ERM50 Series

50 Watts

Quarter-Brick DC-DC

Total Power: 50 Watts
Input Voltage: 72 or 110 Vdc
# of Outputs: Single

Special Features

- Small 57.9 x 36.8 x12.7 mm package
- Input Ranges 43-101 Vdc or 66-160 Vdc
- High Efficiency up to 92%
- No Minimum Load Requirement
- Operating Temp. Range -40 ºC to +85 ºC with derating
- Reinforced Insulation 3000 VACrms
- Under-Voltage Shutdown
- Remote On/Off
- Metal Case with Isolated Baseplate
- Vibration and Thermal Shock to EN61373
- EN60950-1 Safety Standard
- EN50155/EN50121-3-2 Railway Standard
- 3 Year Warranty

Safety

cUL/UL 60950-1
IEC/EN 60950-1
IEC/EN 50155

Product Descriptions

ERM50 series is a new generation of high performance, isolated dc-dc converter modules. The product offers 50W in a small, fully encapsulated package. The input voltage ranges comply with European railway standard EN50155. Reinforced insulation and high EMC immunity qualifies these converters also for many demanding applications in railway and other transportation systems.

Advanced circuit topology provides a very high efficiency up to 92% which allows ambient temperatures range up to +85ºC with derating.

Further features include remote On/Off, under-voltage shutdown as well as overload and over-temperature protection.

EMERSON
Network Power

Model Numbers

Model	Input Voltage Range	Output Voltage	Minimum Load	Maximum Load
ERM10A72	72 (43 - 101) Vdc	5V	0A	10A
ERM04B72	72 (43 - 101) Vdc	12V	0A	4.17A
ERM03C72	72 (43 - 101) Vdc	15V	0A	3.33A
ERM02H72	72 (43 - 101) Vdc	24V	0A	2.08A
ERM10A110	110 (66 - 160) Vdc	5V	0A	10A
ERM04B110	110 (66 - 160) Vdc	12V	0A	4.17A
ERM03C110	110 (66 - 160) Vdc	15V	0A	3.33A
ERM02H110	110 (66 - 160) Vdc	24V	0A	2.08A

Note - All DC/DC converters should be externally fused at the front end for protection.

Options

Heatsink (-HS)

Electrical Specifications

Absolute Maximum Ratings

Stress in excess of those listed in the "Absolute Maximum Ratings" may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply's reliability.

Table 1. Absolute Maximum Ratings:

Parameter	Model	Symbol	Min	Typ	Max	Unit
Input Voltage: (DC continuous operation)	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	V_I	43 43 43 43 66 66 66 66	- - - - - - - -	101 101 101 101 160 160 160 160	Vdc
Maximum Output Power	All models	$P_{O,max}$	-	-	50	W
Isolation Resistance 500Vdc	All models		1000	-	-	Mohm
I/O Isolation Capacitance 100KHz, 1V	All models		-	-	3000	pF
Isolation Voltage Input to output Input to case Output to case	 All models All models All models		 3000 1500 1500	 - - -	 - - -	 VACrms Vdc Vdc
Operating Temperature (without Heatsink / with Heatsink)	ERM04B72 ERM03C72 ERM03C110 ERM02H72 ERM04B110 ERM02H110 ERM10A72 ERM10A110	T_A	-40	-	72 / 75 72 / 75 72 / 75 68 / 71 68 / 71 68 / 71 63 / 67 63 / 67	ºC
Operating Base-plate Temperature Range	All models		-40	-	+105	ºC
Storage Temperature	All models	T_{STG}	-50	-	+125	ºC
Humidity (non-condensing)	All models		5	-	95	%

Input Specifications

Table 2. Input Specifications:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Operating Input Voltage, DC	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	All	V_I	43 43 43 43 66 66 66 66	72 72 72 72 110 110 110 110	101 101 101 101 160 160 160 160	Vdc
Input Surge Voltage	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	100ms. Max (with 220uF/200V capacitor)		-0.7 -0.7 -0.7 -0.7 -0.7 -0.7 -0.7 -0.7	-	165 165 165 165 250 250 250 250	Vdc
Maximum Input Current	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	Maximum value at Vin= Vin nom; Full Load	$I_{I,max}$	-	771 755 754 762 505 500 494 499	-	mA
No Load Input Current	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	Typical value at Vin = Vin nom; No Load	I_{I,no_load}	-	50 45 45 50 40 35 35 40	-	mA
Efficiency @Max. Load	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	Vin =Vin nom; Full Load; TA =25℃	η	-	90 92 92 91 90 91 92 91	-	%
Input Reflected Ripple Current		0 to 500KHz, 4.7μH source impedance		-	35	-	mApk-pk
Start Up Time				-	0.35	-	S
Internal Filter Type			Pi Filter (for EN55022,Class A/Class B Compliance)				

Output Specifications

Table 3. Output Specifications:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Output Voltage Set-Point	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	Vin=Vin nom; Full Load; TA=25℃	V_O	4.95 11.88 14.85 23.76 4.95 11.88 14.85 23.76	5 12 15 24 5 12 15 24	5.05 12.12 15.15 24.24 5.05 12.12 15.15 24.24	Vdc
Convection Output Current, continuous	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110	Convection cooling	I_O	-	-	10 4.17 3.33 2.08 10 4.17 3.33 2.08	A
Max. Output Capacitance Load	ERM10A72 ERM04B72 ERM03C72 ERM02H72 ERM10A110 ERM04B110 ERM03C110 ERM02H110			-	-	17000 2950 1900 740 17000 2950 1900 740	μF
Output Ripple, pk-pk	ERM10A72 ERM04B72 ERM03C72 ERM10A110 ERM04B110 ERM03C110	20MHz bandwidth, measured with a 1μF MLCC and a 10μF Tantalum Capacitor		-	-	100	mVp-p
	ERM02H72 ERM02H110			-	-	150	mVp-p
Load Transient Response Peak Deviation Settling Time		Measured to within 1% error band 25% Load Step Change	- T_s	- -	±3. 250	±5 -	% μSec
Line Regulation		Vin=Min. to Max. @ Full Load		-	-	±0.2	$\%V_O$
Load Regulation		Min. Load to Full Load		-	-	±0.3	$\%V_O$
Output Voltage Adjustment Range			V_O	-10	-	+10	$\%V_O$
Output Power		Convection cooling	P_O	-	-	50	W
Temperature Coefficient		All models		-	-	±0.02	%/ ℃
Switching Frequency		All models	f_{SW}	-	320	-	KHz

ERM10A72 Performance Curves

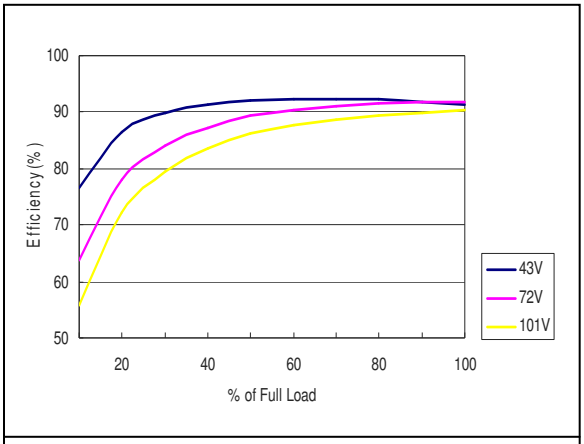


Figure 1: **ERM10A72 Efficiency Versus Output Current**
Vin = 43 to 101Vdc Load: Io = 0 to 10A

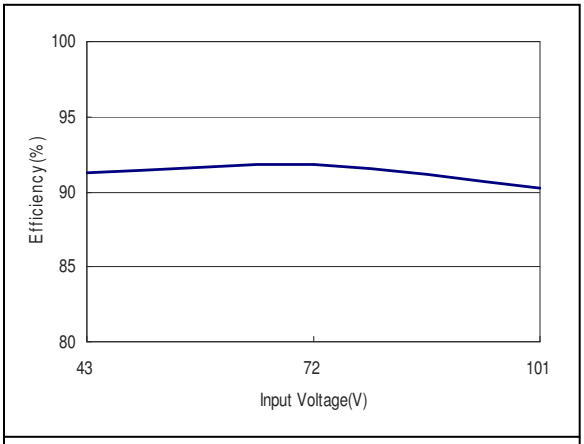


Figure 2: **ERM10A72 Efficiency Versus Input Voltage**
Vin = 43 to 101Vdc Load: Io = 10A

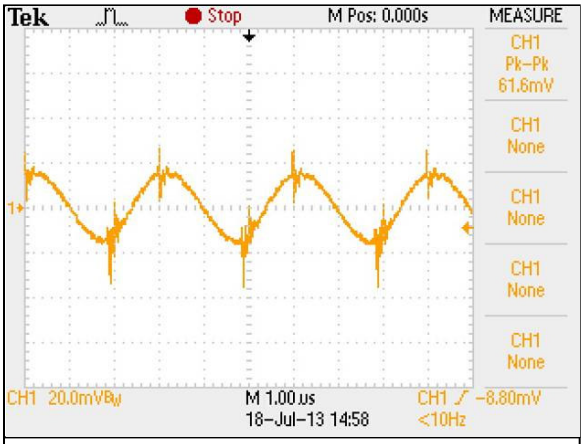


Figure 3: **ERM10A72 Typical Output Ripple and Noise.**
Vin = 72Vdc Load: Io = 10A
Ch 1: Vo

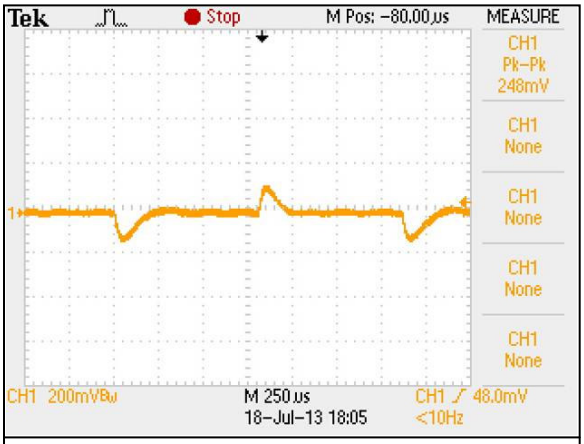


Figure 4: **ERM10A72 Transient Response**
Vin = 72Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

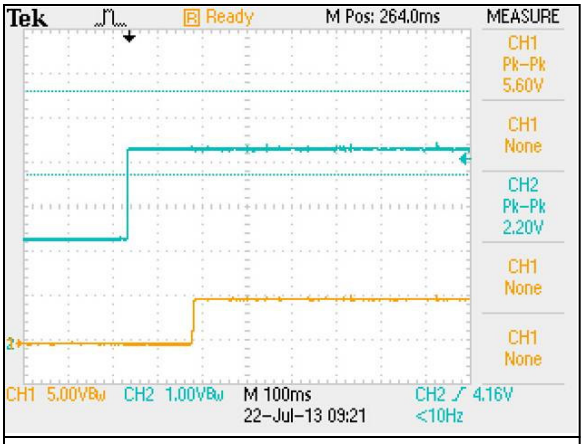


Figure 5: **ERM10A72 Output Voltage Startup Characteristic by ON/OFF**
Vin = 72Vdc Load: Io = 10A
Ch1: Vo Ch2: Remote On/Off

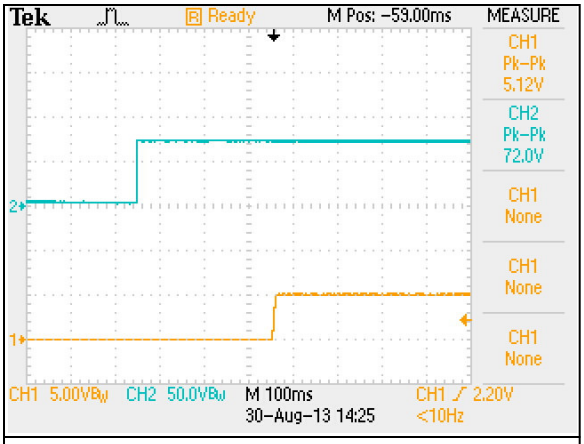


Figure 6: **ERM10A72 Output Voltage Startup Characteristic by Vin**
Vin = 72Vdc Load: Io = 10A
Ch1: Vo Ch2: Vin

ERM10A72 Performance Curves

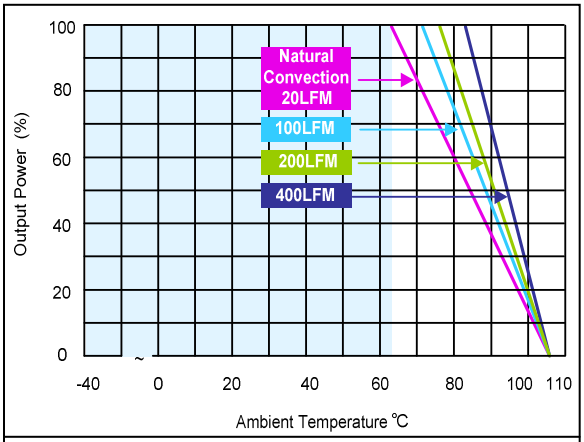


Figure 7: **ERM10A72 Derating Curve without Heatsink**
Vin = 72Vdc Load: Io = 0 to 10A

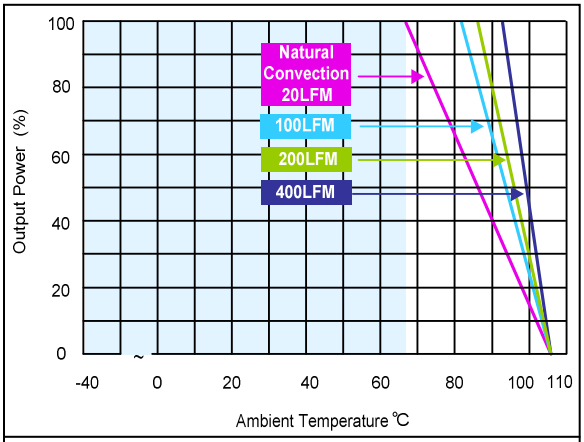


Figure 8: **ERM10A72 Derating Curve with Heatsink**
Vin = 72Vdc Load: Io = 0 to 10A

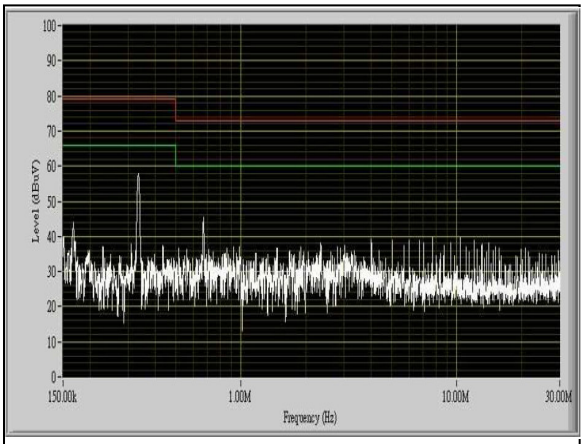


Figure 9: **ERM10A72 Conduction Emission of EN55011 Class A**
Vin = 72Vdc Load: Io = 10A

Note - All test conditions are at 25ºC

ERM04B72 Performance Curves

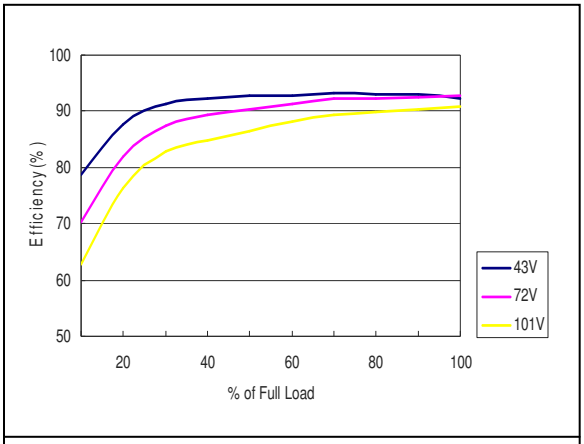


Figure 10: **ERM04B72 Efficiency Versus Output Current**
Vin = 43 to 101Vdc Load: Io = 0 to 4.17A

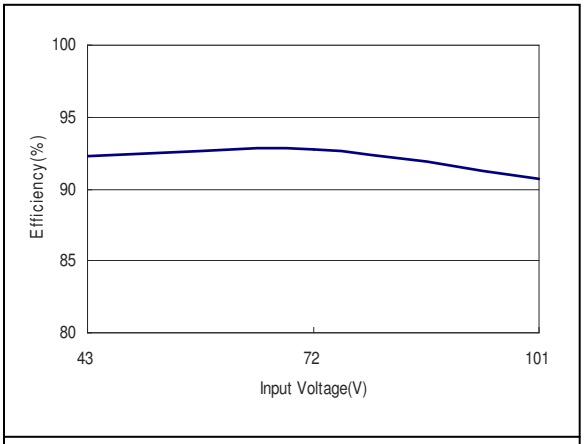


Figure 11: **ERM04B72 Efficiency Versus Input Voltage**
Vin = 43 to 101Vdc Load: Io = 4.17A

Figure 12: **ERM04B72 Typical Output Ripple and Noise.**
Vin = 72Vdc Load: Io = 4.17A
Ch 1: Vo

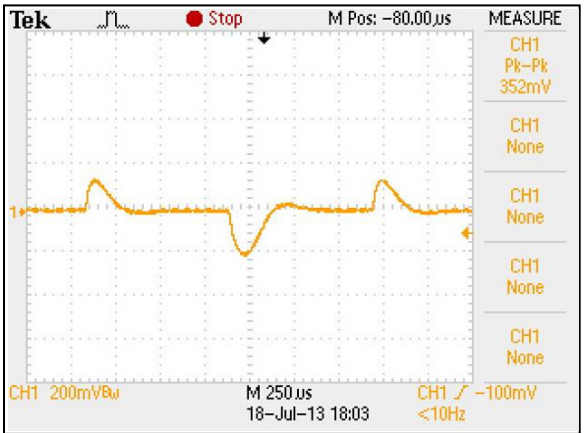


Figure 13: **ERM04B72 Transient Response**
Vin = 72Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

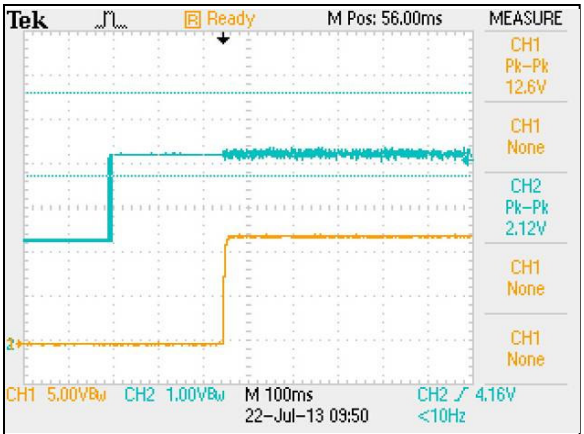


Figure 14: **ERM04B72 Output Voltage Startup Characteristic by ON/OFF**
Vin = 72Vdc Load: Io = 4.17A
Ch1: Vo Ch2: Remote On/Off

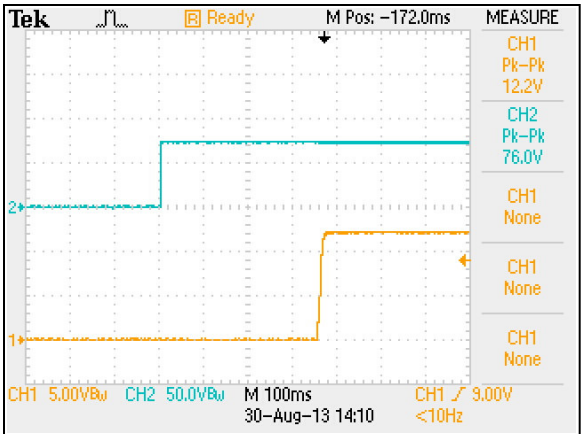


Figure 15: **ERM04B72 Output Voltage Startup Characteristic by Vin**
Vin = 72Vdc Load: Io = 4.17A
Ch1: Vo Ch2: Vin

ERM04B72 Performance Curves

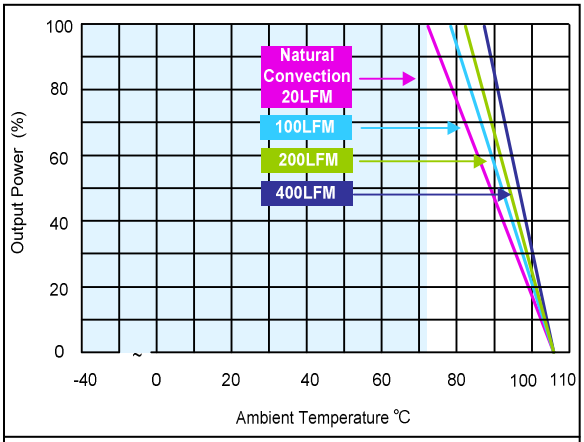


Figure 16: **ERM04B72 Derating Curve without Heatsink**
Vin = 72Vdc Load: Io = 0 to 4.17A

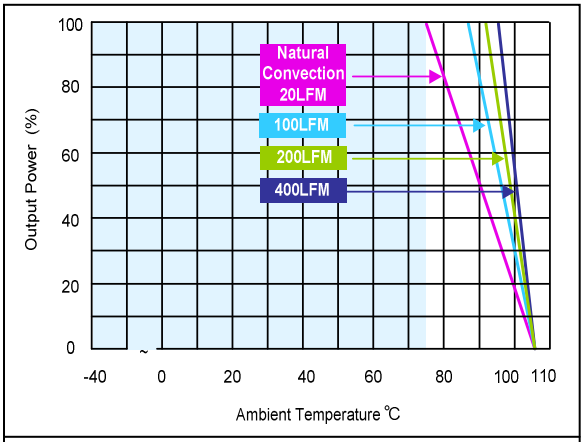


Figure 17: **ERM04B72 Derating Curve with Heatsink**
Vin = 72Vdc Load: Io = 0 to 4.17A

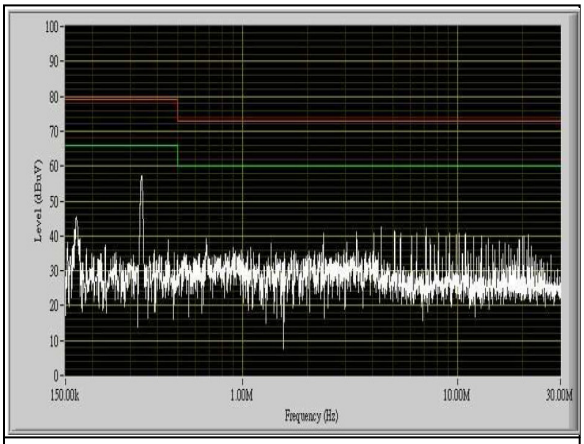


Figure 18: **ERM04B72 Conduction Emission of EN55011 Class A**
Vin = 72Vdc Load: Io = 4.17A

Note - All test conditions are at 25ºC

ERM03C72 Performance Curves

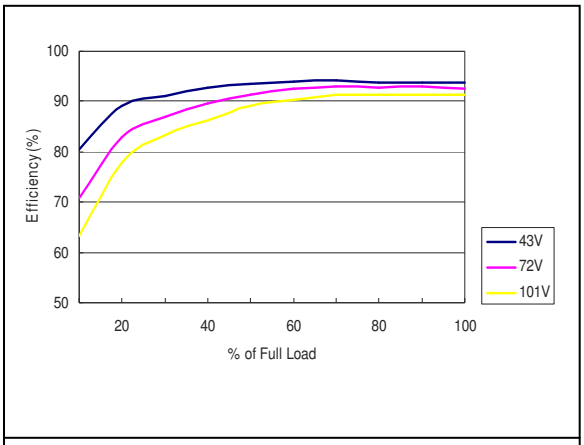


Figure 19: **ERM03C72 Efficiency Versus Output Current**
Vin = 43 to 101Vdc Load: Io = 0 to 3.33A

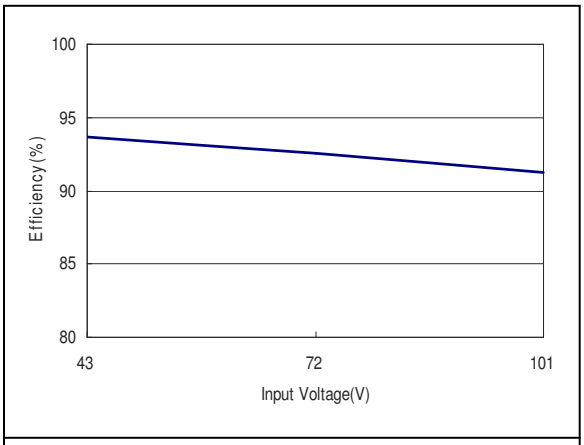


Figure 20: **ERM03C72 Efficiency Versus Input Voltage**
Vin = 43 to 101Vdc Load: Io = 3.33A

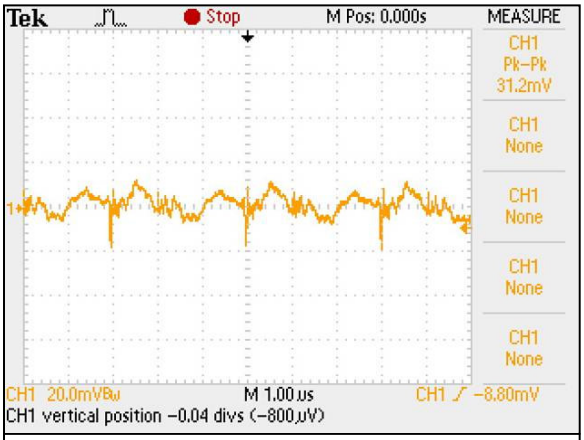


Figure 21: **ERM03C72 Typical Output Ripple and Noise.**
Vin = 72Vdc Load: Io = 3.33A
Ch 1: Vo

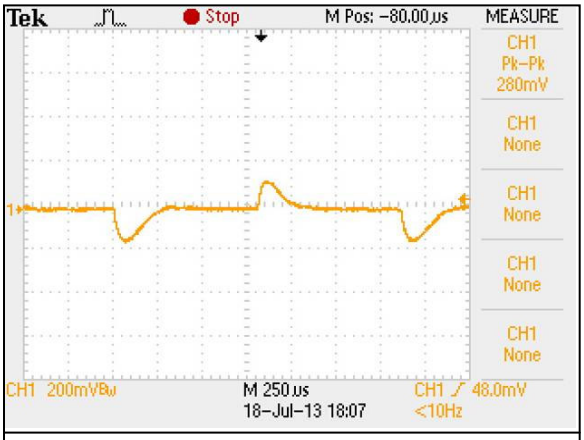


Figure 22: **ERM03C72 Transient Response**
Vin = 72Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

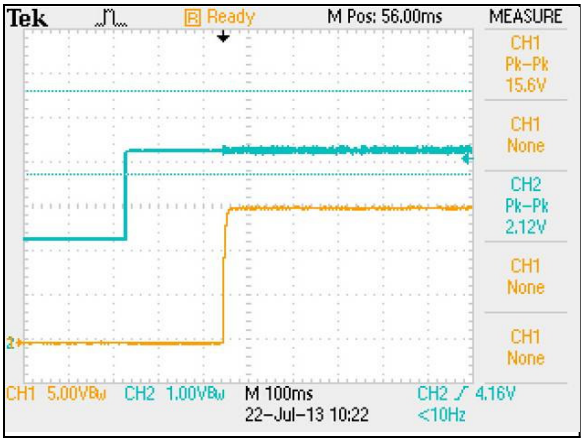


Figure 23: **ERM03C72 Output Voltage Startup Characteristic by ON/OFF**
Vin = 72Vdc Load: Io = 3.33A
Ch1: Vo Ch2: Remote On/Off

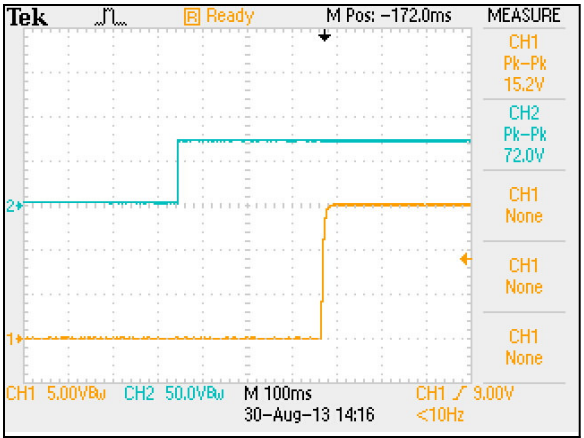


Figure 24: **ERM03C72 Output Voltage Startup Characteristic by Vin**
Vin = 72Vdc Load: Io = 3.33A
Ch1: Vo Ch2: Vin

ERM03C72 Performance Curves

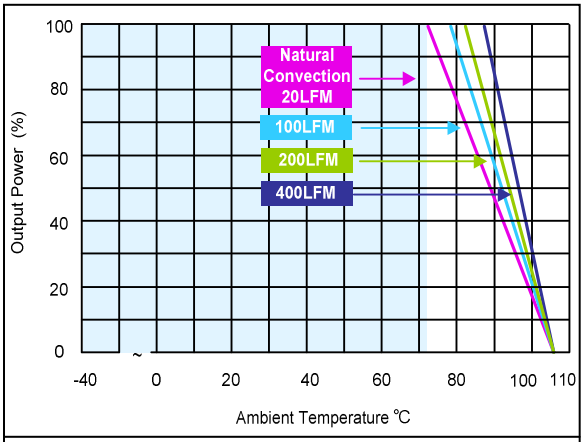


Figure 25: **ERM03C72 Derating Curve without Heatsink**
Vin = 72Vdc Load: Io = 0 to 3.33A

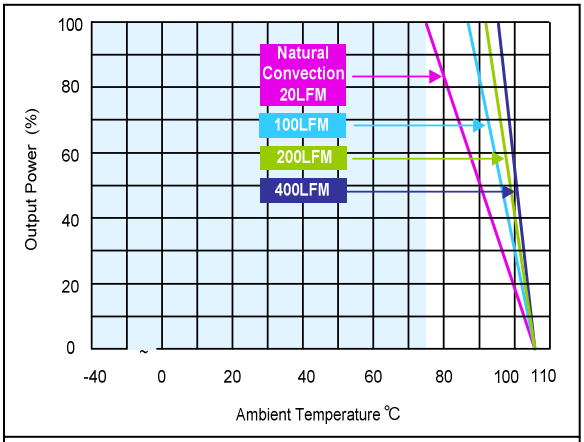


Figure 26: **ERM03C72 Derating Curve with Heatsink**
Vin = 72Vdc Load: Io = 0 to 3.33A

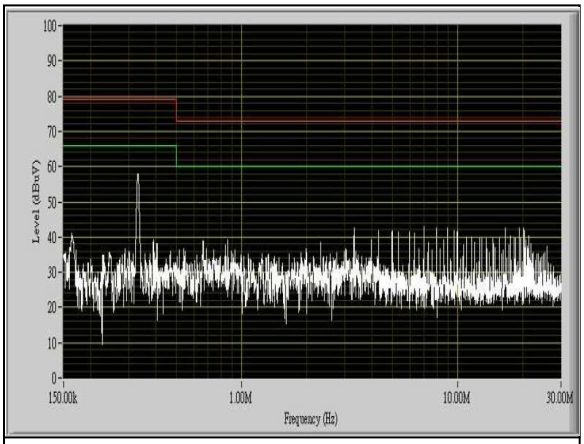


Figure 27: **ERM03C72 Conduction Emission of EN55011 Class A**
Vin = 72Vdc Load: Io = 3.33A

Note - All test conditions are at 25ºC

ERM02H72 Performance Curves

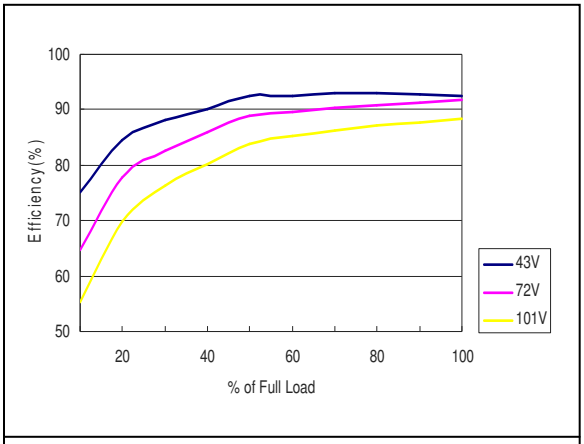


Figure 28: **ERM02H72 Efficiency Versus Output Current**
Vin = 43 to 101Vdc Load: Io = 0 to 2.08A

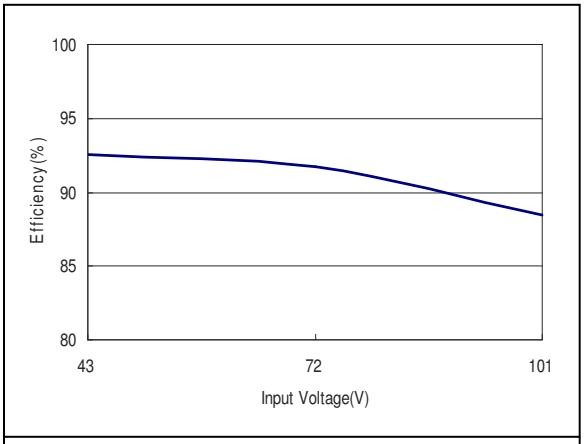


Figure 29: **ERM02H72 Efficiency Versus Input Voltage**
Vin = 43 to 101Vdc Load: Io = 2.08A

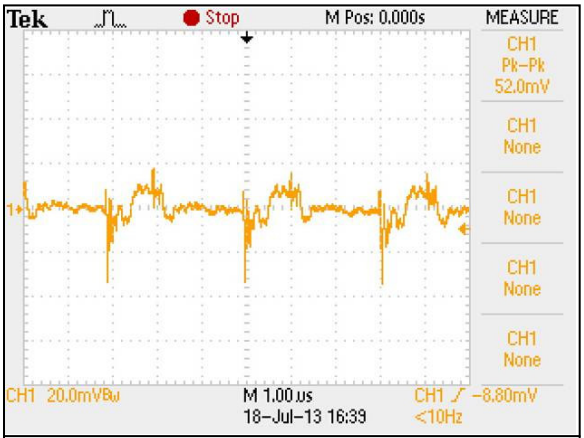


Figure 30: **ERM02H72 Typical Output Ripple and Noise.**
Vin = 72Vdc Load: Io = 2.08A
Ch 1: Vo

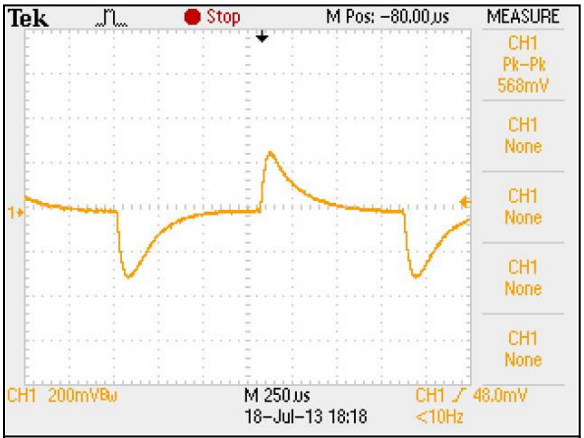


Figure 31: **ERM02H72 Transient Response**
Vin = 72Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

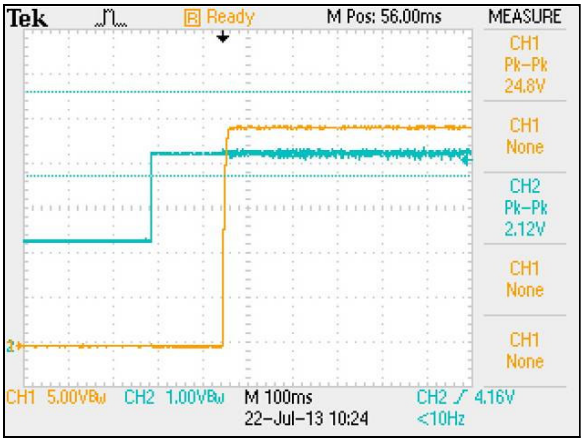


Figure 32: **ERM02H72 Output Voltage Startup Characteristic by ON/OFF**
Vin = 72Vdc Load: Io = 2.08A
Ch1: Vo Ch2: Remote On/Off

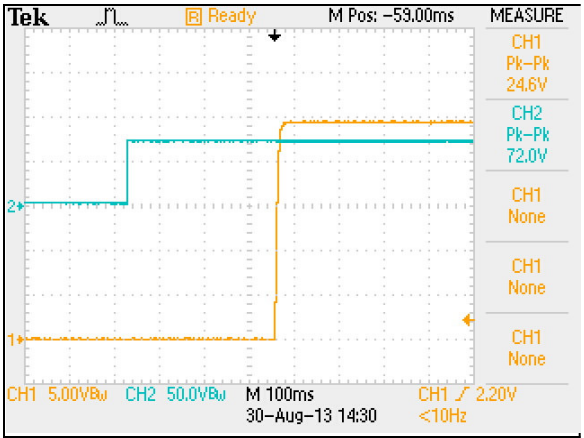


Figure 33: **ERM02H72 Output Voltage Startup Characteristic by Vin**
Vin = 72Vdc Load: Io = 2.08A
Ch1: Vo Ch2: Vin

ERM02H72 Performance Curves

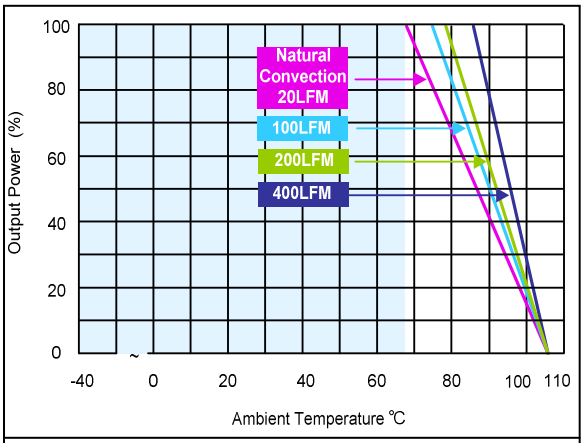


Figure 34: **ERM02H72 Derating Curve without Heatsink**
Vin = 72Vdc Load: Io = 0 to 2.08A

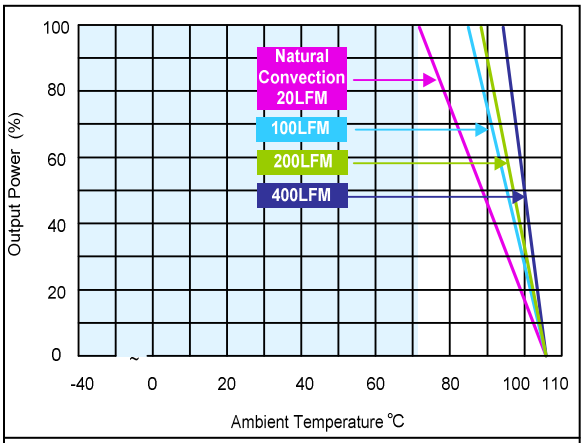


Figure 35: **ERM02H72 Derating Curve with Heatsink**
Vin = 72Vdc Load: Io = 0 to 2.08A

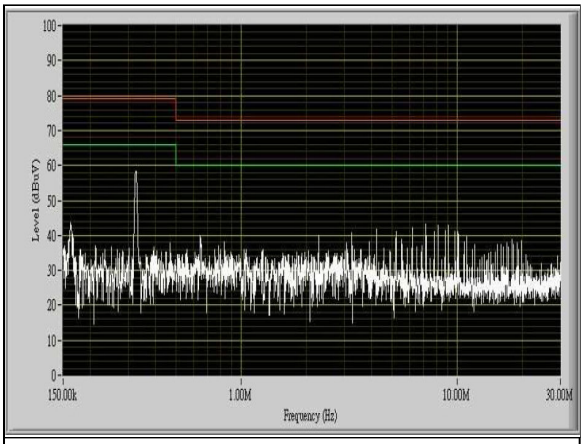


Figure 36: **ERM02H72 Conduction Emission of EN55011 Class A**
Vin = 72Vdc Load: Io = 2.08A

Note - All test conditions are at 25ºC

ERM10A110 Performance Curves

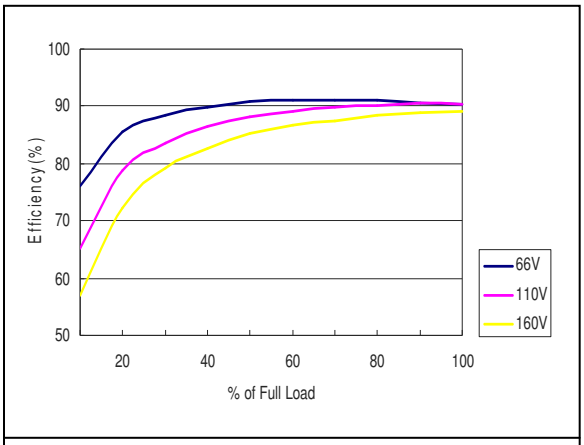


Figure 37: ERM10A110 Efficiency Versus Output Current
Vin = 66 to 160Vdc Load: Io = 0 to 10A

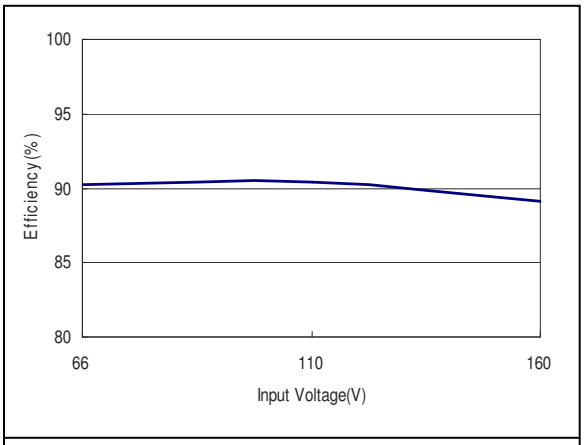


Figure 38: ERM10A110 Efficiency Versus Input Voltage
Vin = 66 to 160Vdc Load: Io = 10A

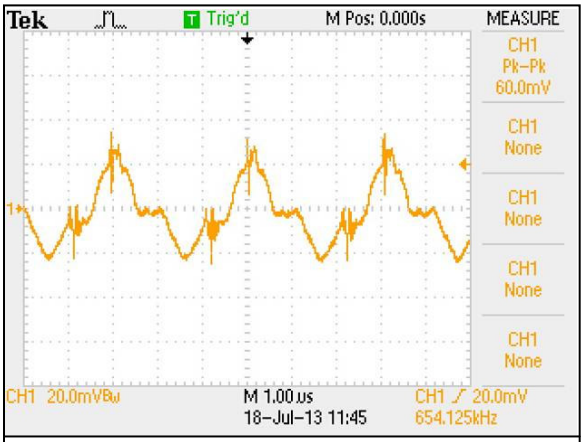


Figure 39: ERM10A110 Typical Output Ripple and Noise.
Vin = 110Vdc Load: Io = 10A
Ch 1: Vo

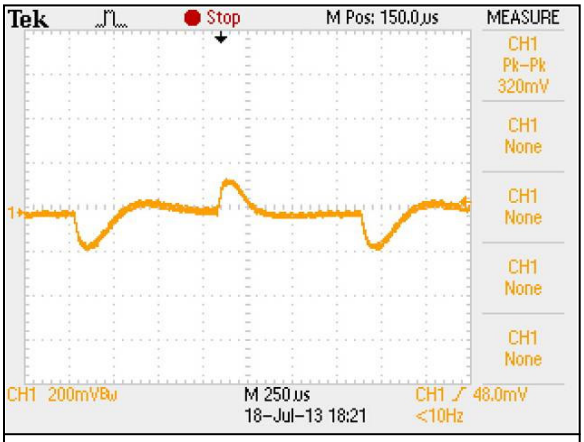


Figure 40: ERM10A110 Transient Response
Vin = 110Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

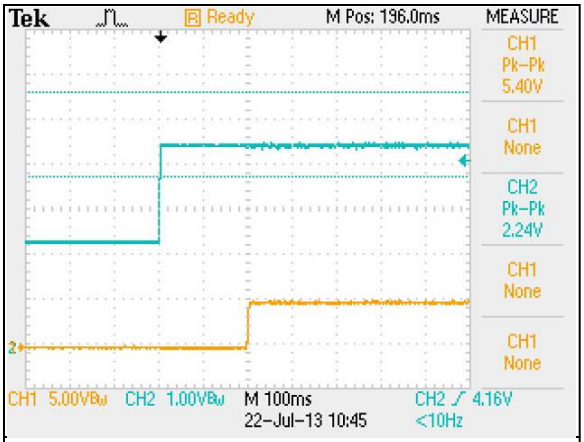


Figure 41: ERM10A110 Output Voltage Startup Characteristic by ON/OFF
Vin = 110Vdc Load: Io = 10A
Ch1: Vo Ch2: Remote On/Off

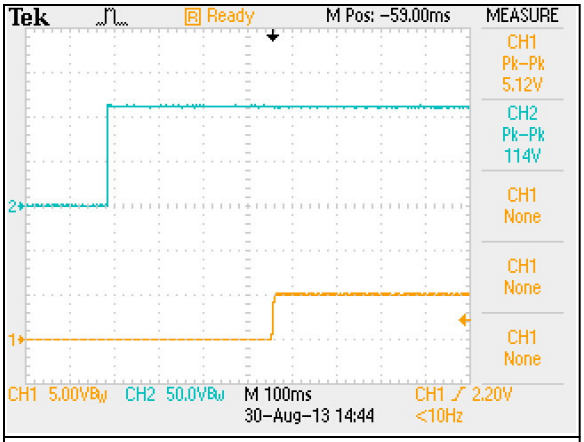


Figure 42: ERM10A110 Output Voltage Startup Characteristic by Vin
Vin = 110Vdc Load: Io = 10A
Ch1: Vo Ch2: Vin

ERM10A110 Performance Curves

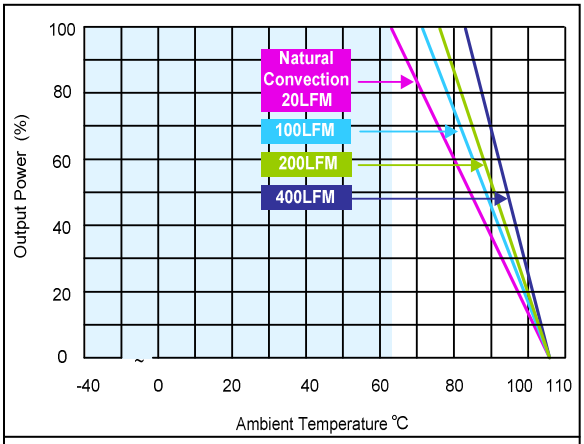


Figure 43: **ERM10A110 Derating Curve without Heatsink**
Vin = 110Vdc Load: Io = 0 to 10A

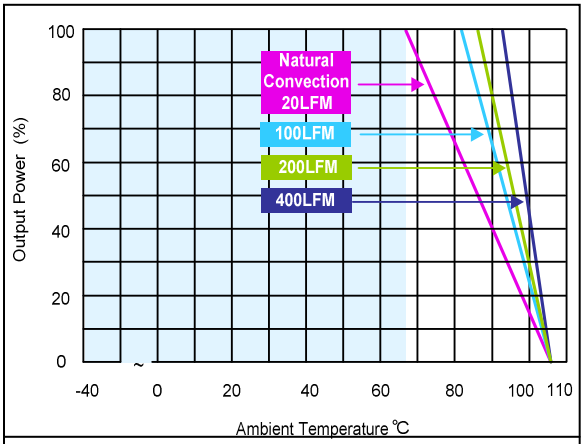


Figure 44: **ERM10A110 Derating Curve with Heatsink**
Vin = 110Vdc Load: Io = 0 to 10A

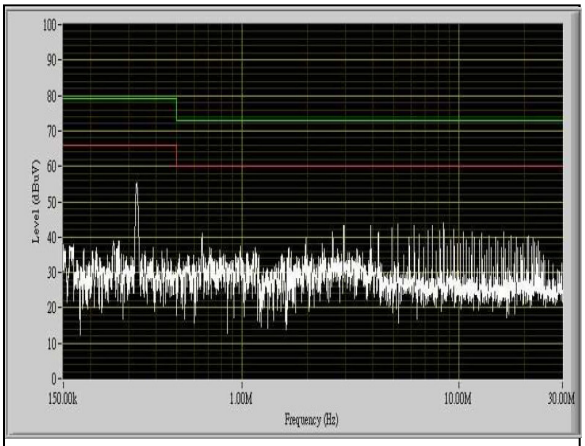


Figure 45: **ERM10A110 Conduction Emission of EN55011 Class A**
Vin = 110Vdc Load: Io = 10A

Note - All test conditions are at 25ºC

ERM04B110 Performance Curves

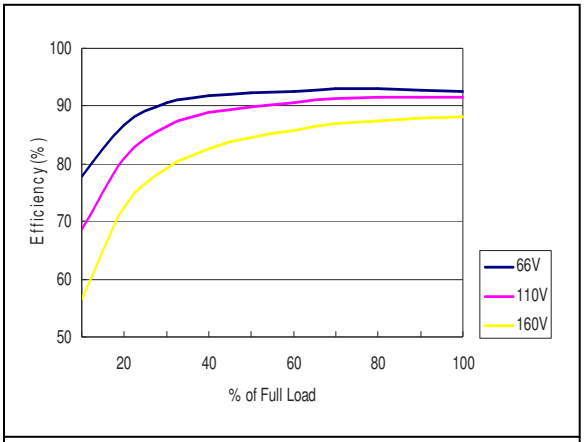


Figure 46: ERM04B110 Efficiency Versus Output Current
Vin = 66 to 160Vdc Load: Io = 0 to 4.17A

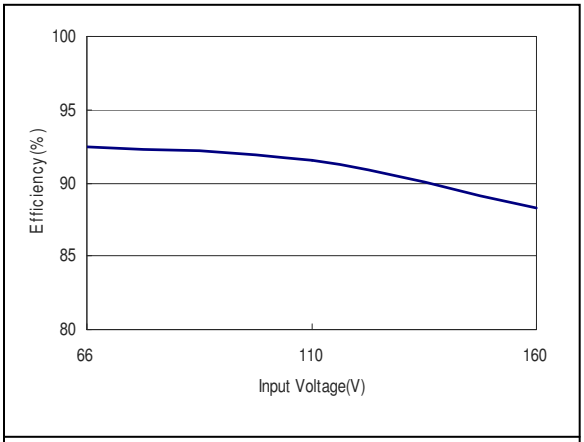


Figure 47: ERM04B110 Efficiency Versus Input Voltage
Vin = 66 to 160Vdc Load: Io = 4.17A

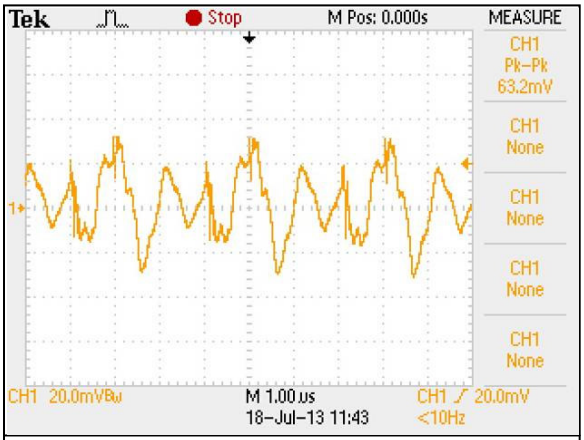


Figure 48: ERM04B110 Typical Output Ripple and Noise.
Vin = 110Vdc Load: Io = 4.17A
Ch 1: Vo

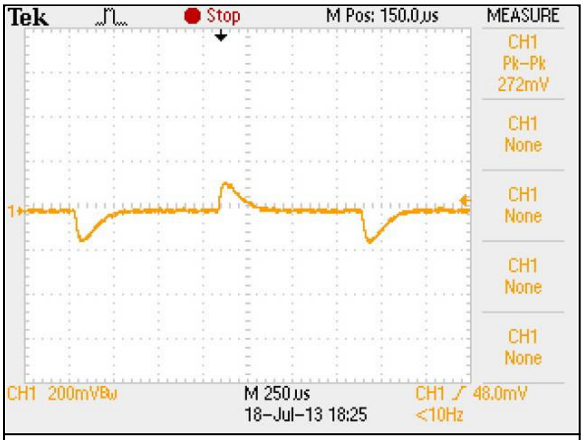


Figure 49: ERM04B110 Transient Response
Vin = 110Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

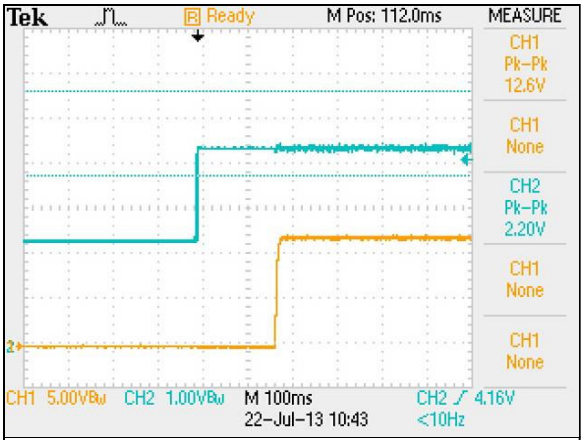


Figure 50: ERM04B110 Output Voltage Startup Characteristic by ON/OFF
Vin = 110Vdc Load: Io = 4.17A
Ch1: Vo Ch2: Remote On/Off

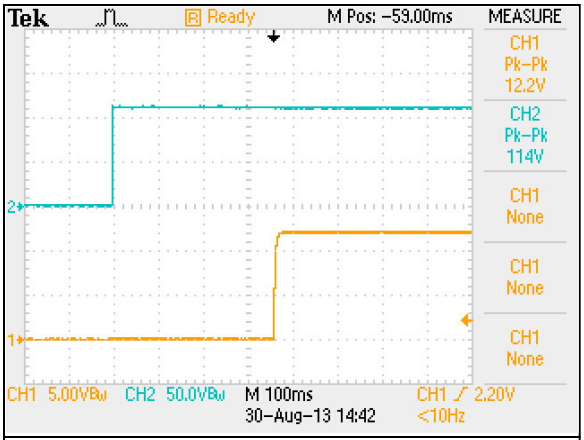


Figure 51: ERM04B110 Output Voltage Startup Characteristic by Vin
Vin = 110Vdc Load: Io = 4.17A
Ch1: Vo Ch2: Vin

ERM04B110 Performance Curves

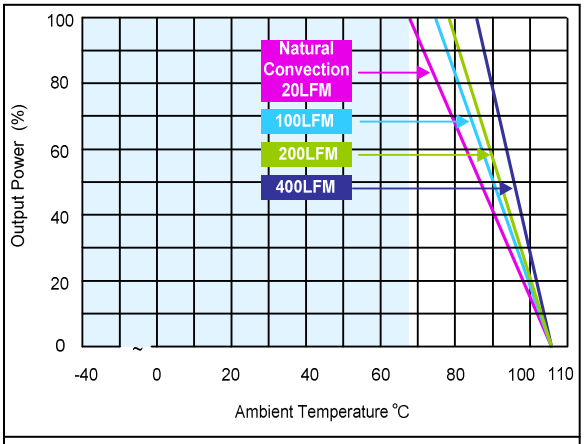


Figure 52: ERM04B110 Derating Curve without Heatsink
Vin = 110Vdc Load: Io = 0 to 4.17A

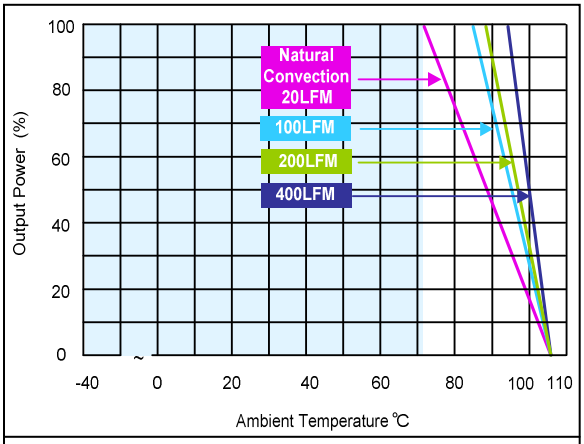


Figure 53: ERM04B110 Derating Curve with Heatsink
Vin = 110Vdc Load: Io = 0 to 4.17A

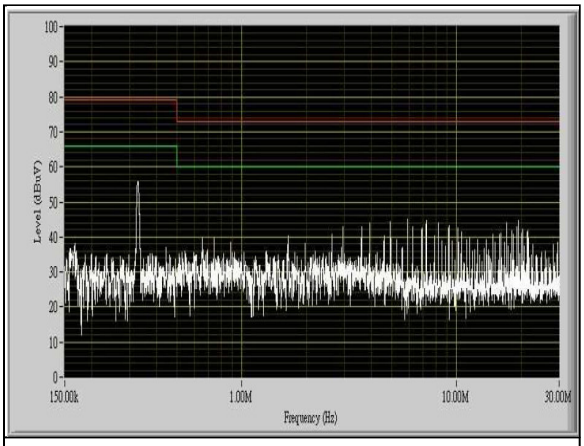


Figure 54: ERM04B110 Conduction Emission of EN55011 Class A
Vin = 110Vdc Load: Io = 4.17A

Note - All test conditions are at 25ºC

ERM03C110 Performance Curves

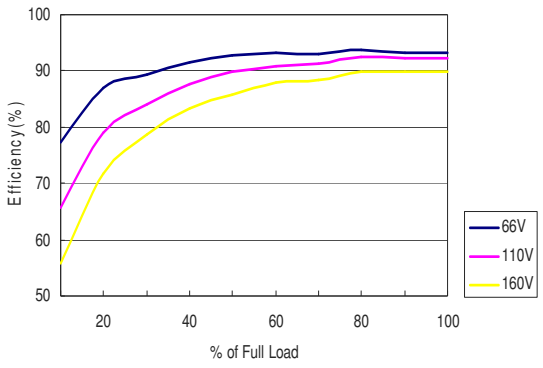


Figure 55: ERM03C110 Efficiency Versus Output Current
Vin = 66 to 160Vdc Load: Io = 0 to 3.33A

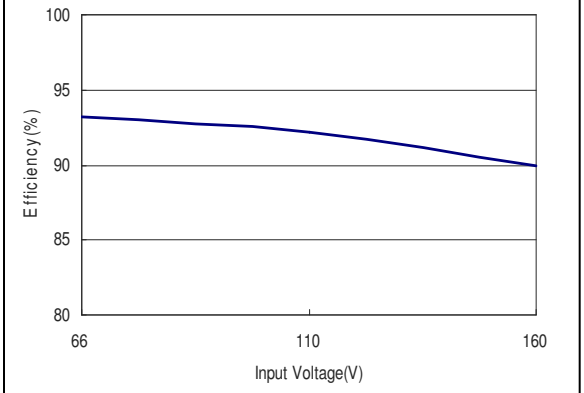


Figure 56: ERM03C110 Efficiency Versus Input Voltage
Vin = 66 to 160Vdc Load: Io = 3.33A

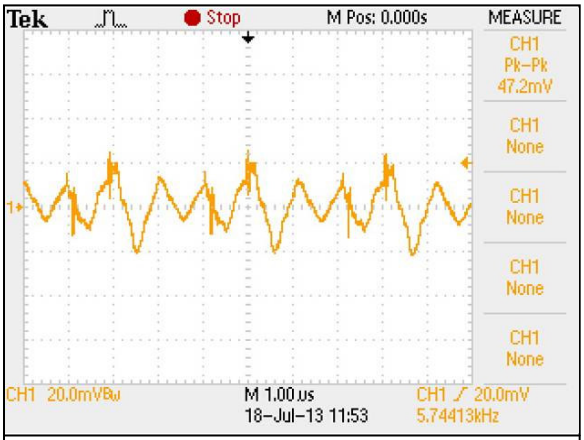


Figure 57: ERM03C110 Typical Output Ripple and Noise.
Vin = 110Vdc Load: Io = 3.33A
Ch 1: Vo

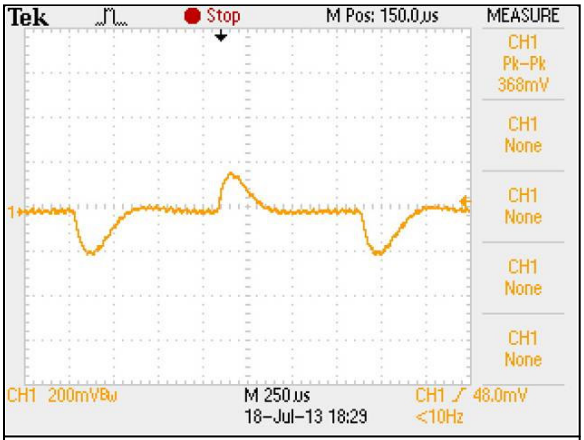


Figure 58: ERM03C110 Transient Response
Vin = 110Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

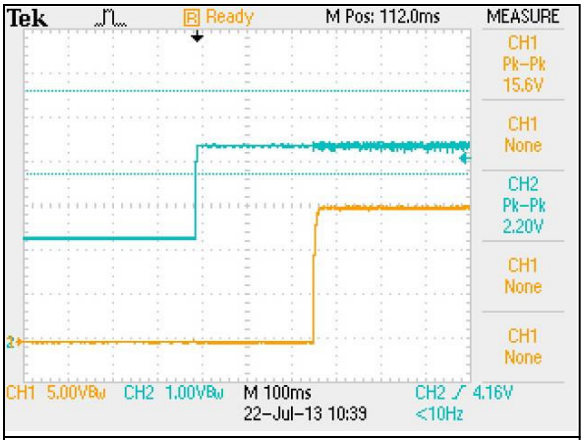


Figure 59: ERM03C110 Output Voltage Startup Characteristic by ON/OFF
Vin = 110Vdc Load: Io = 3.33A
Ch1: Vo Ch2: Remote On/Off

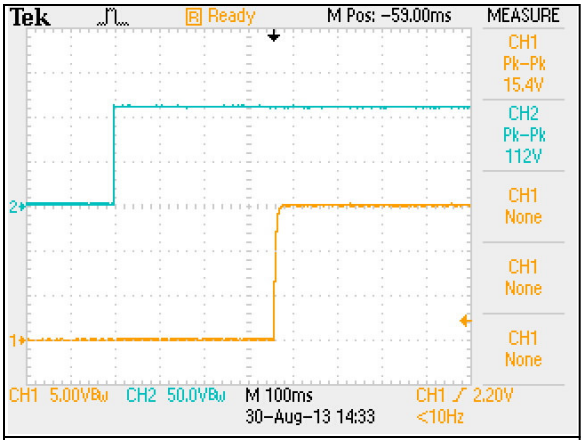


Figure 60: ERM03C110 Output Voltage Startup Characteristic by Vin
Vin = 110Vdc Load: Io = 3.33A
Ch1: Vo Ch2: Vin

ERM03C110 Performance Curves

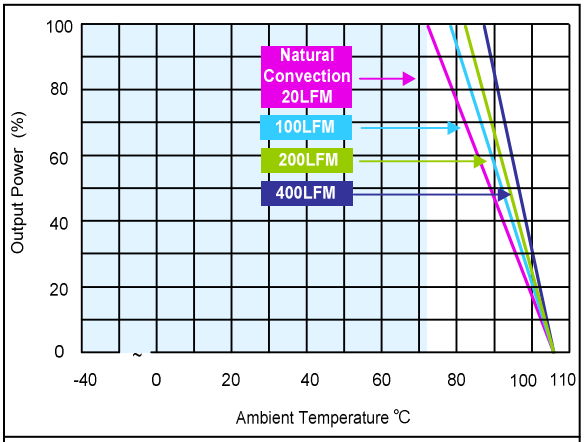


Figure 61: **ERM03C110 Derating Curve without Heatsink**
Vin = 110Vdc Load: Io = 0 to 3.33A

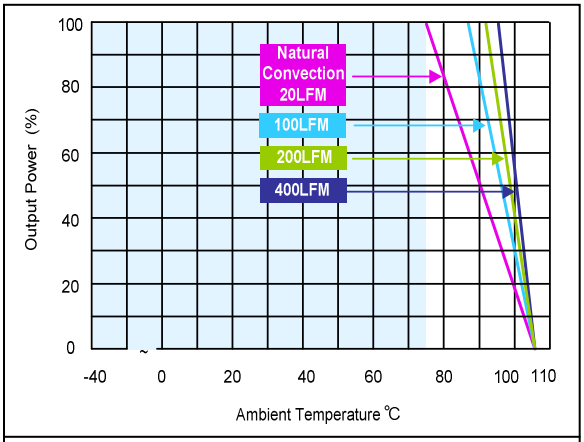


Figure 62: **ERM03C110 Derating Curve with Heatsink**
Vin = 110Vdc Load: Io = 0 to 3.33A

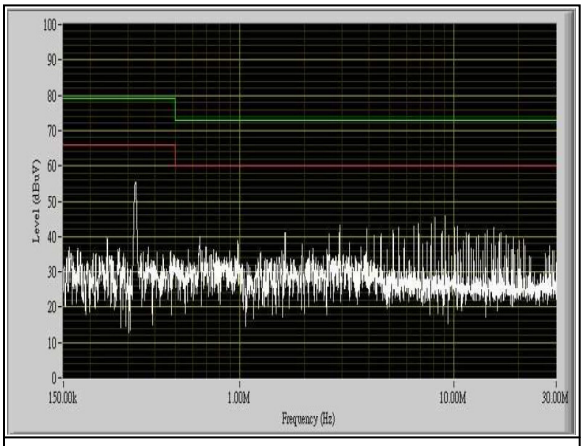


Figure 63: **ERM03C110 Conduction Emission of EN55011 Class A**
Vin = 110Vdc Load: Io = 3.33A

Note - All test conditions are at 25ºC

ERM02H110 Performance Curves

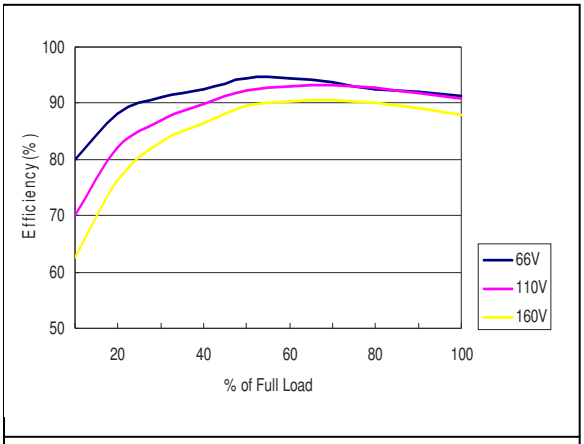


Figure 64: **ERM02H110 Efficiency Versus Output Current**
Vin = 66 to 160Vdc Load: Io = 0 to 2.08A

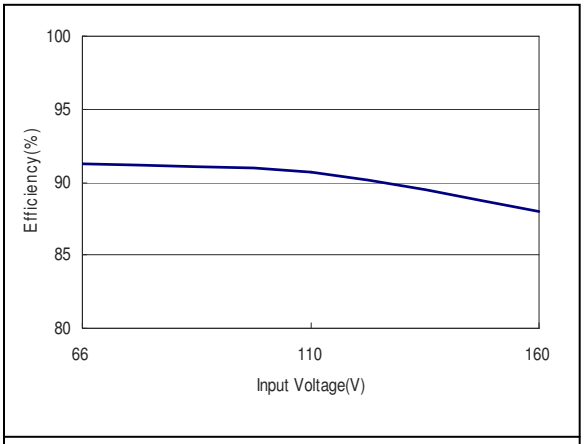


Figure 65: **ERM02H110 Efficiency Versus Input Voltage**
Vin = 66 to 160Vdc Load: Io = 2.08A

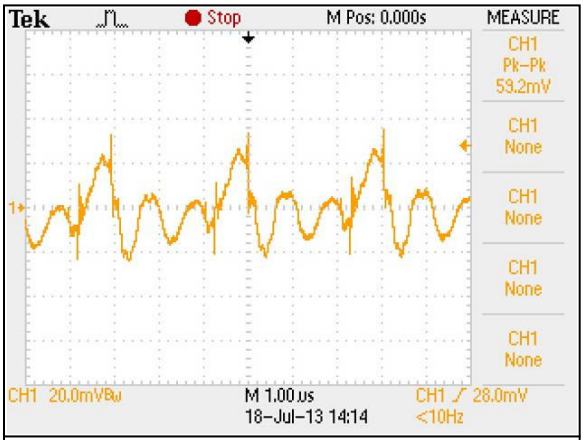


Figure 66: **ERM02H110 Typical Output Ripple and Noise.**
Vin = 110Vdc Load: Io = 2.08A
Ch 1: Vo

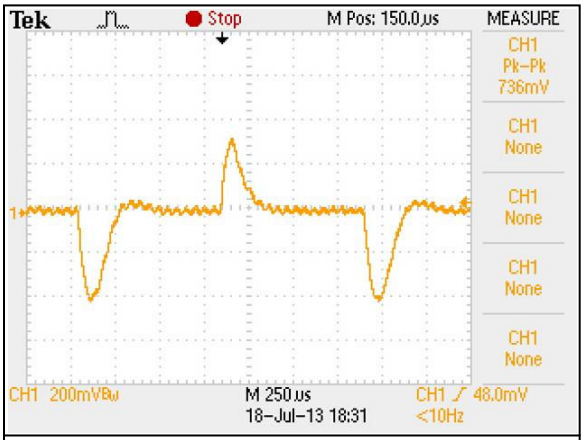


Figure 67: **ERM02H110 Transient Response**
Vin = 110Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

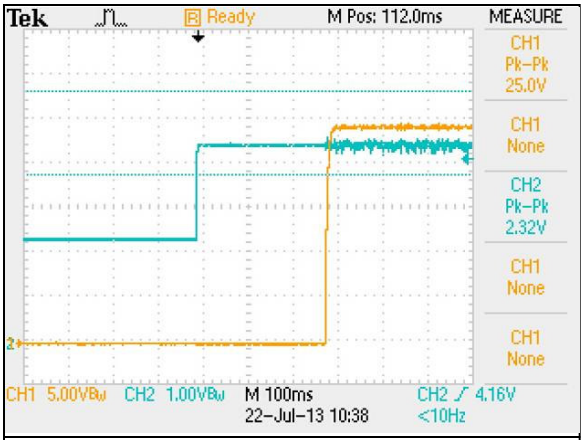


Figure 68: **ERM02H110 Output Voltage Startup Characteristic by ON/OFF**
Vin = 110Vdc Load: Io = 2.08A
Ch1: Vo Ch2: Remote On/Off

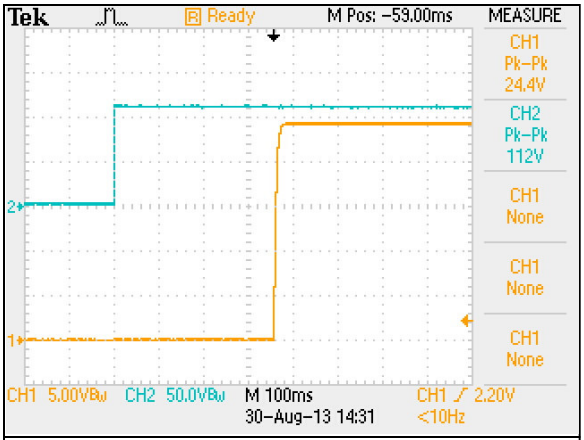


Figure 69: **ERM02H110 Output Voltage Startup Characteristic by Vin**
Vin = 110Vdc Load: Io = 2.08A
Ch1: Vo Ch2: Vin

ERM02H110 Performance Curves

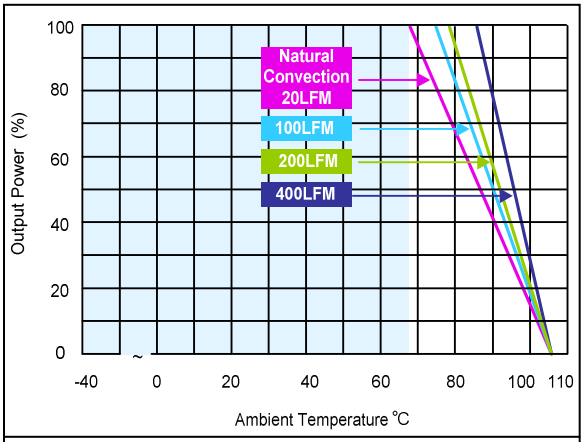


Figure 70: **ERM02H110 Derating Curve without Heatsink**
Vin = 110Vdc Load: Io = 0 to 2.08A

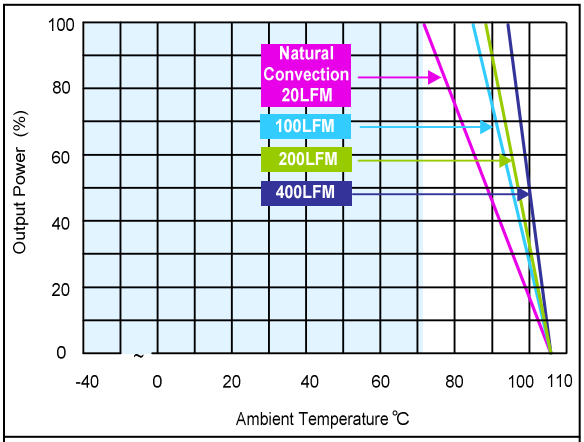


Figure 71: **ERM02H110 Derating Curve with Heatsink**
Vin = 110Vdc Load: Io = 0 to 2.08A

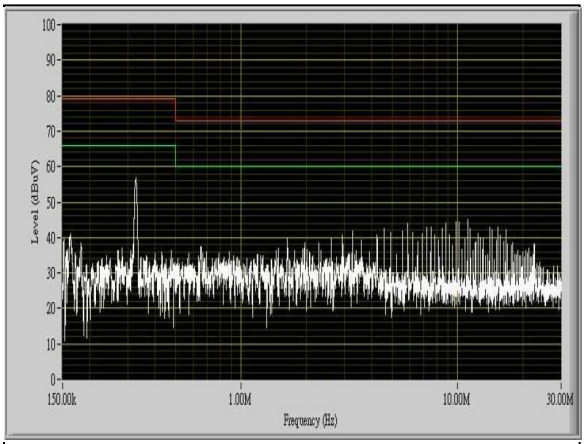


Figure 72: **ERM02H110 Conduction Emission of EN55011 Class A**
Vin = 110Vdc Load: Io = 2.08A

Note - All test conditions are at 25ºC

Over Voltage Protection (OVP)

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage.

Parameter		Min	Nom	Max	Unit
V_O Output Overvoltage	ERM10A72 ERM10A110	/	6.2	/	Vdc
	ERM04B72 ERM04B110	/	15	/	Vdc
	ERM03C72 ERM03C110	/	18	/	Vdc
	ERM02H72 ERM02H110	/	27	/	Vdc

Over Temperature Protection (OTP)

Over Temperature (non-latching), base plate temperature.

Parameter	Min	Nom	Max	Unit
Over - temperature	-50	/	110	ºC

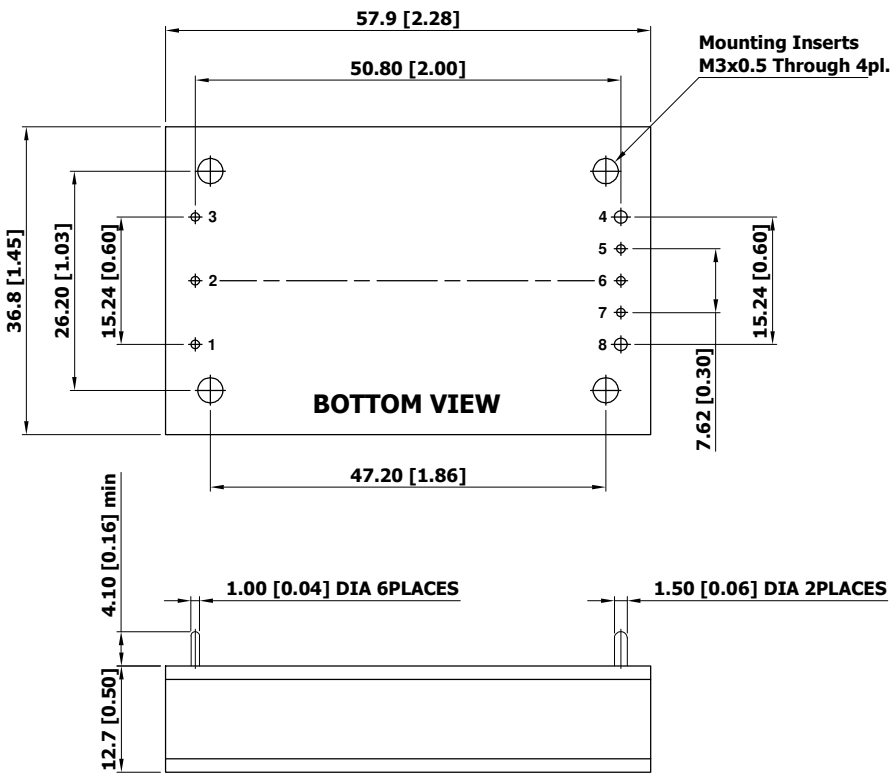
Over Current Protection (OCP)

Current Limitation at 150% typ. of Iout max., Hiccup mode. To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Parameter		Min	Nom	Max	Unit
V_O Output Overcurrent	ERM10A72 ERM10A110	/	15.000	/	A
	ERM04B72 ERM04B110	/	6.255	/	A
	ERM03C72 ERM03C110	/	4.995	/	A
	ERM02H72 ERM02H110	/	3.120	/	A

Mechanical Specifications

Mechanical Outlines



Pin Connections

Pin 1	–	+Vin
Pin 2	–	Remote On/Off
Pin 3	–	-Vin
Pin 4	–	-Vout
Pin 5	–	-Sense(8)
Pin 6	–	Trim
Pin 7	–	+Sense(8)
Pin 8	–	+Vout

Note:

1. If remote sense not used, the +sense should be connected to +output and -sense should be connected to -output.
2. All dimensions in mm (inches)

   Tolerance: X.X±0.5 (X.XX±0.02)

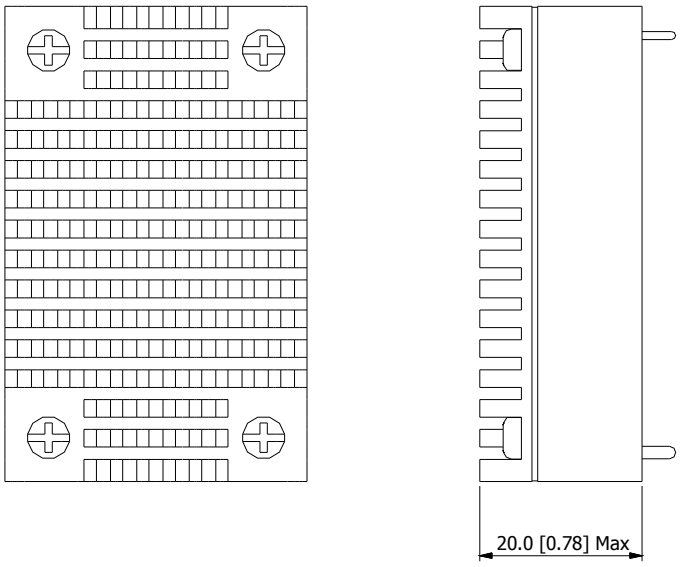
   X.XX±0.25 (X.XXX±0.01)
3. Pin diameter: 1.0 ±0.05 (0.04±0.002)
4. Pin diameter: 1.5 ±0.05 (0.06±0.002)

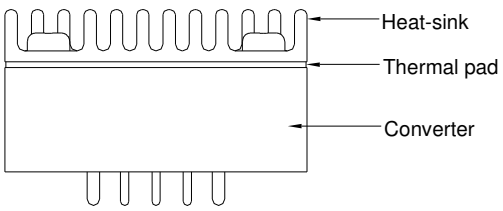
Physical Characteristics

Table 4.

Case Size	57.9x36.8x12.7 mm (2.28x1.45x0.5 inches)
Case Material	Aluminum Frame with Black Anodized Coating
Top Side Base Material	Aluminum Plate
Bottom Side Base Material	Non-conductive Black Plastic Base Plate
Potting Material	Epoxy (UL94-V0)

Heatsink (Option –HS)





Heatsink Material: Aluminum

Finish: Black Anodized Coating

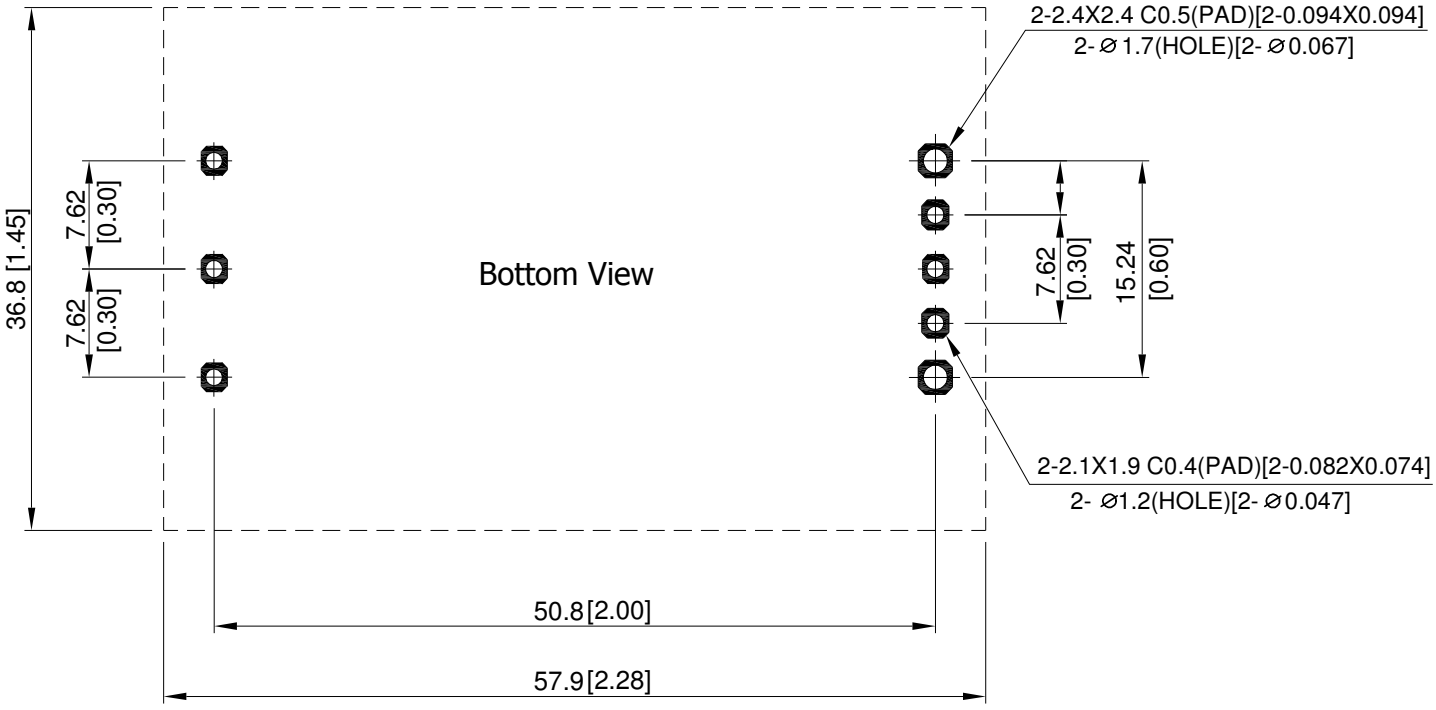
Weight: 13g

The advantages of adding a heatsink are:

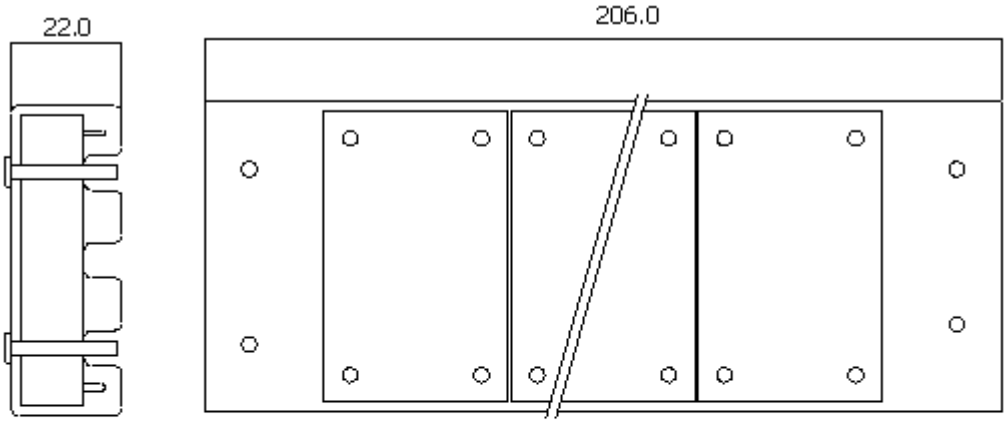
1. To help heat dissipation and increase the stability and reliability of DC/DC converters at high operating temperature atmosphere.

2. To upgrade the operating temperature of DC/DC converters, please refer to Derating Curve.

Recommended Pad Layout



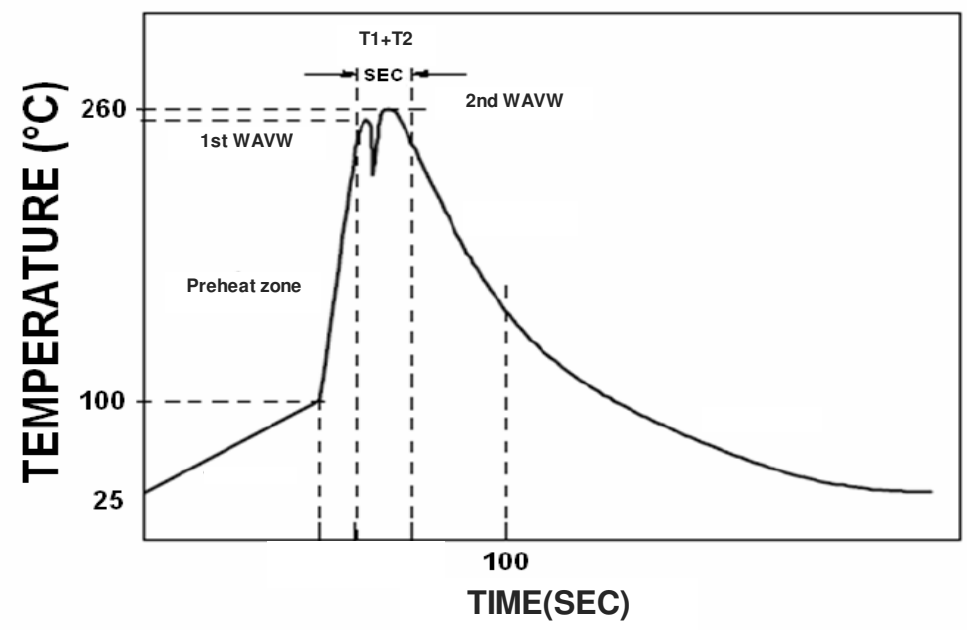
Packaging Information



unit:mm
5 PCS per TUBE

Soldering and Reflow Considerations

Lead free wave solder profile for ERM50 Series



Weight

The ERM50 series weight is 0.13 lb. (61 grams) maximum.

EMC Immunity

ERM50 series power supply is designed to meet the following EMC immunity specifications. The ERM50 series can meet EN61000-4-4 & EN61000-4-5 by adding a capacitor across the input pins. Suggested capacitor: CHEMI-CON KXG 470μF/200V.

Table 5. EMC Specifications:

Parameter	Standards & Level	Performance
EMI	EN55022	Class A/Class B
ESD	EN61000-4-2 air ±8KV , Contact ±6KV	Perf. Criteria A
Radiated immunity	EN61000-4-3 10V/m	Perf. Criteria A
Fast transient	EN61000-4-4 ±2KV	Perf. Criteria A
Surge	EN61000-4-5 ±1KV	Perf. Criteria A
Conducted immunity	EN61000-4-6 10V/m	Perf. Criteria A

Safety Certifications

The ERM50 power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

Table 6. Safety Certifications for ERM50 series power supply system

Document	Description
cUL/UL 60950-1	US and Canada Requirements
IEC/EN 60950-1	European Requirements
IEC/EN 50155	Railway standard

EMI Emissions

EMI-Filter to meet EN 55022, class A, class B

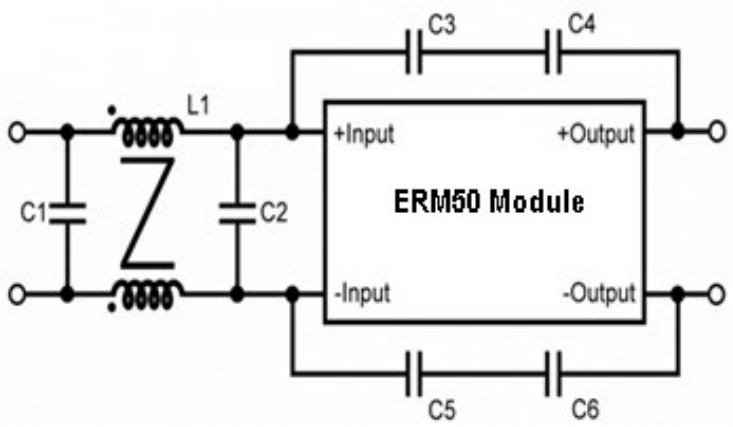


Table 7. Conducted EMI emission specifications

	Class A	Class B	
	All models	ERMXXX72	ERMXXX110
L1	450 µ H/450 µ H	450 µ H/450 µ H	
C1	CHEMI-CON KXG Series 68 µ F/200V	CHEMI-CON KXG Series 220 µ F/200V	
C2	None	CHEMI-CON KXG Series 220 µ F/200V	
C3	2200pF/3KV	None	3300pF/3KV
C4	2200pF/3KV	None	3300pF/3KV
C5	2200pF/3KV	None	None
C6	2200pF/3KV	None	None

Operating Temperature

Table 8. Environmental Specifications:

Parameter	Model / Condition	Min	Max		Unit
			Without Heatsink	With Heatsink	
Operating Ambient Temperature Range Natural Convection[1] Nominal Vin, Load 100% Inom .	ERM04B72 ERM03C72 ERM03C110 ERM02H72 ERM04B110 ERM02H110 ERM10A72 ERM10A110	-40	72 72 72 68 68 68 63 63	75 75 75 71 71 71 67 67	ºC
Thermal Impedance	Natural Convection without Heatsink	7.5	-	-	ºC/W
	Natural Convection with Heatsink	6.8	-	-	
	100LFM Convection without Heatsink	6.1	-	-	
	100LFM Convection with Heatsink	4.1	-	-	
	200LFM Convection without Heatsink	5.3	-	-	
	200LFM Convection with Heatsink	3.3	-	-	
	400LFM Convection without Heatsink	3.9	-	-	
	400LFM Convection with Heatsink	2.2	-	-	
Operating Base-plate Temperature Range		-40	+105		ºC
RFI	Six-Sided Shielded, Metal Case				
Lead Temperature (1.5mm from case for 10Sec.)		-	260		ºC

Note1 - The “natural convection” is about 20LFM but is not equal to still air (0 LFM).

Storage and Shipping Temperature

The ERM50 series power supplies can be stored or shipped at temperatures between –50 ºC to +125 ºC and relative humidity from 5% to 95% non-condensing.

Humidity

The ERM50 series will operate within specifications when subjected to a relative humidity from 5% to 95% non-condensing.

MTBF and Reliability

The MTBF of ERM50 series of DC/DC converters has been calculated using MIL-HDBK 217F NOTICE 2, Operating Temperature 25 °C, Ground Benign.

Model	MTBF	Unit
ERM10A72	315,900	Hours
ERM04B72	482,900	
ERM03C72	460,200	
ERM02H72	420,100	
ERM10A110	314,900	
ERM04B110	431,500	
ERM03C110	456,100	
ERM02H110	414,200	

Power and Signal Pins

These pins provide power and signal interface to the ERM50 series module.

Pin 1 - Vin (+) – Input Voltage Positive
Pin 2 - Remote On/Off – ON / OFF Control
Pin 3 - Vin (-) – Input Voltage Return
Pin 4 - Vout (-) – Output Voltage Return
Pin 5 - SENSE (-) – Remote Sense Return
Pin 6 - TRIM – Output Voltage Trim
Pin 7 - SENSE (+) – Remote Sense Positive
Pin 8 - Vout (+) – Output Voltage Positive

Vin (+), Vin (-) - (Pins 1, 3)

These pins are the Input Voltage Positive and Input Voltage Return pins of the module.

Remote On/Off - (Pin 2)

Remote On/Off pin allows the user to turn ON and OFF the output of the ERM50 series modules.

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	3.5V ~ 12V or Open Circuit				
Converter Off	0V ~ 1.2V or Short Circuit				
Control Input Current (on)	Vctrl = 5.0V	-	0.5	-	mA
Control Input Current (off)	Vctrl = 0V	-	-0.5	-	mA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	-	2.5	-	mA

Vout (+), Vout (-) – (Pins 8, 4)

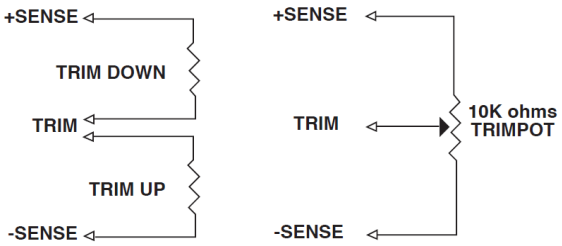
These pins are the Output Voltage Positive and Output Voltage Return pins of the module.

SENSE (+), SENSE (-) – (Pins 7, 5)

The ERM50 is equipped with a Remote Sensing capability that will compensate for voltage drop between the output pins of the module and the sensed voltage point (load). This feature is implemented by connecting the SENSE (+) (pin 7) and the SENSE (-) (pin 5) to the positive and return rails of the output, respectively, at a location that is near to the load. Care should be taken in the routing of the sense lines as any noise sources or additional filtering components introduced into the output voltage rail may affect the stability of the power supply. The ERM50 series will operate appropriately without the sense lines connected; however it is recommended that the sense lines be connected directly to the output pins if remote sensing is not required.

TRIM – (Pin 6)

Output can be externally trimmed by using the method shown below. The trim up/down range is ±10% minimum of the nominal output voltage



ERM10AXX Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	45.53	20.61	12.31	8.15	5.66	4.00	2.81	1.92	1.23	0.68	KOhms
Trim up	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**%**
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	36.57	16.58	9.92	6.59	4.59	3.25	2.30	1.59	1.03	0.59	KOhms

ERM04BXX Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	394.50	179.74	106.08	68.86	46.39	31.36	20.60	12.51	6.21	1.17	KOhms
Trim up	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**%**
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	368.92	161.92	94.97	61.86	42.12	29.00	19.66	12.66	7.23	2.89	KOhms

ERM03CXX Trim Table

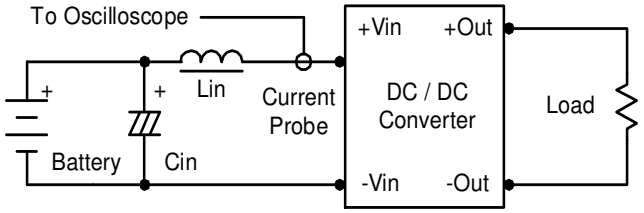
Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	572.67	248.63	145.60	94.97	64.87	44.92	30.72	20.10	11.86	5.28	KOhms
Trim up	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**%**
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	392.98	182.12	108.73	71.43	48.85	33.71	22.86	14.69	8.33	3.23	KOhms

ERM02HXX Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	512	229.6	138.3	90.3	60.7	42.4	29.04	18.67	11.09	4.78	KOhms
Trim up	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**%**
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	574	256.9	149.6	96.5	64.7	43.28	27.68	16.72	7.68	1.11	KOhms

Input Reflected-Ripple Current Test Setup

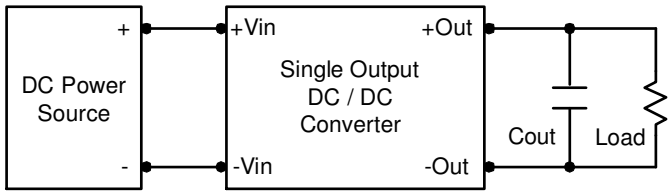
Input reflected-ripple current is measured with a inductor Lin (4.7 μ H) and Cin (220 μ F, ESR < 1.0 Ω at 100 KHz) to simulate source impedance. Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 KHz.



Component	Value	Reference
Lin	4.7 μ H	-
Cin	220 μ F (ESR<1.0 Ω at 100KHz)	Aluminum Electrolytic Capacitor

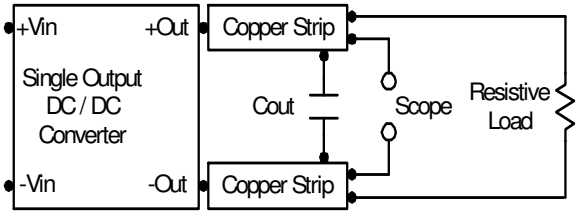
Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7 μ F capacitors at the output.



Peak-to-Peak Output Noise Measurement Test

Use a 1 μ F ceramic capacitor and a 10 μ F tantalum capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20MHz. Position the load between 50 mm and 75 mm from the DC/DC Converter.

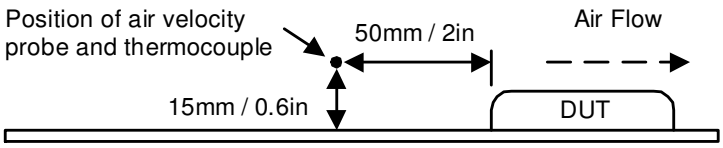


Maximum Capacitive Load

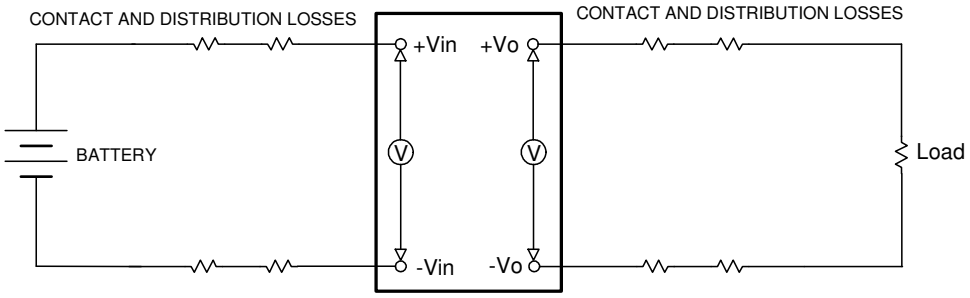
The ERM50 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in below table.

Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105 ºC. The derating curves are determined from measurements obtained in a test setup.



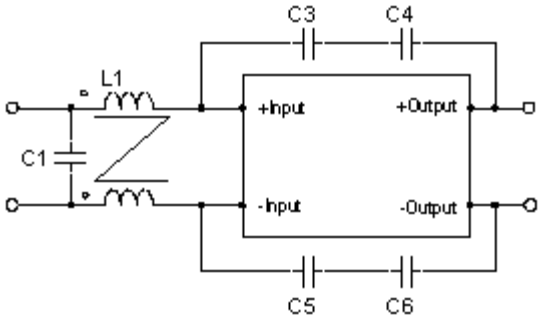
Output voltage and efficiency measurement test up



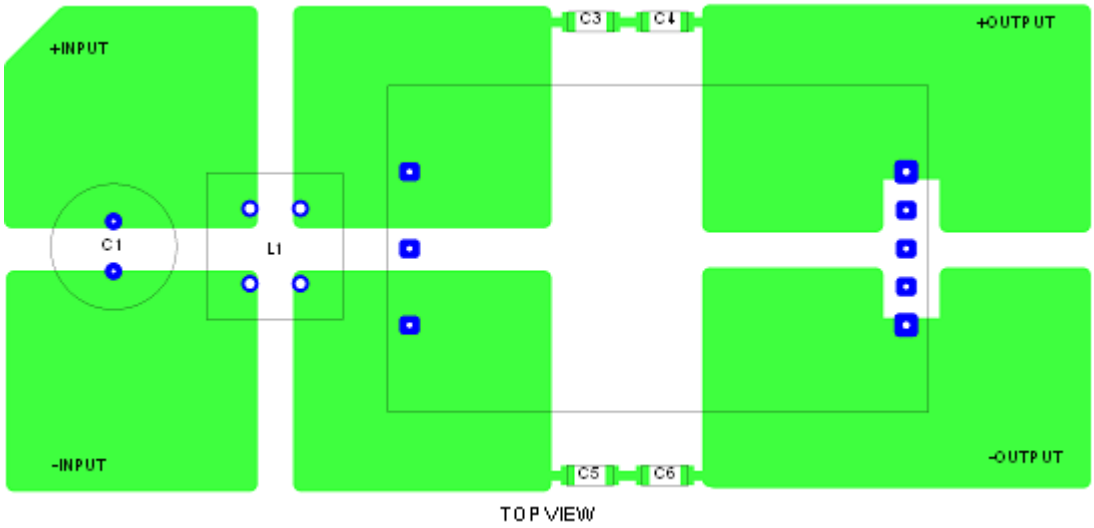
$$Efficiency = \left(\frac{V_{out} \times I_{out}}{V_{in} \times I_{in}} \right) \times 100\% = [\%]$$

EMC considerations

Recommended circuit to comply EN55011 Class A Limits



Recommended PCB Layout with Input Filter



To: comply with EN55011 CLASS A following components are needed:

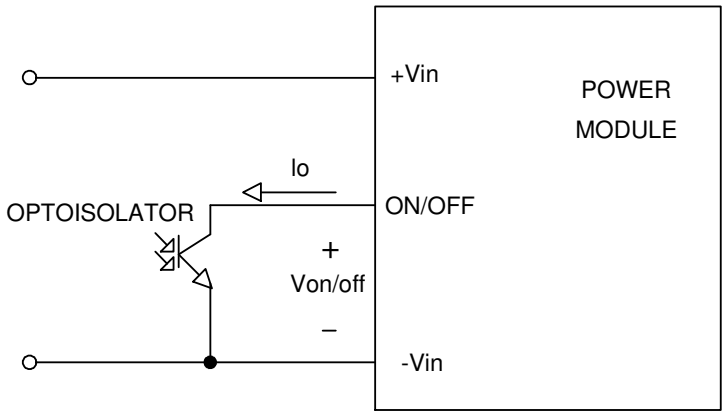
Model	Component	Value
ERM50 Series	C1	CHEMI-CON KXG Series 68 μF/200V
	C3.C4.C5.C6	2200pF/3KV
	L1	450 μH/450 μH

Input Source Impedance

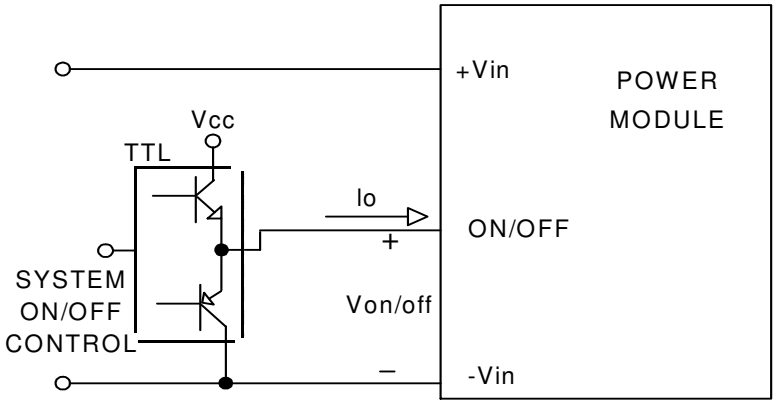
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a capacitor of a 3.3μF for the 72V input devices and a 1μF for the 110V input devices.

Remote ON/OFF Control

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 3) during a logic low is -100μA. The ON/OFF input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please open circuit between on/off pin and -Vin pin to turn the module on. Remote ON/OFF implementation is below.



Isolated-Closure Remote ON/OFF



Level Control Using TTL Output

Americas
5810 Van Allen Way
Carlsbad, CA 92008
USA
Telephone: +1 (760) 930 4600
Facsimile: +1 (760) 930 0698

Europe (UK)
Waterfront Business Park
Merry Hill, Dudley
West Midlands, DY5 1LX
United Kingdom
Telephone: +44 (0) 1384 842 211
Facsimile: +44 (0) 1384 843 355

Asia (HK)
14/F, Lu Plaza
2 Wing Yip Street
Kwun Tong, Kowloon
Hong Kong
Telephone: +852 2176 3333
Facsimile: +852 2176 3888

For global contact, visit:

www.emersonnetworkpower.com

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