

## DC-DC CONVERTER AER50

RAILWAY CONVERTER.

### FOR PCB MOUNTING



### HIGHLIGHTS

- + Output Power up to 50 Watts
- + Efficiency up to 92 %
- + Wide Input Range
- + Wide Temperature Range
- + RoHS compliance
- + According to EN50155

### INPUT

Input Voltage Nominal 72/110 VDC

### OUTPUT

Output Voltage 5, 12, 15, 24 V

Initial Set Accuracy < 1 %\*

Minimum Load No minimum load

Short Circuit Continuous short circuit proof

Line Regulation  $\pm 0,2 \%$

Load Regulation  $\pm 0,3 \%$  (0 % - 100 % load)

Ripple & Noise < 1 % pk-pk, 20 MHz bandwidth

Start Time 35 ms

Max. Output Capacitance See table page 2

Temperature Coefficient  $\pm 0.02 \%/^{\circ}\text{C}$

### FEATURES

Remote On/Off See page 6

Trim  $\pm 10 \%$ , See page 5

### PROTECTION

Over Temperature Protection (OTP) +110°C (baseplate)

Over Voltage Protection (OVP) 120-125%  $V_{out\ nom}$

Over Current Protection (OCP) See table page 2

### GENERAL

Product Standard EN 50155

Isolation Input to Output 4200 VDC, Reinforced  
Input or Output to case 1500 VDC

Isolation Resistance > 1000 M $\Omega$  (@ 500 VDC)

Isolation Capacitance max. 3 nF (100 kHz, 1 V)

Switching Frequency Typ. 320 kHz

Lead Temperature 260°C (1,5 mm from case for 10 sec.)

Dimensions [mm] 57,9 x 36,8 x 12,7

Weight 61 g

MTBF 314.900h acc. to MIL-HDBK-217F (GB,25°)

Fire & Smoke EN 45545-2

### ENVIRONMENTAL

Operating Ambient Temp. -40°C to +85°C

Operating Base-Plate Temp. -40°C to +105°C

Storage Temperature -50°C to +125°C

Vibration / Shock / Bump EN 61373, Cat. 1B

### EMC & SAFETY

EMC Standard EN 50121-3-2

Conducted Emissions EN 55032, FCC part 15, Class A\*\*

Radiated Emissions EN 55011, FCC part 15, Class A\*\*

ESD Immunity EN 61000-4-2 Air  $\pm 8$  kV, Contact  $\pm 6$  kV, Criteria A

Burst EN 61000-4-4  $\pm 2$  kV, Criteria A\*\*\*

Surge EN 61000-4-5  $\pm 2$  kV, Criteria A\*\*\*

Conducted Immunity EN 61000-4-6 10 Vrms, Criteria A

Radiated Immunity EN 61000-4-3 20 V/m, Criteria A

Safety UL/cUL 60950-1, IEC/EN 60950-1, IEC 60571

\* For  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{in\ nom}$ ,  $I_{out\ nom}$

\*\* In built-in condition our devices may show different EMC properties

\*\*\* See note 6 page 4

# TECHNICAL DATA

For  $T_{amb}=25^{\circ}\text{C}$ ,  $V_{in\ nom}$ ,  $I_{out\ nom}$ , unless otherwise specified.

## SPECIFICATION Input 43 - 101 VDC (72 Vin nom) ; K = with Heatsink

	TYPE	Unit	AER50-72S05 AER50-72S05/K			AER50-72S12 AER50-72S12/K			AER50-72S15 AER50-72S15/K			AER50-72S24 AER50-72S24/K		
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max
	ORDER NUMBER		11 75 11 5611 5 11 75 11 5614 8			11 75 11 5621 8 11 75 11 5624 2			11 75 11 5631 2 11 75 11 5634 5			11 75 11 5641 5 11 75 11 5644 8		
INPUT	CHARACTERISTIC	Unit												
	Input Voltage Operating	V	43...101											
	Input Voltage Range	V	43...165 (t ≤ 100 ms)											
	Under Voltage Turn-on (typical)	V	43											
	Under Voltage Turn-off (typical)	V	40											
	Input Current @ Full Load	mA		771			775			754			762	
	Input Current @ No Load	mA		50			45			45			50	
	Standby Input Current (typical)	mA	2,5											
Reflected Ripple Current (typical)	mA	35												
OUTPUT	Output Voltage	V	5			12			15			24		
	Output Current (typical)	A	10			4,17			3,33			2,08		
	Output Power	W	50											
	Max. Capacitive Load	μF			17000			2950			1900			740
	Efficiency @ Full Load	%		90			92			92			91	
	Short Circuit Current (typical)		hiccup mode 150 %, pulse approx 0,5 Hz, automatic recovery											
	Transient Response 75 % /100 % Load Step, Recovery Time < 250 μs	%	±5											

## SPECIFICATION Input 66 - 160 VDC (110 Vin nom) ; K = with Heatsink

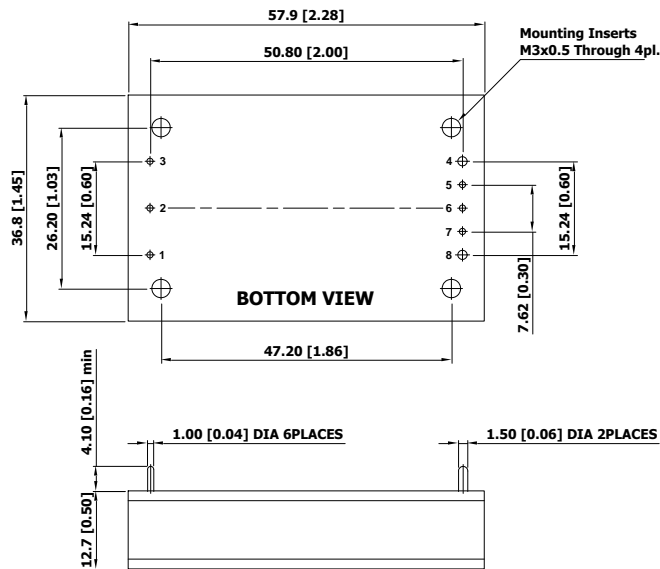
	TYPE	Unit	AER50-110S05 AER50-110S05/K			AER50-110S12 AER50-110S12/K			AER50-110S15 AER50-110S15/K			AER50-110S24 AER50-110S24/K		
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max
	ORDER NUMBER		11 75 11 5711 7 11 75 11 5714 1			11 75 11 5721 1 11 75 11 5724 4			11 75 11 5731 4 11 75 11 5734 7			11 75 11 5741 7 11 75 11 5744 1		
INPUT	CHARACTERISTIC	Unit												
	Input Voltage Operating	V	66...160											
	Input Voltage Range	V	66...250 (t ≤ 100 ms)											
	Under Voltage Turn-on (typical)	V	66											
	Under Voltage Turn-off (typical)	V	63											
	Input Current @ Full Load	mA		505			500			494			499	
	Input Current @ No Load	mA		40			35			35			40	
	Standby Input Current (typical)	mA	2,5											
Reflected Ripple Current (typical)	mA	35												
OUTPUT	Output Voltage	V	5			12			15			24		
	Output Current (typical)	A	10			4,17			3,33			2,08		
	Output Power	W	50											
	Max. Capacitive Load	μF			17000			2950			1900			740
	Efficiency @ Full Load	%		90			91			92			91	
	Short Circuit Current (typical)		hiccup mode 150 %, pulse approx 0,5 Hz, automatic recovery											
	Transient Response 75 % /100 % Load Step, Recovery Time < 250 μs	%	±5											

# TECHNICAL DATA

For  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{in nom}$ ,  $I_{out nom}$  unless otherwise specified.

## MECHANICAL DETAILS

1. Dimensions are 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  $\varnothing 1.0 \pm 0.05$  ( $0.04 \pm 0.002$ )
4. Pin diameter  $\varnothing 1.5 \pm 0.05$  ( $0.06 \pm 0.002$ )



Case Material: Aluminum Frame with Black Anodized Coating  
 Top Side Base Material: Aluminum Plate  
 Bottom Side Base Material: Non-conductive Black Plastic Base Plate  
 Potting Material: Epoxy (UL94-V0)

## PINNING

Pin	Function
1	+V <sub>in</sub>
2	Remote On/Off
3	-V <sub>in</sub>
4	-V <sub>out</sub>
5	-Sense*
6	Trim
7	+Sense*
8	+V <sub>out</sub>

\* If remote sense not used the +sense should be connected to +output and -sense should be connected to -output  
 Maximum output deviation is 10 % inclusive of trim

# TECHNICAL DATA

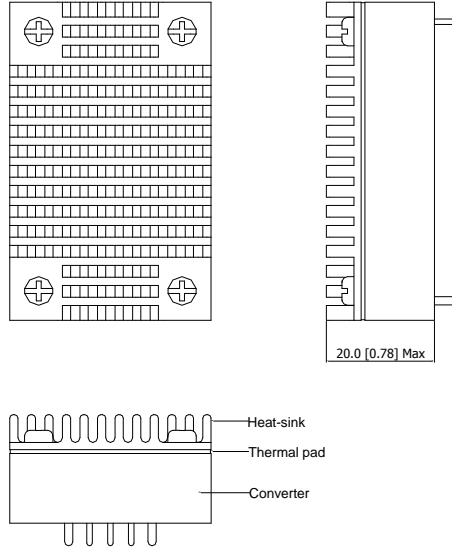
For  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{in\ nom}$ ,  $I_{out\ nom}$  unless otherwise specified.

## MECHANICAL DETAILS

### Heatsink (Option -HS)

The advantages of adding a heatsink are:

1. To improve heat dissipation and increase the stability and reliability of the DC/DC converters at high operating temperatures.
2. To increase operating temperature of the DC/DC converter, please refer to Derating Curve.

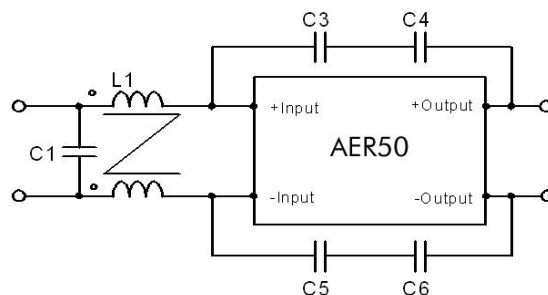


Heatsink Material: Aluminium  
Finish: Black Anodized Coating  
Weight: 13 g

## NOTES

1. Specifications typical at  $T_a = +25^{\circ}\text{C}$ , resistive load, nominal input voltage and rated output current unless otherwise noted.
2. Transient recovery time is measured to within 1% error band for a step change in output load of 75 % to 100 %.
3. Ripple & Noise measurement with a 1  $\mu\text{F}$  MLCC and a 10  $\mu\text{F}$  Tantalum Capacitor.
4. Other input and output voltage may be available, please contact factory.
5. Part number for heat sink only MT-HS1.
6. To meet EN 61000-4-4 & EN 61000-4-5 by adding a capacitor across the input pins. Suggested capacitor: 470  $\mu\text{F}/200\text{ V}$ .
7. It is **necessary to parallel a capacitor across the input pins under normal operation. Minimum Capacitance: 68  $\mu\text{F}/200\text{ V}$ .**
8. That "natural convection" is about 20 LFM but is not equal to still air (0 LFM).
9. Specifications are subject to change without notice.

## EXTERNAL FILTER MEETS CONDUCTED AND RADIATED EMI EN 55011 & EN 55032



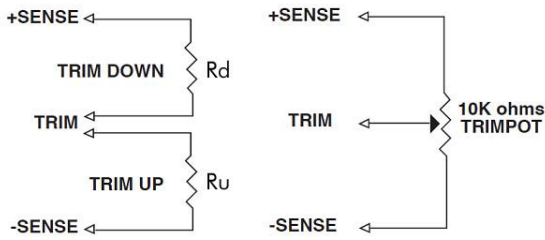
Model	L1	C1	C3	C4	C5	C6
AER50-72SXX	450 $\mu\text{H}/450\ \mu\text{H}$	CHEMI-CON KXG Series	2200 pF/3 kV	2200 pF/3 kV	2200 pF/3 kV	2200 pF/3 kV
AER50-110SXX		68 $\mu\text{F}/200\text{ V}$				

# TECHNICAL DATA

For  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{in\ nom}$ ,  $I_{out\ nom}$  unless otherwise specified.

## EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below



AER50-XXS05 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox0.99}$	$V_{ox0.98}$	$V_{ox0.97}$	$V_{ox0.96}$	$V_{ox0.95}$	$V_{ox0.94}$	$V_{ox0.93}$	$V_{ox0.92}$	$V_{ox0.91}$	$V_{ox0.90}$	Volts
$R_d =$	138.88	62.41	36.92	24.18	16.53	11.44	7.79	5.06	2.94	1.24	kOhms

Trim up	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox1.01}$	$V_{ox1.02}$	$V_{ox1.03}$	$V_{ox1.04}$	$V_{ox1.05}$	$V_{ox1.06}$	$V_{ox1.07}$	$V_{ox1.08}$	$V_{ox1.09}$	$V_{ox1.10}$	Volts
$R_u =$	106.87	47.76	28.06	18.21	12.30	8.36	5.55	3.44	1.79	0.48	kOhms

AER50-XXS12 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox0.99}$	$V_{ox0.98}$	$V_{ox0.97}$	$V_{ox0.96}$	$V_{ox0.95}$	$V_{ox0.94}$	$V_{ox0.93}$	$V_{ox0.92}$	$V_{ox0.91}$	$V_{ox0.90}$	Volts
$R_d =$	413.55	184.55	108.22	70.05	47.15	31.88	20.98	12.80	6.44	1.35	kOhms

Trim up	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox1.01}$	$V_{ox1.02}$	$V_{ox1.03}$	$V_{ox1.04}$	$V_{ox1.05}$	$V_{ox1.06}$	$V_{ox1.07}$	$V_{ox1.08}$	$V_{ox1.09}$	$V_{ox1.10}$	Volts
$R_u =$	351.00	157.50	93.00	60.75	41.40	28.50	19.29	12.37	7.00	2.70	kOhms

AER50-XXS15 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox0.99}$	$V_{ox0.98}$	$V_{ox0.97}$	$V_{ox0.96}$	$V_{ox0.95}$	$V_{ox0.94}$	$V_{ox0.93}$	$V_{ox0.92}$	$V_{ox0.91}$	$V_{ox0.90}$	Volts
$R_d =$	530.73	238.61	141.24	92.56	63.35	43.87	29.96	19.53	11.41	4.92	kOhms

Trim up	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox1.01}$	$V_{ox1.02}$	$V_{ox1.03}$	$V_{ox1.04}$	$V_{ox1.05}$	$V_{ox1.06}$	$V_{ox1.07}$	$V_{ox1.08}$	$V_{ox1.09}$	$V_{ox1.10}$	Volts
$R_u =$	422.77	189.89	112.26	73.44	50.15	34.63	23.54	15.22	8.75	3.58	kOhms

AER50-XXS024 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox0.99}$	$V_{ox0.98}$	$V_{ox0.97}$	$V_{ox0.96}$	$V_{ox0.95}$	$V_{ox0.94}$	$V_{ox0.93}$	$V_{ox0.92}$	$V_{ox0.91}$	$V_{ox0.90}$	Volts
$R_d =$	598.66	267.78	157.49	102.34	69.25	47.19	31.44	19.62	10.43	3.08	kOhms

Trim up	1	2	3	4	5	6	7	8	9	10	%
$V_{out} =$	$V_{ox1.01}$	$V_{ox1.02}$	$V_{ox1.03}$	$V_{ox1.04}$	$V_{ox1.05}$	$V_{ox1.06}$	$V_{ox1.07}$	$V_{ox1.08}$	$V_{ox1.09}$	$V_{ox1.10}$	Volts
$R_u =$	487.14	218.02	128.31	83.46	56.55	38.61	25.79	16.18	8.70	2.72	kOhms

# TECHNICAL DATA

For  $T_{amb} = 25^{\circ}C$ ,  $V_{in nom}$ ,  $I_{out nom}$  unless otherwise specified.

## REMOTE ON/OFF

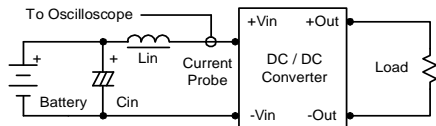
Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0 V to 1,2 V. A logic high is 3,5 V to 12 V. The maximum sink current at the on/off terminal (Pin 2) during a logic low is -500  $\mu A$ . When not in use, leave Remote pin not-connected.

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On		3,5 V ~ 12 V or Open Circuit			
Converter Off		0 V ~ 1,2 V or Short Circuit			
Control Input Current (on)	$V_{ctrl} = 5,0 V$	---	0,5	---	mA
Control Input Current (off)	$V_{ctrl} = 0 V$	---	-0,5	---	mA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	---	2,5	---	mA

## TEST SETUP

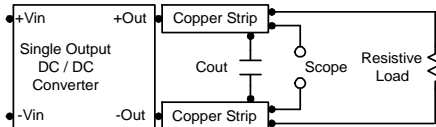
### Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor  $L_{in}$  (4,7  $\mu H$ ) and  $C_{in}$  (220  $\mu F$ , ESR < 1  $\Omega$  at 100 kHz) 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 0-500 kHz.



### Peak-to-Peak Output Noise Measurement Test

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



## TECHNICAL NOTES

### Overload Protection

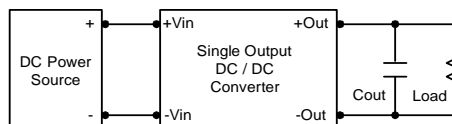
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

### Overvoltage 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.

### Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4,7  $\mu F$  capacitors at the output.



### Maximum Capacitive Load

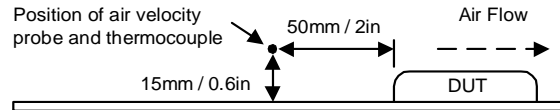
The AER50 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the output data.

# TECHNICAL DATA

For  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{in\ nom}$ ,  $I_{out\ nom}$  unless otherwise specified.

## Thermal Considerations

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

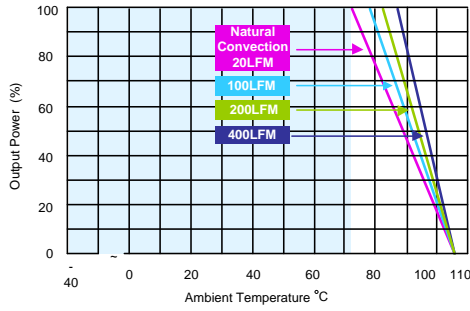


Parameter	Conditions / Model	Min.	Max.		Unit
			without Heatsink	with Heatsink	
Operating Ambient Temperature Range Natural Convection (see note 9 page 4) Nominal $V_{in}$ , Load 100 % $I_{nom}$ . (for Power Derating see relative Derating Curves)	AER50-72S12	-40	72	75	°C
	AER50-72S15, AER50-110S15				
	AER50-72S24				
	AER50-110S12, AER50-110S24				
	AER50-72S05, AER50-110S05		63	67	
Thermal Impedance	Natural Convection without Heatsink	7,5	---		°C/W
	Natural Convection with Heatsink	6,8	---		
	100 LFM Convection without Heatsink	6,1	---		
	100 LFM Convection with Heatsink	4,1	---		
	200 LFM Convection without Heatsink	5,3	---		
	200 LFM Convection with Heatsink	3,3	---		
	400 LFM Convection without Heatsink	3,9	---		
	400 LFM Convection with Heatsink	2,2	---		

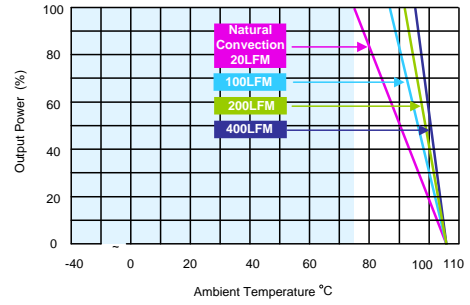
# TECHNICAL DATA

For  $T_{amb} = 25^{\circ}\text{C}$ ,  $V_{in\ nom}$ ,  $I_{out\ nom}$  unless otherwise specified.

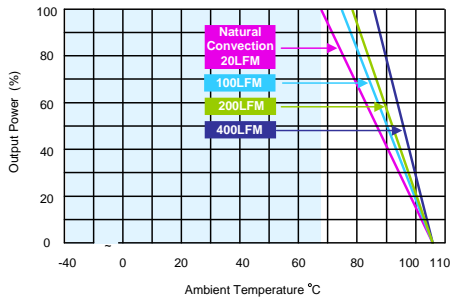
## POWER DERATING CURVE



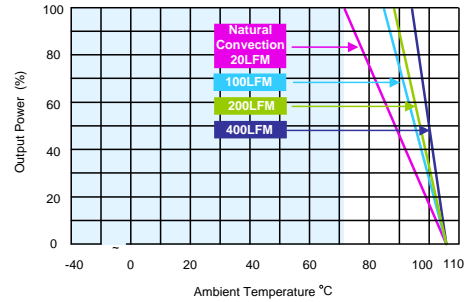
AER50-72S12, AER50-72S15, AER50-110S15  
Derating Curve without Heatsink



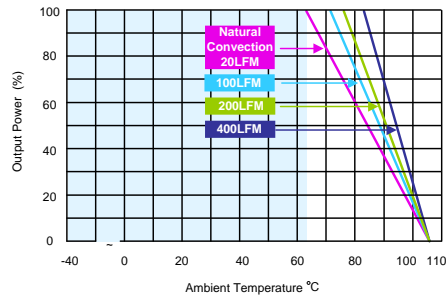
AER50-72S12, AER50-72S15, AER50-110S15  
Derating Curve with Heatsink



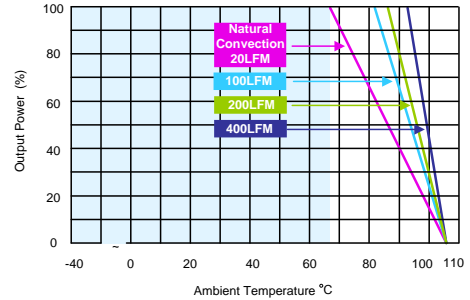
AER50-72S24, AER50-110S12, AER50-110S24  
Derating Curve without Heatsink



AER50-72S24, AER50-110S12, AER50-110S24  
Derating Curve with Heatsink



AER50-72S05, AER50-110S05  
Derating Curve without Heatsink



AER50-72S05, AER50-110S05  
Derating Curve with Heatsink