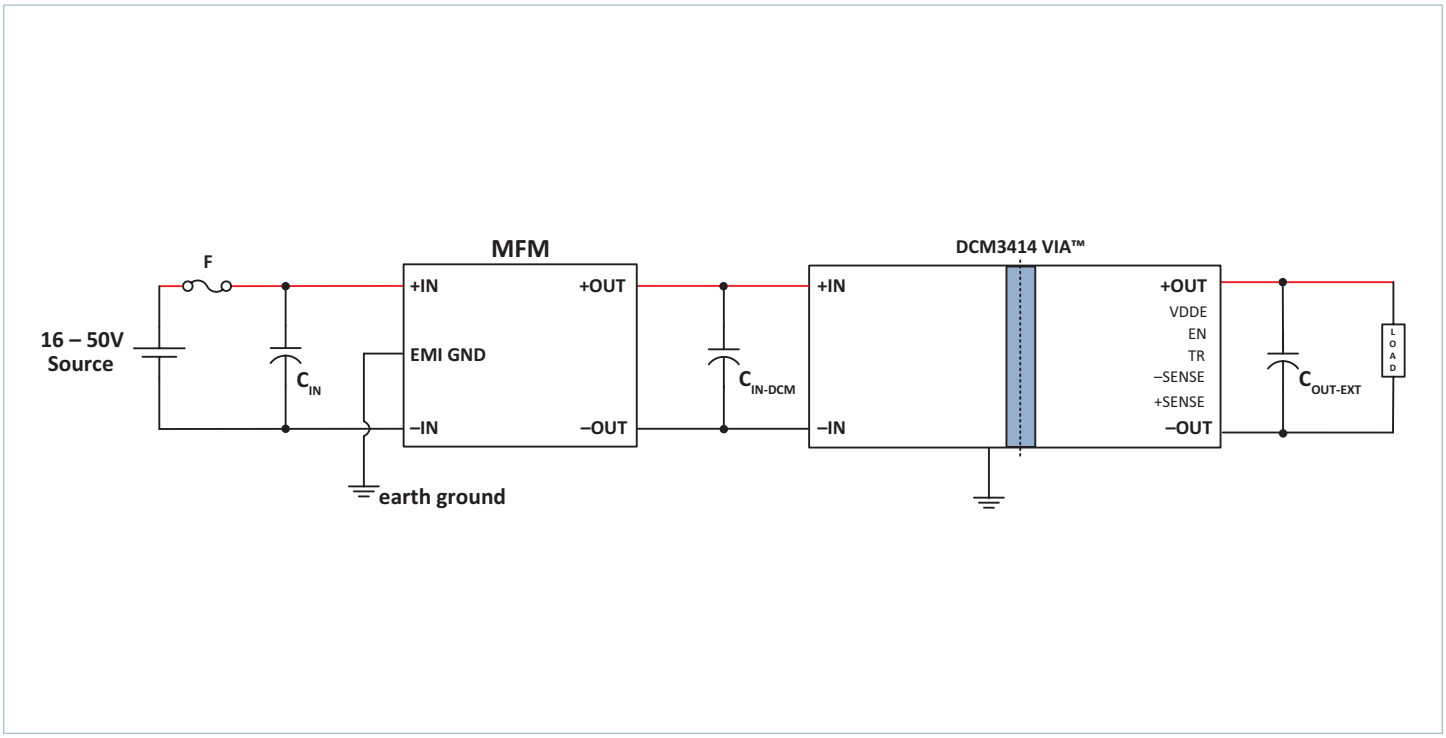
Size:
1.76 x 1.40 x 0.36in
[44.6 x 35.5 x 9.2mm]

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

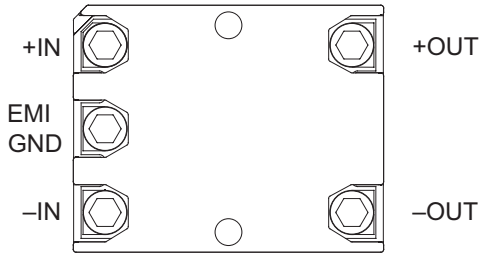
Typical Application



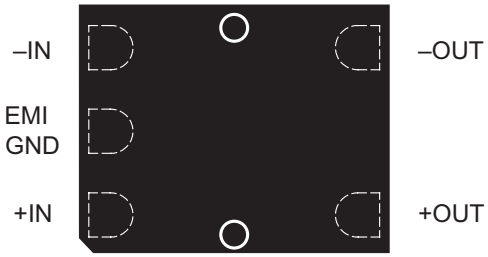
M-Grade DCM3414 VIA with an MFM input filter, to meet the EMI and transient requirements

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



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	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)	Continuous	–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[b]	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[c]	I_{OUT_MAX}	Continuous, at V_{OUT} = 16V (I_{OUT} = P_{OUT}/V_{IN})			22	A
Rated Output Power[c]	P_{OUT}	Continuous, over all line conditions			350	W
Internal Voltage Drop		@16V, 22A, 100°C case			**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		%

[b] Transient immunity specifications are met only when LV MFM is used with M-Grade 16 – 50V_{IN} DCM3414 VIA™.
[c] 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[d]	MIL-STD-1275A/B/D/E	$100V_{DC}$ for 50ms duration
		$250V_{DC}$ for 70µs
MIL-STD-704		
Transient Immunity[d]	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[d]	DO-160E sec. 16, cat. z	$80V_{DC}$ for 100ms

[d] Transient immunity specifications are met only when LV MFM is used with M-grade 16 – $50V_{IN}$ DCM3414 VIA™.

Typical Characteristics

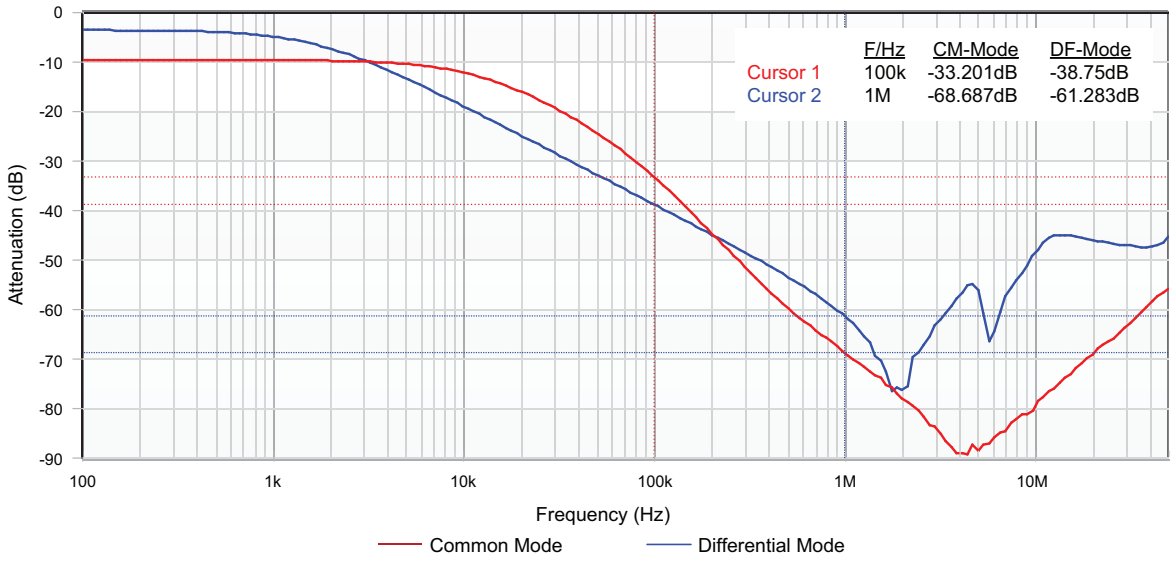


Figure 1 — *Attenuation (dB) vs. frequency (Hz), input leads are terminated with LISN impedances 25Ω for common mode, 100Ω for differential mode*

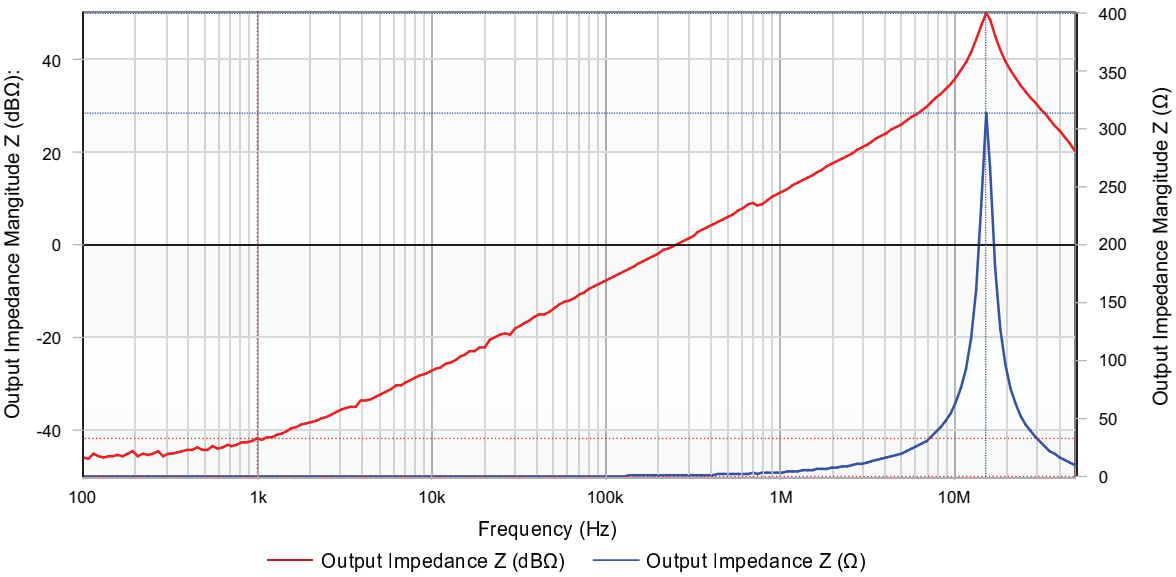


Figure 2 — *Output impedance vs. frequency (Hz) plot looking back into the output terminals of the MFM with shorted input terminals*

Typical Conducted Emissions

CE101 peak scans with MFM1714V50M50C5M00 and DCM3414V50M31C2T01, in either condition: –OUT connected to GND or –OUT floating.

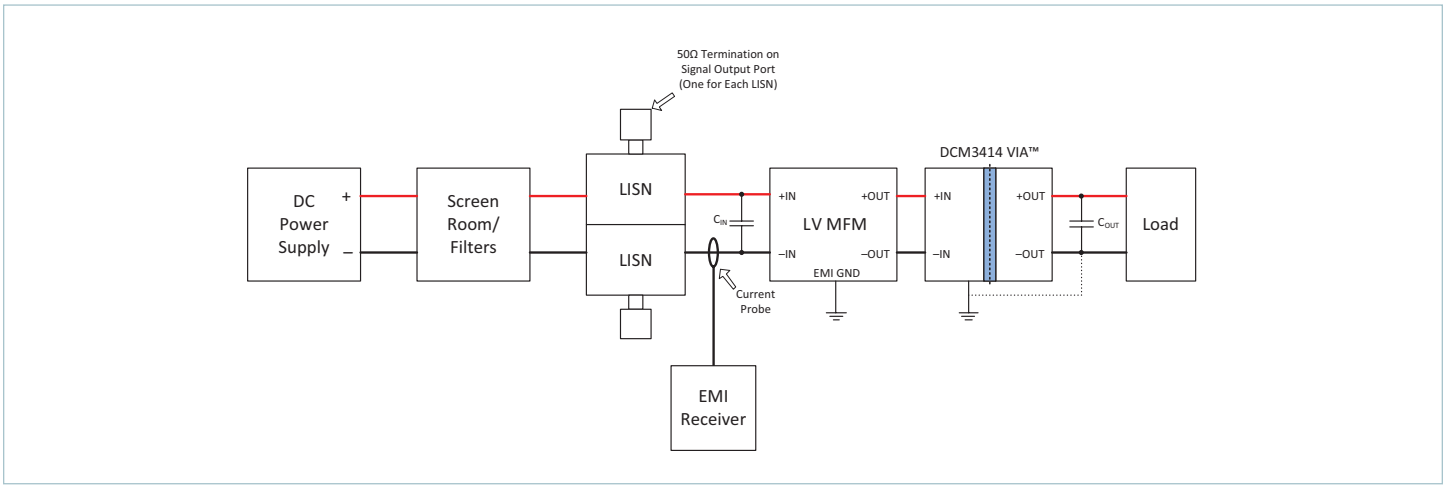


Figure 3 — *A typical test set up for conducted emissions CE101 is shown above. A current probe is used to measure and plot the variations in the current through the RED and BLACK leads at various load conditions.*

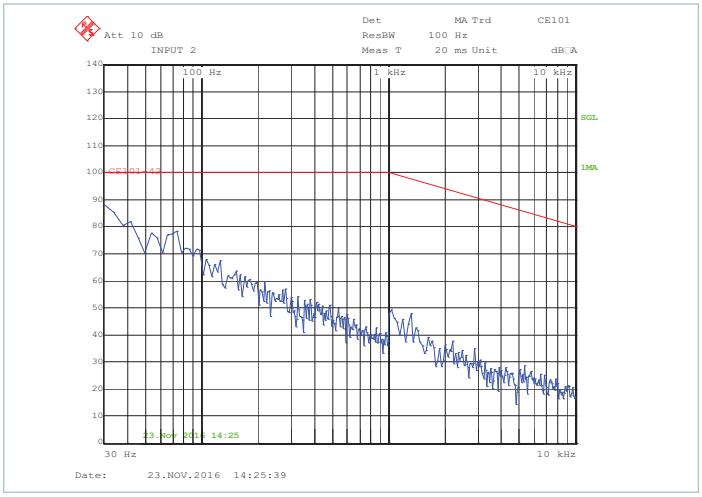


Figure 4 — *Peak scan for the RED lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

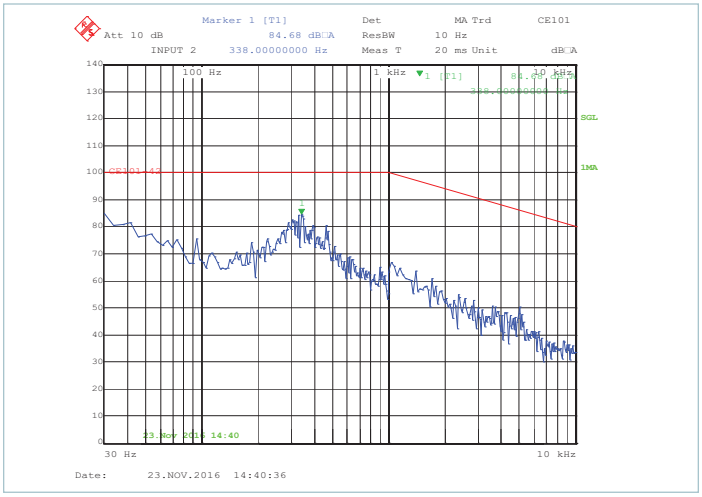


Figure 5 — *Peak scan for the RED lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

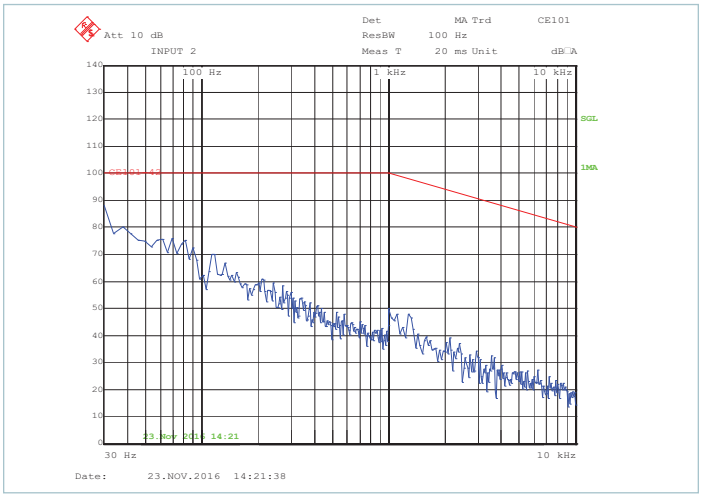


Figure 6 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

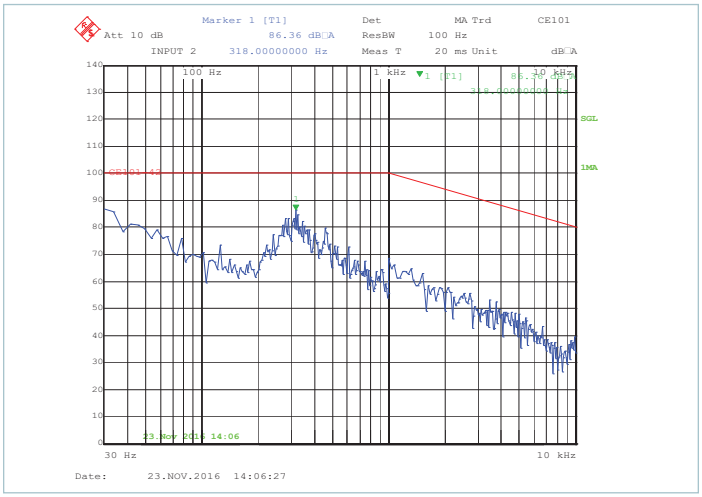


Figure 7 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

Typical Conducted Emissions (Cont.)

CE102 peak scans with MFM1714V50M50C5M00 and DCM3414V50M31C2T01, in either condition: –OUT connected to GND or –OUT floating.

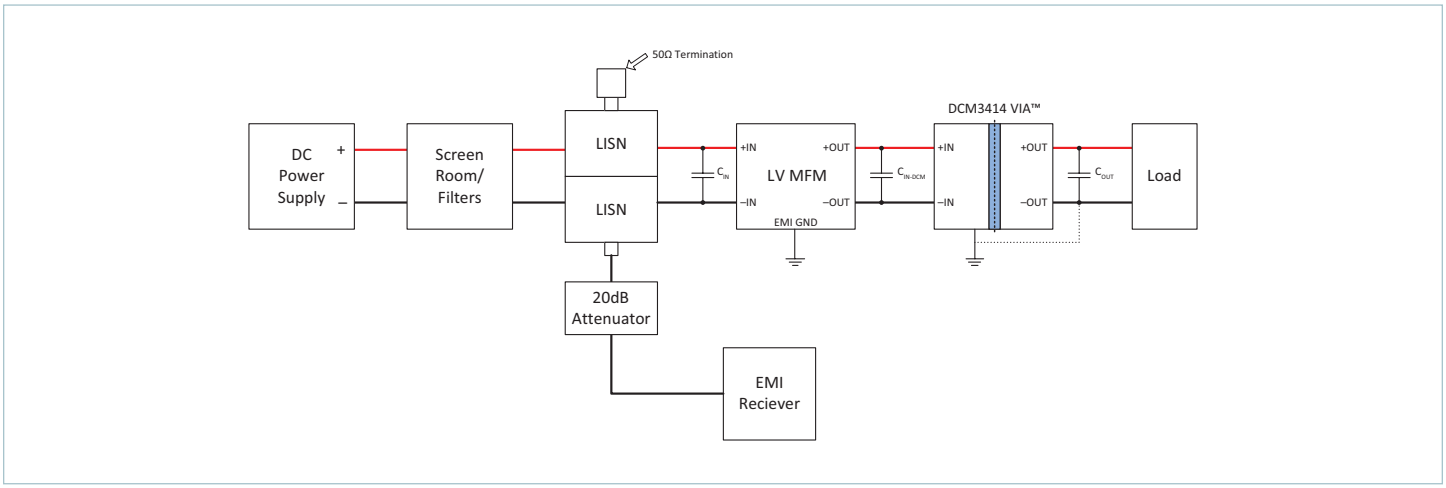


Figure 8 — *A typical test set up for conducted emissions CE102 is shown above. A 50Ω termination is used for LISN and voltage across the RED and BLACK leads are measured at various load conditions.*

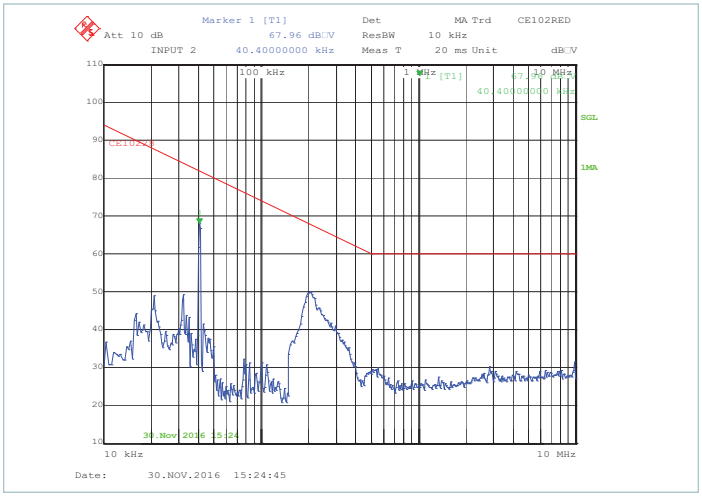


Figure 9— *Peak scan for the RED lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

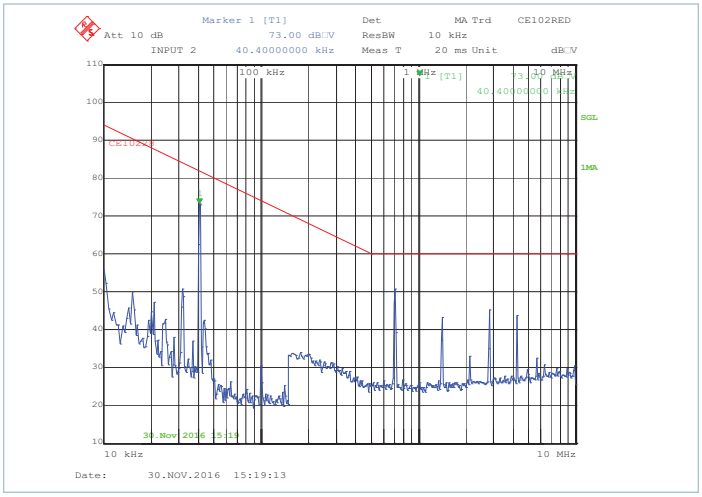


Figure 10 — *Peak scan for the RED lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

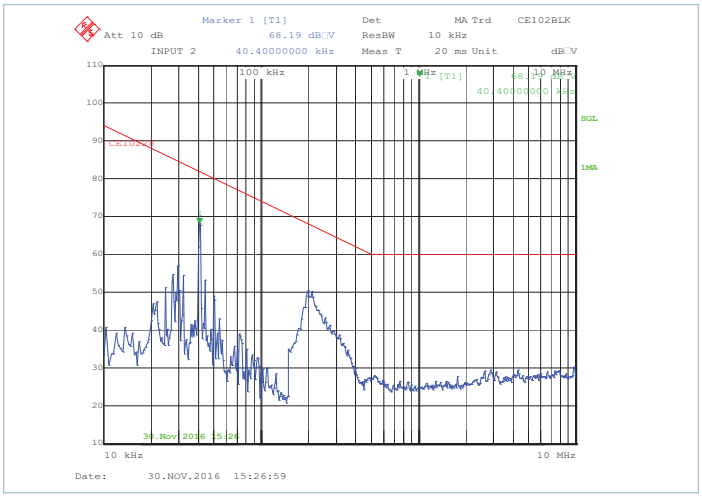


Figure 11 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 0% load*

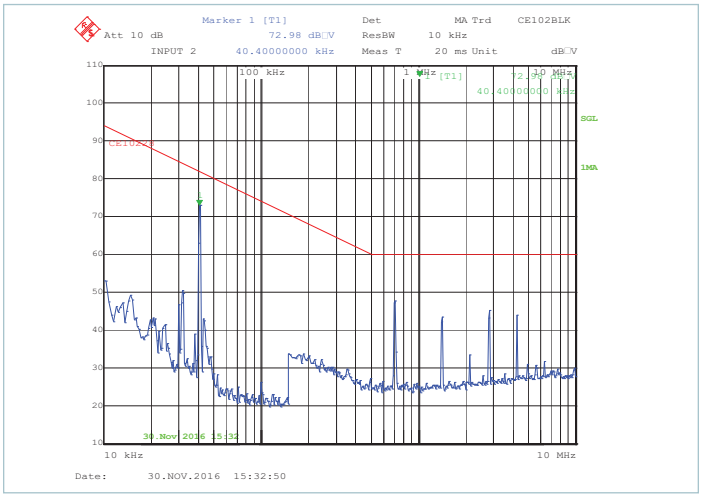
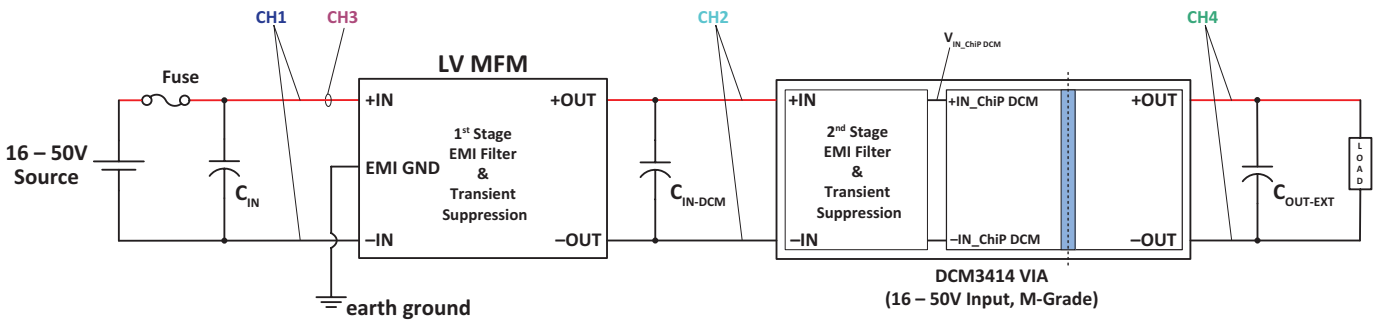


Figure 12 — *Peak scan for the BLACK lead with C_{IN} = 2200µF, C_{IN-DCM} = 1000µF, $C_{OUT-EXT}$ = 1000µF, 100% load*

Electrical Power Characteristics

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



Note: Input line transients are clamped to maximum acceptable input voltage ($V_{IN\_ChiP\ DCM}$) using two stages of active transient suppression circuit.

Example: A 100V, 50ms input line transient is clamped as follows:
1. LV MFM clamps 100V to 80V.
2. DCM3414 VIA™ input transient circuit clamps 80V to $V_{IN\_ChiP\ DCM} = V_{IN}$.
(Please refer to the appropriate DCM3414 VIA data sheet for V_{IN}.)

Figure 13 — *Input line transient suppression block diagram*

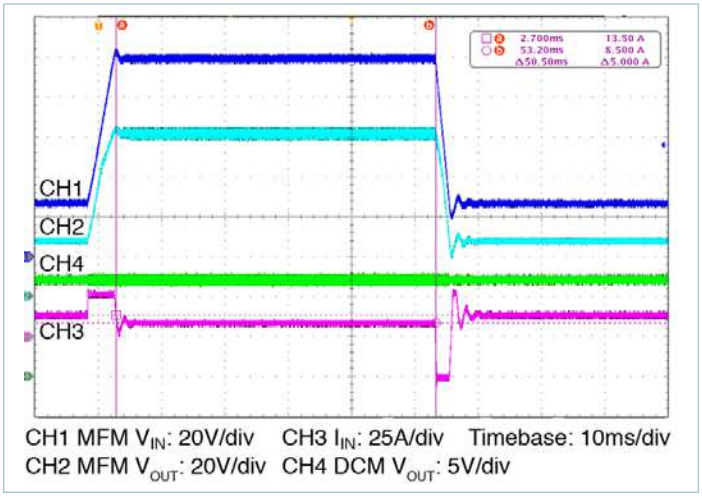


Figure 14 — *Transient immunity; LV MFM and DCM3414 VIA output response to an 100V, 50ms input transient*

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		M-Grade	–55		125	°C
Case Temperature		M-Grade	–55		100	
Thermal Resistance, Internal to Case Non-Pin Side	$\theta_{INT\_NON\_PIN\_SIDE}$			14		°C/W
Thermal Resistance, Internal to Output Terminals	$\theta_{INT\_OUT\_TERMINALS}$			4.7		°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 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

Thermal Considerations

The LV MFM must be operated such that the internal components are kept within the maximum of the operating temperature range by monitoring/controlling the temperature of both the non-pin-side plastic housing and the output terminals. A simplified thermal circuit model of the LV MFM is shown below in Figure 15. In this thermal-circuit model, thermal resistance is 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 based on total power dissipated by the MFM, the temperature maintained on the non-pin side of the housing, and the temperature of the output terminals.

In the example shown in Figure 15, the non-pin side of the plastic housing is maintained 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 operating temperature. 4W of heat is conducted through the lower housing, and the remaining 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 non-pin-side plastic housing.

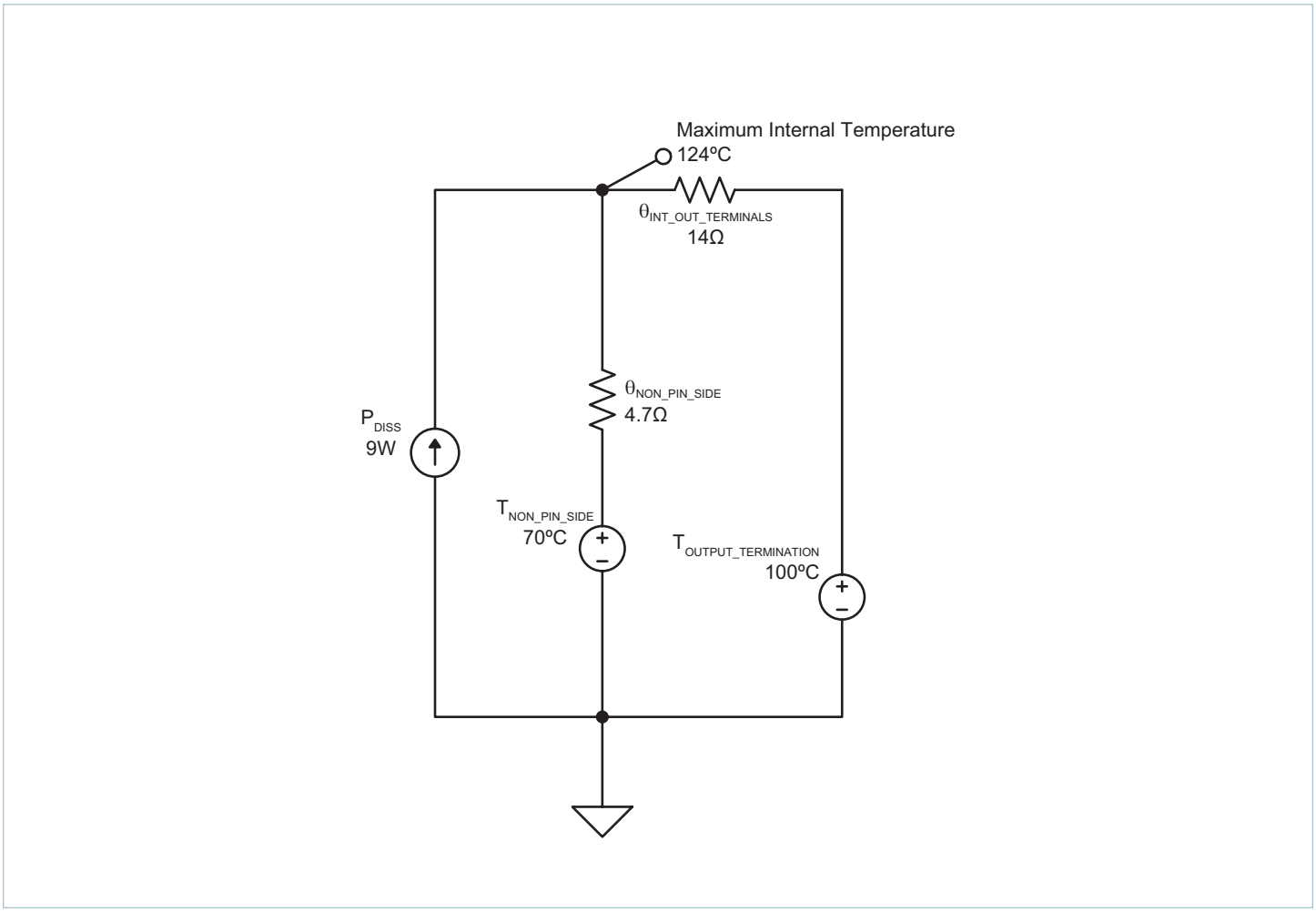
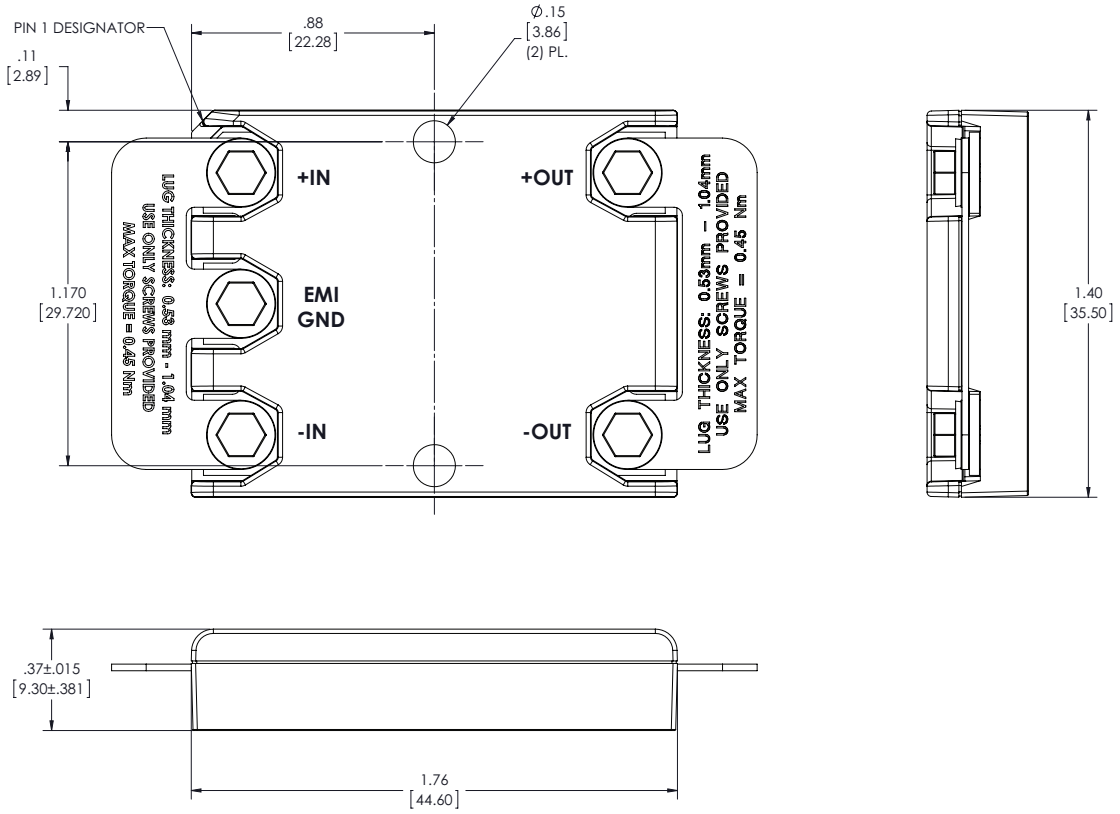


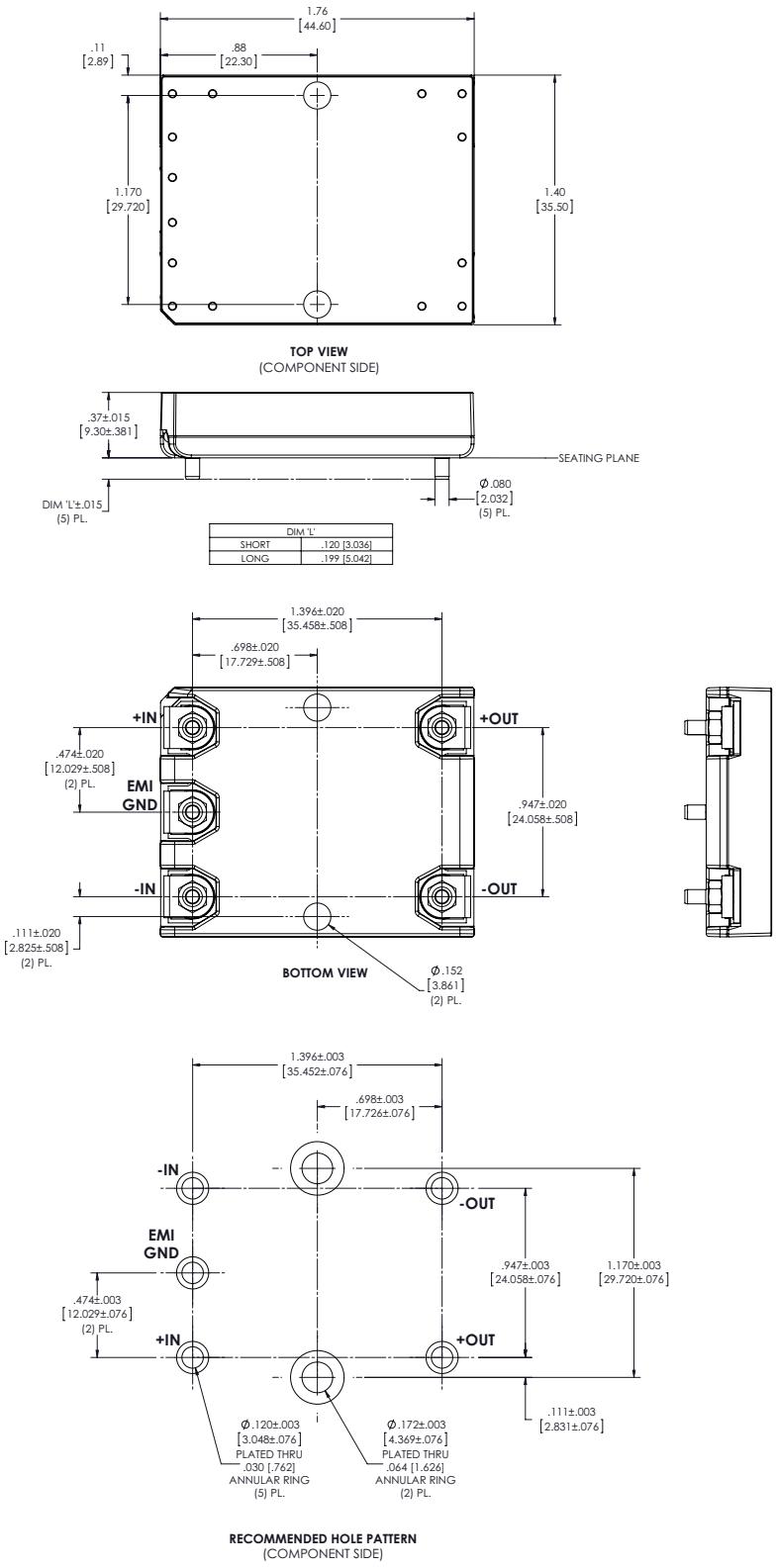
Figure 15 — *LV MFM thermal model*

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	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
1.2	07/17/18	Added input line transient suppression block diagram Updated mechanical drawings	9 13, 14

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

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