Advanced Energy

ARTESYN
AEE 20W-M SERIES
DC/DC Converter

PRODUCT DESCRIPTION

Advanced Energy's Artesyn AEE20W-M series is a new range of high performance dc-dc converter modules with a reinforced insulation system. I/O isolation voltage is specified for 4200Vac, which rated for 300Vrms working voltage. The product comes in a compact 2"x1" industrial standard package. All 18 models available for 12, 24, 48Vdc with wide 2:1 input voltage range and tight output regulation.

The AEE20W-M series DC/DC converters offer an economical solution for demanding applications in medical instrumentation requesting a certified supplementary or reinforced insulation system to comply with the latest medical safety standards.

SPECIAL FEATURES

- 4200Vac reinforced Insulation
- Insulation rated for 300Vrms working voltage
- Medical safety certifications
- 2 x MOPP rated
- Wide 2:1 input voltage range
- Low leakage current <5uA
- Operating temperature range –40 ^{O}C to +80 ^{O}C (With derating)
- No minimum load requirement
- Overload/voltage and short circuit protection
- Input filter meets EN 55011, class A and FCC, level A
- Medical EMC Standard meets 4th Edition of EMI EN55011 and EMS EN60601-1-2
- 2"x 1" plastic package
- 3 Years product warranty

SAFETY

- EN/IEC 60601-1 3rd Edition, ANSI/AAMI ES60601-1, 2x MOPP
- CE Mark

TYPICAL APPLICATIONS

- Industrial
- Medical

TECHNICAL REFERENCE NOTE

Total Power:

20 Watts

Input Voltage:

9-18 Vdc

18-36 Vdc

36-75 Vdc

# of Outputs:

Single / Dual

RoHS

Model Numbers

Model	Input Voltage	Output Voltage	Maximum Load	Efficiency
AEE04A12-M	9-18Vdc	5Vdc	4A	86%
AEE02B12-M	9-18Vdc	12Vdc	1.67A	89%
AEE02C12-M	9-18Vdc	15Vdc	1.33A	88%
AEE02H12-M	9-18Vdc	24Vdc	0.84A	89%
AEE02BB12-M	9-18Vdc	±12 Vdc	±0.84A	89%
AEE02CC12-M	9-18Vdc	±15 Vdc	±0.67A	89%
AEE04A24-M	18-36Vdc	5Vdc	4A	88%
AEE02B24-M	18-36Vdc	12Vdc	1.67A	89%
AEE02C24-M	18-36Vdc	15Vdc	1.33A	89%
AEE02H24-M	18-36Vdc	24Vdc	0.84A	90%
AEE02BB24-M	18-36Vdc	±12 Vdc	±0.84A	90%
AEE02CC24-M	18-36Vdc	±15 Vdc	±0.67A	90%
AEE04A48-M	36-75Vdc	5Vdc	4A	88%
AEE02B48-M	36-75Vdc	12Vdc	1.67A	89%
AEE02C48-M	36-75Vdc	15Vdc	1.33A	90%
AEE02H48-M	36-75Vdc	24Vdc	0.84A	89%
AEE02BB48-M	36-75Vdc	±12 Vdc	±0.84A	89%
AEE02CC48-M	36-75Vdc	±15 Vdc	±0.67A	90%

Options

None

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 Surge Voltage 100 mSec. max	12V Input Models 24V Input Models 48V Input Models	$V_{IN,DC}$	-0.7 -0.7 -0.7	- - -	25 50 100	Vdc Vdc Vdc
Maximum Output Power	All models	$P_{O,max}$	-	-	20	W
Isolation Voltage Input to output (60 seconds)	All models		4200	-	-	Vac
Isolation Resistance (500Vdc)	All models		10	-	-	Gohm
Isolation Capacitance (100KHz,1V)	All models		-	-	80	pF
Thermal Impedance	Natural Convection		13	-	-	$^{O}C/W$
Operating Ambient Temperature Range	Convection Cooling		-40		+80[1]	^{O}C
Operating Case Temperature	All models	T_{CASE}	-	-	+95	^{O}C
Storage Temperature	All models	T_{STG}	-50		+125	^{O}C
Humidity (non-condensing) Operating Non-operating	 All models All models		 - -	 - -	 95 95	 % %
MTBF	MIL-HDBK-217F@25^{O}C, Ground Benign		1000000	-	-	Hours

Note 1 - With Derating

Electrical Specifications

Input Specifications

Table 2. Input Specifications

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Operating Input Voltage, DC	12V Input Models 24V Input Models 48V Input Models	All	$V_{IN,DC}$	9 18 36	12 24 48	18 36 75	Vdc Vdc Vdc
Start-Up Threshold Voltage	12V Input Models 24V Input Models 48V Input Models	All	$V_{IN,ON}$	- - -	- - -	9 18 36	Vdc Vdc Vdc
Under Voltage Lockout	12V Input Models 24V Input Models 48V Input Models	All	$V_{IN,OFF}$	- - -	7.5 15 33	- - -	Vdc Vdc Vdc
Input reflected ripple current	12V Input Models 24V Input Models 48V Input Models	0 to 500KHz, 4.7uH source impedance	$I_{IN,ripple}$	- - -	100 50 30	- - -	mA mA mA
Input Current	AEE04A12-M AEE02B12-M AEE02C12-M AEE02H12-M AEE02BB12-M AEE02CC12-M AEE04A24-M AEE02B24-M AEE02C24-M AEE02H24-M AEE02BB24-M AEE02CC24-M AEE04A48-M AEE02B48-M AEE02C48-M AEE02H48-M AEE02BB48-M AEE02CC48-M	$V_{IN,DC}=V_{IN,nom}$	$I_{IN,full\ load}$	- - - - - - - - - - - - - - - - - -	1938 1876 1893 1888 1888 1882 947 938 936 933 933 931 473 469 463 472 472 465	- - - - - - - - - - - - - - - - - -	mA mA mA mA mA mA mA mA mA mA mA mA mA mA mA mA mA mA
No Load Input Current (V_O On, I_O = 0A)	12V Input Models 24V Input Models 48V Input Models	$V_{IN,DC}=V_{IN,nom}$	I_{IN,no_load}	- - -	20 15 10	- - -	mA mA mA

Electrical Specifications

Input Specifications

Table 2. Input Specifications con't							
Parameter		Condition	Symbol	Min	Typ	Max	Unit
Efficiency @Max. Load	AEE04A12-M	$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$ $T_A=25\ ^{O}C$	η	-	86	-	%
	AEE02B12-M			-	89	-	%
	AEE02C12-M			-	88	-	%
	AEE02H12-M			-	89	-	%
	AEE02BB12-M			-	89	-	%
	AEE02CC12-M			-	89	-	%
	AEE04A24-M			-	88	-	%
	AEE02B24-M			-	89	-	%
	AEE02C24-M			-	89	-	%
	AEE02H24-M			-	90	-	%
	AEE02BB24-M			-	90	-	%
	AEE02CC24-M			-	90	-	%
	AEE04A48-M			-	88	-	%
	AEE02B48-M			-	89	-	%
	AEE02C48-M			-	90	-	%
	AEE02H48-M			-	89	-	%
	AEE02BB48-M			-	89	-	%
	AEE02CC48-M			-	90	-	%
Leakage current		$V_{IN,DC}$=240Vac F=60Hz	$I_{leakage}$	-	-	5	uA
Internal Filter Type		All	Internal Pi Type				

Electrical Specifications

Output Specifications

Table 3. Output Specifications							
Parameter		**Condition**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Output Voltage Set -Point		$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$ $T_A=25\ ^{O}C$	$\pm\%V_O$	-	1	-	%
Output Voltage Balance	Dual Output, Balanced Loads	All	$\pm\%V_O$	-	-	2.0	%
Output Current	AEE04A12-M AEE02B12-M AEE02C12-M AEE02H12-M AEE02BB12-M AEE02CC12-M AEE04A24-M AEE02B24-M AEE02C24-M AEE02H24-M AEE02BB24-M AEE02CC24-M AEE04A48-M AEE02B48-M AEE02C48-M AEE02H48-M AEE02BB48-M AEE02CC48-M	Convection Cooling	I_O	- - - - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - - - -	4 1.67 1.33 0.84 ±0.84 ±0.67 4 1.67 1.33 0.84 ±0.84 ±0.67 4 1.67 1.33 0.84 ±0.84 ±0.67	A A A A A A A A A A A A A A A A A A
Load Capacitance[1]	AEE04A12-M AEE02B12-M AEE02C12-M AEE02H12-M AEE02BB12-M AEE02CC12-M AEE04A24-M AEE02B24-M AEE02C24-M AEE02H24-M AEE02BB24-M AEE02CC24-M AEE04A48-M AEE02B48-M AEE02C48-M AEE02H48-M AEE02BB48-M AEE02CC48-M	All		- - - - - - - - - - - - - - - - - -	- - - - - - - - - - - - - - - - - -	6800 1160 750 295 590# 380# 6800 1160 750 295 590# 380# 6800 1160 750 295 590# 380#	uF uF uF uF uF uF uF uF uF uF uF uF uF uF uF uF uF uF

Note 1 - # for each output

Electrical Specifications

Output Specifications

Table 3. Output Specifications Con't							
Parameter		**Condition**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Start Up Time (Power On)		$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$ Resistive Load	$T_{Turn\text{-}On}$	-	-	30	mSec
Line Regulation		$V_{IN,DC}=V_{IN,min}$ to $V_{IN,max}$	$\pm\%V_O$	-	-	0.5	%
Load Regulation	Single Output Dual Output	$I_O=I_{O,min}$ to $I_{O,max}$	$\pm\%V_O$ $\pm\%V_O$	- -	- -	0.5 1.0	% %
Switching Frequency		All	f_{SW}	-	285	-	KHz
V_O Dynamic Response	Peak Deviation Settling Time	25% load change	$\pm\%V_O$ t_s	- -	±3 -	±5 300	% uSec
Temperature Coefficient		All	$\%/^{O}C$	-	-	0.02	%
Output Over Current Protection[2]		All	$\%I_{O,max}$	-	150	-	%
Output Short Circuit Protection		All		Hiccup Mode 0.7 Hz type, Automatic Recovery			
Output Over Voltage Protection	AEE04A12-M AEE02B12-M AEE02C12-M AEE02H12-M AEE02BB12-M AEE02CC12-M AEE04A24-M AEE02B24-M AEE02C24-M AEE02H24-M AEE02BB24-M AEE02CC24-M AEE04A48-M AEE02B48-M AEE02C48-M AEE02H48-M AEE02BB48-M AEE02CC48-M	All		- - - - - - - - - - - - - - - - - -	6.2 15 18 27 ±15 ±18 6.2 15 18 27 ±15 ±18 6.2 15 18 27 ±15 ±18	- - - - - - - - - - - - - - - - - -	Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc Vdc

Note 2 - Hiccup Automatic Recovery

Electrical Specifications

Output Specifications

Table 3. Output Specifications Con't							
Parameter		Condition	Symbol	Min	Typ	Max	Unit
Output Ripple, pk-pk	AEE04A12-M	Measure with a 4.7uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	V_O	-	50	-	mV_{PK-PK}
	AEE02B12-M			-	100	-	mV_{PK-PK}
	AEE02C12-M			-	100	-	mV_{PK-PK}
	AEE02H12-M			-	150	-	mV_{PK-PK}
	AEE02BB12-M			-	100	-	mV_{PK-PK}
	AEE02CC12-M			-	100	-	mV_{PK-PK}
	AEE04A24-M			-	50	-	mV_{PK-PK}
	AEE02B24-M			-	100	-	mV_{PK-PK}
	AEE02C24-M			-	100	-	mV_{PK-PK}
	AEE02H24-M			-	150	-	mV_{PK-PK}
	AEE02BB24-M			-	100	-	mV_{PK-PK}
	AEE02CC24-M			-	100	-	mV_{PK-PK}
	AEE04A48-M			-	50	-	mV_{PK-PK}
	AEE02B48-M			-	100	-	mV_{PK-PK}
	AEE02C48-M			-	100	-	mV_{PK-PK}
	AEE02H48-M			-	150	-	mV_{PK-PK}
	AEE02BB48-M			-	100	-	mV_{PK-PK}
	AEE02CC48-M			-	100	-	mV_{PK-PK}

Electrical Specifications

AEE04A12-M Performance Curves

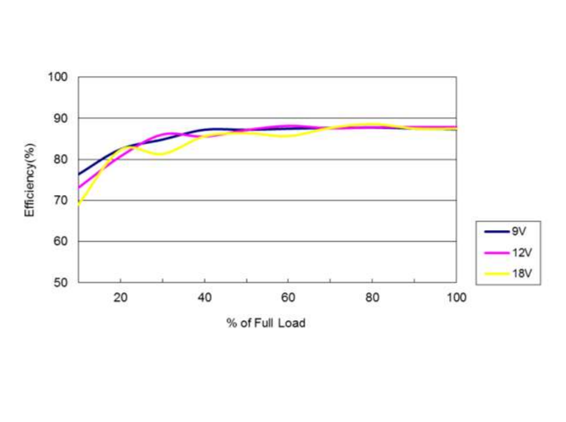


Figure 1: AEE04A12-M Efficiency Versus Output Current Curve
Vin = 9 to 18Vdc Load: Io = 0 to 4A

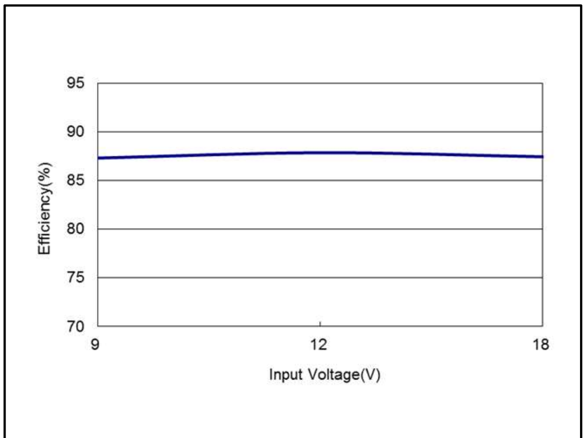


Figure 2: AEE04A12-M Efficiency Versus Input Voltage Curve
Vin = 9 to 18Vdc Load: Io = 4A

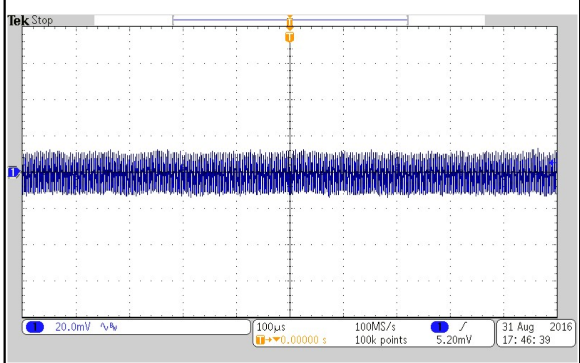


Figure 3: AEE04A12-M Ripple and Noise Measurement
Vin = 12Vdc Load: Io = 4A
Ch 1: Vo

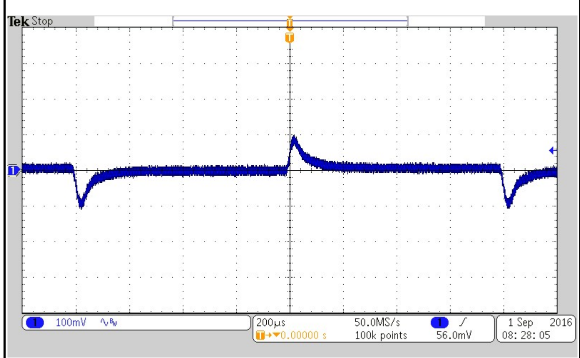


Figure 4: AEE04A12-M Transient Response
Vin = 12Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

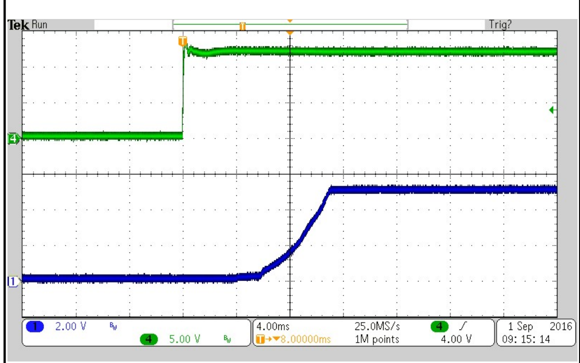


Figure 5: AEE04A12-M Output Voltage Startup Characteristic by Vin
Vin = 12Vdc Load: Io = 4A
Ch 1: Vo Ch 4: Vin

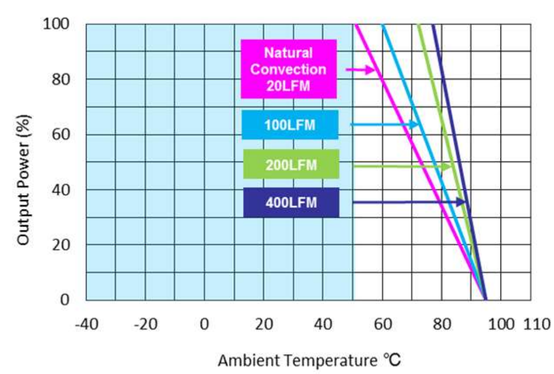


Figure 6: AEE04A12-M Derating Output Current vs Ambient Temp.
Vin = 12Vdc Load: Io = 4A

Electrical Specifications

AEE02B12-M Performance Curves

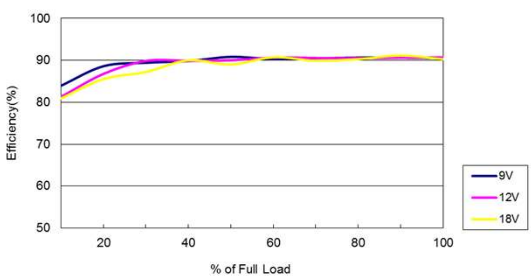


Figure 7: AEE02B12-M Efficiency Versus Output Current Curve
Vin = 9 to 18Vdc Load: Io = 0 to 1.67A

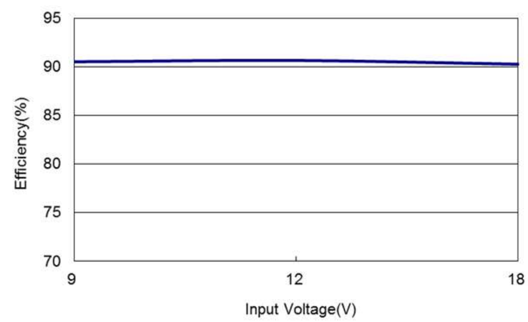


Figure 8: AEE02B12-M Efficiency Versus Input Voltage Curve
Vin = 9 to 18Vdc Load: Io = 1.67A

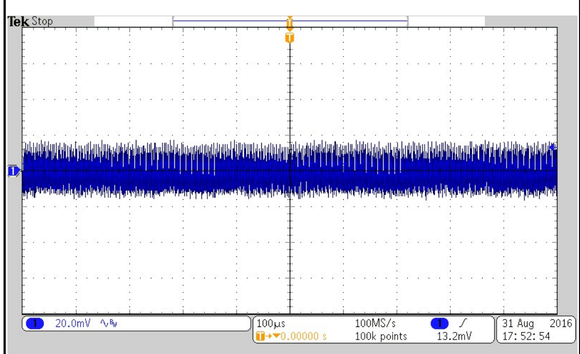


Figure 9: AEE02B12-M Ripple and Noise Measurement
Vin = 12Vdc Load: Io = 1.67A
Ch 1: Vo

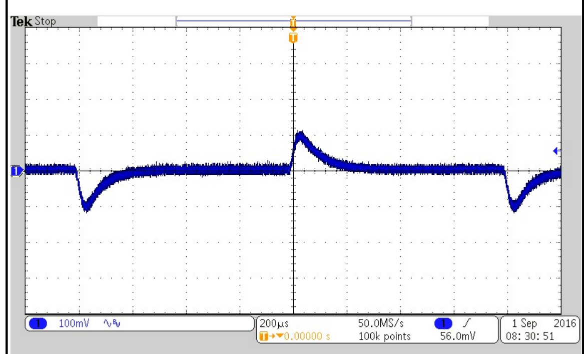


Figure 10: AEE02B12-M Transient Response
Vin = 12Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

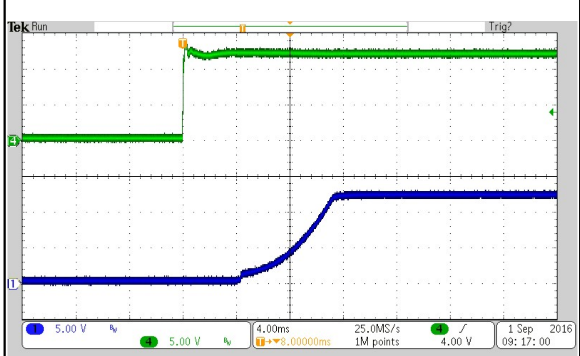


Figure 11: AEE02B12-M Output Voltage Startup Characteristic by Vin
Vin = 12Vdc Load: Io = 1.67A
Ch 1: Vo Ch 4: Vin

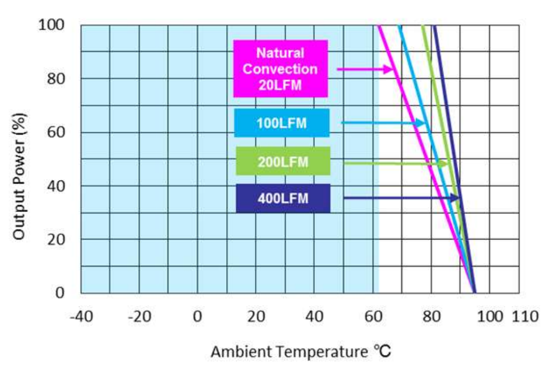


Figure 12: AEE02B12-M Derating Output Current vs Ambient Temp.
Vin = 12Vdc Load: Io = 1.67A

Electrical Specifications

AEE02C12-M Performance Curves

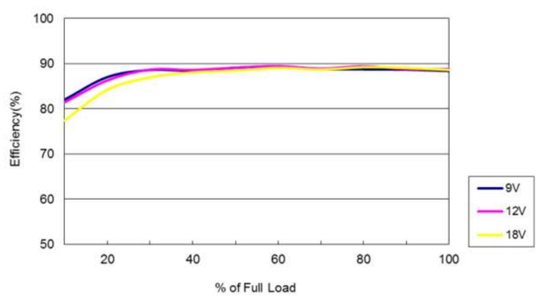


Figure 13: AEE02C12-M Efficiency Versus Output Current Curve
Vin = 9 to 18Vdc Load: Io = 0 to 1.33A

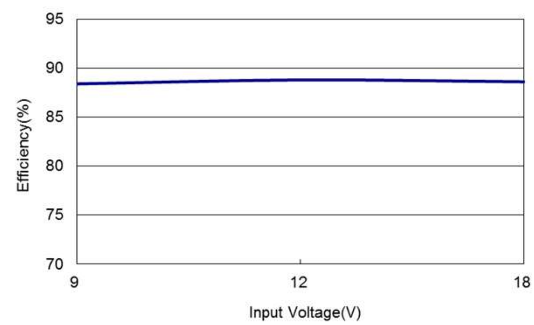


Figure 14: AEE02C12-M Efficiency Versus Input Voltage Curve
Vin = 9 to 18Vdc Load: Io = 1.33A

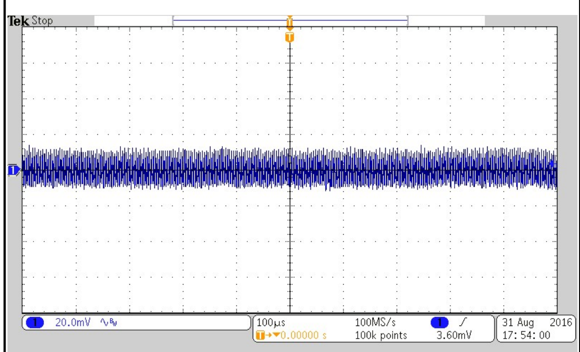


Figure 15: AEE02C12-M Ripple and Noise Measurement
Vin = 12Vdc Load: Io = 1.33A
Ch 1: Vo

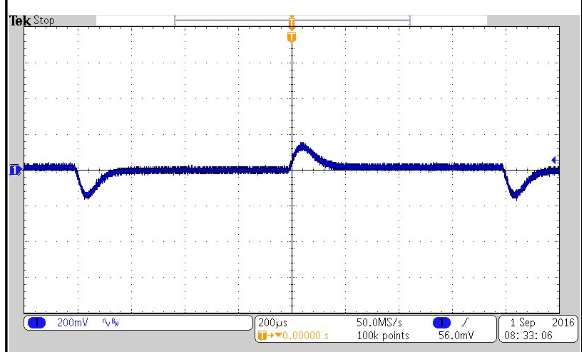


Figure 16: AEE02C12-M Transient Response
Vin = 12Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

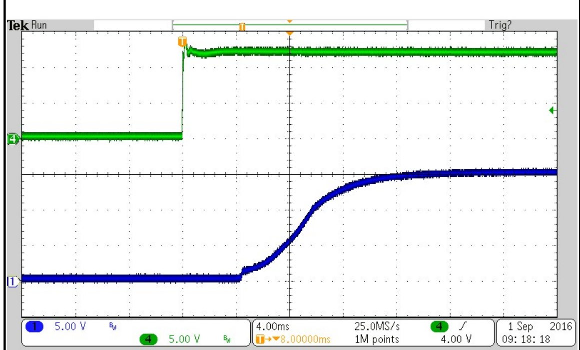


Figure 17: AEE02C12-M Output Voltage Startup Characteristic by Vin
Vin = 12Vdc Load: Io = 1.33A
Ch 1: Vo Ch 4: Vin

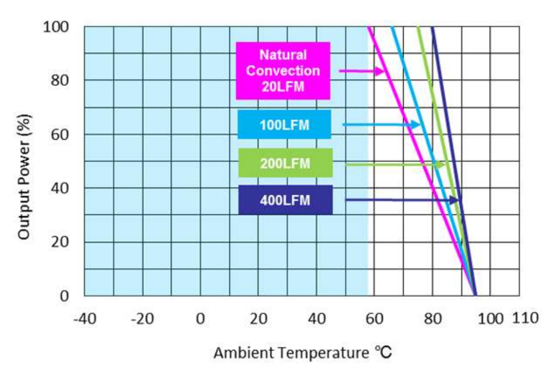


Figure 18: AEE02C12-M Derating Output Current vs Ambient Temp.
Vin = 12Vdc Load: Io = 1.33A

Electrical Specifications

AEE02H12-M Performance Curves

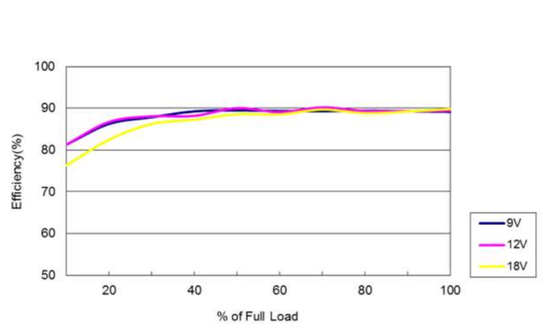


Figure 19: AEE02H12-M Efficiency Versus Output Current Curve
Vin = 9 to 18Vdc Load: Io = 0 to 0.84A

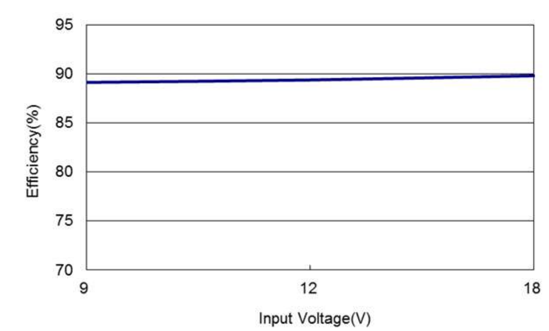


Figure 20: AEE02H12-M Efficiency Versus Input Voltage Curve
Vin = 9 to 18Vdc Load: Io = 0.84A

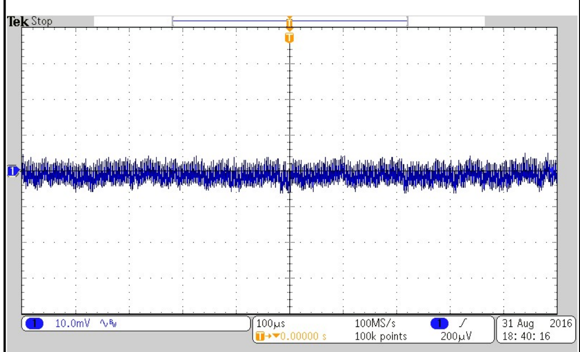


Figure 21: AEE02H12-M Ripple and Noise Measurement
Vin = 12Vdc Load: Io = 0.84A
Ch 1: Vo

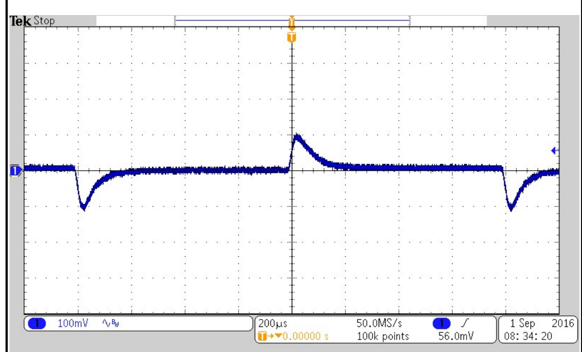


Figure 22: AEE02H12-M Transient Response
Vin = 12Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

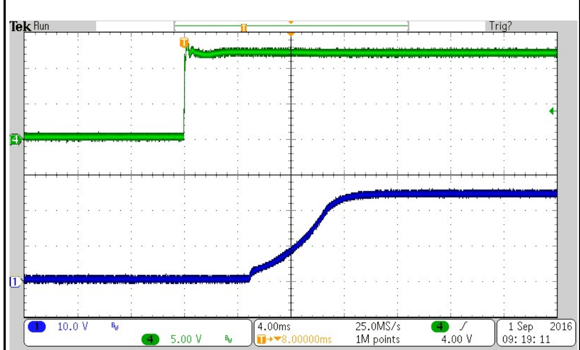


Figure 23: AEE02H12-M Output Voltage Startup Characteristic by Vin
Vin = 12Vdc Load: Io = 0.84A
Ch 1: Vo Ch 4: Vin

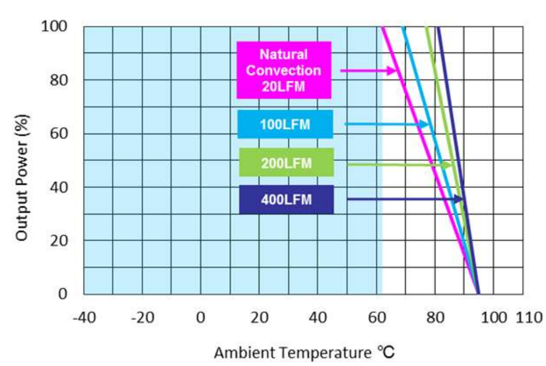


Figure 24: AEE02H12-M Derating Output Current vs Ambient Temp.
Vin = 12Vdc Load: Io = 0.84A

Electrical Specifications

AEE02BB12-M Performance Curves

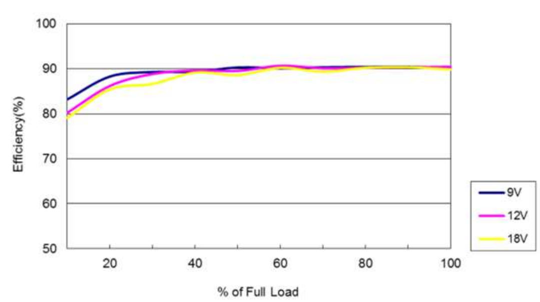


Figure 25: AEE02BB12-M Efficiency Versus Output Current Curve
Vin = 9 to 18Vdc Load: Io = 0 to ±0.84A

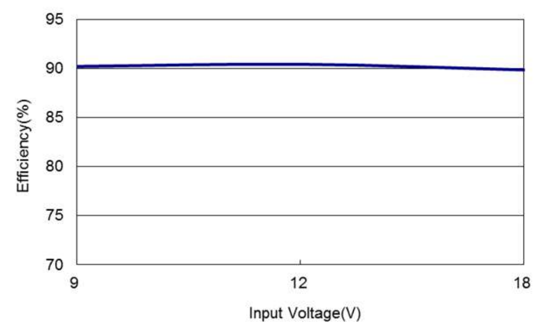


Figure 26: AEE02BB12-M Efficiency Versus Input Voltage Curve
Vin = 9 to 18Vdc Load: Io = ±0.84A

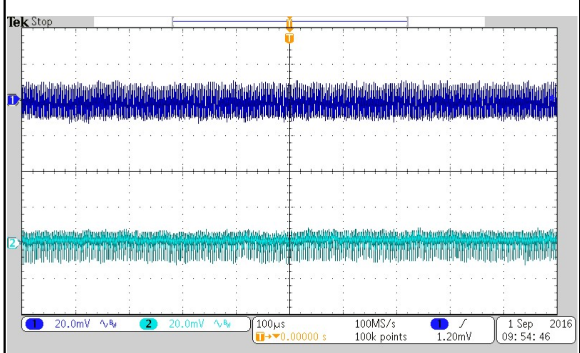


Figure 27: AEE02BB12-M Ripple and Noise Measurement
Vin = 12Vdc Load: Io = ±0.84A
Ch 1: Vo1 Ch 2: Vo2

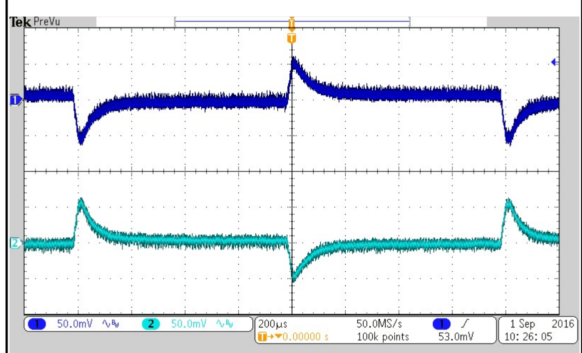


Figure 28: AEE02BB12-M Transient Response
Vin = 12Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1 Ch 2: Vo2

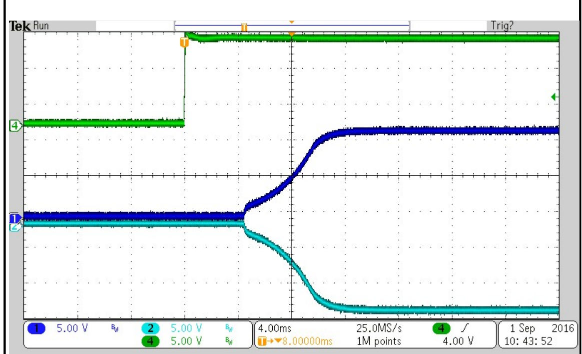


Figure 29: AEE02BB12-M Output Voltage Startup Characteristic by Vin
Vin = 12Vdc Load: Io = ±0.84A
Ch 1: Vo Ch 4: Vin

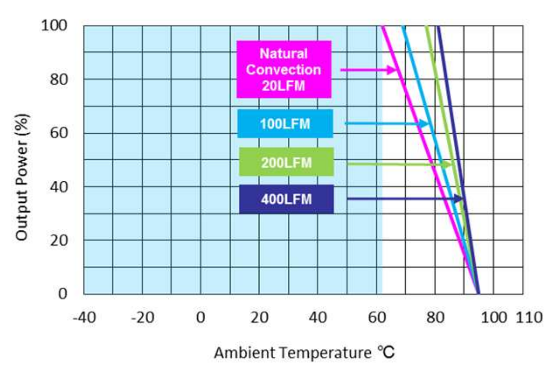


Figure 30: AEE02BB12-M Derating Output Current vs Ambient Temp.
Vin = 12Vdc Load: Io = ±0.84A

Electrical Specifications

AEE02CC12-M Performance Curves

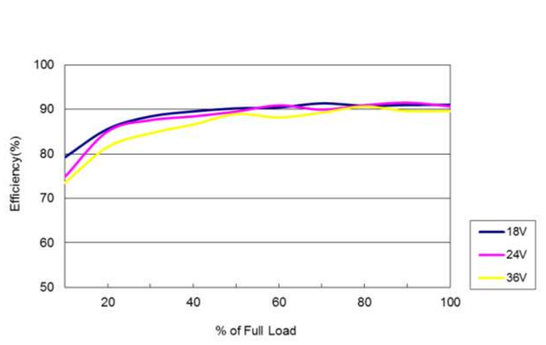


Figure 31: AEE02CC12-M Efficiency Versus Output Current Curve
Vin = 9 to 18Vdc Load: Io = 0 to ±0.67A

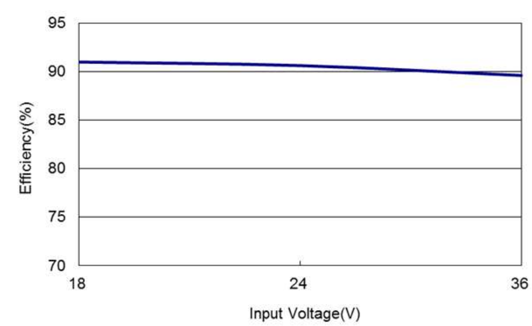


Figure 32: AEE02CC12-M Efficiency Versus Input Voltage Curve
Vin = 9 to 18Vdc Load: Io = ±0.67A

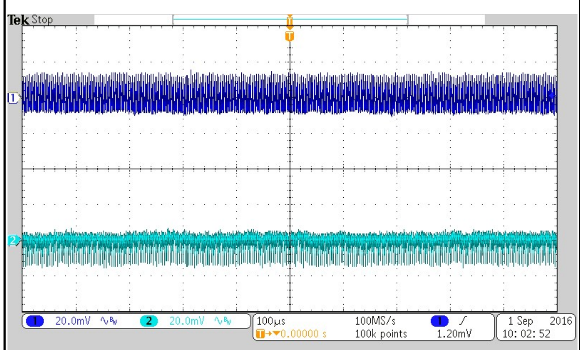


Figure 33: AEE02CC12-M Ripple and Noise Measurement
Vin = 12Vdc Load: Io = ±0.67A
Ch 1: Vo1 Ch 2: Vo2

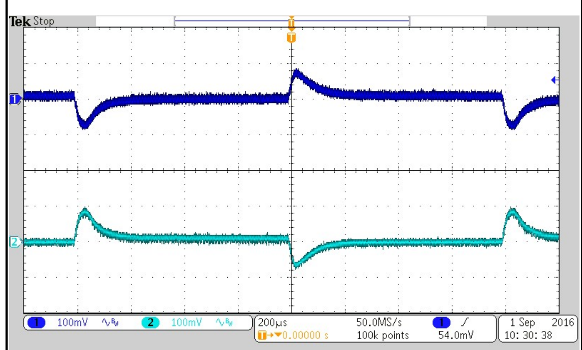


Figure 34: AEE02CC12-M Transient Response
Vin = 12Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1 Ch 2: Vo2

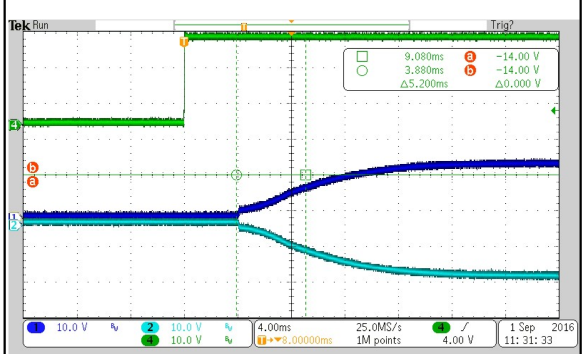


Figure 35: AEE02CC12-M Output Voltage Startup Characteristic by Vin
Vin = 12Vdc Load: Io = ±0.67A
Ch 1: Vo Ch 4: Vin

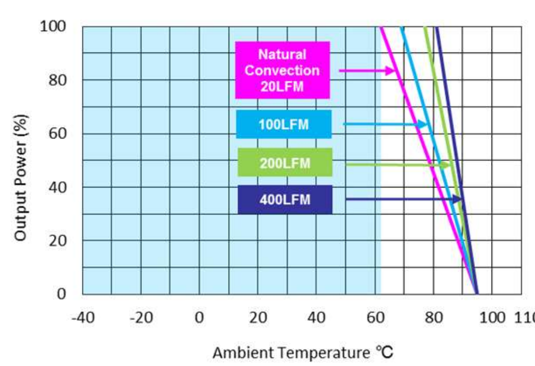


Figure 36: AEE02CC12-M Derating Output Current vs Ambient Temp.
Vin = 12Vdc Load: Io = ±0.67A

Electrical Specifications

AEE04A24-M Performance Curves

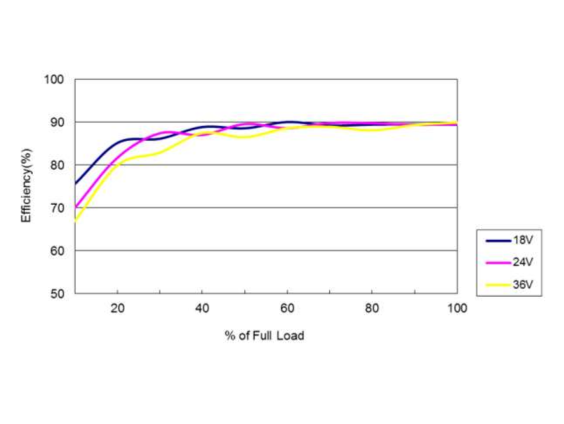


Figure 37: AEE04A24-M Efficiency Versus Output Current Curve
Vin = 18 to 36Vdc Load: Io = 0 to 4A

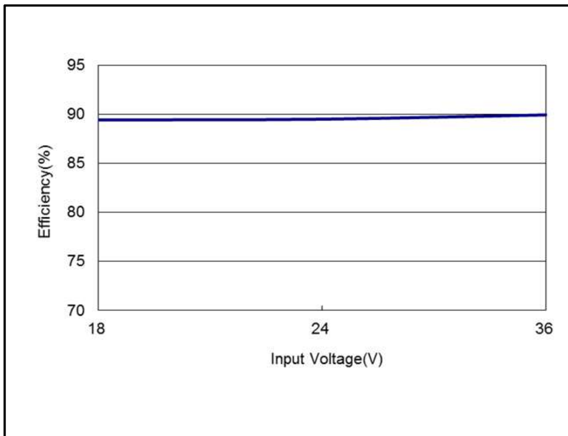


Figure 38: AEE04A24-M Efficiency Versus Input Voltage Curve
Vin = 18 to 36Vdc Load: Io = 4A

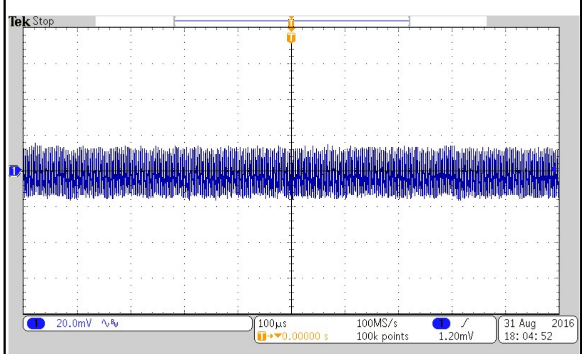


Figure 39: AEE04A24-M Ripple and Noise Measurement
Vin = 24Vdc Load: Io = 4A
Ch 1: Vo1

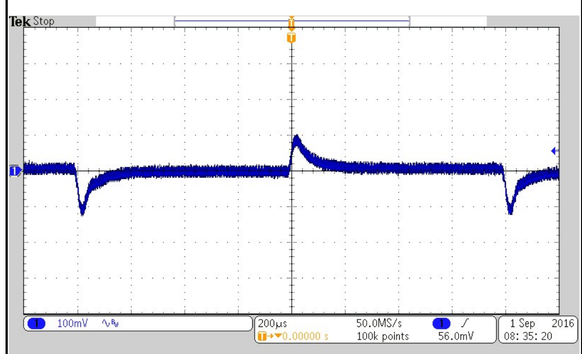


Figure 40: AEE04A24-M Transient Response
Vin = 24Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1

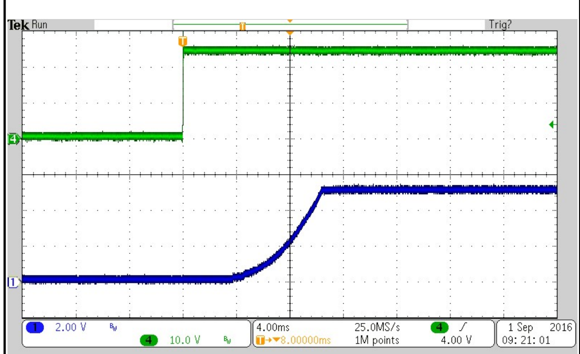


Figure 41: AEE04A24-M Output Voltage Startup Characteristic by Vin
Vin = 24Vdc Load: Io = 4A
Ch 1: Vo Ch 4: Vin

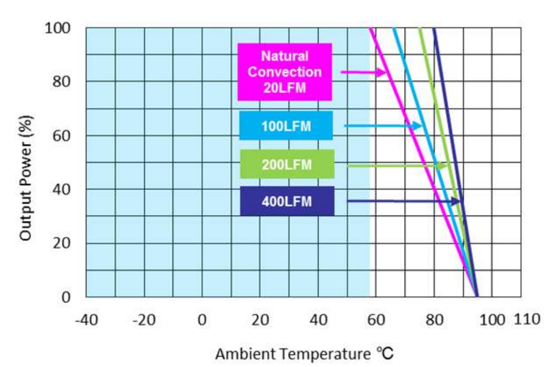


Figure 42: AEE04A24-M Derating Output Current vs Ambient Temp.
Vin = 24Vdc Load: Io = 4A

Electrical Specifications

AEE02B24-M Performance Curves

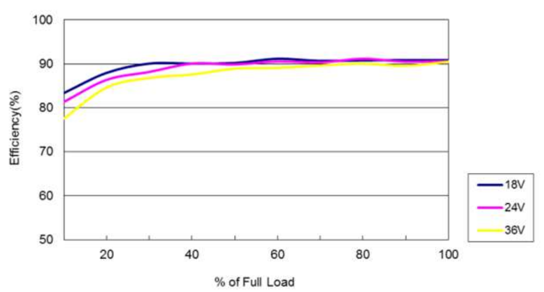


Figure 43: AEE02B24-M Efficiency Versus Output Current Curve
Vin = 18 to 36Vdc Load: Io = 0 to 1.67A

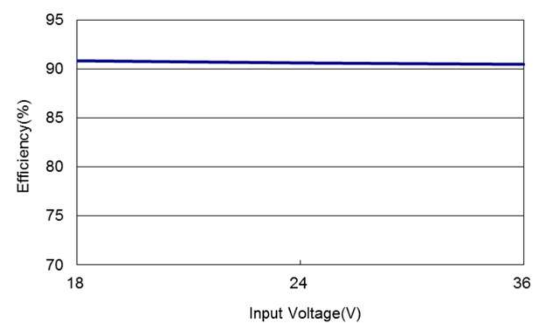


Figure 44: AEE02B24-M Efficiency Versus Input Voltage Curve
Vin = 18 to 36Vdc Load: Io = 1.67A

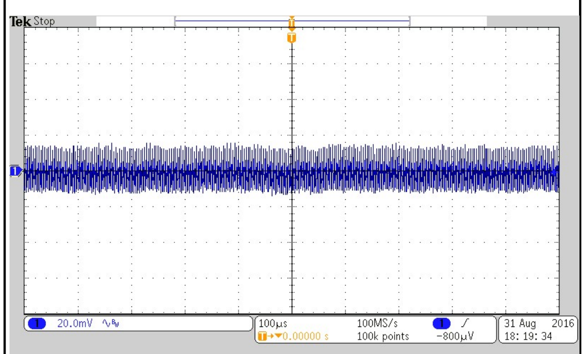


Figure 45: AEE02B24-M Ripple and Noise Measurement
Vin = 24Vdc Load: Io = 1.67A
Ch 1: Vo

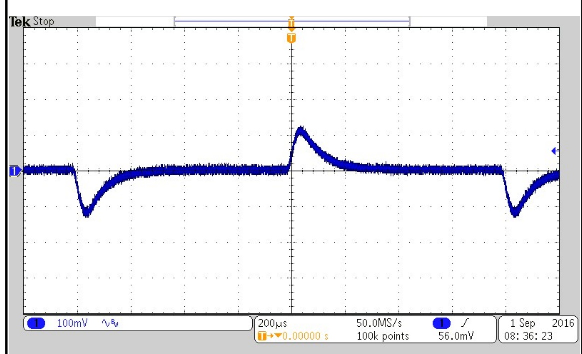


Figure 46: AEE02B24-M Transient Response
Vin = 24Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

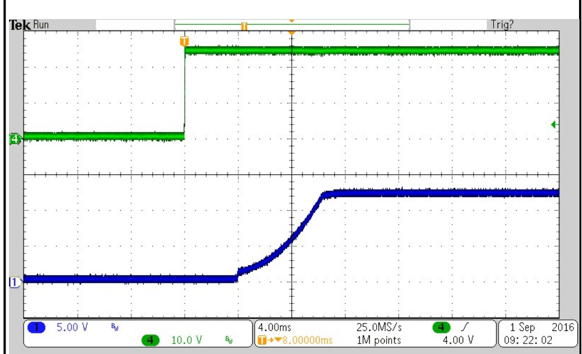


Figure 47: AEE02B24-M Output Voltage Startup Characteristic by Vin
Vin = 24Vdc Load: Io = 1.67A
Ch 1: Vo Ch 4: Vin

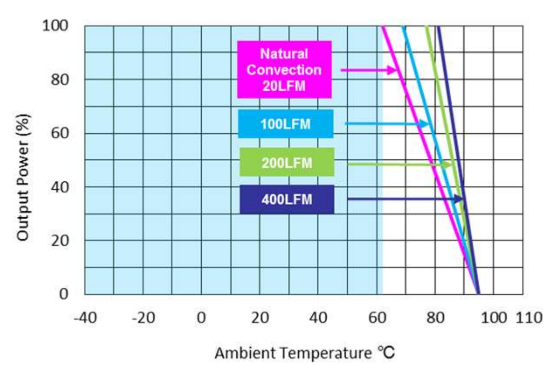


Figure 48: AEE02B24-M Derating Output Current vs Ambient Temp.
Vin = 24Vdc Load: Io = 1.67A

Electrical Specifications

AEE02C24-M Performance Curves

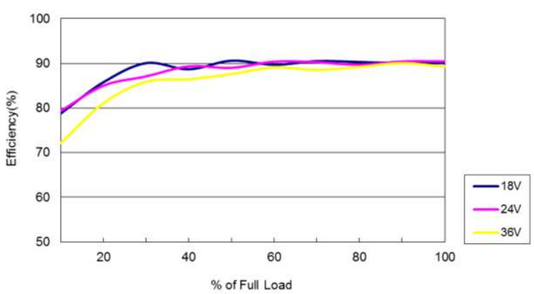


Figure 49: AEE02C24-M Efficiency Versus Output Current Curve
Vin = 18 to 36Vdc Load: Io = 0 to 1.33A

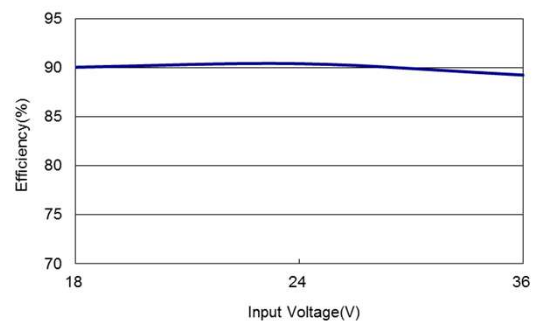


Figure 50: AEE02C24-M Efficiency Versus Input Voltage Curve
Vin = 18 to 36Vdc Load: Io = 1.33A

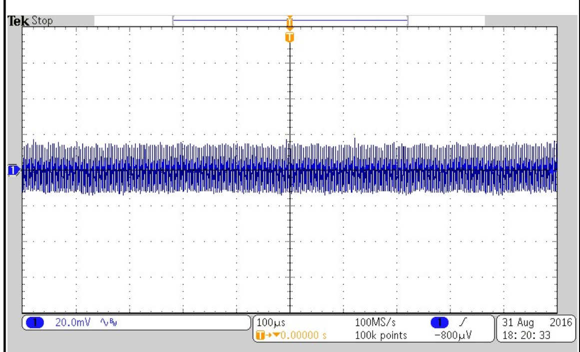


Figure 51: AEE02C24-M Ripple and Noise Measurement
Vin = 24Vdc Load: Io = 1.33A
Ch 1: Vo

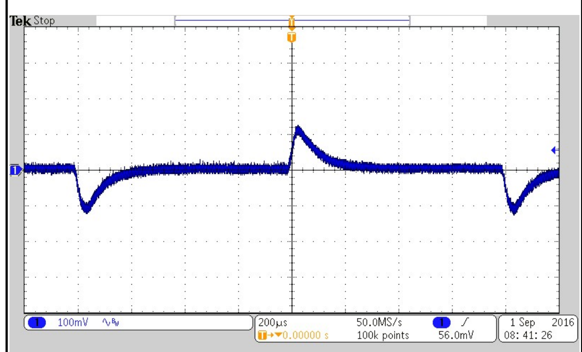


Figure 52: AEE02C24-M Transient Response
Vin = 24Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

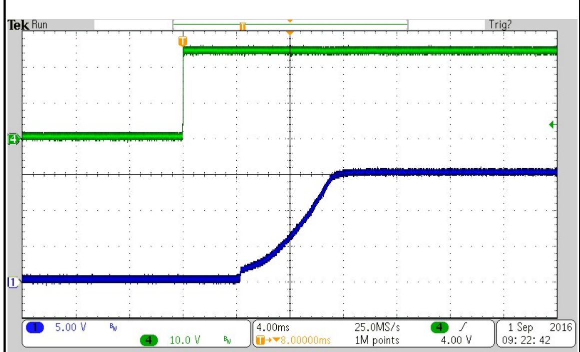


Figure 53: AEE02C24-M Output Voltage Startup Characteristic by Vin
Vin = 24Vdc Load: Io = 1.33A
Ch 1: Vo Ch 4: Vin

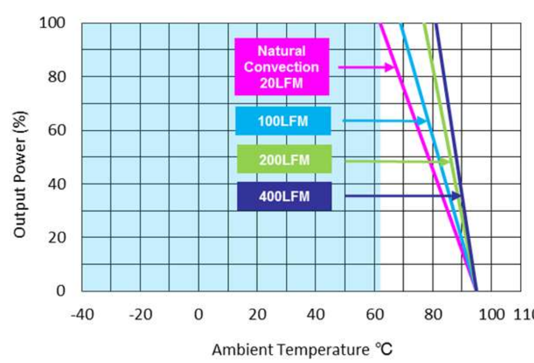


Figure 54: AEE02C24-M Derating Output Current vs Ambient Temp.
Vin = 24Vdc Load: Io = 1.33A

Electrical Specifications

AEE02H24-M Performance Curves

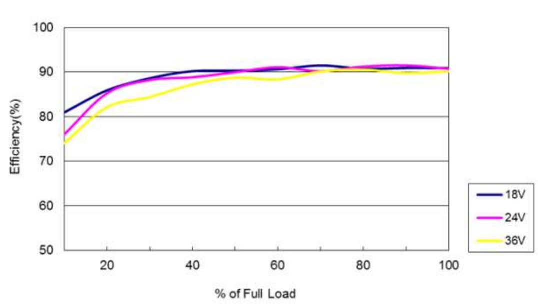


Figure 55: AEE02H24-M Efficiency Versus Output Current Curve
Vin = 18 to 36Vdc Load: Io = 0 to 0.84A

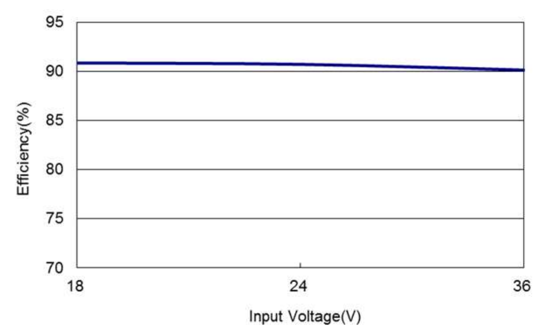


Figure 56: AEE02H24-M Efficiency Versus Input Voltage Curve
Vin = 18 to 36Vdc Load: Io = 0.84A

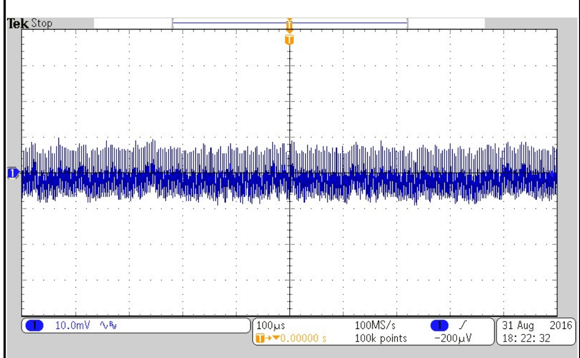


Figure 57: AEE02H24-M Ripple and Noise Measurement
Vin = 24Vdc Load: Io = 0.84A
Ch 1: Vo

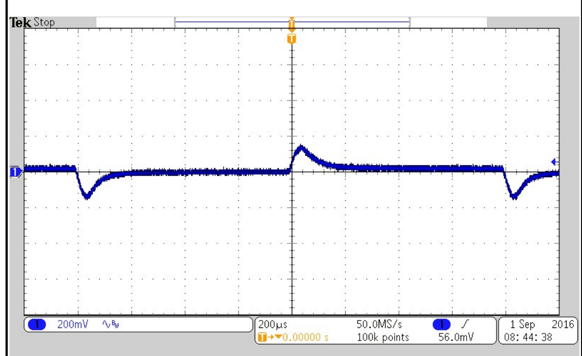


Figure 58: AEE02H24-M Transient Response
Vin = 24Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

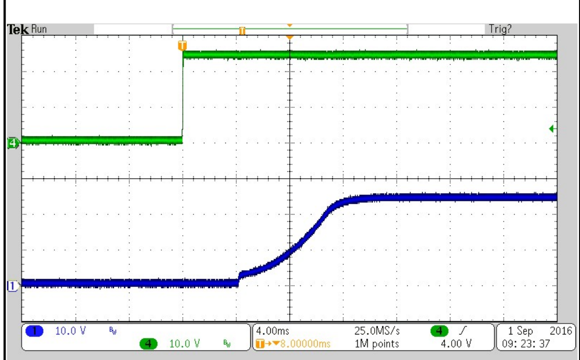


Figure 59: AEE02H24-M Output Voltage Startup Characteristic by Vin
Vin = 24Vdc Load: Io = 0.84A
Ch 1: Vo Ch 4: Vin

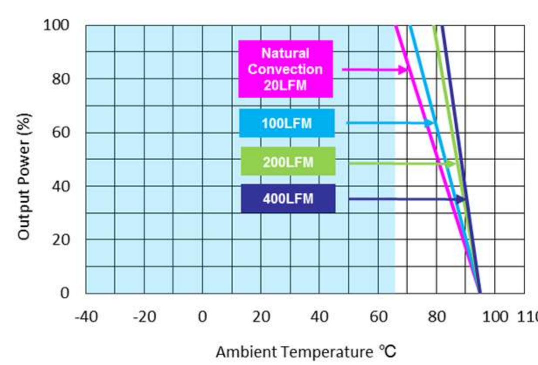


Figure 60: AEE02H24-M Derating Output Current vs Ambient Temp.
Vin = 24Vdc Load: Io = 0.84A

Electrical Specifications

AEE02BB24-M Performance Curves

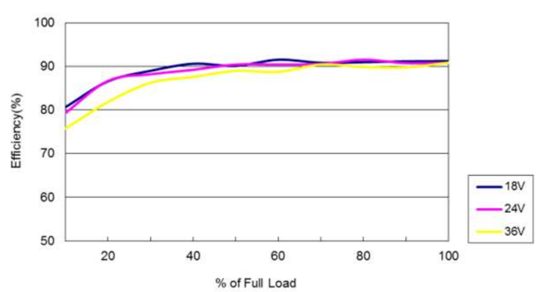


Figure 61: AEE02BB24-M Efficiency Versus Output Current Curve
Vin = 18 to 36Vdc Load: Io = 0 to ±0.84A

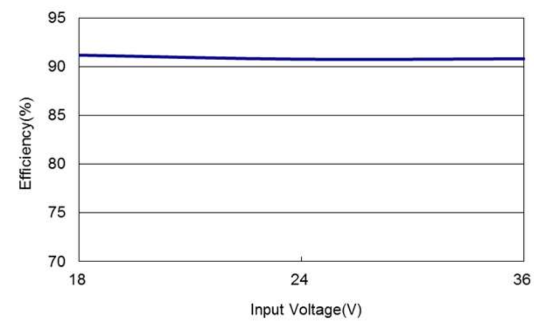


Figure 62: AEE02BB24-M Efficiency Versus Input Voltage Curve
Vin = 18 to 36Vdc Load: Io = ±0.84A

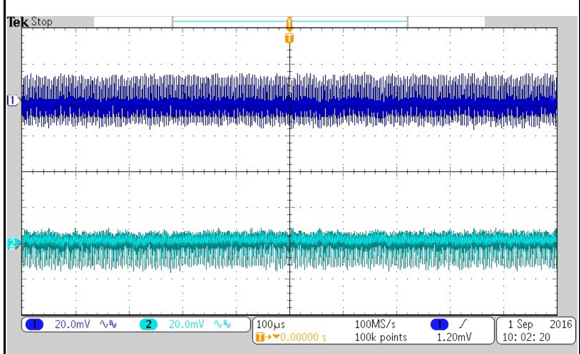


Figure 63: AEE02BB24-M Ripple and Noise Measurement
Vin = 24Vdc Load: Io = ±0.84A
Ch 1: Vo1 Ch 2: Vo2

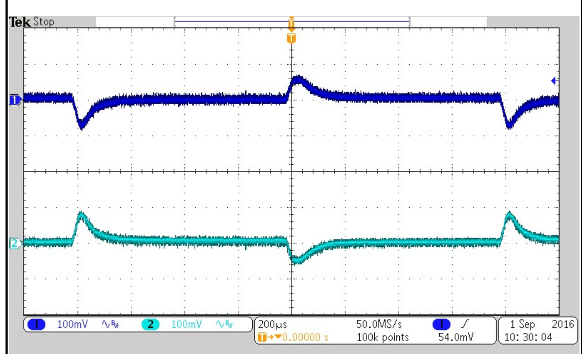


Figure 64: AEE02BB24-M Transient Response
Vin = 24Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1 Ch 2: Vo2

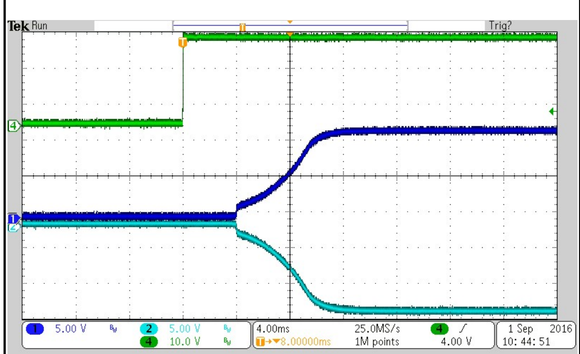


Figure 65: AEE02BB24-M Output Voltage Startup Characteristic by Vin
Vin = 24Vdc Load: Io = ±0.84A
Ch 1: Vo Ch 4: Vin

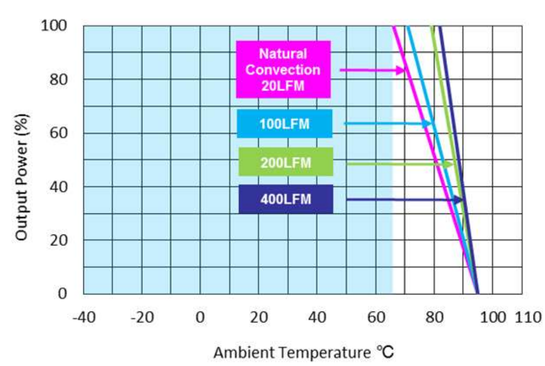


Figure 66: AEE02BB24-M Derating Output Current vs Ambient Temp.
Vin = 24Vdc Load: Io = ±0.84A

Electrical Specifications

AEE02CC24-M Performance Curves

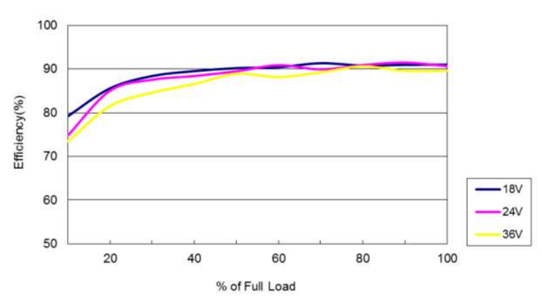


Figure 67: AEE02CC24-M Efficiency Versus Output Current Curve
Vin = 18 to 36Vdc Load: Io = 0 to ±0.67A

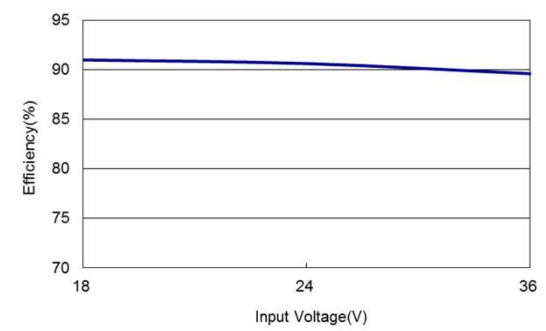


Figure 68: AEE02CC24-M Efficiency Versus Input Voltage Curve
Vin = 18 to 36Vdc Load: Io = ±0.67A

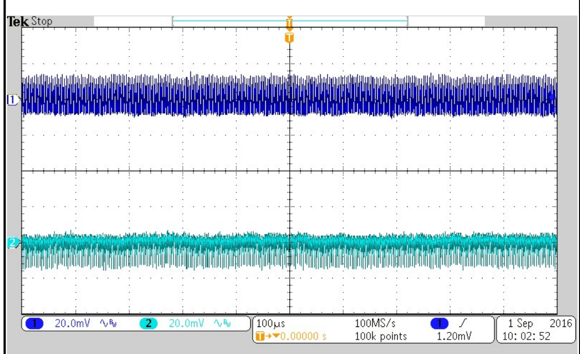


Figure 69: AEE02CC24-M Ripple and Noise Measurement
Vin = 24Vdc Load: Io = ±0.67A
Ch 1: Vo1 Ch 2: Vo2

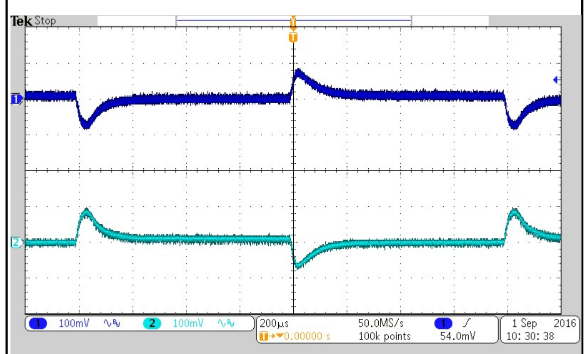


Figure 70: AEE02CC24-M Transient Response
Vin = 24Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1 Ch 2: Vo2

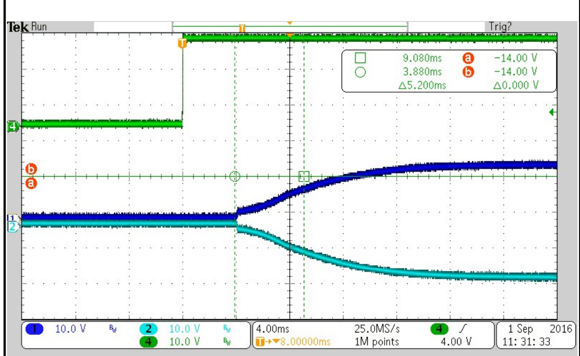


Figure 71: AEE02CC24-M Output Voltage Startup Characteristic by Vin
Vin = 24Vdc Load: Io = ±0.67A
Ch 1: Vo Ch 4: Vin

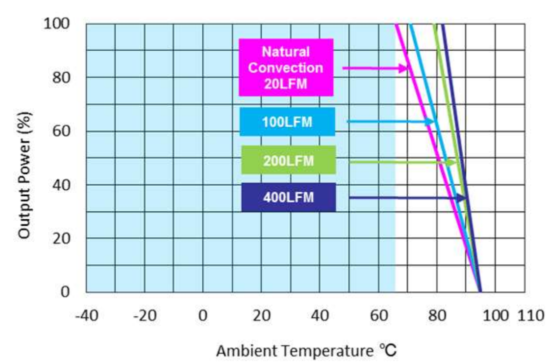


Figure 72: AEE02CC24-M Derating Output Current vs Ambient Temp.
Vin = 24Vdc Load: Io = ±0.67A

Electrical Specifications

AEE04A48-M Performance Curves

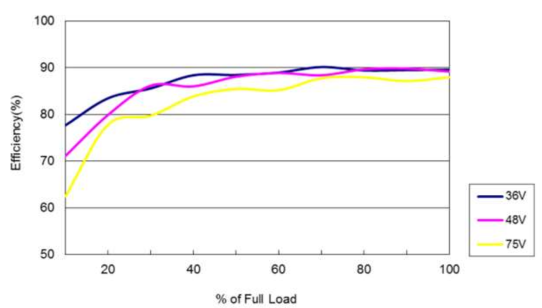


Figure 73: AEE04A48-M Efficiency Versus Output Current Curve
Vin = 36 to 75Vdc Load: Io = 0 to 4A

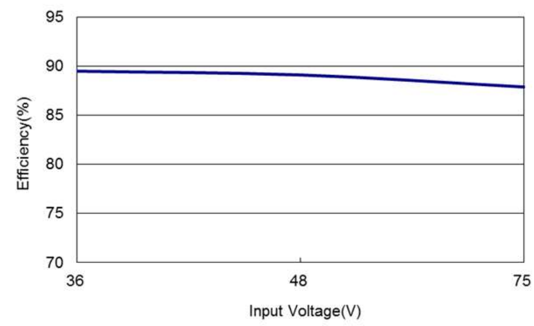


Figure 74: AEE04A48-M Efficiency Versus Input Voltage Curve
Vin = 36 to 75Vdc Load: Io = 4A

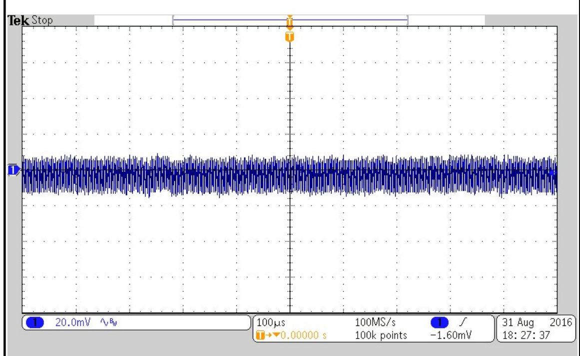


Figure 75: AEE04A48-M Ripple and Noise Measurement
Vin = 48Vdc Load: Io = 4A
Ch 1: Vo

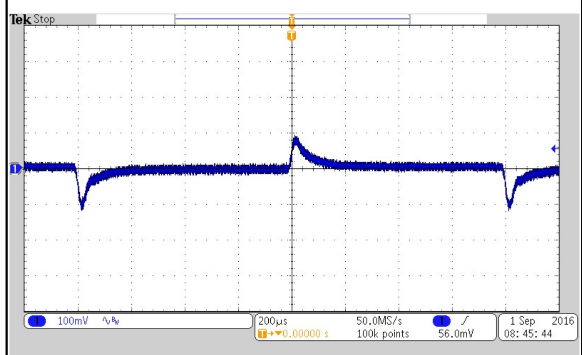


Figure 76: AEE04A48-M Transient Response
Vin = 48Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

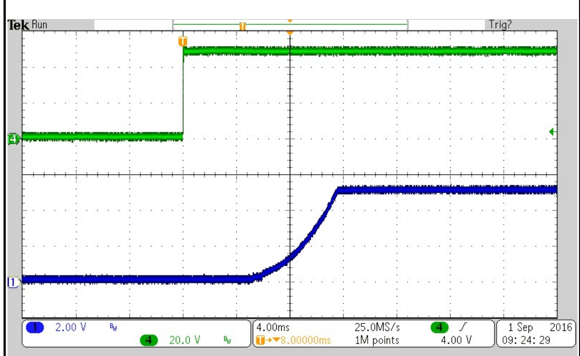


Figure 77: AEE04A48-M Output Voltage Startup Characteristic by Vin
Vin = 48Vdc Load: Io = 4A
Ch 1: Vo Ch 4: Vin

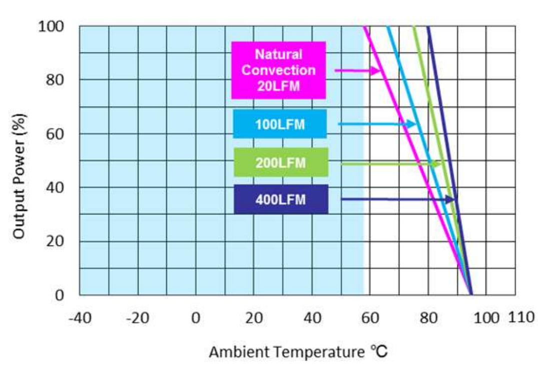


Figure 78: AEE04A48-M Derating Output Current vs Ambient Temp.
Vin = 48Vdc Load: Io = 4A

Electrical Specifications

AEE02B48-M Performance Curves

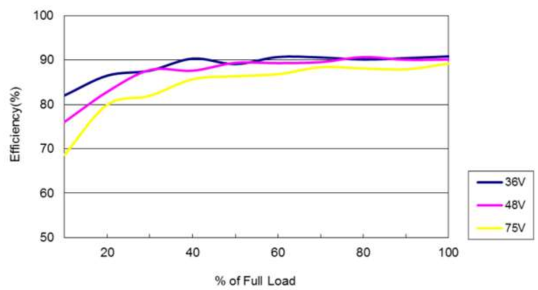


Figure 79: AEE02B48-M Efficiency Versus Output Current Curve
Vin = 36 to 75Vdc Load: Io = 0 to 1.67A

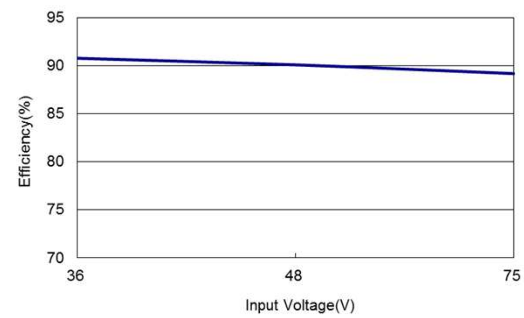


Figure 80: AEE02B48-M Efficiency Versus Input Voltage Curve
Vin = 36 to 75Vdc Load: Io = 1.67A

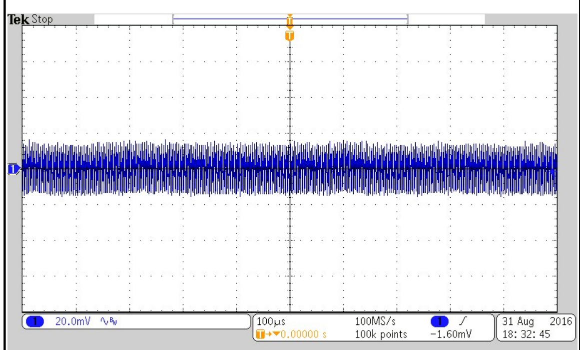


Figure 81: AEE02B48-M Ripple and Noise Measurement
Vin = 48Vdc Load: Io = 1.67A
Ch 1: Vo

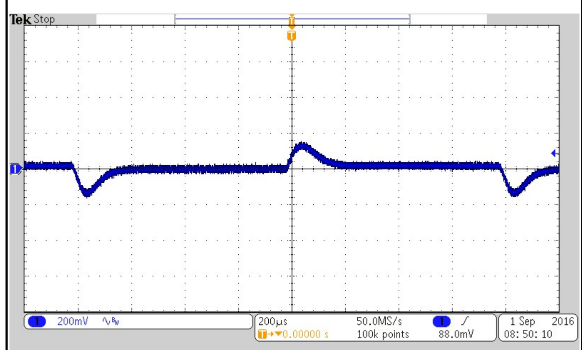


Figure 82: AEE02B48-M Transient Response
Vin = 48Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

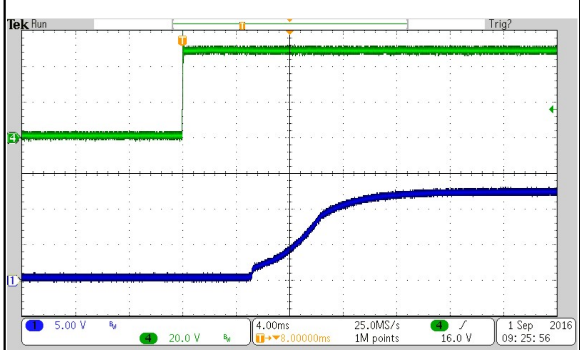


Figure 83: AEE02B48-M Output Voltage Startup Characteristic by Vin
Vin = 48Vdc Load: Io = 1.67A
Ch 1: Vo Ch 4: Vin

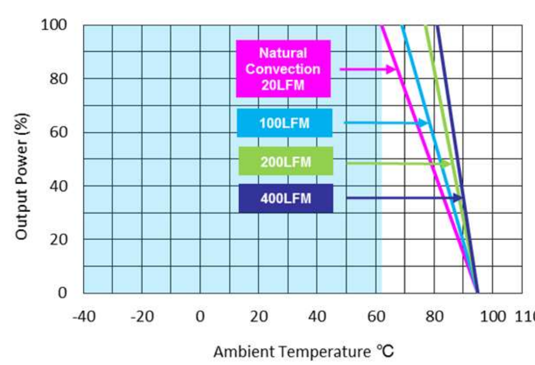


Figure 84: AEE02B48-M Derating Output Current vs Ambient Temp.
Vin = 48Vdc Load: Io = 1.67A

Electrical Specifications

AEE02C48-M Performance Curves

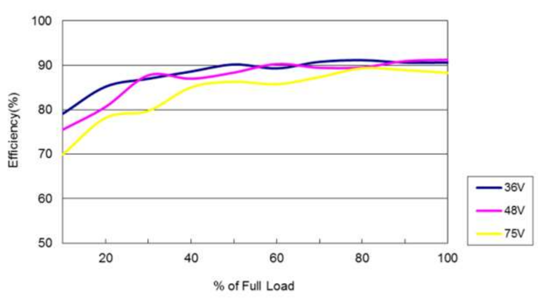


Figure 85: AEE02C48-M Efficiency Versus Output Current Curve
Vin = 36 to 75Vdc Load: Io = 0 to 1.33A

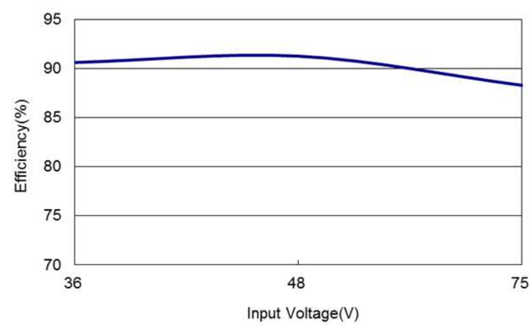


Figure 86: AEE02C48-M Efficiency Versus Input Voltage Curve
Vin = 36 to 75Vdc Load: Io = 1.33A

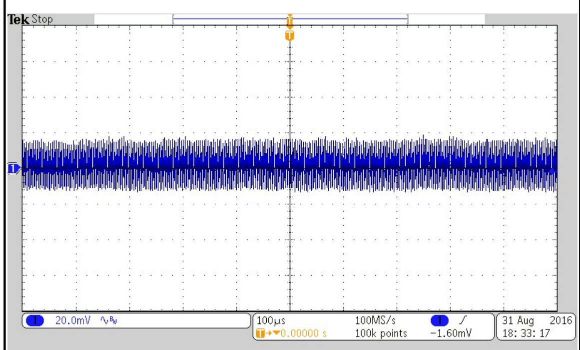


Figure 87: AEE02C48-M Ripple and Noise Measurement
Vin = 48Vdc Load: Io = 1.33A
Ch 1: Vo

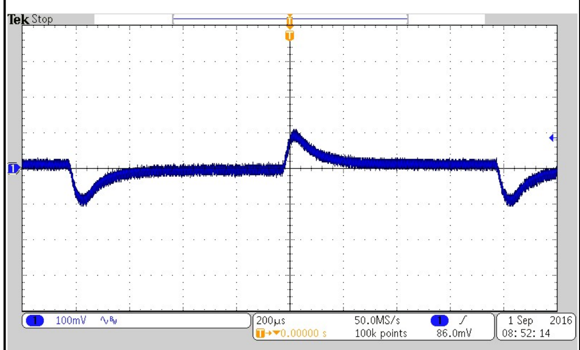


Figure 88: AEE02C48-M Transient Response
Vin = 48Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

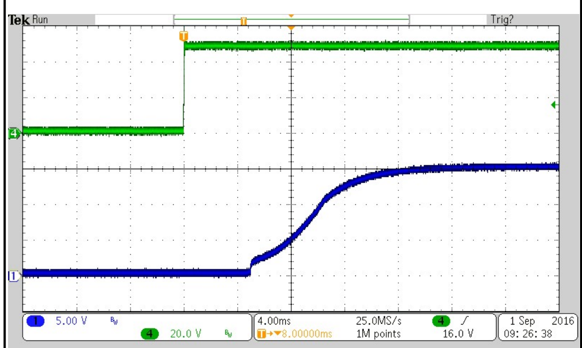


Figure 89: AEE02C48-M Output Voltage Startup Characteristic by Vin
Vin = 48Vdc Load: Io = 1.33A
Ch 1: Vo Ch 4: Vin

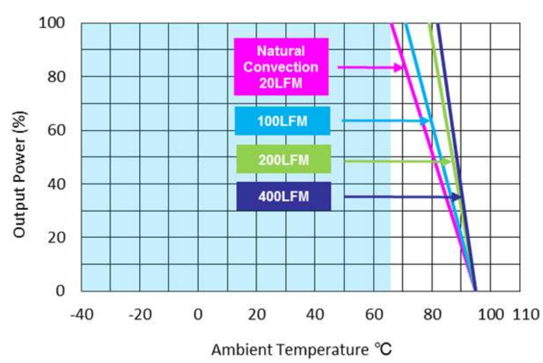


Figure 90: AEE02C48-M Derating Output Current vs Ambient Temp.
Vin = 48Vdc Load: Io = 1.33A

Electrical Specifications

AEE02H48-M Performance Curves

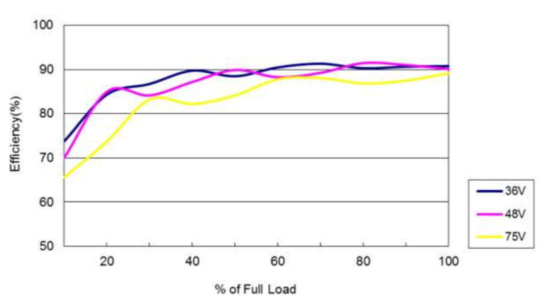


Figure 91: AEE02H48-M Efficiency Versus Output Current Curve
Vin = 36 to 75Vdc Load: Io = 0 to 0.84A

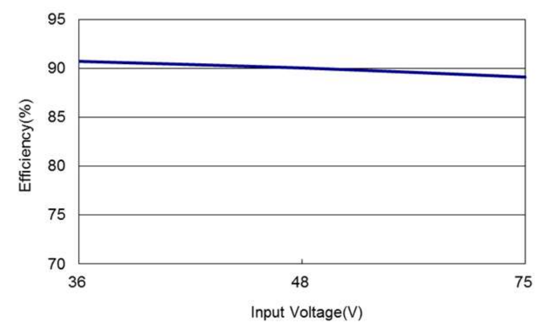


Figure 92: AEE02H48-M Efficiency Versus Input Voltage Curve
Vin = 36 to 75Vdc Load: Io = 0.84A

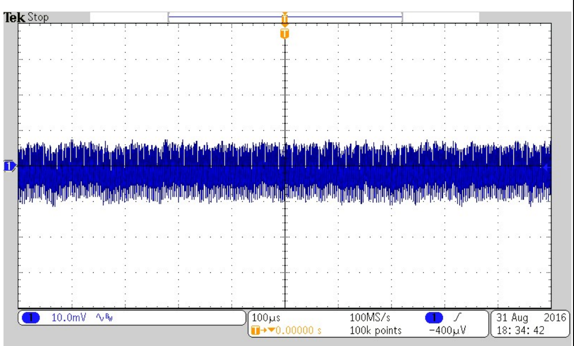


Figure 93: AEE02H48-M Ripple and Noise Measurement
Vin = 48Vdc Load: Io = 0.84A
Ch 1: Vo

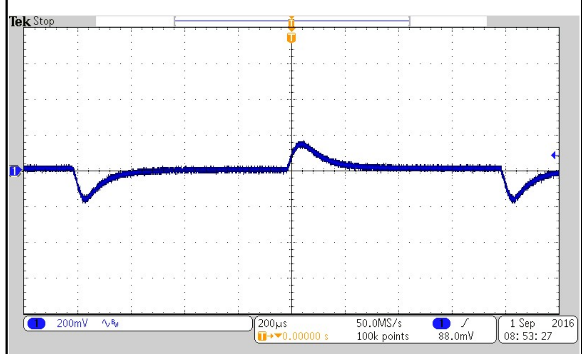


Figure 94: AEE02H48-M Transient Response
Vin = 48Vdc Load: Io = 100% to 75% load change
Ch 1: Vo

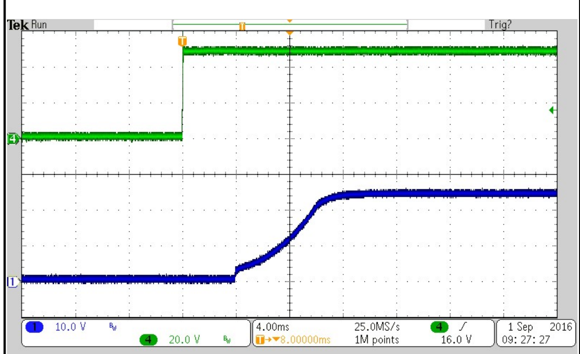


Figure 95: AEE02H48-M Output Voltage Startup Characteristic by Vin
Vin = 48Vdc Load: Io = 0.84A
Ch 1: Vo Ch 4: Vin

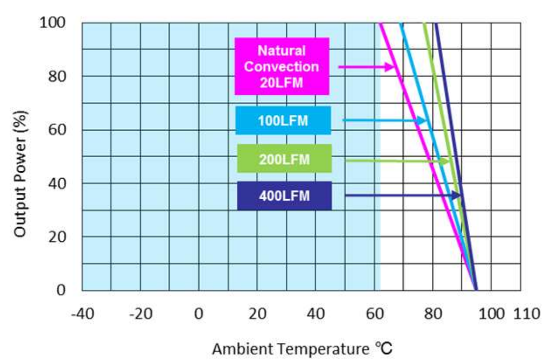


Figure 96: AEE02H48-M Derating Output Current vs Ambient Temp.
Vin = 48Vdc Load: Io = 0.84A

Electrical Specifications

AEE02BB48-M Performance Curves

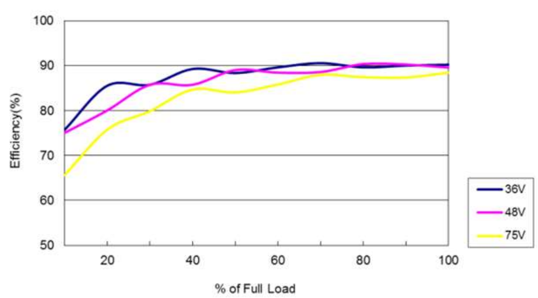


Figure 97: AEE02BB48-M Efficiency Versus Output Current Curve
Vin = 36 to 75Vdc Load: Io = 0 to ±0.84A

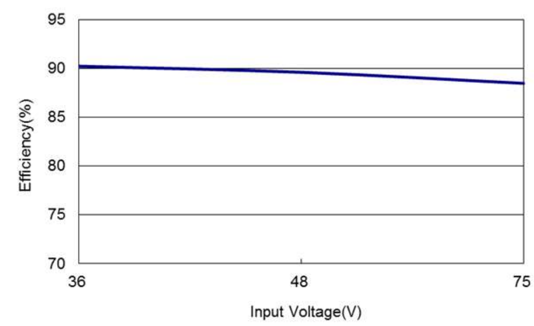


Figure 98: AEE02BB48-M Efficiency Versus Input Voltage Curve
Vin = 36 to 75Vdc Load: Io = ±0.84A

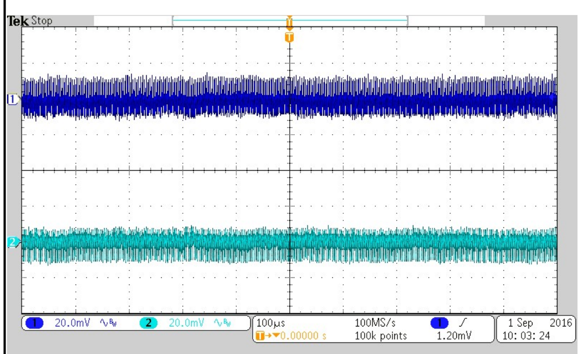


Figure 99: AEE02BB48-M Ripple and Noise Measurement
Vin = 48Vdc Load: Io = ±0.84A
Ch 1: Vo1 Ch 1: Vo2

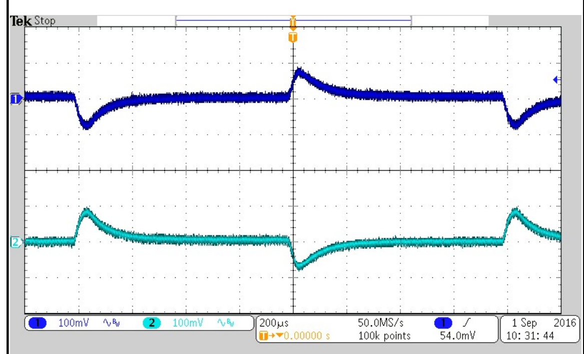


Figure 100: AEE02BB48-M Transient Response
Vin = 48Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1 Ch 1: Vo2

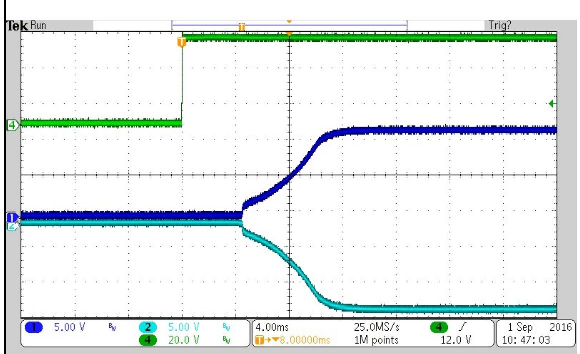


Figure 101: AEE02BB48-M Output Voltage Startup Characteristic by Vin
Vin = 48Vdc Load: Io = ±0.84A
Ch 1: Vo Ch 4: Vin

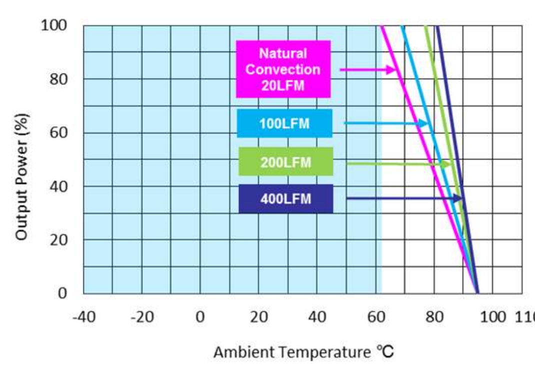


Figure 102: AEE02BB48-M Derating Output Current vs Ambient Temp.
Vin = 48Vdc Load: Io = ±0.84A

Electrical Specifications

AEE02CC48-M Performance Curves

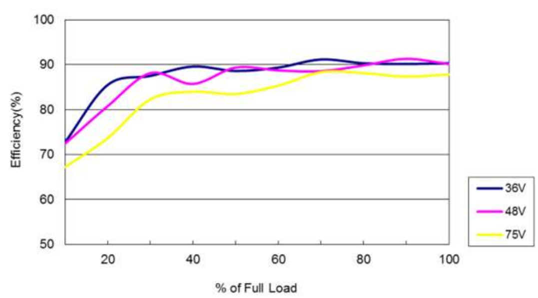


Figure 103: AEE02CC48-M Efficiency Versus Output Current Curve
Vin = 36 to 75Vdc Load: Io = 0 to ±0.67A

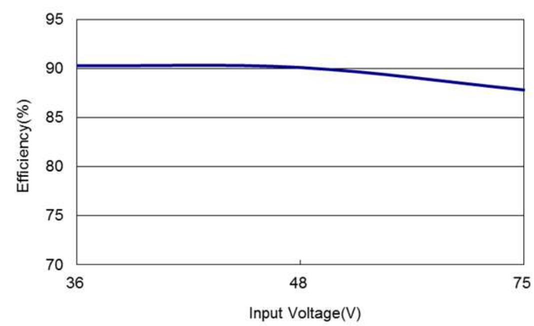


Figure 104: AEE02CC48-M Efficiency Versus Input Voltage Curve
Vin = 36 to 75Vdc Load: Io = ±0.67A

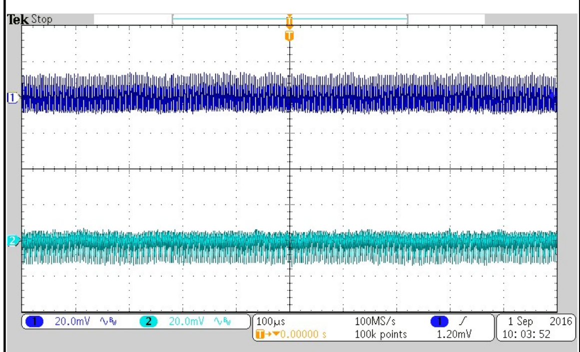


Figure 105: AEE02CC48-M Ripple and Noise Measurement
Vin = 48Vdc Load: Io = ±0.67A
Ch 1: Vo1 Ch 1: Vo2

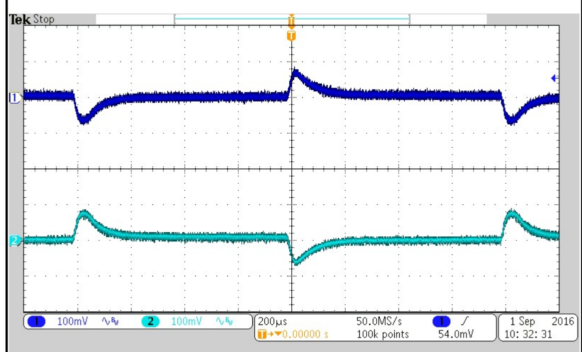


Figure 106: AEE02CC48-M Transient Response
Vin = 48Vdc Load: Io = 100% to 75% load change
Ch 1: Vo1 Ch 1: Vo2

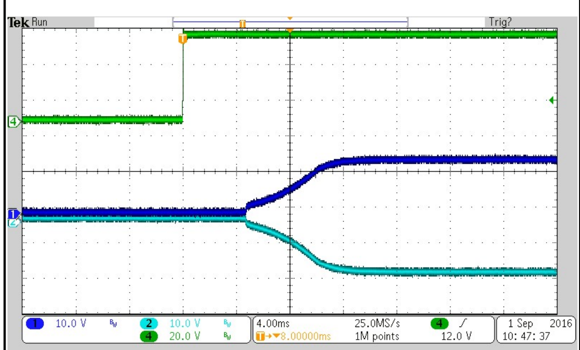


Figure 107: AEE02CC48-M Output Voltage Startup Characteristic by Vin
Vin = 48Vdc Load: Io = ±0.67A
Ch 1: Vo Ch 4: Vin

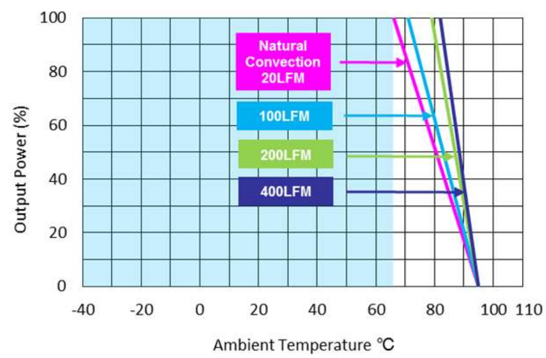
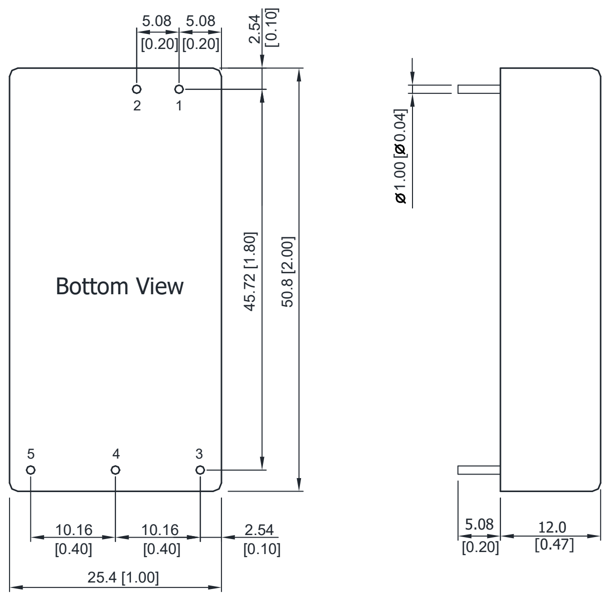


Figure 108: AEE02CC48-M Derating Output Current vs Ambient Temp.
Vin = 48Vdc Load: Io = ±0.67A

Mechanical Specifications

Mechanical Outlines (unit: mm)



Note:

1.All dimensions in mm (inches)

2.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)

Pin Connections

Single output

Pin 1 – +Vin

Pin 2 – -Vin

Pin 3 – +Vout

Pin 4 – No Pin

Pin 5 – -Vout

Dual Output

Pin 1 – +Vin

Pin 2 – -Vin

Pin 3 – +Vout

Pin 4 – Common

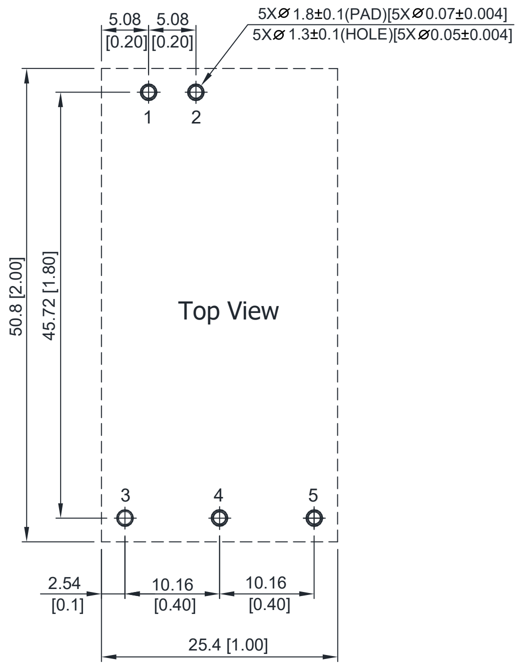
Pin 5 – -Vout

Physical Characteristics

Case Size	50.8x25.4x12.0mm (2.0x1.0x0.47 inches)
Case Material	Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	Tinned Copper
Weight	30g

Mechanical Specifications

Recommended Pad Layout



Environmental Specifications

EMC Immunity

AEE20W-M series power supply is designed to meet the following EMC immunity specifications.

Table 4. EMC Specifications

Parameter	Standards & Level		Performance
EMI	Conduction & Radiation	EN55011, FCC part15	Class A
EMS	EN60601-1-2 4th		
	ESD	EN61000-4-2 Air ±15kV, Contact ±8kV	Perf. Criteria A
	Radiated immunity	EN61000-4-3 10V/m	
	Fast transient[1]	EN61000-4-4 ±2KV	Perf. Criteria A
	Surge[1]	EN61000-4-5 ±1KV	Perf. Criteria A
	Conducted immunity	EN61000-4-6 10Vrms	Perf. Criteria A
	PFMF	EN61000-4-8 30A/M	Perf. Criteria A

Note 1: To meet EN61000-4-4 & EN61000-4-5, an external capacitor across the input pins is required. Suggested capacitor : 330μF/100V.

Environmental Specifications

Safety Certifications

The AEE20W-M series 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 5. Safety Certifications for AEE10W-M series power supply system

Document	Description
cUL/UL 60950-1 (CSA certificate)	US and Canada Requirements
IEC/EN 60950-1 (CB-scheme)	European Requirements (All CENELEC Countries)
UL60601-1	US Medical Requirements
IEC/EN 60950-1, IEC/EN 60601-1 3rd Edition, 2 MOPP	International and European Medical Requirements

Environmental Specifications

Operating Temperature

Table 6. Operating Temperature				
Parameter	Model / Condition	Min	Max	Unit
Operating Temperature Range (Natural Convection[1], See Derating)	AEE02H24-M AEE02BB24-M AEE02CC24-M AEE02C48-M AEE02CC48-M	-40	66	°C
	AEE02B12-M AEE02H12-M AEE02BB12-M AEE02CC12-M AEE02B24-M AEE02C24-M AEE02B48-M AEE02H48-M AEE02BB48-M		62	
	AEE02C12-M AEE04A24-M AEE04A48-M		58	
	AEE04A12-M		51	
Operating Case Temperature	All	-	+95	°C
Storage Temperature Range		-50	+125	°C
Humidity (non condensing)		-	95	%
Altitude		-	4000	m
Cooling	Free-Air convection			
Lead Temperature (1.5mm from case for 10Sec.)		-	260	°C

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

Environmental Specifications

MTBF and Reliability

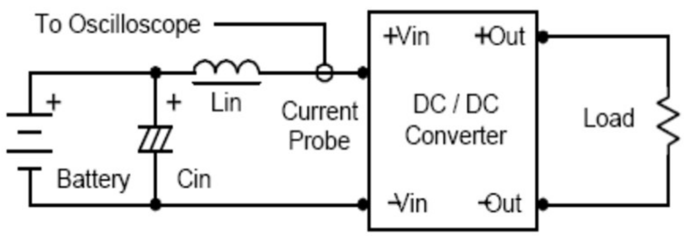
The MTBF of AEE20W-M series of DC/DC converters has been calculated using MIL-HDBK 217F NOTICE2, Operating Temperature 25 ^{O}C, Ground Benign.

Model	MTBF	Unit
AEE04A12-M	1087344	Hours
AEE02B12-M	1598916	
AEE02C12-M	1655302	
AEE02H12-M	1565185	
AEE02BB12-M	1565185	
AEE02CC12-M	1758649	
AEE04A24-M	1308922	
AEE02B24-M	1639993	
AEE02C24-M	1691078	
AEE02H24-M	1708823	
AEE02BB24-M	1708823	
AEE02CC24-M	1780647	
AEE04A48-M	1419400	
AEE02B48-M	1641012	
AEE02C48-M	1692282	
AEE02H48-M	1474814	
AEE02BB48-M	1474814	
AEE02CC48-M	1793561	

Application Notes

Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with a inductor Lin (4.7µH) and Cin (220uF, ESR < 1.0Ω 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.

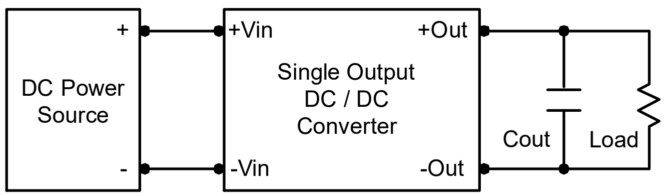


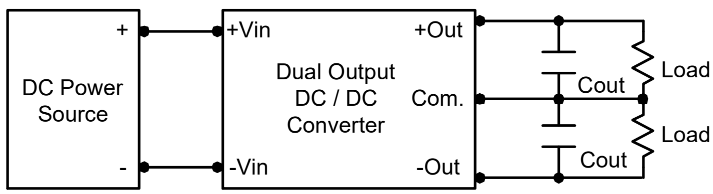
Component	Value	Reference
Lin	4.7µH	-
Cin	220uF (ESR<1.0Ω at 100KHz)	Aluminum Electrolytic Capacitor

Application Notes

Output Ripple Reduction

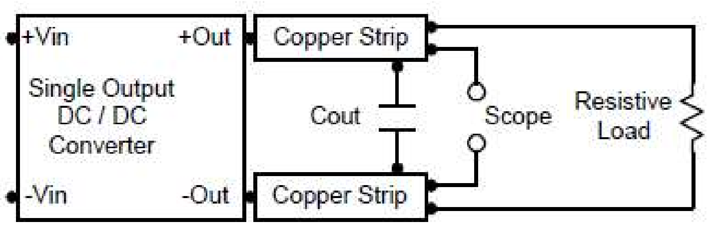
A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7uF capacitors at the output.

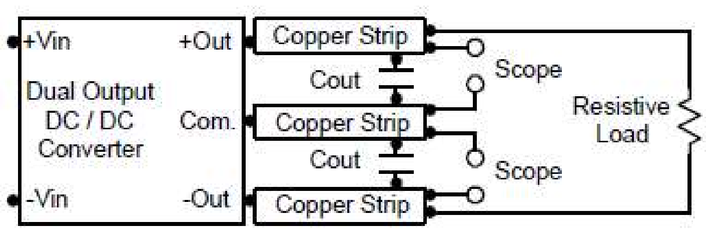




Peak-to-Peak Output Noise Measurement Test

Use a Cout 0.47uF ceramic 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.

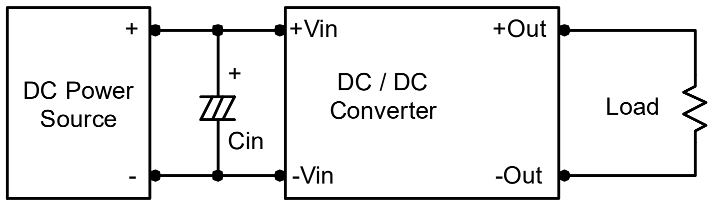




Application Notes

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. By using a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 10μF for the 12V input devices and a 4.7μF for the 24V input devices and a 2.2μF for the 48V devices, capacitor mounted close to the power module helps ensure stability of the unit.



Output Over Current Protection

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.

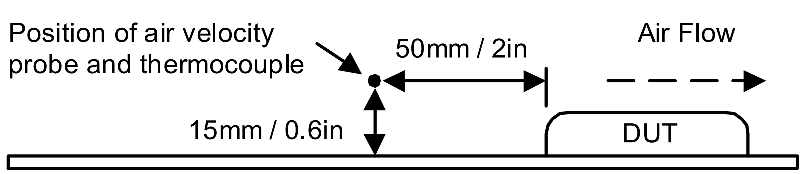
Output Over Voltage Protection

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. The OVP level can be found in the output data.

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 95 ^{O}C. The derating curves are determined from measurements obtained in a test setup.

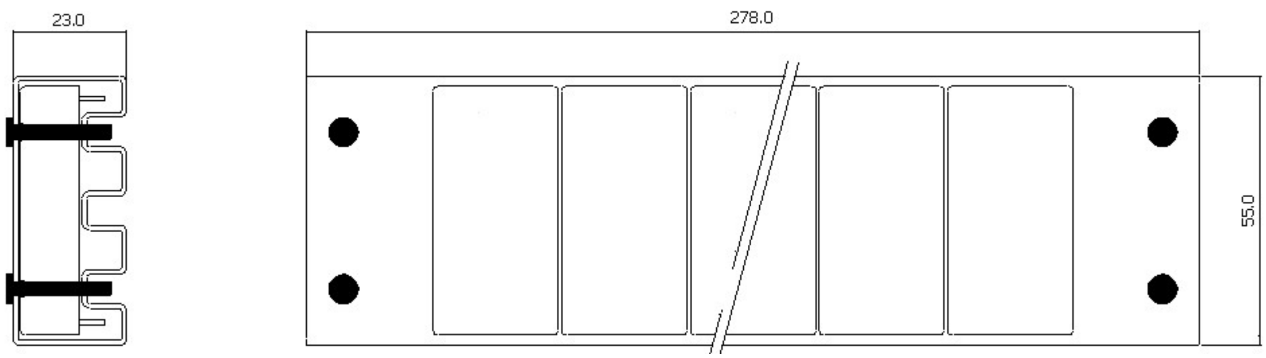


Maximum Capacitive Load

The AEE20W-M series has limitation of maximum connected capacitance at the output. The power module may operate in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the datasheet.

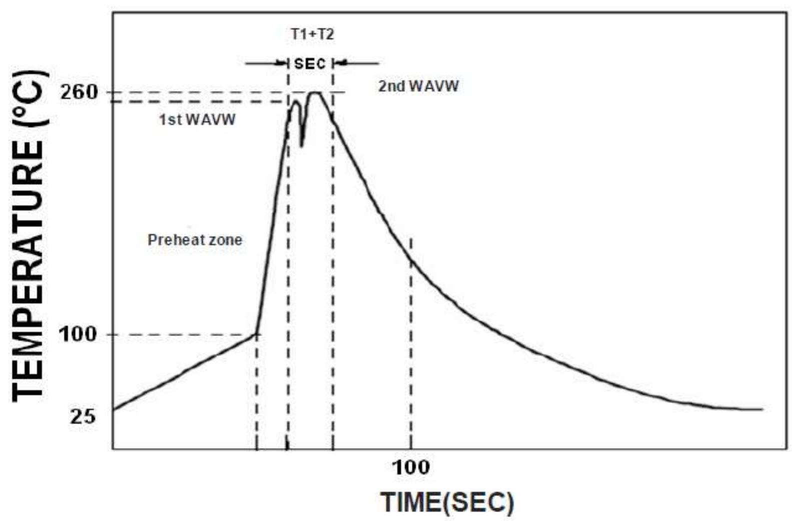
Application Notes

Packaging Information



Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Heating rate during preheat	Rise temp speed: 3^{O}C/sec max.
Final preheat temperature	Preheat temp: 100~130^{O}C
Peak temperature	Peak temp: 250~260^{O}C Peak Time
Time within peak temperature	Peak time(T1+T2): 4~6 sec

Reference Solder: Sn-Ag-Cu: Sn-Cu: Sn-Ag
Hand Welding: Soldering iron: Power 60W
Welding Time: 2~4 sec
Temp.: 380~400 ^{O}C

Record of Revision and Changes

Issue	Date	Description	Originators
1.0	01.11.2017	First Issue	K. Wang
1.1	09.25.2017	Update the ESD voltage rating; Add the 4th edition EMI EN55011 and EMS EN60601-1-2; Update input current, ripple, operating temperature, pin diameter and derating curves	A. Zhang

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

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