

## AEE15W-M Series

15 Watts

DC/DC Converter

**Total Power:** 15 Watts  
**Input Voltage:** 9 to 18 Vdc  
18 to 36 Vdc  
36 to 75 Vdc  
**# of Outputs:** Single, Dual

### Special Features

- 4200 VAC reinforced insulation
- Insulation rated for 300 VAC working voltage
- Medical safety to UL/CSA/EN/IEC 60601-1 3<sup>rd</sup> edition
- 2 \*MOPP rated
- Wide 2:1 input voltage range
- Fully regulated output voltage
- No min. load requirement
- Overload/Voltage and Short Circuit Protection
- Low leakage current <5  $\mu$ A
- Operating temperature range -40 °C to +80 °C (with derating)
- Input filter meets EN55022, Class A and FCC, Level A
- 2"x 1" plastic package
- 3 Years product warranty

### Safety

EN/IEC60601-1 3<sup>rd</sup> Edition,  
ANSI/AAMI ES60601-1  
UL/cUL/IEC/ EN62368-1 (60950-1),  
2 \*MOPP  
CE Mark



## Product Descriptions

The AEE15W-M series is the new range of high performance DC-DC converter with a reinforced insulation system. I/O- isolation voltage is specified for 4200VACrms. The product comes in a compact 2"x1" industry standard package. All models provide wide 2:1 input voltage range and fully regulated output voltage regulation.

The AEE15W-M series DC/DC converters offer an economical solution for demanding applications in industrial and medical instrumentation requesting a certified supplementary or reinforced insulation system to comply with industrial or latest medical safety standards.

## Model Numbers

Model	Input Voltage	Output Voltage	Maximum Load	Efficiency
AEE03A12-M	9 - 18Vdc	5Vdc	3A	85%
AEE01B12-M	9 - 18Vdc	12Vdc	1.25A	89%
AEE01C12-M	9 - 18Vdc	15Vdc	1A	88%
AEE01H12-M	9 - 18Vdc	24Vdc	0.625A	88%
AEE01BB12-M	9 - 18Vdc	±12Vdc	±0.625A	88%
AEE01CC12-M	9 - 18Vdc	±15Vdc	±0.5A	89%
AEE03A24-M	18 - 36Vdc	5Vdc	3A	87%
AEE01B24-M	18 - 36Vdc	12Vdc	1.25A	89%
AEE01C24-M	18 - 36Vdc	15Vdc	1A	88%
AEE01H24-M	18 - 36Vdc	24Vdc	0.625A	90%
AEE01BB24-M	18 - 36Vdc	±12Vdc	±0.625A	90%
AEE01CC24-M	18 - 36Vdc	±15Vdc	±0.5A	89%
AEE03A48-M	36 - 75Vdc	5Vdc	3A	88%
AEE01B48-M	36 - 75Vdc	12Vdc	1.25A	88%
AEE01C48-M	36 - 75Vdc	15Vdc	1A	87%
AEE01H48-M	36 - 75Vdc	24Vdc	0.625A	88%
AEE01BB48-M	36 - 75Vdc	±12Vdc	±0.625A	88%
AEE01CC48-M	36 - 75Vdc	±15Vdc	±0.5A	88%

## 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 100ms. max	12V Input Models	$V_{IN,DC}$	-0.7	-	25	Vdc
	24V Input Models		-0.7	-	50	Vdc
	48V Input Models		-0.7	-	100	Vdc
Maximum Output Power	All Models	$P_{O,max}$	-	-	15	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	-	-	°C/W
Operating Ambient Temperature Range	Natural Convection		-40		+80 <sup>1</sup>	°C
Operating Case Temperature	All Models	$T_{CASE}$	-	-	+95	°C
Storage Temperature	All Models	$T_{STG}$	-50		+125	°C
Humidity (non-condensing)	All Models		-	-	95	%
			Operating	-	-	95
MTBF	MIL-HDBK-217F@25°C, Ground Benign		1000000	-	-	Hours

Note 1 - With Derating

## Input Specifications

Table 2. Input Specifications:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Operating Input Voltage, DC	12V Input Models	All	$V_{IN,DC}$	9	12	18	Vdc
	24V Input Models			18	24	36	Vdc
	48V Input Models			36	48	75	Vdc
Start-Up Threshold Voltage	12V Input Models	All	$V_{IN,ON}$	-	-	9	Vdc
	24V Input Models			-	-	18	Vdc
	48V Input Models			-	-	36	Vdc
Under Voltage Lockout	12V Input Models	All	$V_{IN,OFF}$	-	7.5	-	Vdc
	24V Input Models			-	15	-	Vdc
	48V Input Models			-	33	-	Vdc
Input reflected ripple current	12V Input Models	0 to 500KHz, $L_{in}=4.7\mu H$ $C_{in}=220\mu F$ , ESR< 1.0Ω at 100 KHz	$I_{IN,ripple}$	-	100	-	mA
	24V Input Models			-	50	-	mA
	48V Input Models			-	30	-	mA
Input Current	AEE03A12-M	$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$	$I_{IN,max\_load}$	-	1471	-	mA
	AEE01B12-M			-	1404	-	mA
	AEE01C12-M			-	1420	-	mA
	AEE01H12-M			-	1420	-	mA
	AEE01BB12-M			-	1420	-	mA
	AEE01CC12-M			-	1404	-	mA
	AEE03A24-M			-	718	-	mA
	AEE01B24-M			-	702	-	mA
	AEE01C24-M			-	710	-	mA
	AEE01H24-M			-	694	-	mA
	AEE01BB24-M			-	694	-	mA
	AEE01CC24-M			-	702	-	mA
	AEE03A48-M			-	355	-	mA
	AEE01B48-M			-	355	-	mA
	AEE01C48-M			-	359	-	mA
	AEE01H48-M			-	355	-	mA
	AEE01BB48-M			-	355	-	mA
AEE01CC48-M	-	355	-	mA			
No Load Input Current ( $V_O$ On, $I_O = 0A$ )	12V Input Models	$V_{IN,DC}=V_{IN,nom}$	$I_{IN,no\_load}$	-	20	-	mA
	24V Input Models			-	15	-	mA
	48V Input Models			-	10	-	mA

## Input Specifications

Table 2. Input Specifications con't:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Efficiency @Max. Load	AEE03A12-M	$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$ $T_A=25^{\circ}C$	$\eta$	-	85	-	%
	AEE01B12-M			-	89	-	%
	AEE01C12-M			-	88	-	%
	AEE01H12-M			-	88	-	%
	AEE01BB12-M			-	88	-	%
	AEE01CC12-M			-	89	-	%
	AEE03A24-M			-	87	-	%
	AEE01B24-M			-	89	-	%
	AEE01C24-M			-	88	-	%
	AEE01H24-M			-	90	-	%
	AEE01BB24-M			-	90	-	%
	AEE01CC24-M			-	89	-	%
	AEE03A48-M			-	88	-	%
	AEE01B48-M			-	88	-	%
	AEE01C48-M			-	87	-	%
	AEE01H48-M			-	88	-	%
AEE01BB48-M	-	88	-	%			
AEE01CC48-M	-	88	-	%			
Leakage Current		$V_{IN,AC}=240Vac$ $f_{IN}=60Hz$	$I_{IN,Leakage}$	-	-	5	$\mu A$
Internal Filter Type		All	Internal Pi Type				

## Output Specifications

Table 3. Output Specifications:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Output Voltage Set -Point		$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$ $T_A=25\text{ }^\circ\text{C}$	$V_O$	-	1	-	%
Output Voltage Balance	Dual Output, Balanced Loads	All	$\pm\%V_O$	-	-	2.0	%
Output Current	AEE03A12-M	Natural Convection	$I_O$	-	-	3	A
	AEE01B12-M			-	-	1.25	A
	AEE01C12-M			-	-	1	A
	AEE01H12-M			-	-	0.625	A
	AEE01BB12-M			-	-	$\pm 0.625$	A
	AEE01CC12-M			-	-	$\pm 0.5$	A
	AEE03A24-M			-	-	3	A
	AEE01B24-M			-	-	1.25	A
	AEE01C24-M			-	-	1	A
	AEE01H24-M			-	-	0.625	A
	AEE01BB24-M			-	-	$\pm 0.625$	A
	AEE01CC24-M			-	-	$\pm 0.5$	A
	AEE03A48-M			-	-	3	A
	AEE01B48-M			-	-	1.25	A
	AEE01C48-M			-	-	1	A
	AEE01H48-M			-	-	0.625	A
AEE01BB48-M	-	-	$\pm 0.625$	A			
AEE01CC48-M	-	-	$\pm 0.5$	A			
$V_O$ Load Capacitance	AEE03A12-M	All	$C_O$	-	-	5100	$\mu\text{F}$
	AEE01B12-M			-	-	870	$\mu\text{F}$
	AEE01C12-M			-	-	560	$\mu\text{F}$
	AEE01H12-M			-	-	220	$\mu\text{F}$
	AEE01BB12-M			-	-	440 <sup>1</sup>	$\mu\text{F}$
	AEE01CC12-M			-	-	280 <sup>1</sup>	$\mu\text{F}$
	AEE03A24-M			-	-	5100	$\mu\text{F}$
	AEE01B24-M			-	-	870	$\mu\text{F}$
	AEE01C24-M			-	-	560	$\mu\text{F}$
	AEE01H24-M			-	-	220	$\mu\text{F}$
	AEE01BB24-M			-	-	440 <sup>1</sup>	$\mu\text{F}$
	AEE01CC24-M			-	-	280 <sup>1</sup>	$\mu\text{F}$
	AEE03A48-M			-	-	5100	$\mu\text{F}$
	AEE01B48-M			-	-	870	$\mu\text{F}$
	AEE01C48-M			-	-	560	$\mu\text{F}$
	AEE01H48-M			-	-	220	$\mu\text{F}$
AEE01BB48-M	-	-	440 <sup>1</sup>	$\mu\text{F}$			
AEE01CC48-M	-	-	280 <sup>1</sup>	$\mu\text{F}$			

## Output Specifications

Table 3. Output Specifications con't:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Start Up Time		$V_{IN,DC}=V_{IN,nom}$ $I_O=I_{O,max}$ Resistive Load	$T_{Turn-On}$	-	-	30	mSec
Line Regulation		$V_{IN,DC}=V_{IN,min}$ to $V_{IN,max}$ $I_O=I_{O,max}$	$\pm\%V_O$	-	-	0.5	%
Load Regulation	Single Output	$I_O=I_{O,min}$ to $I_{O,max}$	$\pm\%V_O$	-	-	0.5	%
	Dual Output			-	-	1.0	%
Switching Frequency		All	$f_{sw}$	-	285	-	KHz
$V_O$ Dynamic Response	Peak Deviation	25% load change	$\pm\%V_O$	-	$\pm 3$	$\pm 5$	%
	Settling Time			$t_s$	-	-	300
Temperature Coefficient		All	$\%/^{\circ}C$	-0.02	-	0.02	%
Output Over Current Protection <sup>2</sup>		All	$\%I_{O,max}$	-	150	-	%
Output Short Circuit Protection <sup>3</sup>		All		Hiccup Automatic Recovery			
Output Over Voltage Protection	AEE03A12-M	All		-	6.2	-	Vdc
	AEE01B12-M			-	15	-	Vdc
	AEE01C12-M			-	18	-	Vdc
	AEE01H12-M			-	27	-	Vdc
	AEE01BB12-M			-	$\pm 15$	-	Vdc
	AEE01CC12-M			-	$\pm 18$	-	Vdc
	AEE03A24-M			-	6.2	-	Vdc
	AEE01B24-M			-	15	-	Vdc
	AEE01C24-M			-	18	-	Vdc
	AEE01H24-M			-	27	-	Vdc
	AEE01BB24-M			-	$\pm 15$	-	Vdc
	AEE01CC24-M			-	$\pm 18$	-	Vdc
	AEE03A48-M			-	6.2	-	Vdc
	AEE01B48-M			-	15	-	Vdc
	AEE01C48-M			-	18	-	Vdc
	AEE01H48-M			-	27	-	Vdc
	AEE01BB48-M			-	$\pm 15$	-	Vdc
	AEE01CC48-M			-	$\pm 18$	-	Vdc

Note 1 - For each output

Note 2 - Hiccup Automatic Recovery

Note 3 - Hiccup Mode 0.7Hz typ., Automatic Recovery



## Output Specifications

Table 3. Output Specifications con't:

Parameter		Condition	Symbol	Min	Nom	Max	Unit
Output Ripple, pk-pk	AEE03A12-M	Measure with a 4.7uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth	$V_o$	-	5	-	mV <sub>PK-PK</sub>
	AEE03A24-M			-	5	-	mV <sub>PK-PK</sub>
	AEE03A48-M			-	5	-	mV <sub>PK-PK</sub>
	AEE01B12-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01C12-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01BB12-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01CC12-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01B24-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01C24-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01BB24-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01CC24-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01B48-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01C48-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01BB48-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01CC48-M			-	100	-	mV <sub>PK-PK</sub>
	AEE01H12-M			-	150	-	mV <sub>PK-PK</sub>
AEE01H24-M	-	150	-	mV <sub>PK-PK</sub>			
AEE01H48-M	-	150	-	mV <sub>PK-PK</sub>			



## AEE03A12-M Performance Curves

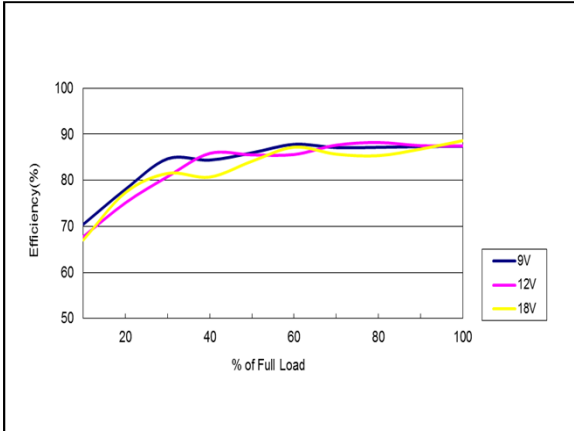


Figure 1: AEE03A12-M Efficiency Versus Output Current Curve  
Vin = 9 to 18Vdc, Io = 0 to 3A, Ta = 25°C

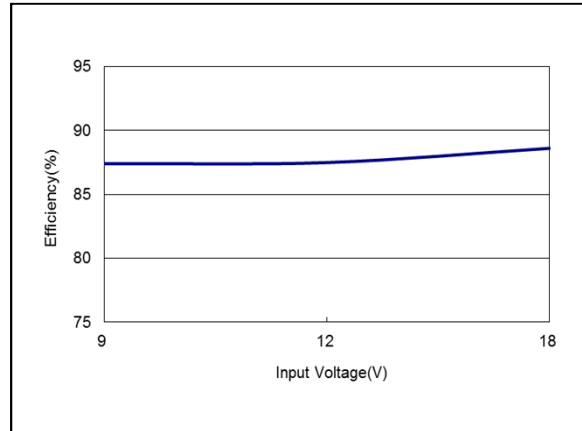


Figure 2: AEE03A12-M Efficiency Versus Input Voltage Curve  
Vin = 9 to 18Vdc, Io = 3A, Ta = 25°C

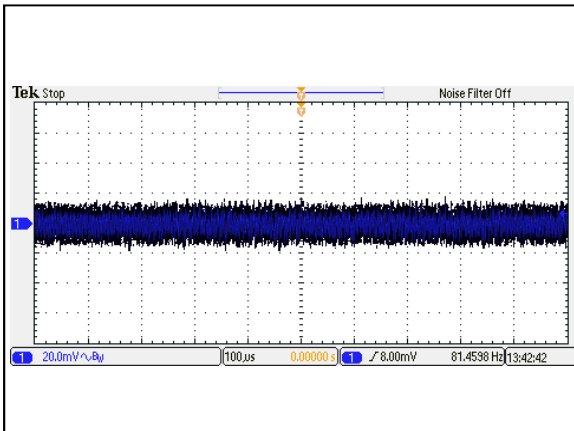


Figure 3: AEE03A12-M Ripple and Noise Measurement  
Vin = 12Vdc, Io = 3A, Ta = 25°C  
Ch 1: Vo

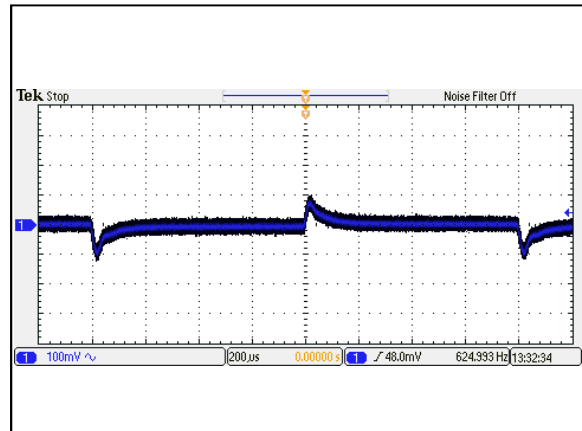


Figure 4: AEE03A12-M Transient Response  
Vin = 12Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

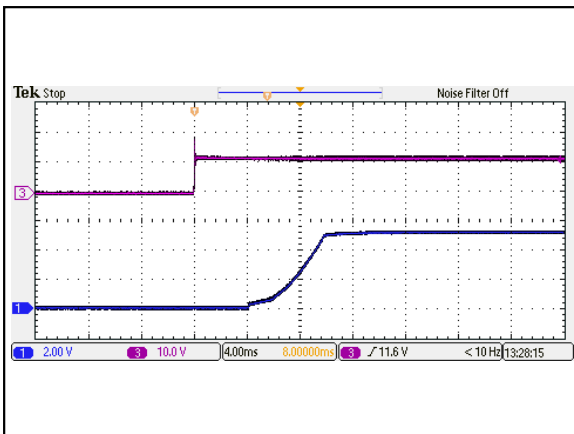


Figure 5: AEE03A12-M Output Voltage Startup Characteristic by Vin  
Vin = 12Vdc, Io = 3A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

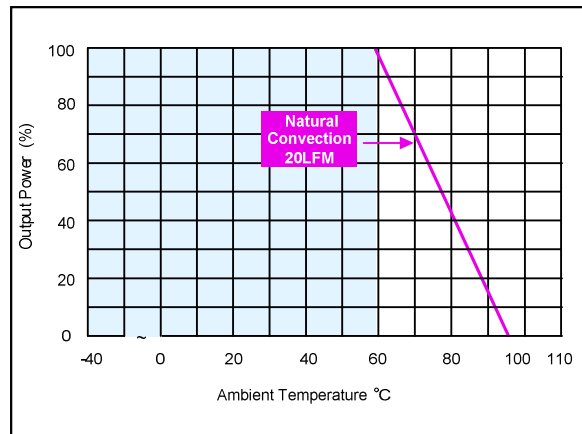


Figure 6: AEE03A12-M Derating Curve (without heatsink)  
Vin = 12Vdc, Io = 0 to 3A, Ta = 25°C

## AEE01B12-M Performance Curves

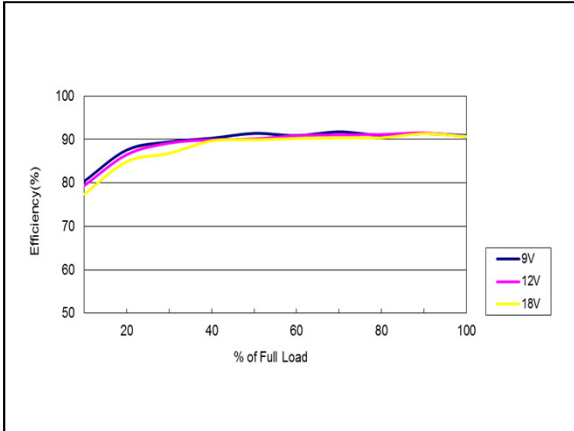


Figure 7: AEE01B12-M Efficiency Versus Output Current Curve  
Vin = 9 to 18Vdc, Io = 0 to 1.25A, Ta = 25°C

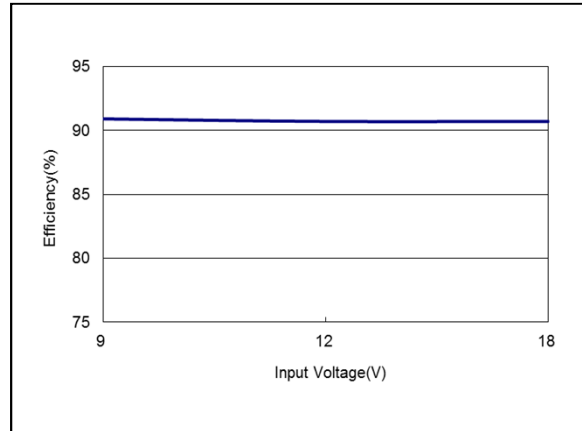


Figure 8: AEE01B12-M Efficiency Versus Input Voltage Curve  
Vin = 9 to 18Vdc, Io = 1.25A, Ta = 25°C

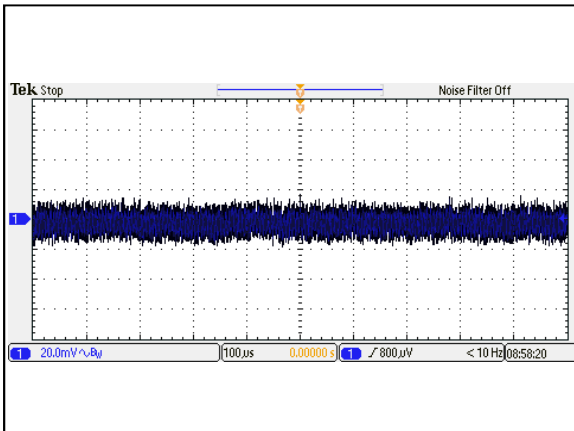


Figure 9: AEE01B12-M Ripple and Noise Measurement  
Vin = 12Vdc, Io = 1.25A, Ta = 25°C  
Ch 1: Vo

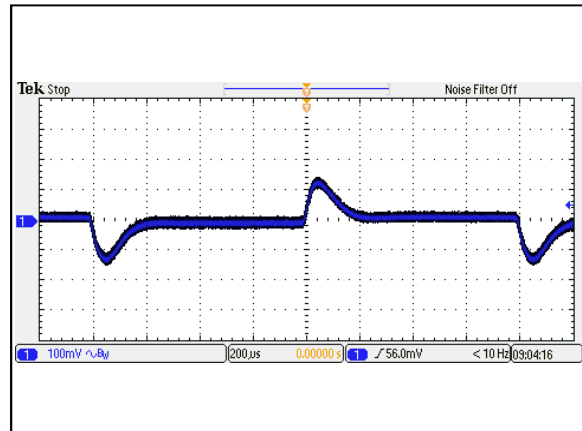


Figure 10: AEE01B12-M Transient Response  
Vin = 12Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

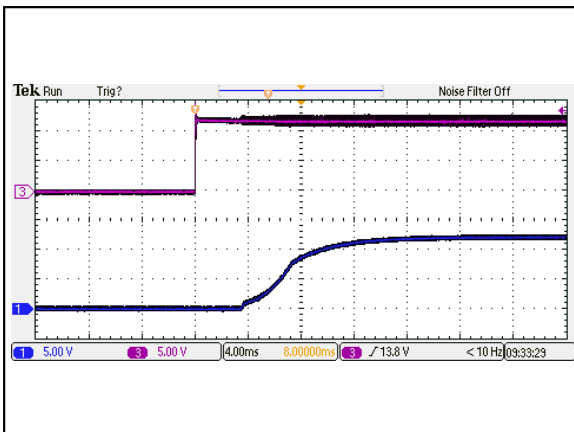


Figure 11: AEE01B12-M Output Voltage Startup Characteristic by Vin  
Vin = 12Vdc, Io = 1.25A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

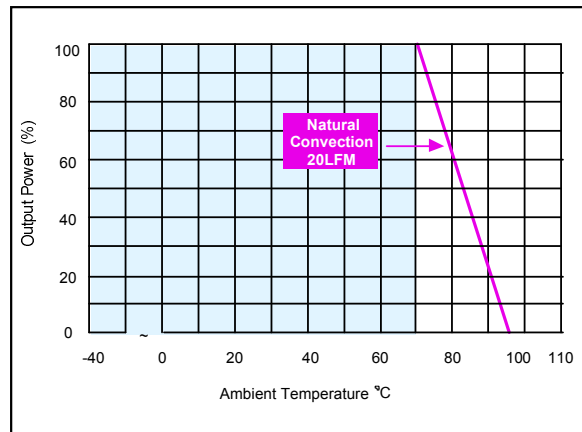


Figure 12: AEE01B12-M Derating Curve (without heatsink)  
Vin = 12Vdc, Io = 0 to 1.25A, Ta = 25°C

## AEE01C12-M Performance Curves

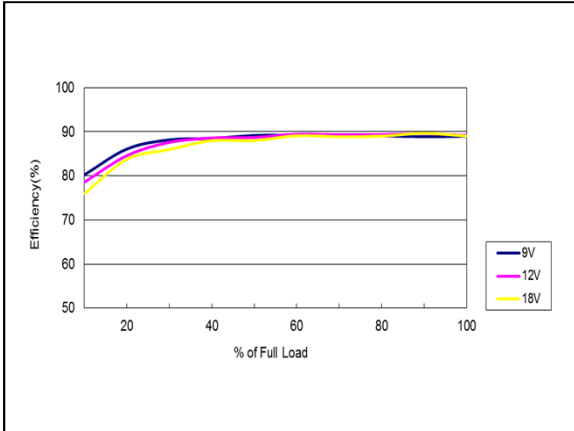


Figure 13: AEE01C12-M Efficiency Versus Output Current Curve  
Vin = 9 to 18Vdc, Io = 0 to 1A, Ta = 25°C

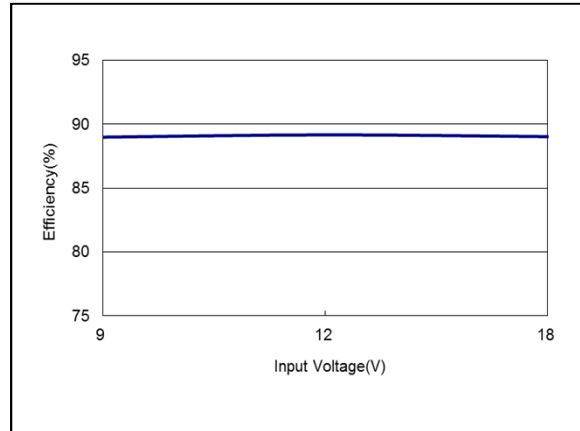


Figure 14: AEE01C12-M Efficiency Versus Input Voltage Curve  
Vin = 9 to 18Vdc, Io = 1A, Ta = 25°C

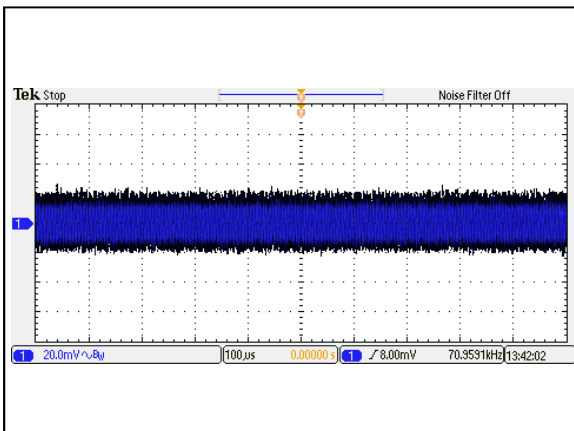


Figure 15: AEE01C12-M Ripple and Noise Measurement  
Vin = 12Vdc, Io = 1A, Ta = 25°C  
Ch 1: Vo

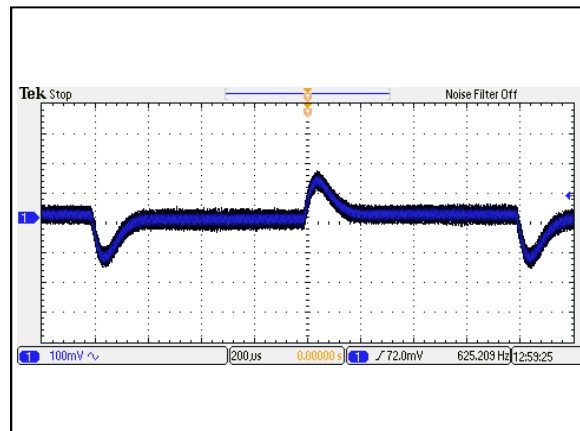


Figure 16: AEE01C12-M Transient Response  
Vin = 12Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

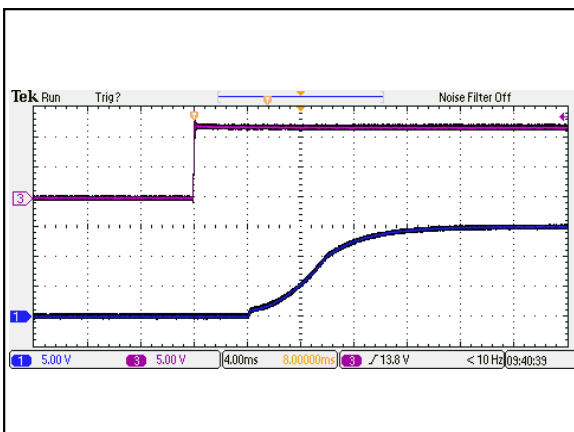


Figure 17: AEE01C12-M Output Voltage Startup Characteristic by Vin  
Vin = 12Vdc, Io = 1A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

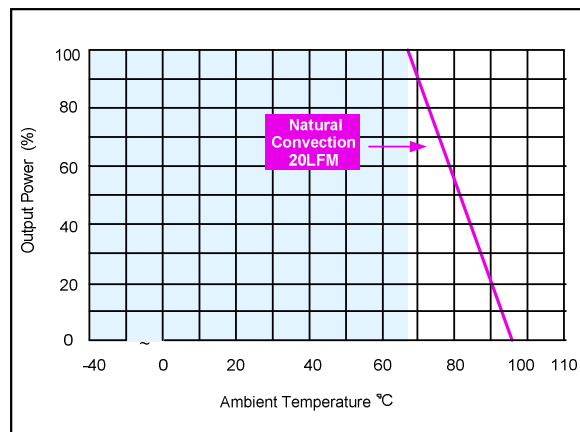


Figure 18: AEE01C12-M Derating Curve (without heatsink)  
Vin = 12Vdc, Io = 0 to 1A, Ta = 25°C

## AEE01H12-M Performance Curves

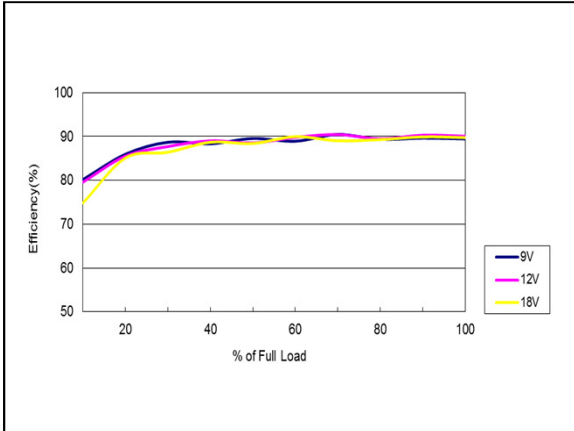


Figure 19: AEE01H12-M Efficiency Versus Output Current Curve  
Vin = 9 to 18Vdc, Io = 0 to 0.625A, Ta = 25°C

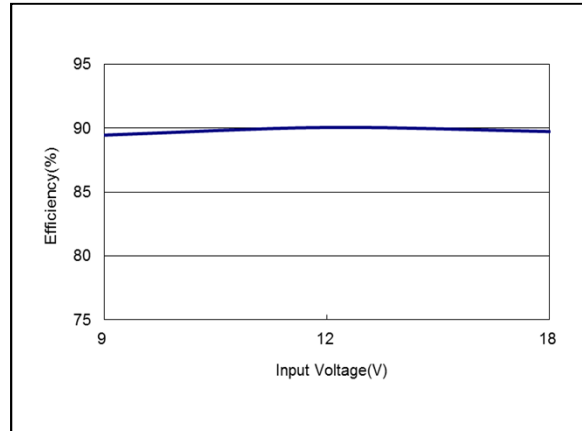


Figure 20: AEE01H12-M Efficiency Versus Input Voltage Curve  
Vin = 9 to 18Vdc, Io = 0.625A, Ta = 25°C

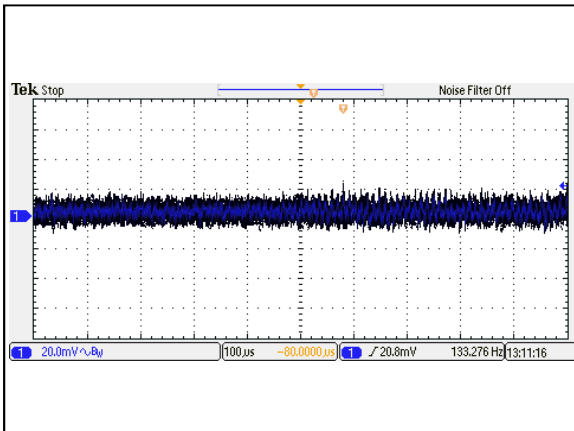


Figure 21: AEE01H12-M Ripple and Noise Measurement  
Vin = 12Vdc, Io = 0.625A, Ta = 25°C  
Ch 1: Vo

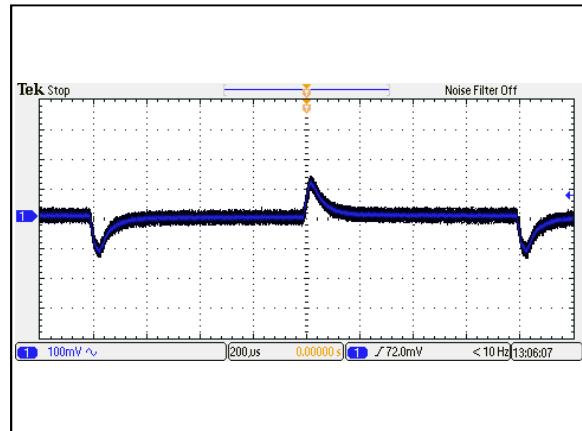


Figure 22: AEE01H12-M Transient Response  
Vin = 12Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

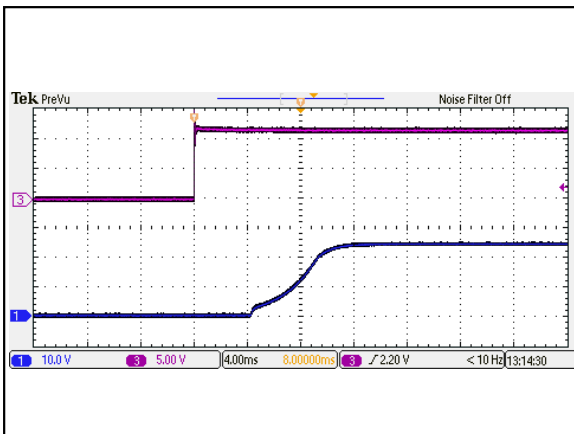


Figure 23: AEE01H12-M Output Voltage Startup Characteristic by Vin  
Vin = 12Vdc, Io = 0.625A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

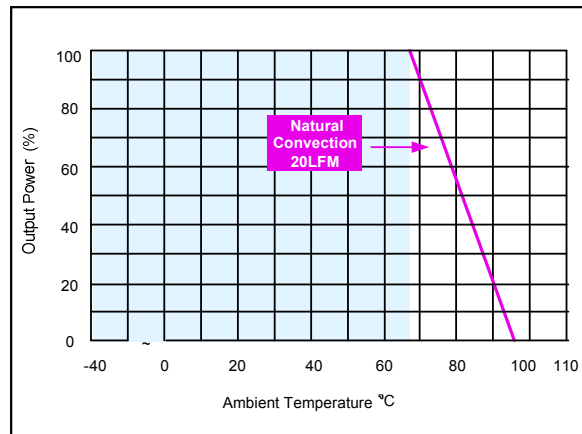


Figure 24: AEE01H12-M Derating Curve (without heatsink)  
Vin = 12Vdc, Io = 0 to 0.625A, Ta = 25°C

## AEE01BB12-M Performance Curves

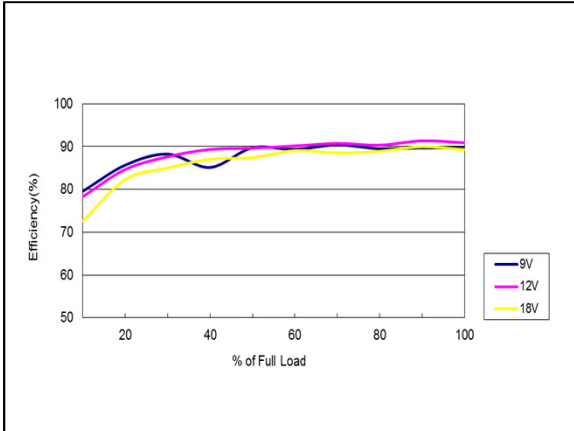


Figure 25: AEE01BB12-M Efficiency Versus Output Current Curve  
Vin = 9 to 18Vdc, Io = 0 to ±0.625A, Ta = 25°C

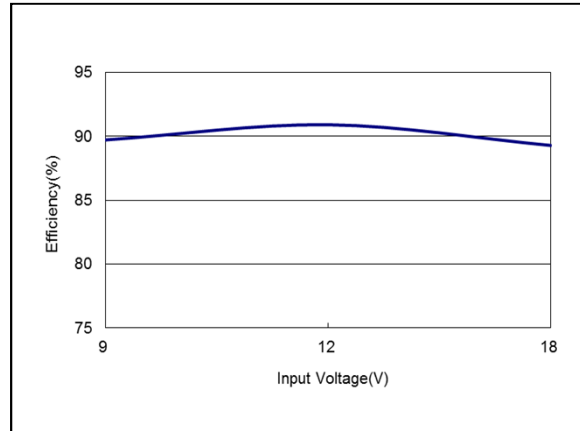


Figure 26: AEE01BB12-M Efficiency Versus Input Voltage Curve  
Vin = 9 to 18Vdc, Io = ±0.625A, Ta = 25°C

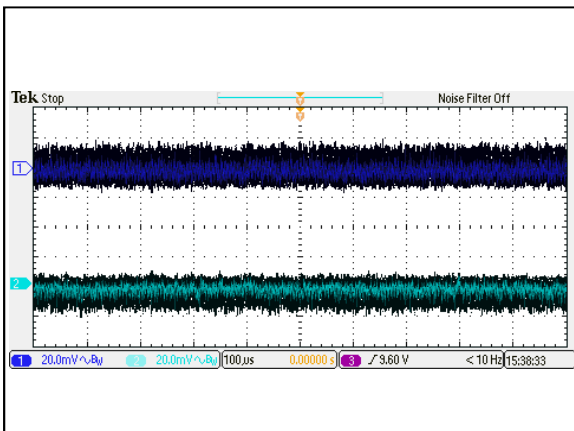


Figure 27: AEE01BB12-M Ripple and Noise Measurement  
Vin = 12Vdc, Io = ±0.625A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

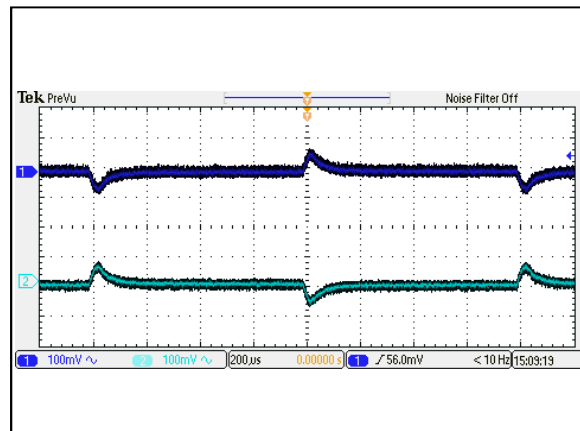


Figure 28: AEE01BB12-M Transient Response  
Vin = 12Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

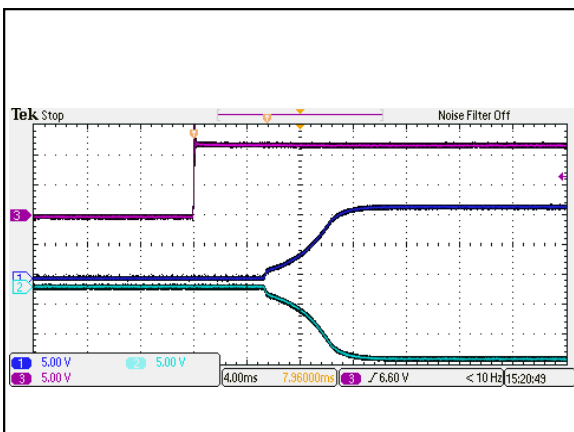


Figure 29: AEE01BB12-M Output Voltage Startup Characteristic by Vin  
Vin = 12Vdc, Io = ±0.625A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2 Ch 3: Vin

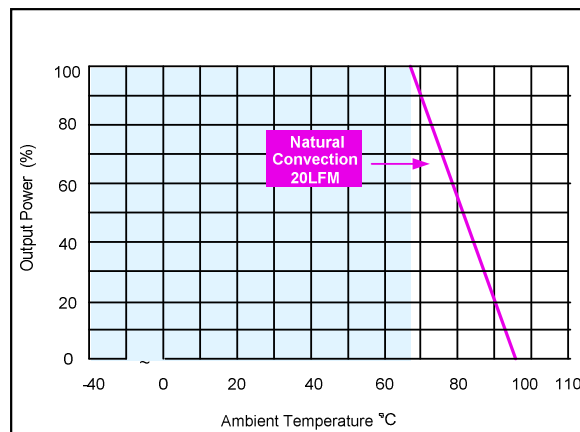


Figure 30: AEE01BB12-M Derating Curve (without heatsink)  
Vin = 12Vdc, Io = 0 to ±0.625A, Ta = 25°C

## AEE01CC12-M Performance Curves

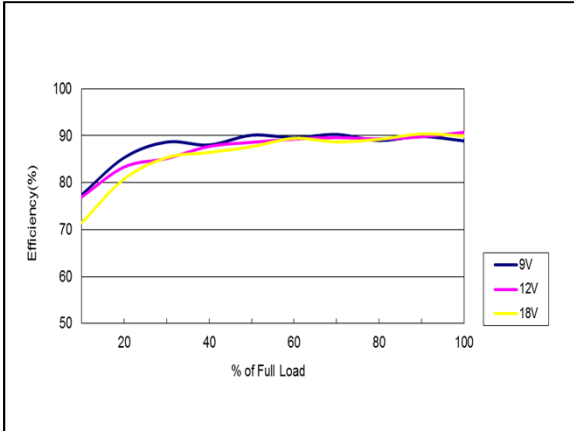


Figure 31: AEE01CC12-M Efficiency Versus Output Current Curve  
Vin = 9 to 18Vdc, Io = 0 to ±0.5A, Ta = 25°C

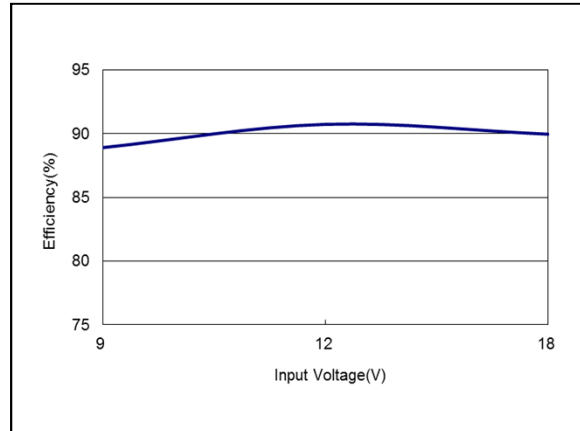


Figure 32: AEE01CC12-M Efficiency Versus Input Voltage Curve  
Vin = 9 to 18Vdc, Io = ±0.5A, Ta = 25°C

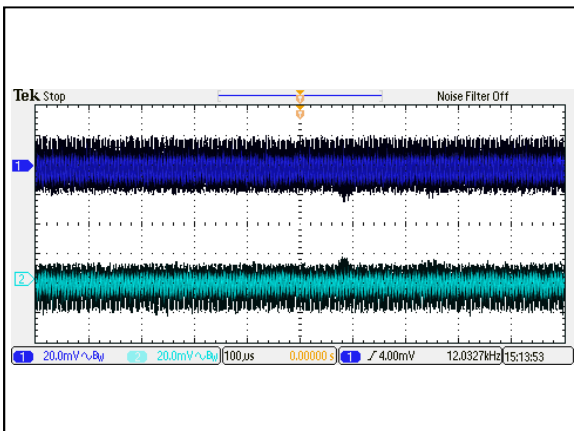


Figure 33: AEE01CC12-M Ripple and Noise Measurement  
Vin = 12Vdc, Io = ±0.5A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

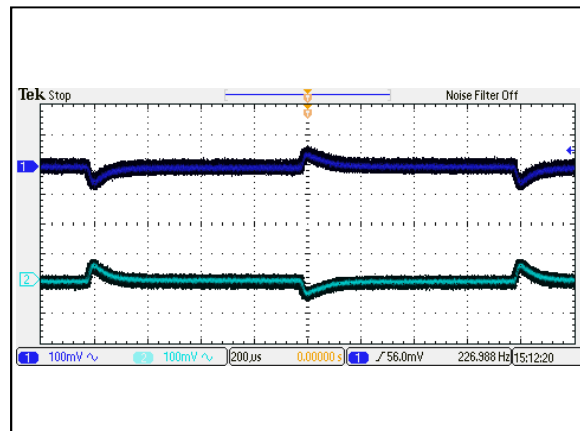


Figure 34: AEE01CC12-M Transient Response  
Vin = 12Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

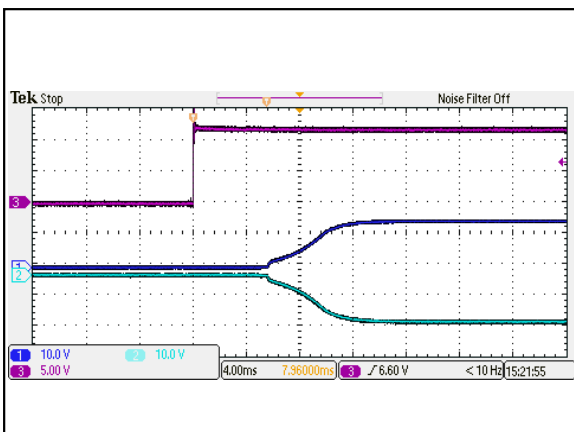


Figure 35: AEE01CC12-M Output Voltage Startup Characteristic by Vin  
Vin = 12Vdc, Io = ±0.5A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2 Ch 3: Vin

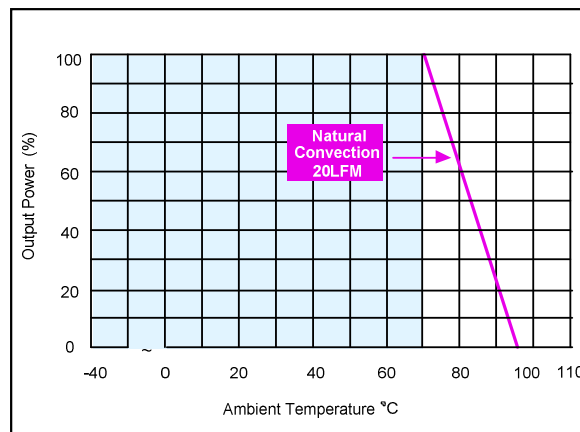


Figure 36: AEE01CC12-M Derating Curve (without heatsink)  
Vin = 12Vdc, Io = 0 to ±0.5A, Ta = 25°C

## AEE03A24-M Performance Curves

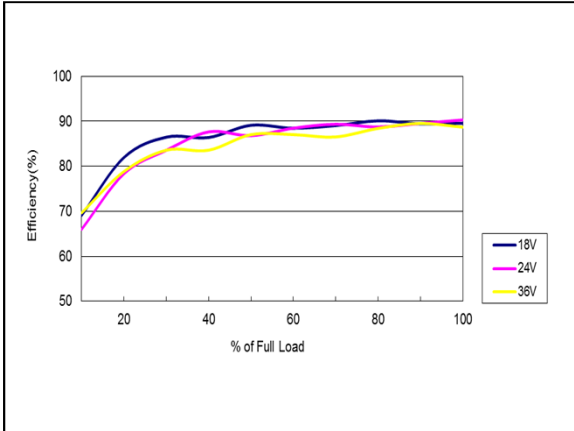


Figure 37: AEE03A24-M Efficiency Versus Output Current Curve  
Vin = 18 to 36Vdc, Io = 0 to 3A, Ta = 25°C

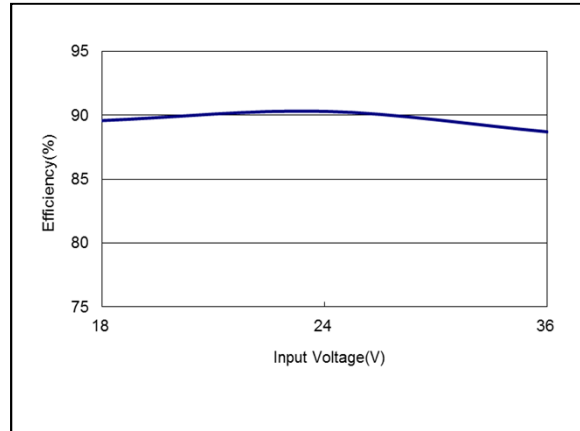


Figure 38: AEE03A24-M Efficiency Versus Input Voltage Curve  
Vin = 18 to 36Vdc, Io = 3A, Ta = 25°C

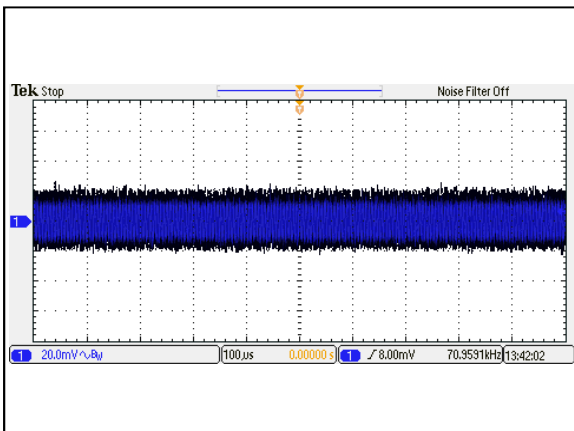


Figure 39: AEE03A24-M Ripple and Noise Measurement  
Vin = 24Vdc, Io = 3A, Ta = 25°C  
Ch 1: Vo

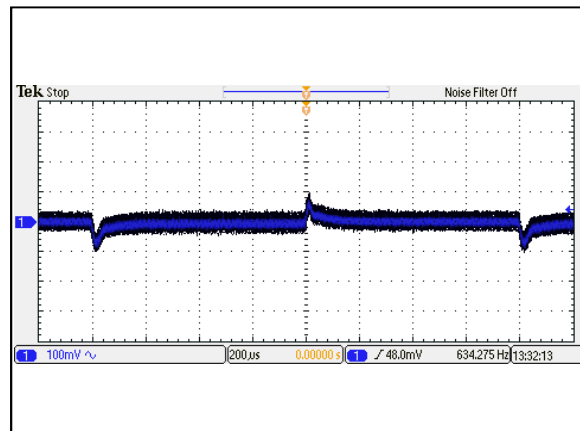


Figure 40: AEE03A24-M Transient Response  
Vin = 24Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

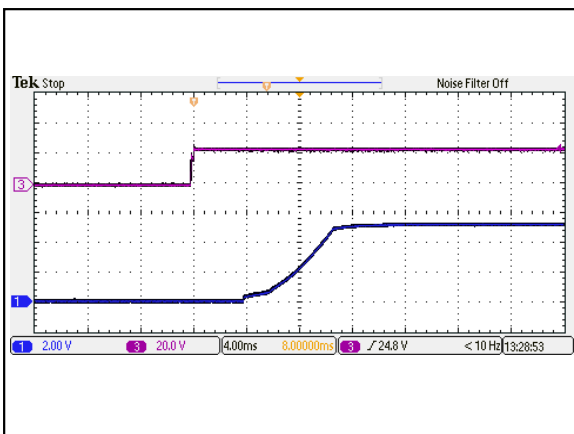


Figure 41: AEE03A24-M Output Voltage Startup Characteristic by Vin  
Vin = 24Vdc, Io = 3A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

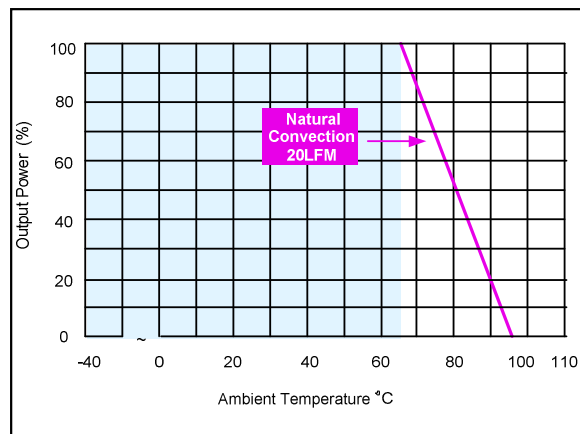


Figure 42: AEE03A24-M Derating Curve (without heatsink)  
Vin = 24Vdc, Io = 0 to 3A, Ta = 25°C



## AEE01B24-M Performance Curves

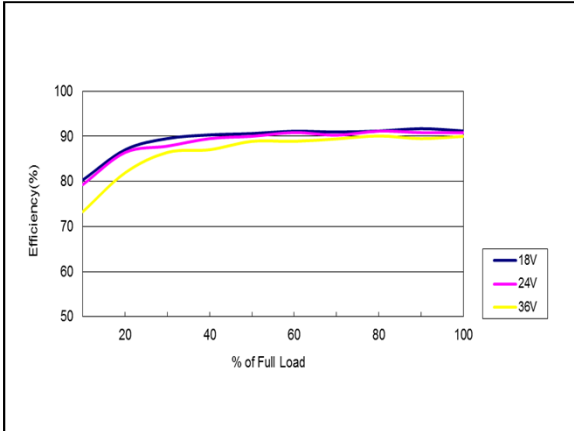


Figure 43: AEE01B24-M Efficiency Versus Output Current Curve  
Vin = 18 to 36Vdc, Io = 0 to 1.25A, Ta = 25°C

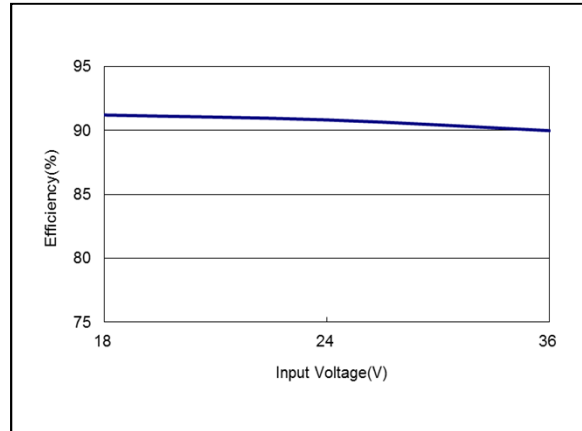


Figure 44: AEE01B24-M Efficiency Versus Input Voltage Curve  
Vin = 18 to 36Vdc, Io = 1.25A, Ta = 25°C

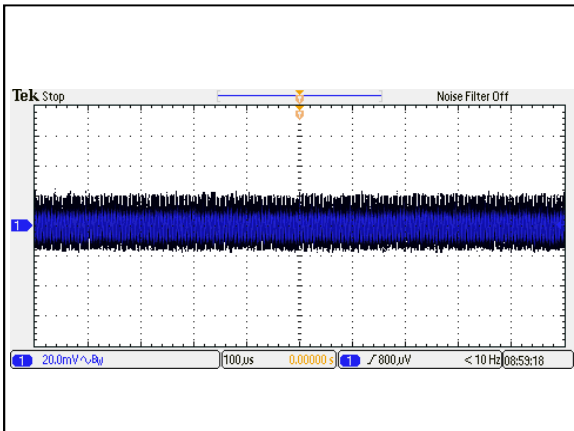


Figure 45: AEE01B24-M Ripple and Noise Measurement  
Vin = 24Vdc, Io = 1.25A, Ta = 25°C  
Ch 1: Vo

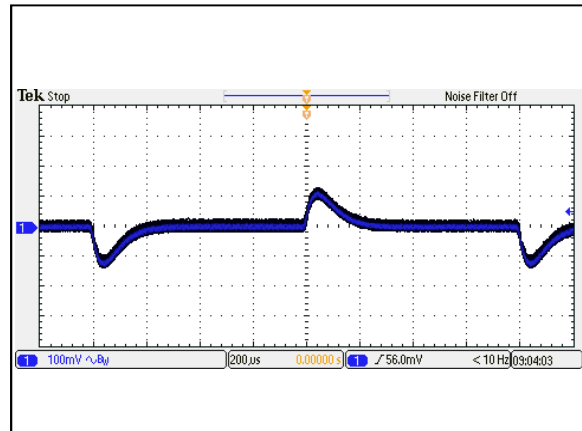


Figure 46: AEE01B24-M Transient Response  
Vin = 24Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

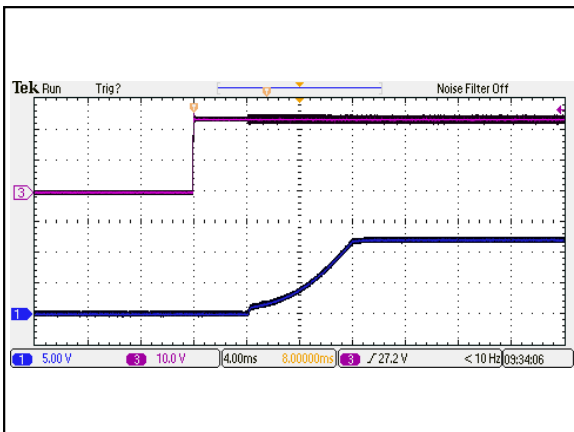


Figure 47: AEE01B24-M Output Voltage Startup Characteristic by Vin  
Vin = 24Vdc, Io = 1.25A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

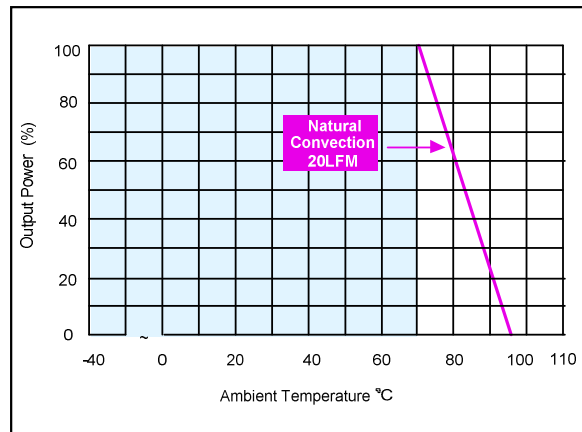


Figure 48: AEE01B24-M Derating Curve (without heatsink)  
Vin = 24Vdc, Io = 0 to 1.25A, Ta = 25°C

## AEE01C24-M Performance Curves

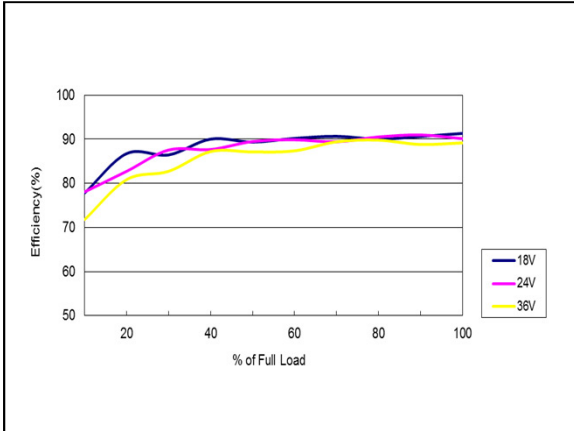


Figure 49: AEE01C24-M Efficiency Versus Output Current Curve  
Vin = 18 to 36Vdc, Io = 0 to 1A, Ta = 25°C

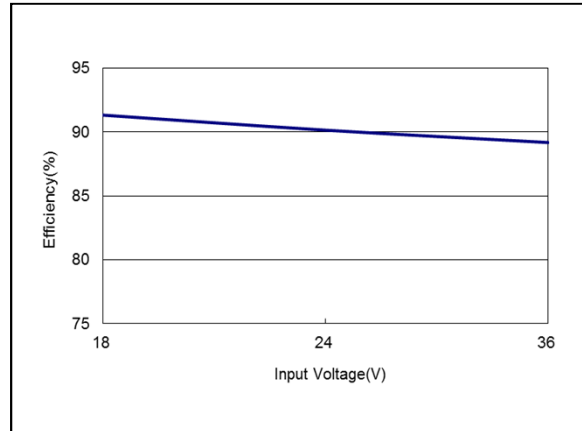


Figure 50: AEE01C24-M Efficiency Versus Input Voltage Curve  
Vin = 18 to 36Vdc, Io = 1A, Ta = 25°C

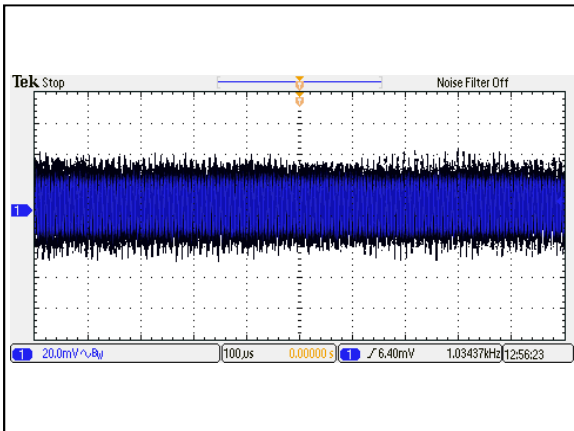


Figure 51: AEE01C24-M Ripple and Noise Measurement  
Vin = 24Vdc, Io = 1A, Ta = 25°C  
Ch 1: Vo

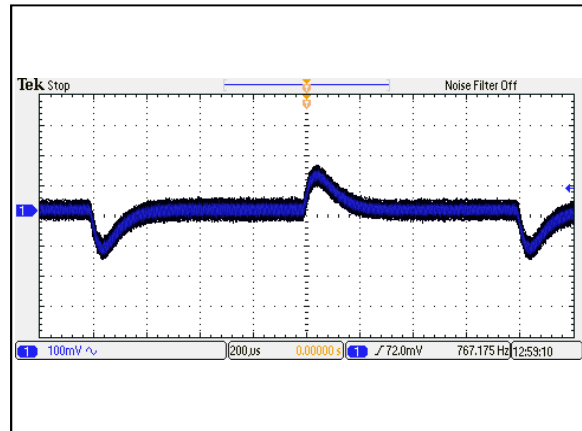


Figure 52: AEE01C24-M Transient Response  
Vin = 24Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

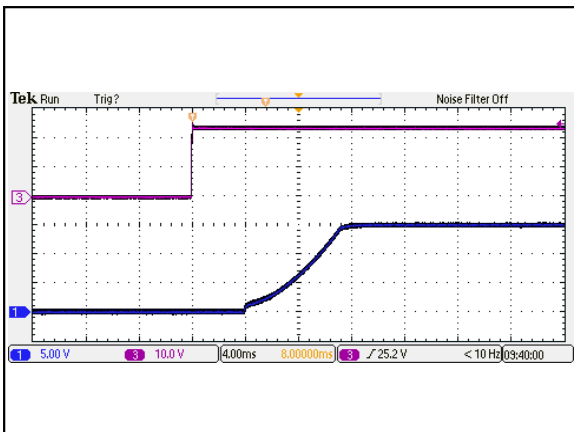


Figure 53: AEE01C24-M Output Voltage Startup Characteristic by Vin  
Vin = 24Vdc, Io = 1A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

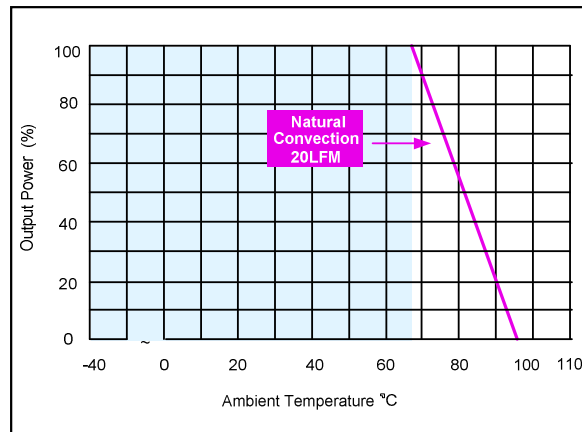


Figure 54: AEE01C24-M Derating Curve (without heatsink)  
Vin = 24Vdc, Io = 0 to 1A, Ta = 25°C

## AEE01H24-M Performance Curves

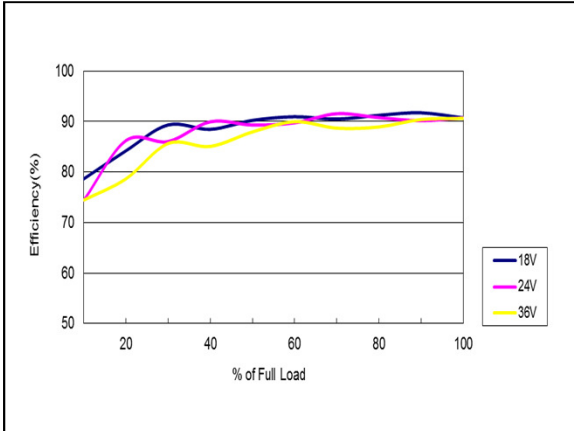


Figure 55: AEE01H24-M Efficiency Versus Output Current Curve  
Vin = 18 to 36Vdc, Io = 0 to 0.625A, Ta = 25°C

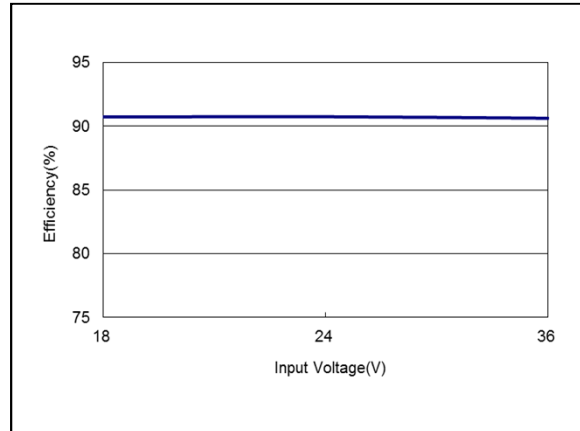


Figure 56: AEE01H24-M Efficiency Versus Input Voltage Curve  
Vin = 18 to 36Vdc, Io = 0.625A, Ta = 25°C

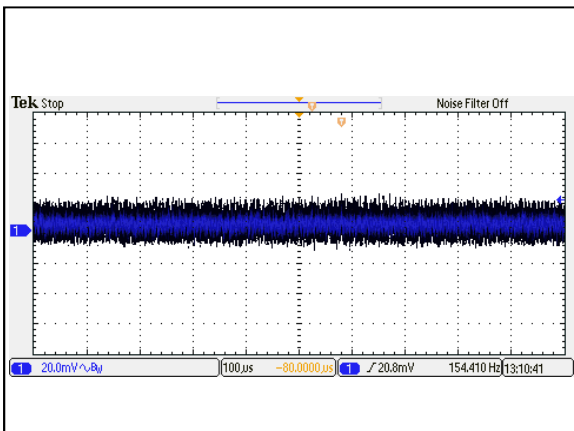


Figure 57: AEE01H24-M Ripple and Noise Measurement  
Vin = 24Vdc, Io = 0.625A, Ta = 25°C  
Ch 1: Vo

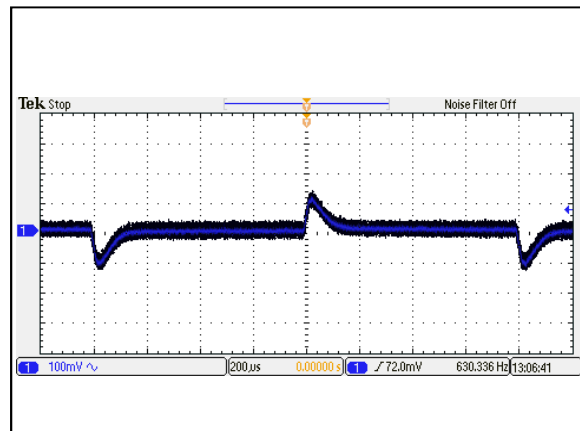


Figure 58: AEE01H24-M Transient Response  
Vin = 24Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

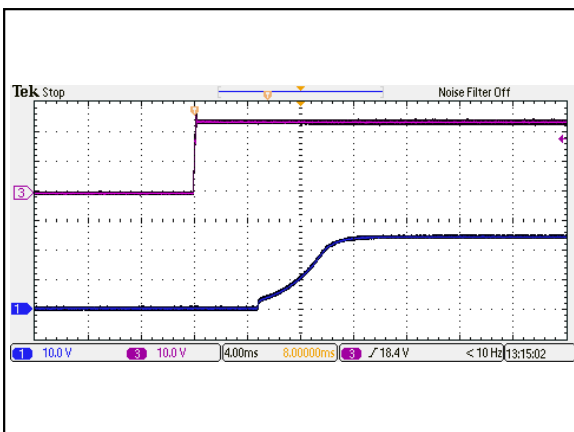


Figure 59: AEE01H24-M Output Voltage Startup Characteristic by Vin  
Vin = 24Vdc, Io = 0.625A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

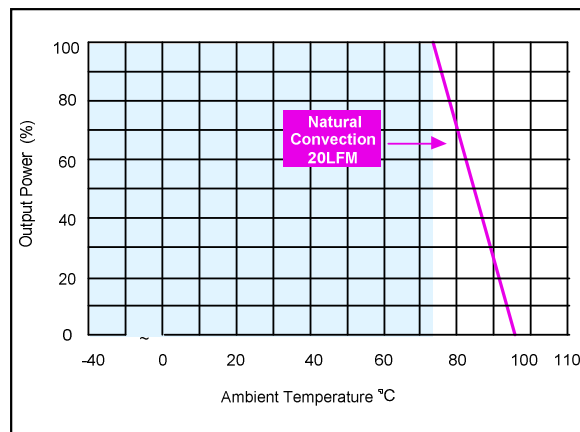


Figure 60: AEE01H24-M Derating Curve (without heatsink)  
Vin = 24Vdc, Io = 0 to 0.625A, Ta = 25°C

## AEE01BB24-M Performance Curves

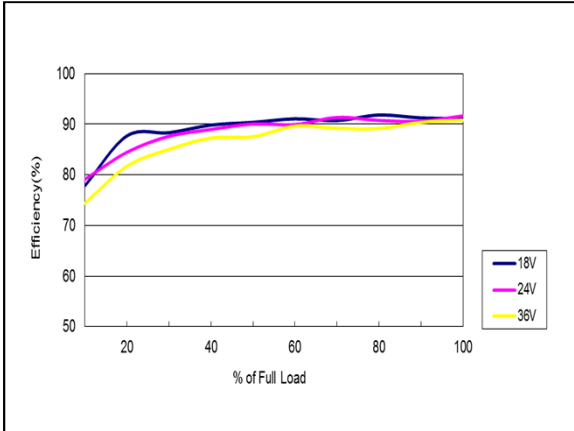


Figure 61: AEE01BB24-M Efficiency Versus Output Current Curve  
Vin = 18 to 36Vdc, Io = 0 to ±0.625A, Ta = 25°C

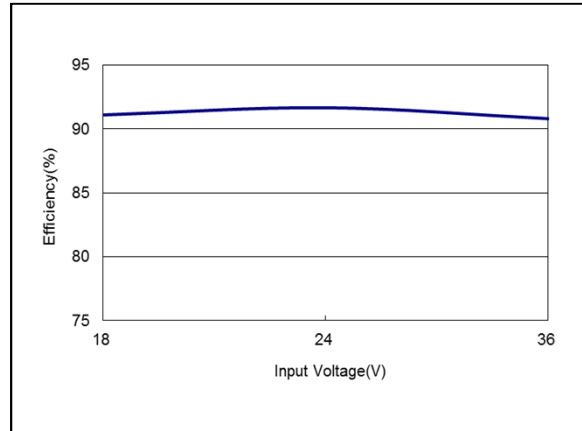


Figure 62: AEE01BB24-M Efficiency Versus Input Voltage Curve  
Vin = 18 to 36Vdc, Io = ±0.625A, Ta = 25°C

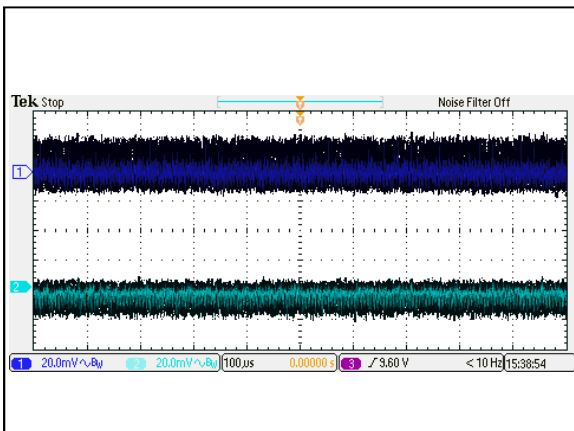


Figure 63: AEE01BB24-M Ripple and Noise Measurement  
Vin = 24Vdc, Io = ±0.625A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

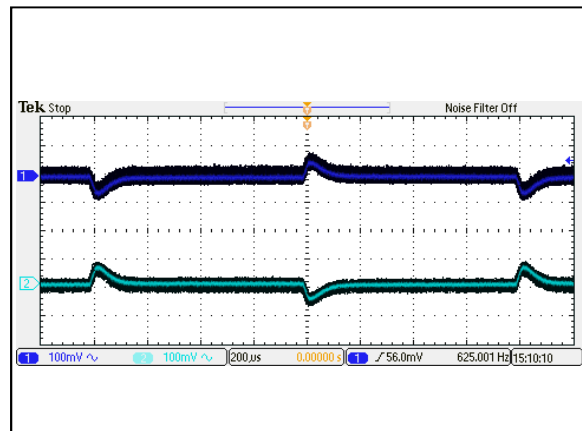


Figure 64: AEE01BB24-M Transient Response  
Vin = 24Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

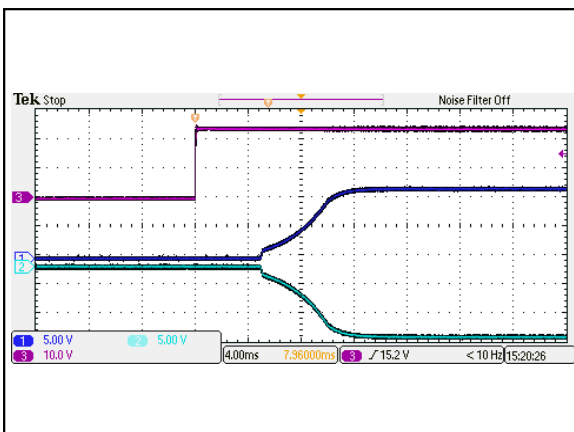


Figure 65: AEE01BB24-M Output Voltage Startup Characteristic by Vin  
Vin = 24Vdc, Io = ±0.625A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2 Ch 3: Vin

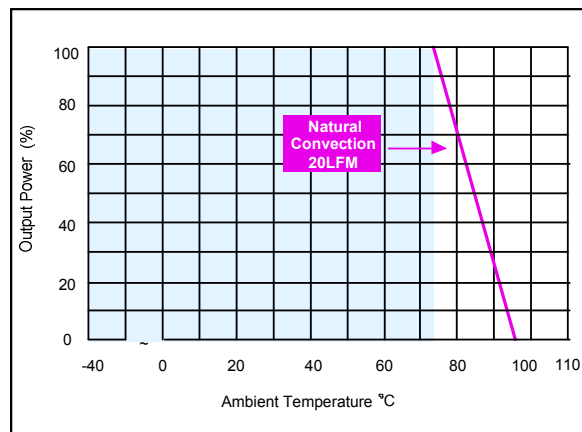


Figure 66: AEE01BB24-M Derating Curve (without heatsink)  
Vin = 24Vdc, Io = 0 to ±0.625A, Ta = 25°C

## AEE01CC24-M Performance Curves

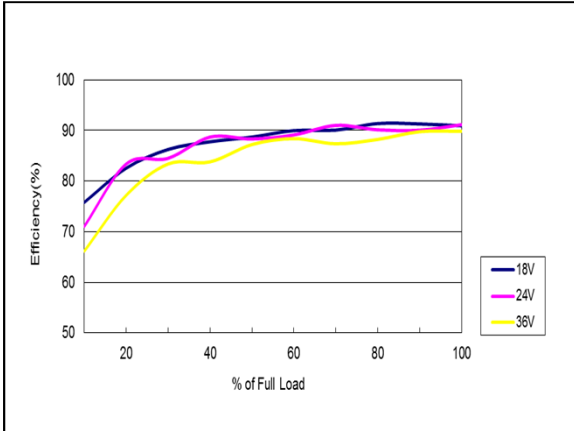


Figure 67: AEE01CC24-M Efficiency Versus Output Current Curve  
Vin = 18 to 36Vdc, Io = 0 to ±0.5A, Ta = 25°C

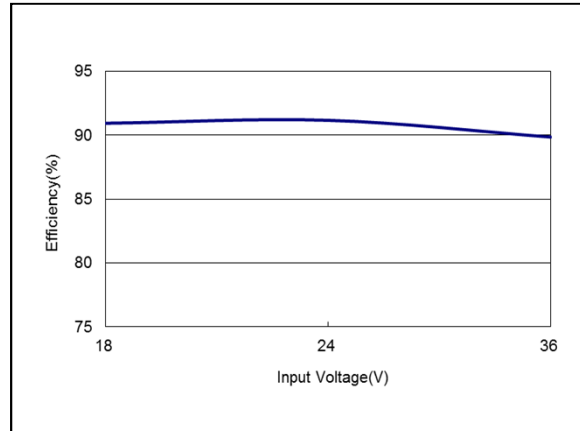


Figure 68: AEE01CC24-M Efficiency Versus Input Voltage Curve  
Vin = 18 to 36Vdc, Io = ±0.5A, Ta = 25°C

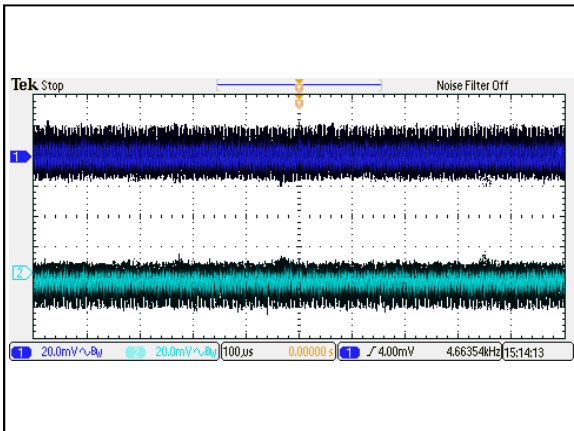


Figure 69: AEE01CC24-M Ripple and Noise Measurement  
Vin = 24Vdc, Io = ±0.5A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

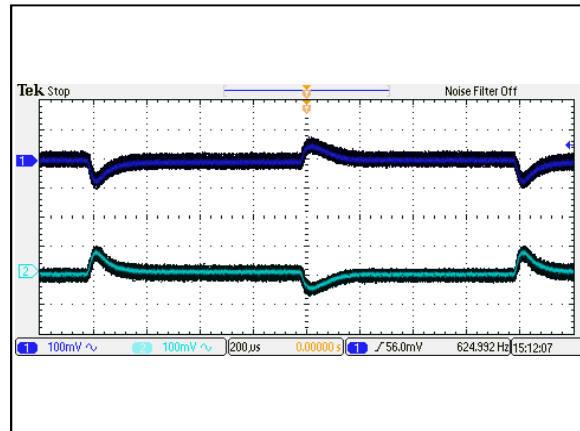


Figure 70: AEE01CC24-M Transient Response  
Vin = 24Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

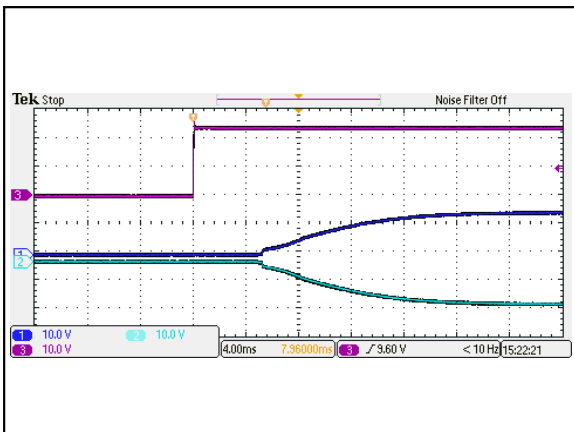


Figure 71: AEE01CC24-M Output Voltage Startup Characteristic by Vin  
Vin = 24Vdc, Io = ±0.5A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2 Ch 3: Vin

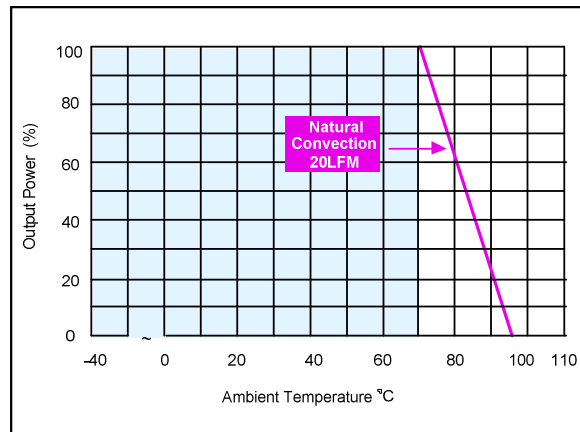


Figure 72: AEE01CC24-M Derating Curve (without heatsink)  
Vin = 24Vdc, Io = 0 to ±0.5A, Ta = 25°C

## AEE03A48-M Performance Curves

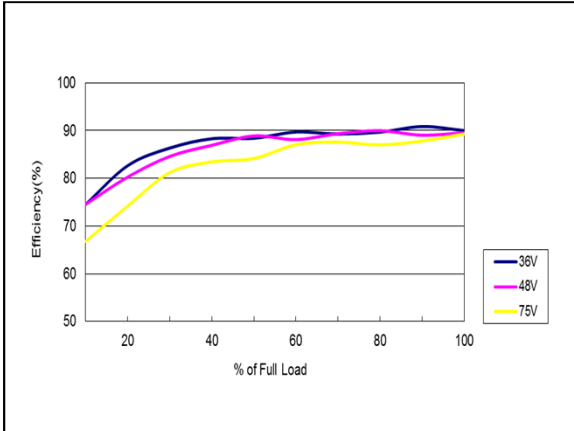


Figure 73: AEE03A48-M Efficiency Versus Output Current Curve  
Vin = 36 to 75Vdc, Io = 0 to 3A, Ta = 25°C

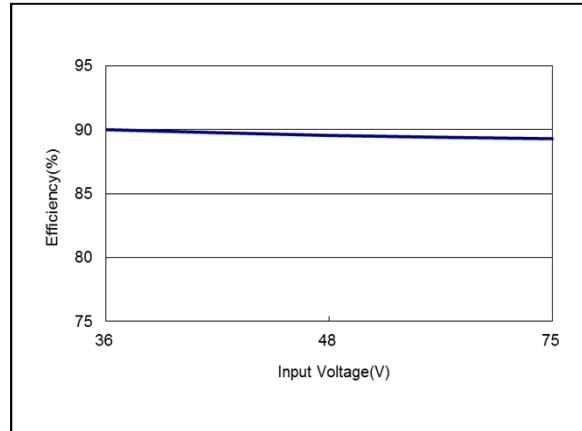


Figure 74: AEE03A48-M Efficiency Versus Input Voltage Curve  
Vin = 36 to 75Vdc, Io = 3A, Ta = 25°C

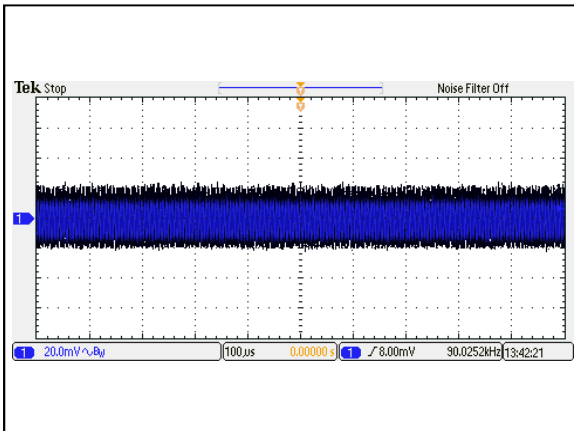


Figure 75: AEE03A48-M Ripple and Noise Measurement  
Vin = 48Vdc, Io = 3A, Ta = 25°C  
Ch 1: Vo

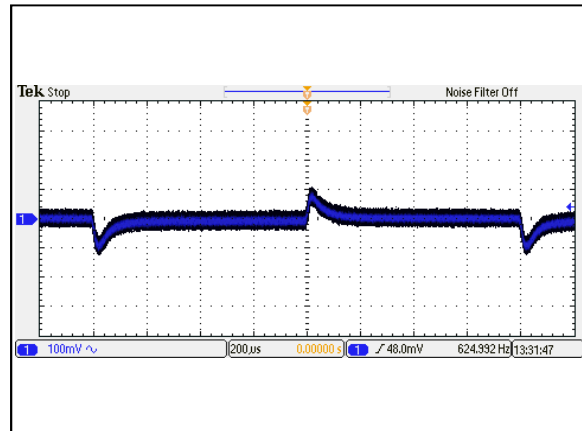


Figure 76: AEE03A48-M Transient Response  
Vin = 48Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

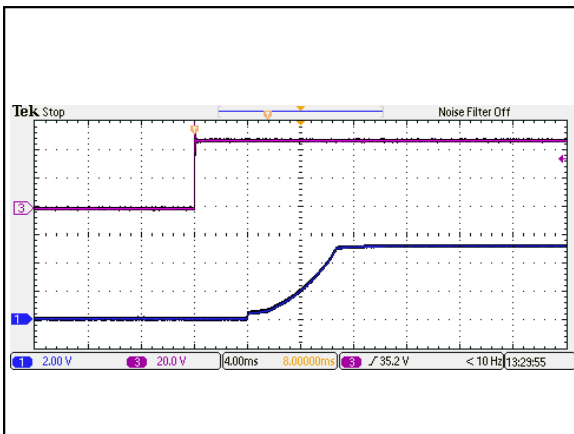


Figure 77: AEE03A48-M Output Voltage Startup Characteristic by Vin  
Vin = 48Vdc, Io = 3A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

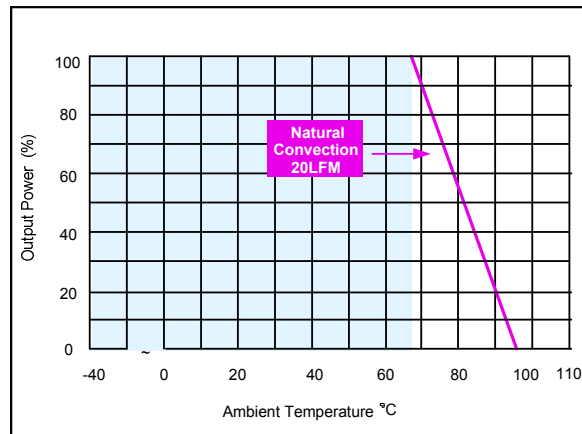


Figure 78: AEE03A48-M Derating Curve (without heatsink)  
Vin = 48Vdc, Io = 0 to 3A, Ta = 25°C

## AEE01B48-M Performance Curves

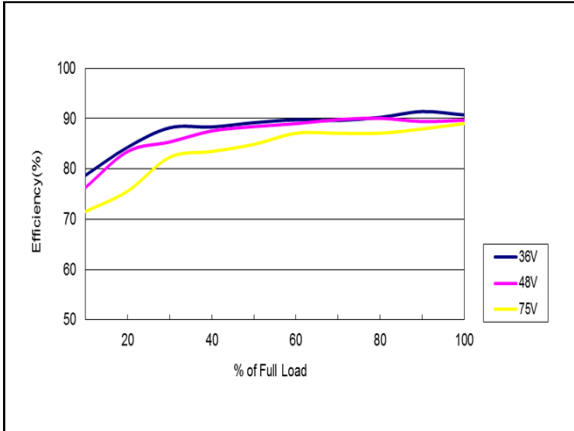


Figure 79: AEE01B48-M Efficiency Versus Output Current Curve  
Vin = 36 to 75Vdc, Io = 0 to 1.25A, Ta = 25°C

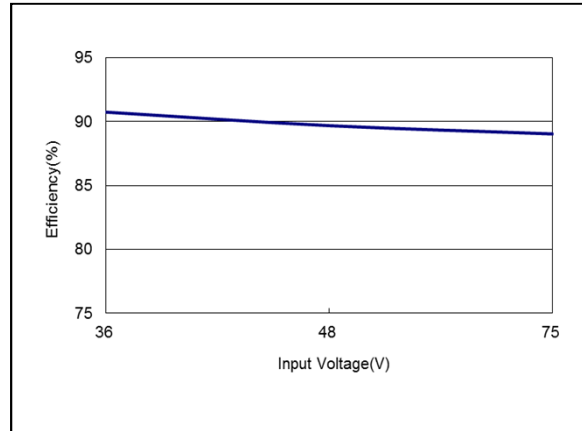


Figure 80: AEE01B48-M Efficiency Versus Input Voltage Curve  
Vin = 36 to 75Vdc, Io = 1.25A, Ta = 25°C

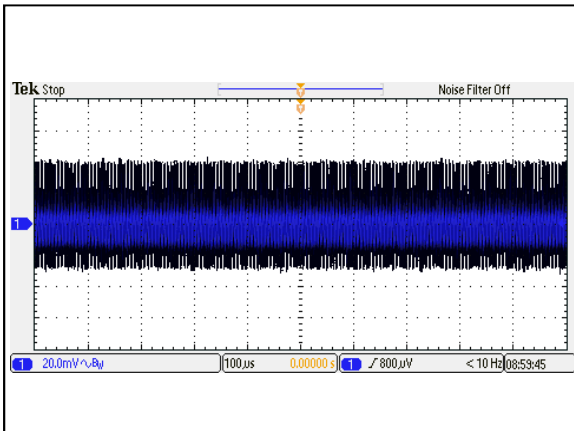


Figure 81: AEE01B48-M Ripple and Noise Measurement  
Vin = 48Vdc, Io = 1.25A, Ta = 25°C  
Ch 1: Vo

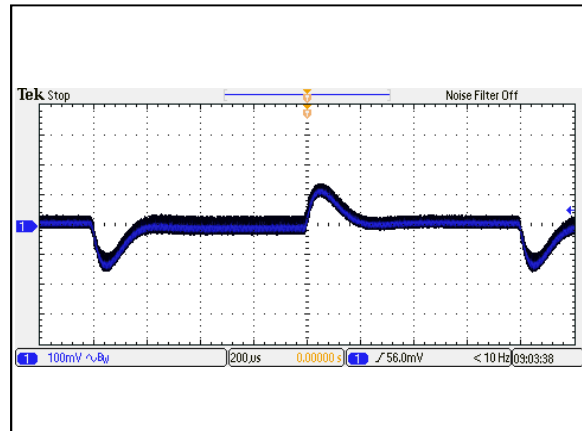


Figure 82: AEE01B48-M Transient Response  
Vin = 48Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

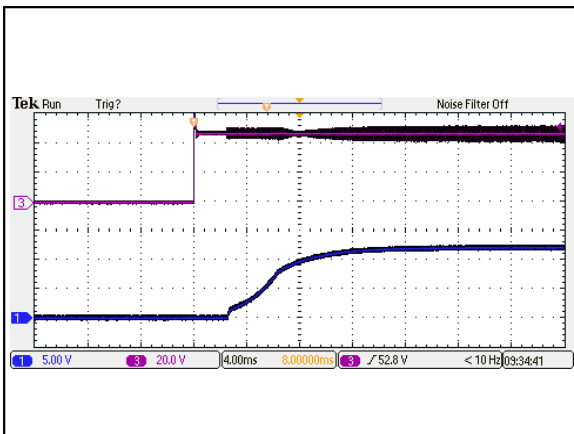


Figure 83: AEE01B48-M Output Voltage Startup Characteristic by Vin  
Vin = 48Vdc, Io = 1.25A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

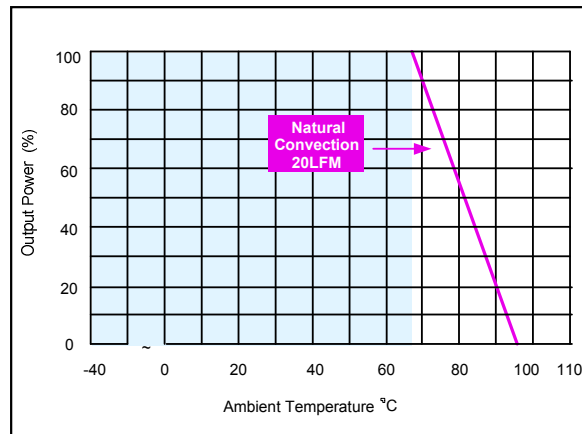


Figure 84: AEE01B48-M Derating Curve (without heatsink)  
Vin = 48Vdc, Io = 0 to 1.25A, Ta = 25°C



## AEE01C48-M Performance Curves

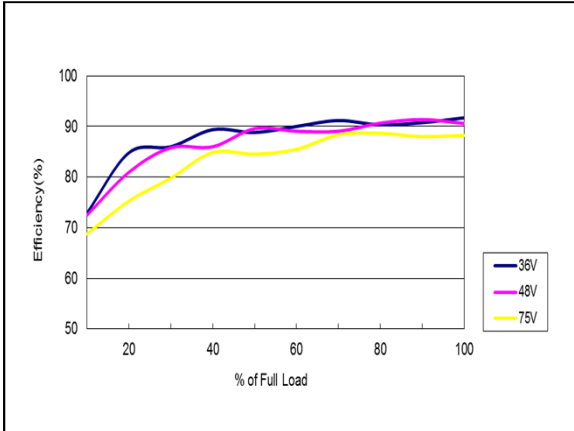


Figure 85: AEE01C48-M Efficiency Versus Output Current Curve  
Vin = 36 to 75Vdc, Io = 0 to 1A, Ta = 25°C

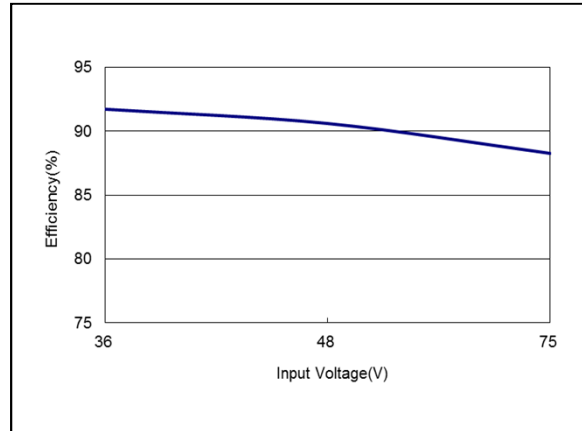


Figure 86: AEE01C48-M Efficiency Versus Input Voltage Curve  
Vin = 36 to 75Vdc, Io = 1A, Ta = 25°C

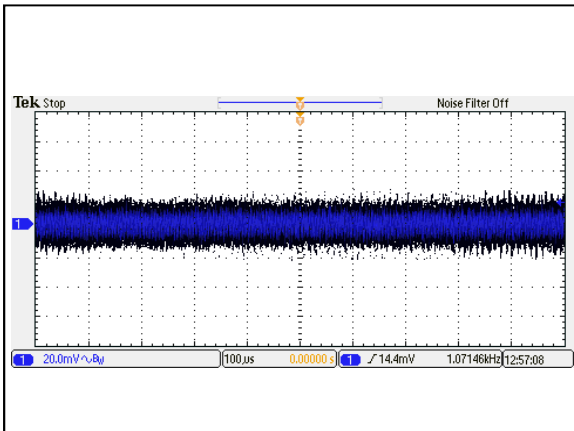


Figure 87: AEE01C48-M Ripple and Noise Measurement  
Vin = 48Vdc, Io = 1A, Ta = 25°C  
Ch 1: Vo

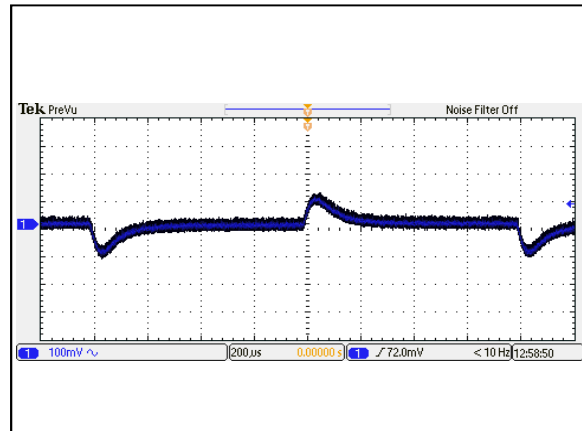


Figure 88: AEE01C48-M Transient Response  
Vin = 48Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

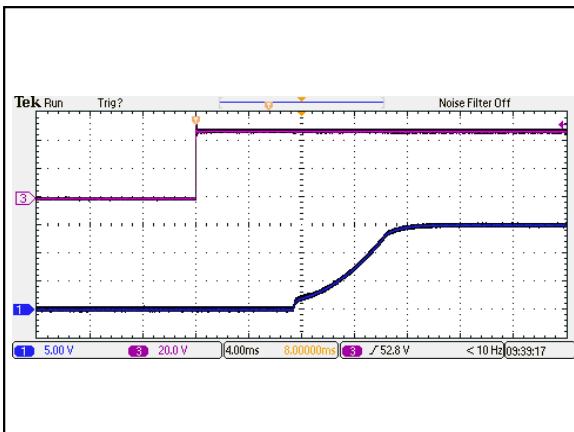


Figure 89: AEE01C48-M Output Voltage Startup Characteristic by Vin  
Vin = 48Vdc, Io = 1A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

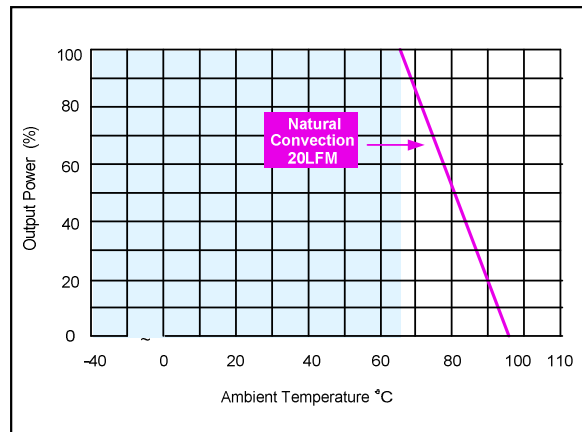


Figure 90: AEE01C48-M Derating Curve (without heatsink)  
Vin = 48Vdc, Io = 0 to 1A, Ta = 25°C

## AEE01H48-M Performance Curves

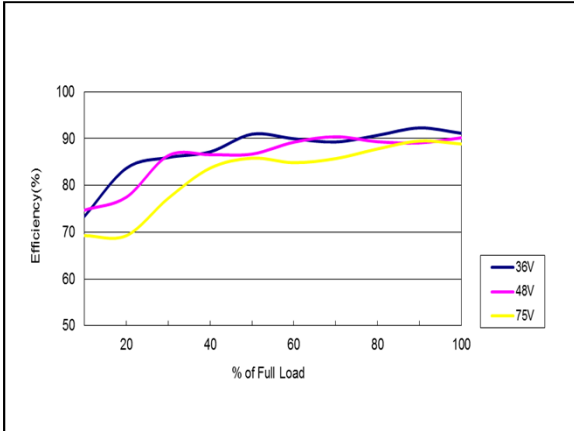


Figure 91: AEE01H48-M Efficiency Versus Output Current Curve  
Vin = 36 to 75Vdc, Io = 0 to 0.625A, Ta = 25°C

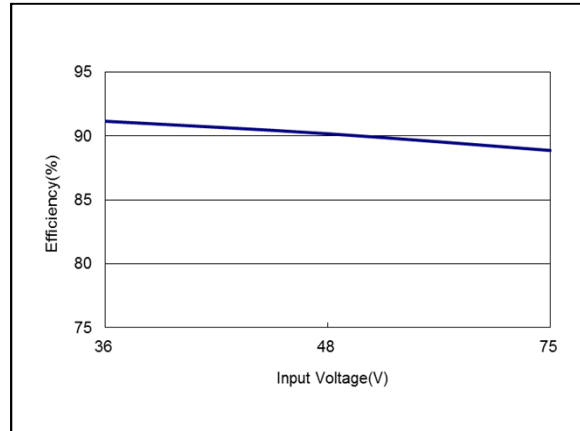


Figure 92: AEE01H48-M Efficiency Versus Input Voltage Curve  
Vin = 36 to 75Vdc, Io = 0.625A, Ta = 25°C

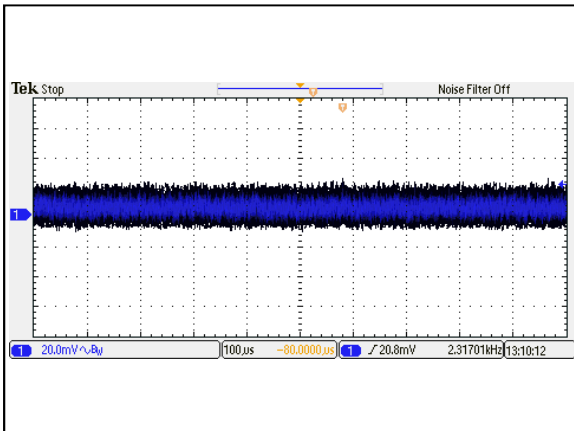


Figure 93: AEE01H48-M Ripple and Noise Measurement  
Vin = 48Vdc, Io = 0.625A, Ta = 25°C  
Ch 1: Vo

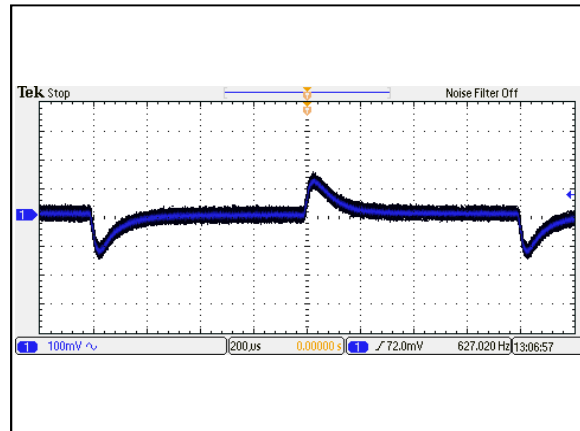


Figure 94: AEE01H48-M Transient Response  
Vin = 48Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo

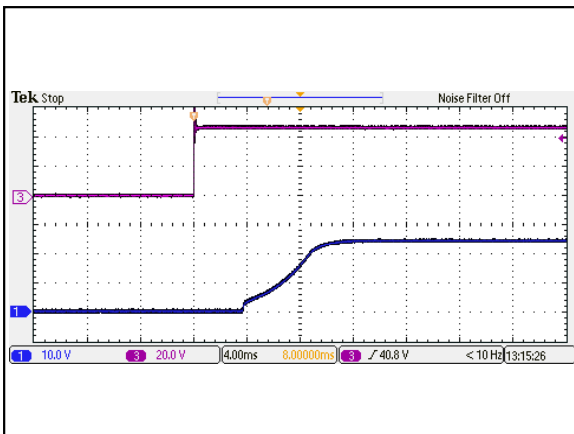


Figure 95: AEE01H48-M Output Voltage Startup Characteristic by Vin  
Vin = 48Vdc, Io = 0.625A, Ta = 25°C  
Ch 1: Vo  
Ch 3: Vin

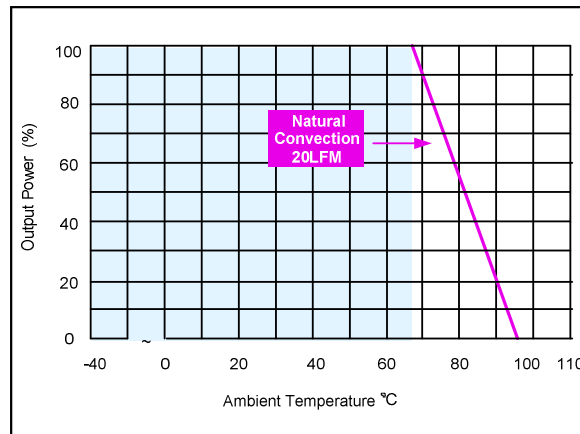


Figure 96: AEE01H48-M Derating Curve (without heatsink)  
Vin = 48Vdc, Io = 0 to 0.625A, Ta = 25°C

## AEE01BB48-M Performance Curves

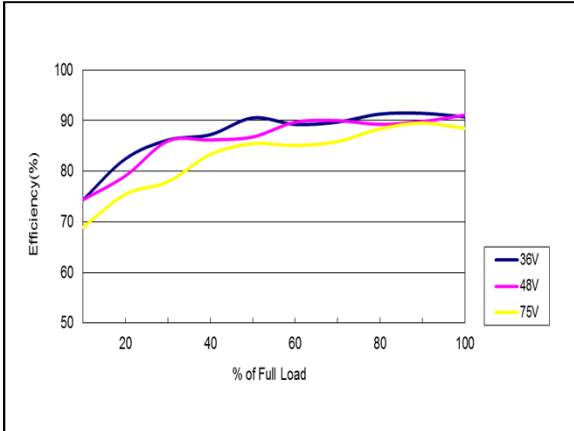


Figure 97: AEE01BB48-M Efficiency Versus Output Current Curve  
Vin = 36 to 75Vdc, Io = 0 to ±0.625A, Ta = 25°C

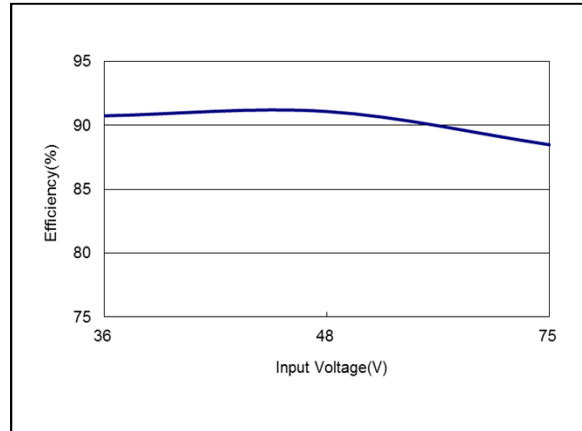


Figure 98: AEE01BB48-M Efficiency Versus Input Voltage Curve  
Vin = 36 to 75Vdc, Io = ±0.625A, Ta = 25°C

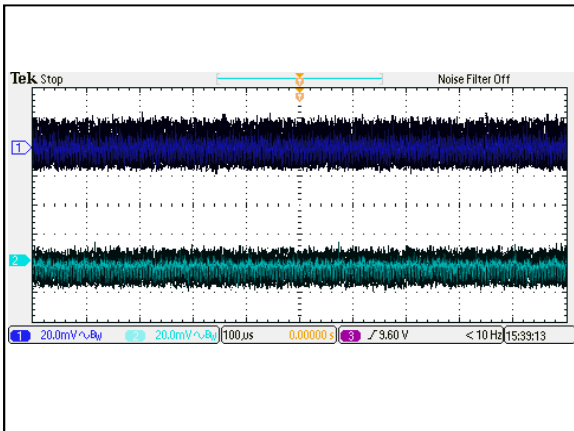


Figure 99: AEE01BB48-M Ripple and Noise Measurement  
Vin = 48Vdc, Io = ±0.625A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

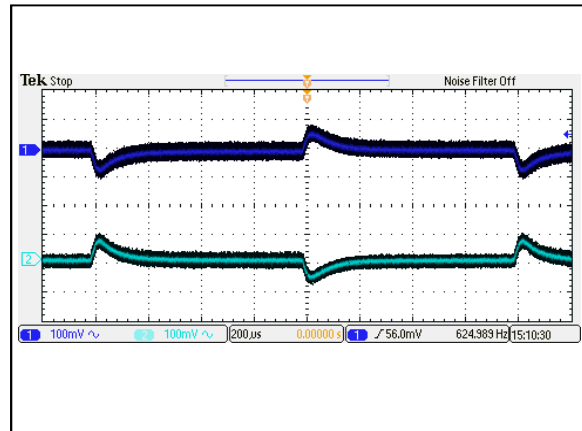


Figure 100: AEE01BB48-M Transient Response  
Vin = 48Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

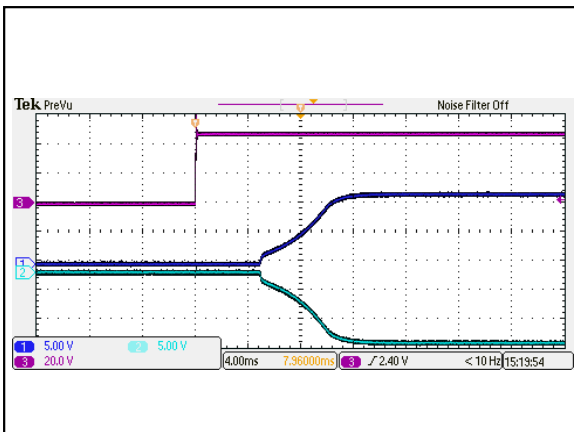


Figure 101: AEE01BB48-M Output Voltage Startup Characteristic by Vin  
Vin = 48Vdc, Io = ±0.625A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2 Ch 3: Vin

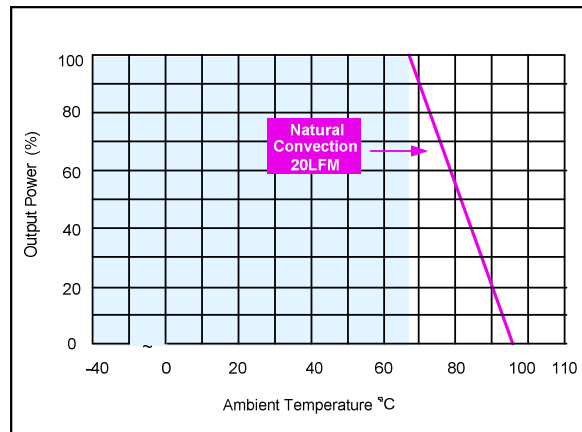


Figure 102: AEE01BB48-M Derating Curve (without heatsink)  
Vin = 48Vdc, Io = 0 to ±0.625A, Ta = 25°C

## AEE01CC48-M Performance Curves

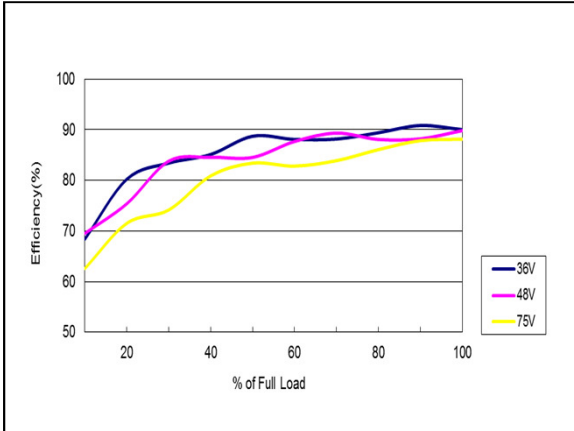


Figure 103: AEE01CC48-M Efficiency Versus Output Current Curve  
Vin = 36 to 75Vdc, Io = 0 to ±0.5A, Ta = 25°C

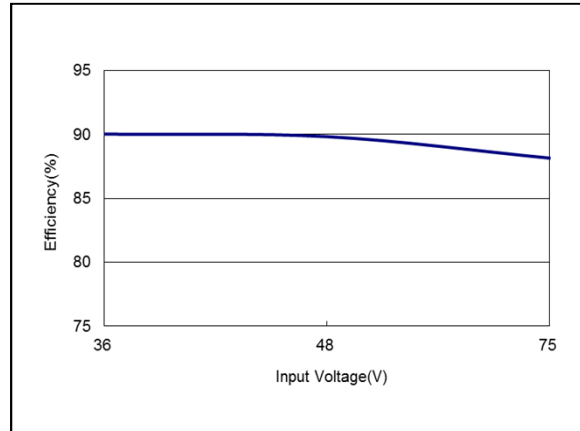


Figure 104: AEE01CC48-M Efficiency Versus Input Voltage Curve  
Vin = 36 to 75Vdc, Io = ±0.5A, Ta = 25°C

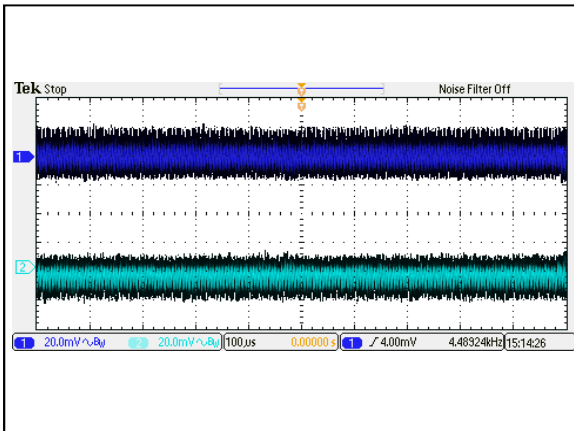


Figure 104: AEE01CC48-M Ripple and Noise Measurement  
Vin = 48Vdc, Io = ±0.5A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

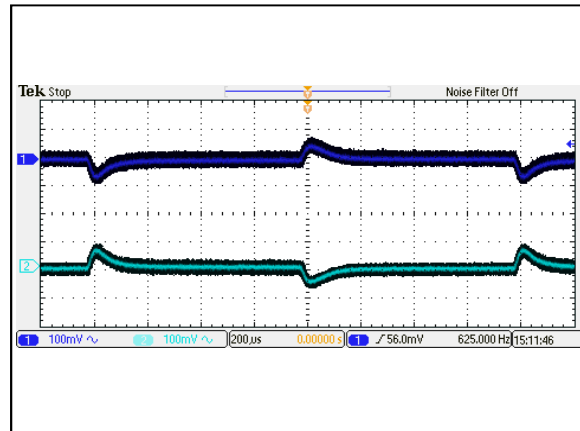


Figure 105: AEE01CC48-M Transient Responses  
Vin = 48Vdc, Io = 100% to 75% of full load change, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2

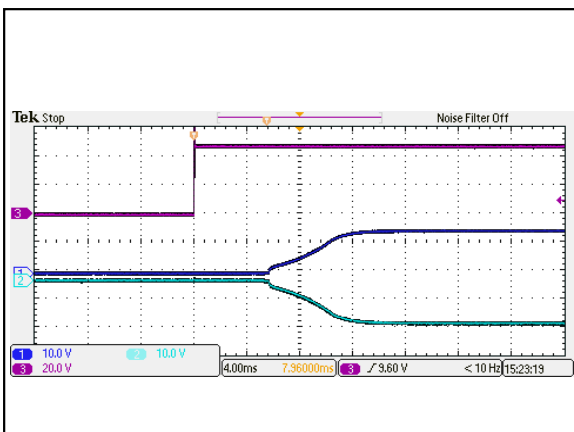


Figure 106: AEE01CC48-M Output Voltage Startup Characteristic by Vin  
Vin = 48Vdc, Io = ±0.5A, Ta = 25°C  
Ch 1: Vo1 Ch 2: Vo2 Ch 3: Vin

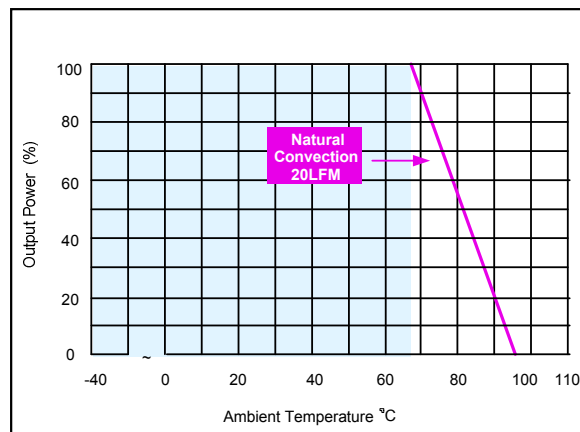
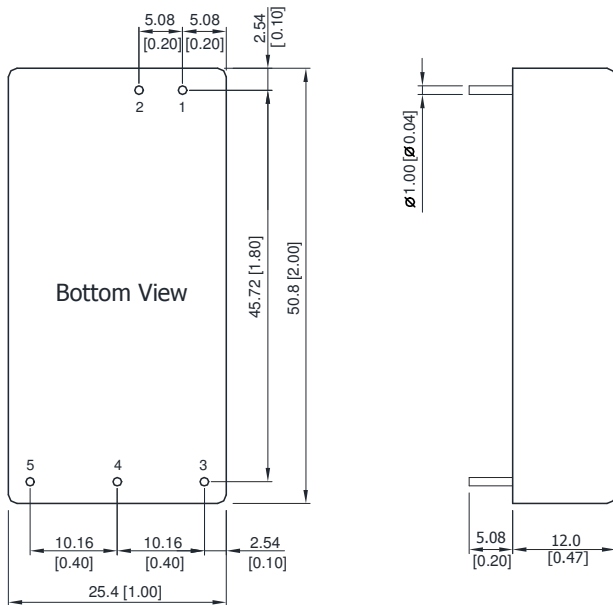


Figure 107: AEE01CC48-M Derating Curve (without heatsink)  
Vin = 48Vdc, Io = 0 to ±0.5A, Ta = 25°C

## Mechanical Specifications

### Mechanical Outlines



**Note:**

1. All dimensions in mm (inches)
2. Tolerance:  $X.X \pm 0.5$  ( $X.XX \pm 0.02$ )  
 $X.XX \pm 0.25$  ( $X.XXX \pm 0.01$ )
3. Pin diameter  $0.5 \pm 0.05$  ( $0.02 \pm 0.002$ )

### Pin Connections

#### Single output

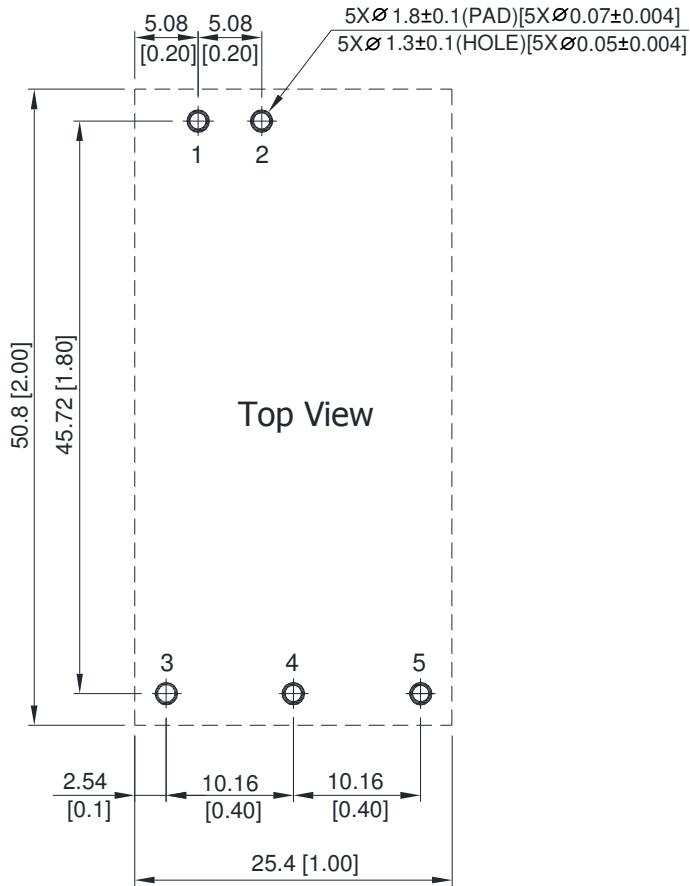
- Pin 1 – +Vin
- Pin 2 – -Vin
- Pin 3 – +Vout
- Pin 4 – No Pin
- Pin 5 – -Vout

#### 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)
ESD	Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Radiated immunity	Tinned Copper
Fast transient <sup>1</sup>	30g

**Recommended Pad Layout**



## Environmental Specifications

### EMC Immunity

AEE15W-M series power supply is designed to meet the following EMC immunity specifications.

Table 4. EMC Specifications:

Parameter	Standards & Level		Performance
EMI	Conduction	EN55022, EN55032, EN55022, FCC part15	Class A
EMS	EN60601-1-2, EN55024		
	ESD	EN61000-4-2 Air $\pm 8\text{kV}$ , Contact $\pm 6\text{kV}$	Perf. Criteria A
	Radiated immunity	EN61000-4-3 10V/m	
	Fast transient <sup>1</sup>	EN61000-4-4 $\pm 2\text{KV}$	Perf. Criteria A
	Surge <sup>1</sup>	EN61000-4-5 $\pm 1\text{KV}$	Perf. Criteria A
	Conducted immunity	EN61000-4-6 10Vrms	Perf. Criteria A
	PFMF	EN61000-4-8 3A/M	Perf. Criteria A

Note 1: To meet EN61000-4-4 & EN61000-4-5, an external capacitor across the input pins is required.



## Safety Certifications

The AEE15W-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 AEE15W-M series power supply system:

Document	Description
cUL/UL 60950-1, CSA C22.2 No. 60950-1	US and Canada Requirements
ANSI/AAMI ES60601-1, CAN/CSA-C22.2 No. 60601-1	International and Canada Medical Requirements
IEC/EN 60950-1, IEC/EN 62638-1, IEC/EN 60601-1 3 <sup>rd</sup> Edition 2 *MOPP	International and European Medical Requirements

## Operating Temperature

Table 6. Operating Temperature:

Parameter	Model / Condition	Min	Max	Unit
Operating Temperature Range (Natural Convection <sup>1</sup> , See Derating)	AEE01H24-M AEE01BB24-M	-40	+73	°C
	AEE01B12-M AEE01CC12-M AEE01B24-M AEE01CC24-M		+70	
	AEE01C12-M AEE01H12-M AEE01BB12-M AEE01C24-M AEE03A48-M AEE01B48-M AEE01H48-M AEE01BB48-M AEE01CC48-M		+67	
	AEE03A24-M AEE01C48-M		+65	
	AEE03A12-M		+59	
Operating Case Temperature	All	-	+95	°C
Thermal Impedance (Natural Convection <sup>1</sup> )		13	-	°C/W
Storage Temperature Range		-50	+125	°C
Humidity (non-condensing)		-	95	%
Altitude		-	4000	m
Cooling	Natural Convection <sup>1</sup>			
Lead Temperature (1.5mm from case for 10Sec.)		-	260	°C

Note1 - The "Natural Convection" is about 20LFM but is not equal to still air (0LFM).

## MTBF and Reliability

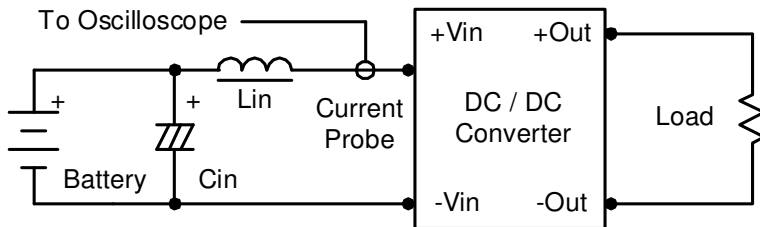
The MTBF of AEE15W-M series of DC/DC converters has been calculated using MIL-HDBK 217F NOTICE2, Operating Temperature 25°C, Ground Benign.

Model	MTBF	Unit
AEE03A12-M	1,428,181	Hours
AEE01B12-M	1,927,407	
AEE01C12-M	2,026,516	
AEE01H12-M	1,780,163	
AEE01BB12-M	1,780,163	
AEE01CC12-M	2,108,738	
AEE03A24-M	1,646,820	
AEE01B24-M	1,975,949	
AEE01C24-M	2,068,481	
AEE01H24-M	2,019,674	
AEE01BB24-M	2,019,674	
AEE01CC24-M	2,134,001	
AEE03A48-M	1,749,638	
AEE01B48-M	1,866,230	
AEE01C48-M	1,953,706	
AEE01H48-M	1,809,937	
AEE01BB48-M	1,809,937	
AEE01CC48-M	2,031,988	

## Application Notes

### Input Reflected-Ripple Current Test Setup

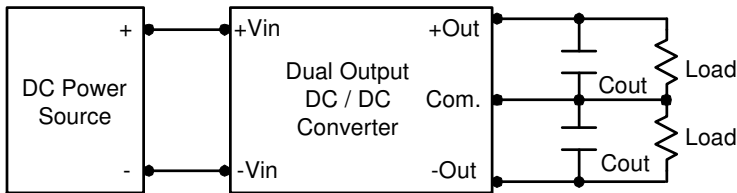
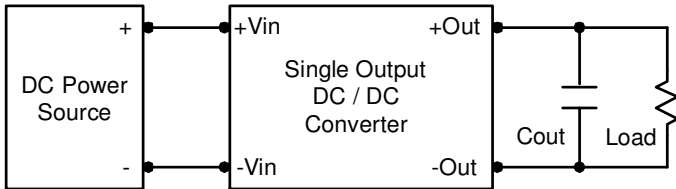
Input reflected-ripple current is measured with an inductor  $L_{in}$  ( $4.7\mu H$ ) and  $C_{in}$  ( $220\mu F$ ,  $ESR < 1.0\Omega$  at  $100KHz$ ) to simulate source impedance. Capacitor  $C_{in}$ , offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is  $0-500KHz$ .



Component	Value	Reference
Lin	$4.7\mu H$	-
Cin	$220\mu F$ ( $ESR < 1.0\Omega$ at $100KHz$ )	Aluminum Electrolytic Capacitor

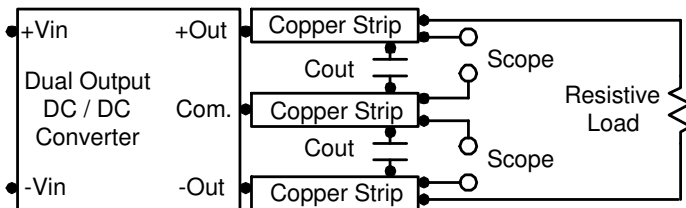
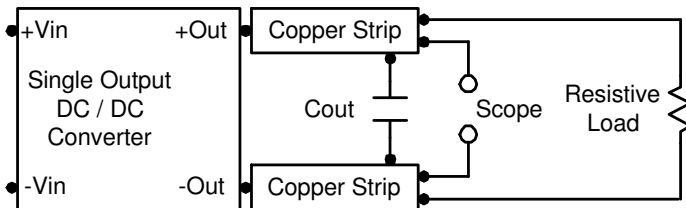
## Output Ripple Reduction

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 4.7uF capacitors at the output.



## Peak-to-Peak Output Noise Measurement Test

Use a 4.7uF ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20MHz. Position the load between 50mm and 75mm from the DC/DC Converter

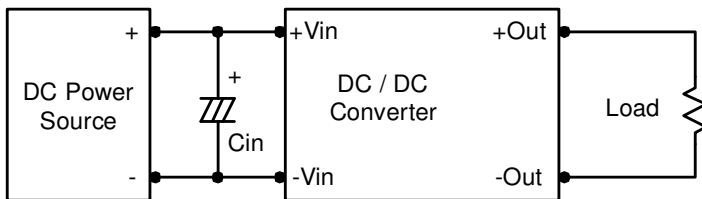


## Input Source Impedance

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 good quality low Equivalent Series Resistance ( $ESR < 1.0\Omega$  at 100KHz) capacitor of a 10uF for the 12V input modules and a 4.7uF for the 24V input modules and a 2.2uF for the 48V input modules.



## 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.

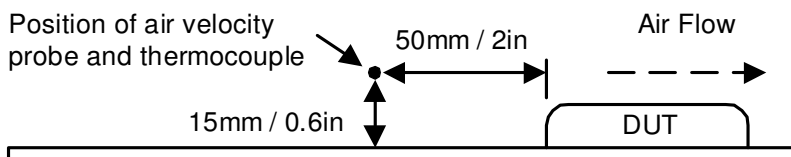
## Output Over Voltage Protection

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 Table 3.

## Thermal Considerations

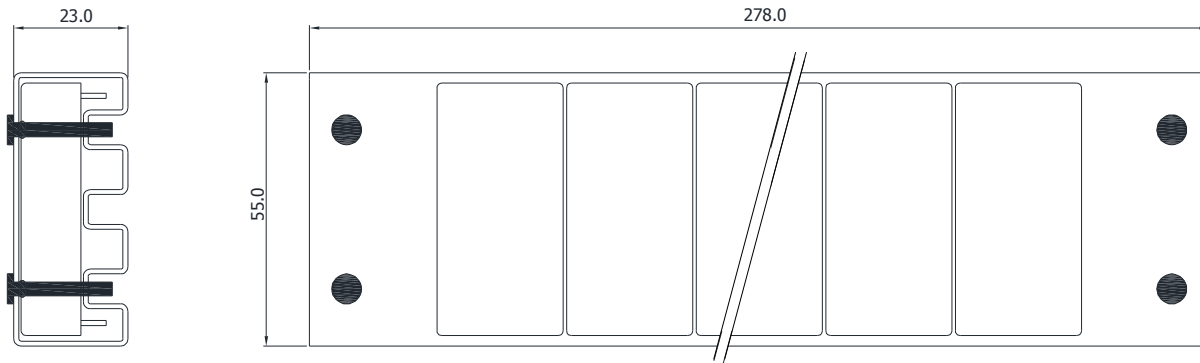
Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 95°C. The derating curves are determined from measurements obtained in a test setup.



## Maximum Capacitive Load

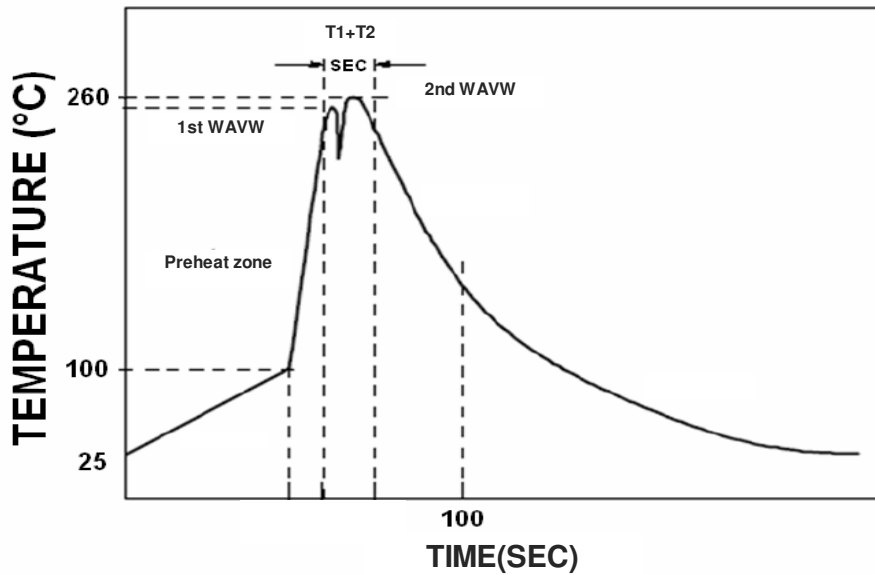
The AEE15W-M series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the Table 3.

## Packaging Information



## Soldering and Reflow Considerations

Lead free wave solder profile for AEE15W-M Series



Zone	Reference Parameter
Preheat zone	Rise temp speed : 3°C/Sec max.
	Preheat temp : 100~130°C
Actual heating	Peak temp: 250~260°C Peak Time
	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 °C



## Record of Revision and Changes

Issue	Date	Description	Originators
1.0	01.11.2017	First Issue	X. Sun

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