Technical Reference Note
AET (30W) Family

AET (30W) Isolated DC/DC Converter Module
Industry Standard Size, 2" ×1.6" ×0.48"
9-36V/18-75V Inputs, 2.5V/3.3V/5V/12V/±12V/15V/±15V Outputs

The AET (30W) Isolated DC/DC Converter is 4:1 wide input voltage family for low power applications. With efficiency up to 84% typical for 5V module, this product is allowed to work at operating temperature range from -40ºC to 71ºC and a wide input voltage range of 4:1. Single-output and dual-output models are available for a wide range of applications in telecommunication, transportation equipment, etc.. Housed in small package, 2" × 1.6" × 0.48", with industry standard pinout, AET family eases the PCB designs and mechanical designs of customers' end products.

Industry Standard Size
2" × 1.6" × 0.48"

Special Features

- **Wide 4:1 input range**
- **High efficiency, 84%@5V**
- **-40°C to 90°C case surface operating temperature**
- **Input / Output isolation 1.5KVdc**
- **Low output ripple and noise**
- **Shielded metal case with size (2"x1.6"x0.48")**
- **Industrial standard pinout**
- **Lead-free soldering pins**
- **Fixed switching frequency (300KHz)**
- **Positive enable function**
- **Adjustable Output Voltage**
- **Built-in input filter meets EN55022 / FCC Class A without external components**

Environmental Specifications

- **Operating temperature: -40°C to +71°C**
- **Storage temperature: -55°C to +105°C**
- **RoHS compliant**

Electrical Parameters

Input

Input range	**9-36 VDC; 18-75 VDC**
Input Surge	**50V / 100ms; 100V / 100ms**
Efficiency	**84% @5V (Typical)**

Output

Regulation (Line, Load, Temp)	**<1.5%**
Ripple and noise	**100mV p-p max**
Output Voltage Adjust Range	**± 10% of nominal output**
Transient Response	**5% max deviation with 50% load to full load 300uS (max) recovery**
Short Circuit Protection	**Indefinite**
Over Voltage Protection	**120-140% nominal output**
Over Temperature Protection	**100 to 120°C case surface**

Safety

Designed to meet EN60950

AET (30W) SERIES

THIS SPECIFICATION COVERS THE REQUIREMENTS
FOR AN INDUSTRY STANDARD PACKAGE OF 2"x1.6"x0.48", 4:1 INPUT RANGE,
30W, SINGLE OUTPUT AND DUAL OUTPUT ISOLATED DC/DC CONVERTER

PART NUMBERS

MODEL NAME / SIS CODE	Nominal Vin ($V_{I, nom}$) / Range of Vin	Vout / Iout
AET08G18-L	**24V / 9-36V**	**2.5V / 8A**
AET07F18-L	**24V / 9-36V**	**3.3V / 7A**
AET06A18-L	**24V / 9-36V**	**5V / 6A**
AET02B18-L	**24V / 9-36V**	**12V / 2.5A**
AET01BB18-L	**24V / 9-36V**	**±12V / ±1.25A**
AET02C18-L	**24V / 9-36V**	**15V / 2A**
AET01CC18-L	**24V / 9-36V**	**±15V / ±1A**
AET08G36-L	**48V / 18-75V**	**2.5V / 8A**
AET07F36-L	**48V / 18-75V**	**3.3V / 7A**
AET06A36-L	**48V / 18-75V**	**5V / 6A**
AET02B36-L	**48V / 18-75V**	**12V / 2.5A**
AET01BB36-L	**48V / 18-75V**	**±12V / ±1.25A**
AET02C36-L	**48V / 18-75V**	**15V / 2A**
AET01CC36-L	**48V / 18-75V**	**±15V / ±1A**

ELECTRICAL SPECIFICATIONS

STANDARD TEST CONDITION on a single unit, unless otherwise specified.

T_A :	25°C (Ambient Air)
+Vin :	24V ±2% (AETxxxx18-L)
	48V ±2% (AETxxxx36-L)
–Vin :	Return pin for +Vin
Enable:	Open (Positive Enable)
+Vout :	Connect to load
–Vout :	Connect to load (return)
Trim (Vadj) :	Open

ABSOLUTE MAXIMUM RATINGS

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the IPS. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Device	Symbol	Min	Typ	Max	Unit
a) Input Voltage:						
Continuous:	AETxxxx18-L	V_I	0	-	36	V_{dc}
Transient (100ms)	AETxxxx18-L	$V_{I, trans}$	0	-	50	V_{dc}
Continuous:	AETxxxx36-L	V_I	0	-	75	V_{dc}
Transient (100ms)	AETxxxx36-L	$V_{I, trans}$	0	-	100	V_{dc}
b) Operating Temperature						
Ambient	All	T_A	-40	-	71	ºC
Case Surface		T_C	-40	-	100	ºC
c) Storage Temperature	All	T_{STG}	-55	-	105	ºC
d) Operating Humidity	All	-	-	-	95	%
e) I/O Isolation (Conditions : 0.5mA for 60 sec)						
Input-Output	All	-	-	-	1500	V_{dc}
f) Output Power	2.5V	$P_{o, max}$	-	-	20	W
	3.3V	$P_{o, max}$	-	-	23.1	W
	Others	$P_{o, max}$	-	-	30	W

INPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
a) Operating Input Voltage	AETxxxx18-L	V_I	9	24	36	V_{dc}
	AETxxxx36-L	V_I	18	48	75	V_{dc}
b) Maximum Input Current						
AETxxxx18-L	2.5V	$I_{I, max}$	-	-	3.5	A
(V_I = 0 to $V_{I, max}$; Io = $I_{o, max}$)	3.3V	$I_{I, max}$	-	-	4	A
	5V	$I_{I, max}$	-	-	5	A
	12V / ±12V	$I_{I, max}$	-	-	5	A
	15V / ±15V	$I_{I, max}$	-	-	5	A
AETxxxx36-L	2.5V	$I_{I, max}$	-	-	2	A
(V_I = 0 to $V_{I, max}$; Io = $I_{o, max}$)	3.3V	$I_{I, max}$	-	-	2.5	A
	5V	$I_{I, max}$	-	-	3	A
	12V / ±12V	$I_{I, max}$	-	-	3	A
	15V / ±15V	$I_{I, max}$	-	-	3	A
c) No Load Input Power (V_I = $V_{I, nom}$)	All	-	-	-	0.5	W
d) Recommended External Fuse Ratings						
AETxxxx18-L	2.5V		-	4	-	A
	3.3V		-	5	-	A
	5V		-	6	-	A
	12V / ±12V		-	6	-	A
	15V / ±15V		-	6	-	A
AETxxxx36-L	2.5V		-	3	-	A
	3.3V		-	3	-	A
	5V		-	4	-	A
	12V / ±12V		-	4	-	A
	15V / ±15V		-	4	-	A

CAUTION: This power module is not internally fused. An input fuse must always be used.

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
a) Output Voltage Setpoint ($V_I = V_{I, min}$ to $V_{I, max}$; Io = $I_{o, max}$; T_A = 25 ºC)	2.5V	$V_{o, set}$	2.46	2.50	2.54	V_{dc}
	3.3V	$V_{o, set}$	3.25	3.30	3.35	V_{dc}
	5V	$V_{o, set}$	4.92	5.00	5.08	V_{dc}
	12V	$V_{o, set}$	11.82	12.00	12.18	V_{dc}
	15V	$V_{o, set}$	14.77	15.00	15.23	V_{dc}
	±12V	$V_{o, set}$	±11.82	±12.00	±12.18	V_{dc}
	±15V	$V_{o, set}$	±14.77	±15.00	±15.23	V_{dc}
b) Output Regulation:						
Line ($V_I = V_{I, max}$ to $V_{I, min}$; Io = $I_{o, max}$)	All	-	-	-	0.5	%
Load ($V_I = V_{I, nom}$; Io = $I_{o, min}$ to $I_{o, max}$)	All	-	-	-	0.5	%
Cross ($V_I = V_{I, nom}$; Io = $+I_{o, max}$,$-I_{o, min}$ or $+I_{o, min}$,$-I_{o, max}$ to $+I_{o, max}$,$-I_{o, max}$)	±12V/±15V	-	-	-	4	%
Temperature (T_c = -40ºC to +100ºC)	All	-	-	-	1	%Vo
c) Output Ripple and Noise (Across 1µF @50V, X7R ceramic capacitor & 10µF @25V tantalum capacitor) See Figure 1. Peak-to-Peak (5 Hz to 20 MHz)	All	-	-	-	100	mVp-p
d) Rated Output Current						
Single Output	2.5V	Io	800	-	8000	mA
	3.3V	Io	700	-	7000	mA
	5V	Io	600	-	6000	mA
	12V	Io	250	-	2500	mA
	15V	Io	200	-	2000	mA
Dual Output	±12V	Io	±125	-	±1250	mA
	±15V	Io	±100	-	±1000	mA
				-		
e) Efficiency ($V_I = V_{I, nom}$; $I_{o, max}$; T_A = 25°C)	2.5V	-	-	79	-	%
	3.3V	-	-	82	-	%
	5V	-	-	84	-	%
	12V	-	-	85	-	%
	15V	-	-	85	-	%
	±12V	-	-	85	-	%
	±15V	-	-	85	-	%
f) Switching Frequency	All	-	270	300	330	KHz

OUTPUT SPECIFICATIONS (Cont.)

Parameter	Device	Symbol	Min	Typ	Max	Unit
g) Dynamic Response : ($\Delta Io/\Delta t = 0.08A/\mu s$; $V_I = V_{I, nom}$; $T_A = 25°C$)						
Load Change from Io = 50% to 100% of $I_{o, max}$	2.5V/3.3V/5V	-	-	-	5	%Vo
	12V/±12V/15V/±15V	-	-	-	2	%Vo
Peak Deviation Settling Time (to $V_{o, nom}$)	All	-	-	-	300	µsec
h) Turn-On Time ($Io = I_{o, max}$; Vo within 1%)	All	-	-	6	10	msec
i) Output Voltage Overshoot ($Io = I_{o, max}$; $T_A = 25°C$)	All	-	-	1	4	%Vo

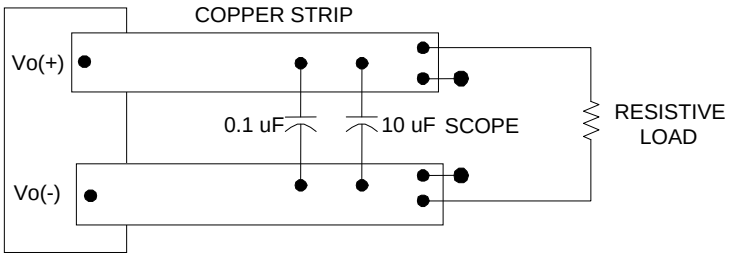
FEATURE SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Enable Pin Voltage						
Logic Low	All	OFF	-0.7	-	1.0	V
Logic High	All	ON	3.0	-	V_I	V
OPEN	All	ON	-	-	-	
Enable Pin Current						
Logic Low	All	OFF	-	-	2	mA
Logic High (leakage current, @ V_I)	All	ON	-	-	50	uA
OPEN	All	ON	-	-	0	uA
Output Voltage Adjustment Range	All	-	90	-	110	%Vo
Output Overvoltage Clamp	2.5V	$Vo, clamp$	3.0	-	3.5	V
	3.3V	$Vo, clamp$	4.0	-	4.6	V
	5V	$Vo, clamp$	6.0	-	7.0	V
	12V	$Vo, clamp$	14.4	-	16.8	V
	15V	$Vo, clamp$	18.0	-	20.0	V
	±12V	$Vo, clamp$	±14.4	-	±16.8	V
	±15V	$Vo, clamp$	±18.0	-	±20.0	V
Overtemperature Clamp	All	$T_{c, clamp}$	100	-	120	ºC

FEATURE SPECIFICATIONS (Cont.)

Undervoltage Lockout Turn-on Point	AETxxxx18-L	-	-	8.7	9	V
	AETxxxx36-L	-	-	16.5	18	V
Turn-off Point	AETxxxx18-L	-	6.5	8.5	-	V
	AETxxxx36-L	-	13	15	-	V
Isolation Capacitance	All	-	-	1000	-	PF
Isolation Resistance	All	-	10	-	-	MΩ
Calculated MTBF (Io = $I_{o,\,max}$; T_A = 25°C)	All	-	400K	500K	-	Hours
Weight	All	-	-	-	70	g

TEST SETUP



Note: Use a 0.1µF @50V X7R ceramic capacitor and a 10µF @25V tantalum capacitor. Scope measurement should be made using a BNC socket. Position the load between 51 mm and 76 mm (2 in. and 3 in.) from module.

Figure 1 : Peak-to-Peak Output Noise Measurement Test Setup

Basic Operation and Features

The AET converters were designed specifically to address applications where high power density is required.
These modules provide 1500Vdc isolation and operate from the input ranges of 9V-36V and 18V-75V with standard features such as Enable, Trim, OCP, OVP and OTP.

Output Overcurrent Protection

To provide protection in an output overload or short circuit condition, the converter is equipped with current limiting circuitry and can endure the fault condition for an unlimited duration. At the point of current-limit inception, the converter goes into "Hiccup Mode", causing the output current to be limited both in peak and duration. The converter will operate back normally once the output current is brought back into its specified range.

Output Overvoltage Protection

The output overvoltage system consists of a separate control loop, independent of the primary control loop. This control loop has a higher voltage set point than the primary loop. In a fault condition of output overvoltage, the converter latches and clamps the output to a lower voltage level to ensure that the output voltage does not exceed $V_{o,\,clamp,\,max.}$ The converter will operate back normally once the fault is removed and the input voltage is cycled or the enable pin is toggled.

Overtemperature Protection

In a fault condition of overtemperature, the converter goes into "Hiccup Mode" to reduce heat generated internally and ensure that the case temperature does not exceed $T_{c,\,clamp,\,max.}$ The converter will operate back normally once the case temperature is brought back below $T_{c,\,clamp,\,min.}$

Enable Function

Positive Logic Enable turns the converter on during a logic-high voltage or an open circuit on the enable pin, and off during a logic-low.

Trim Function

Output Voltage adjustment is accomplished by connecting an external resistor between the Trim Pin and either the +Vout or –Vout Pins.

To adjust Vo to a higher value, please refer to Figure 2. An external resistor, Radj_up, should be connected between the Trim Pin and the –Vout Pin. From equation (1), Radj_up resistor can be determined for the required output voltage.

Equation (1)

For Vo=2.5V modules, $Vo = \frac{3800}{15200+Radj\_up} + 2.5$

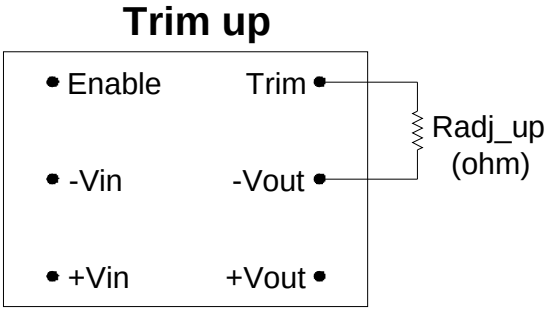


Figure 2. Circuit Configuration to Increase Output Voltage

For Vo=3.3V modules, $Vo = \frac{2393}{7250+Radj\_up} + 3.3$

For Vo=5V modules, $Vo = \frac{9550}{19100+Radj\_up} + 5$

For Vo=12V modules, $Vo = \frac{37200}{31000+Radj\_up} + 12$

For Vo=15V modules, $Vo = \frac{36450}{24300+Radj\_up} + 15$

For Vo=±12V modules, $Vo = \pm \left| \left(\frac{87600}{36500+Radj\_up} + 24 \right) \div 2 \right|$

For Vo=±15V modules, $Vo = \pm \left| \left(\frac{66300}{22100+Radj\_up} + 30 \right) \div 2 \right|$

Where: Radj_up is in Ω
Vo is not changed when Radj_up is not connected
110% Vo is obtained when Radj_up = 0 Ω (i.e. Trim Pin is shorted to –Vout Pin)

To adjust Vo to a lower value, please refer to Figure 3.
An external resistor, Radj_down, should be connected between the Trim Pin and the +Vout Pin. From equation (2), Radj_down resistor can be determined for the required output voltage.

Equation (2)

For Vo=2.5V modules, $Vo = \frac{35100+2.5\ Radj\_down}{15600+Radj\_down}$

For Vo=3.3V modules, $Vo = \frac{43956+3.3\ Radj\_down}{14800+Radj\_down}$

For Vo=5V modules, $Vo = \frac{86400+5\ Radj\_down}{19200+Radj\_down}$

For Vo=12V modules, $Vo = \frac{1468800+12\ Radj\_down}{136000+Radj\_down}$

For Vo=15V modules, $Vo = \frac{1957500+15\ Radj\_down}{145000+Radj\_down}$

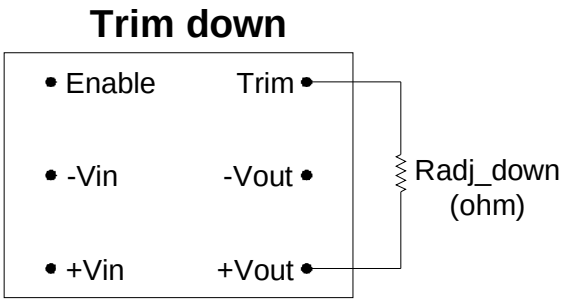


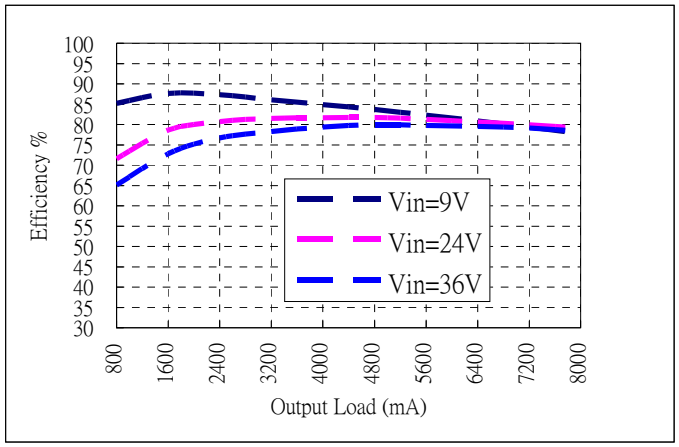
Figure 3. Circuit Configuration to Decrease Output Voltage

For Vo=±12V modules, $Vo = \pm \left| \left(\frac{8152000+24\ Radj\_down}{377400+Radj\_down} \right) \div 2 \right|$

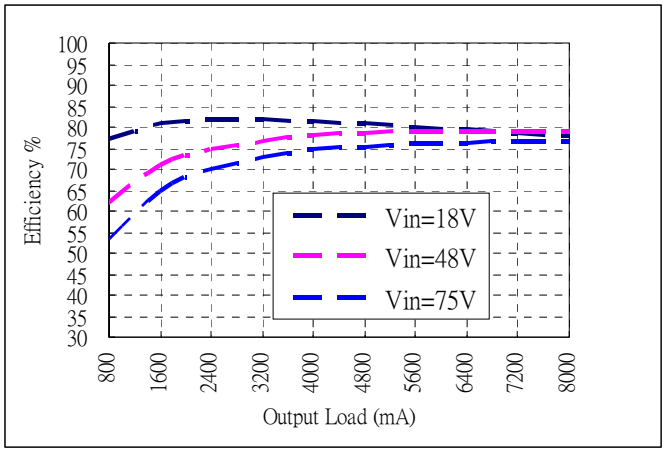
For Vo=±15V modules, $Vo = \pm \left| \left(\frac{7971000+30\ Radj\_down}{295220+Radj\_down} \right) \div 2 \right|$

Where: Radj_down is in Ω
Vo is not changed when Radj_down is not connected
90% Vo is obtained when Radj_down = 0 Ω (i.e. Trim Pin is shorted to +Vout Pin)

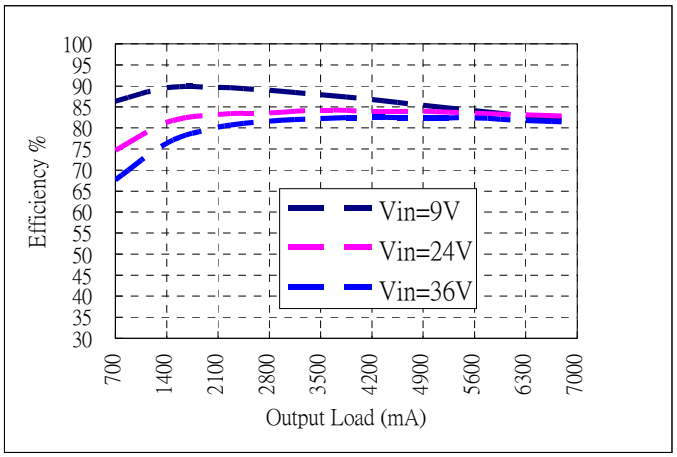
Performance Curves – Efficiency Curve



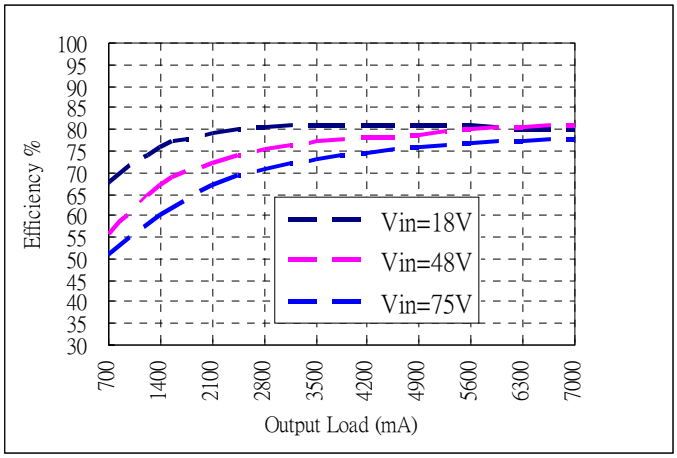
Efficiency vs. Load @ +25℃ Ambient, AET08G18-L



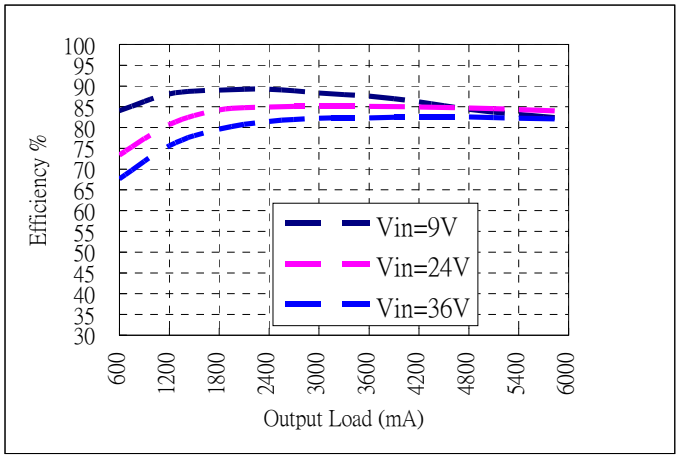
Efficiency vs. Load @ +25℃ Ambient, AET08G36-L



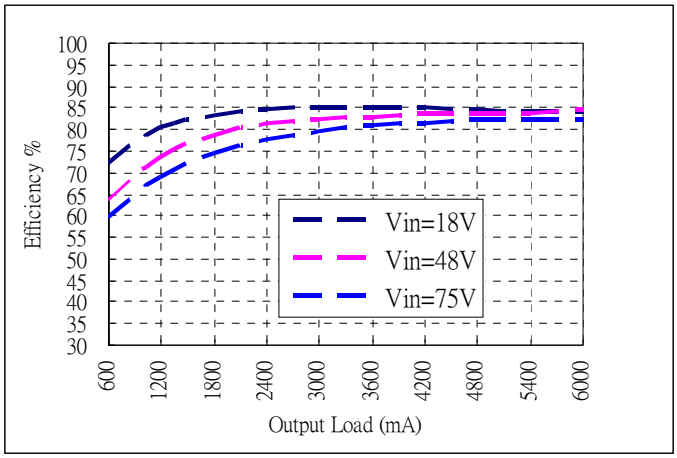
Efficiency vs. Load @ +25℃ Ambient, AET07F18-L



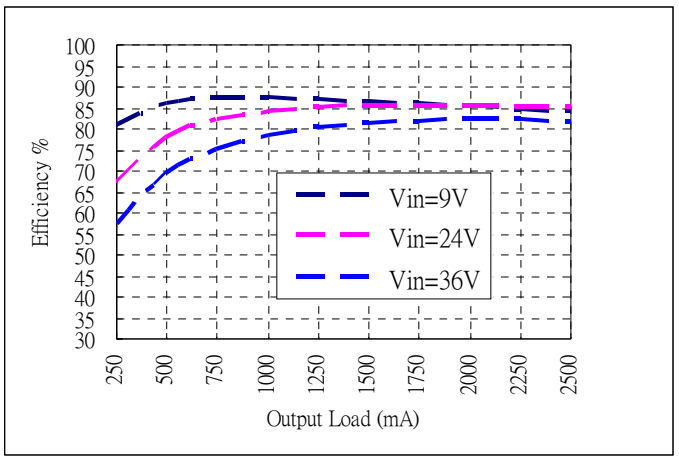
Efficiency vs. Load @ +25℃ Ambient, AET07F36-L



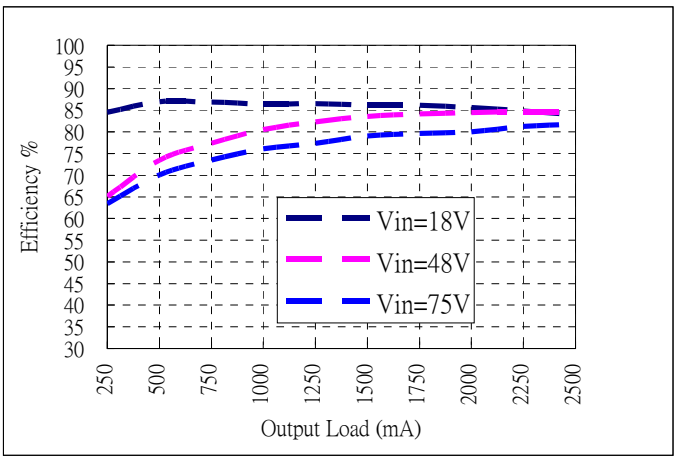
Efficiency vs. Load @ +25℃ Ambient, AET06A18-L



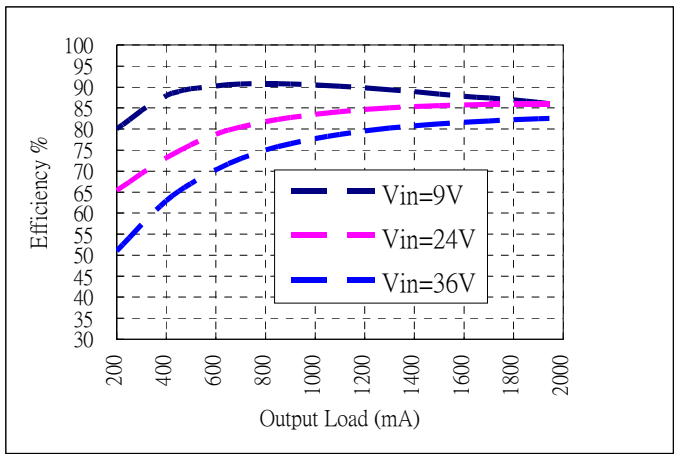
Efficiency vs. Load @ +25℃ Ambient, AET06A36-L



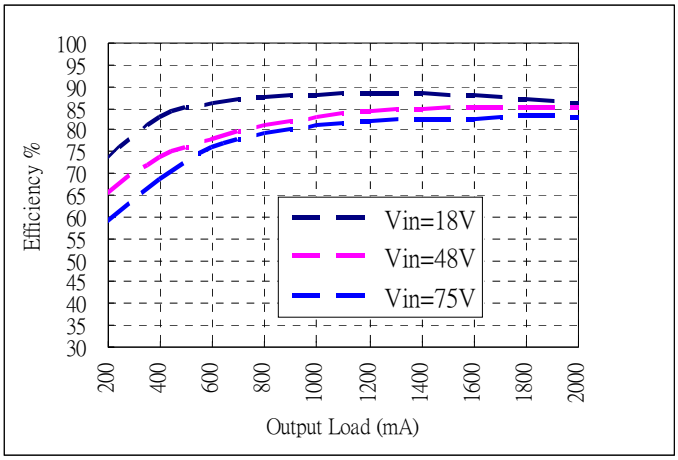
Efficiency vs. Load @ +25℃ Ambient, AET02B18-L



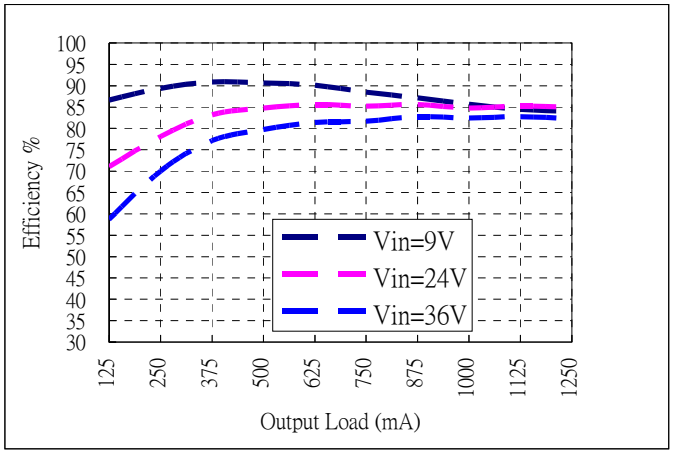
Efficiency vs. Load @ +25℃ Ambient, AET02B36-L



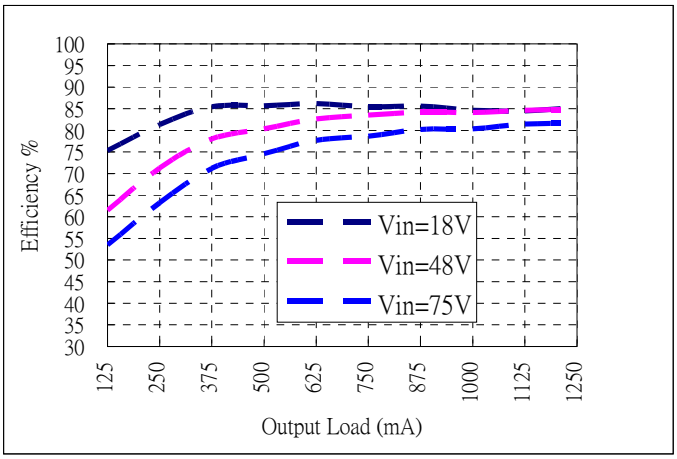
Efficiency vs. Load @ +25℃ Ambient, AET02C18-L



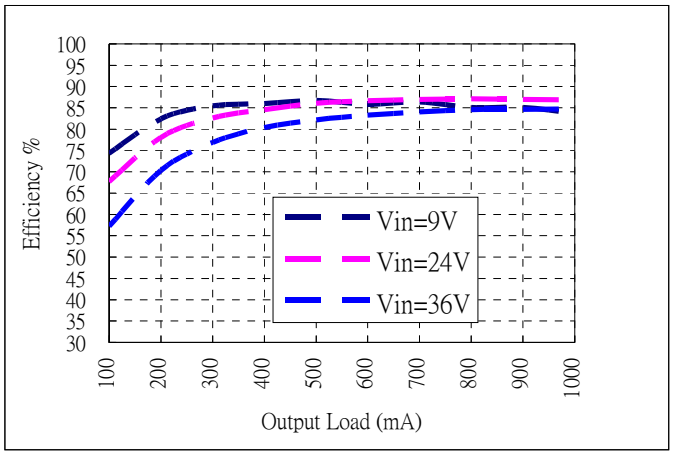
Efficiency vs. Load @ +25℃ Ambient, AET02C36-L



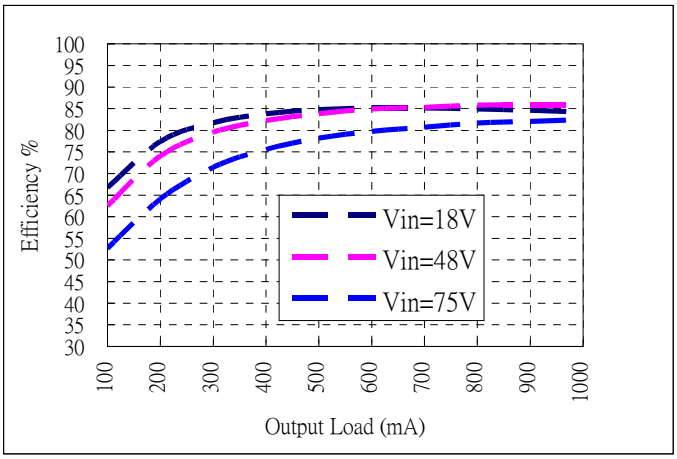
Efficiency vs. Load @ +25℃ Ambient, AET01BB18-L



Efficiency vs. Load @ +25℃ Ambient, AET01BB36-L

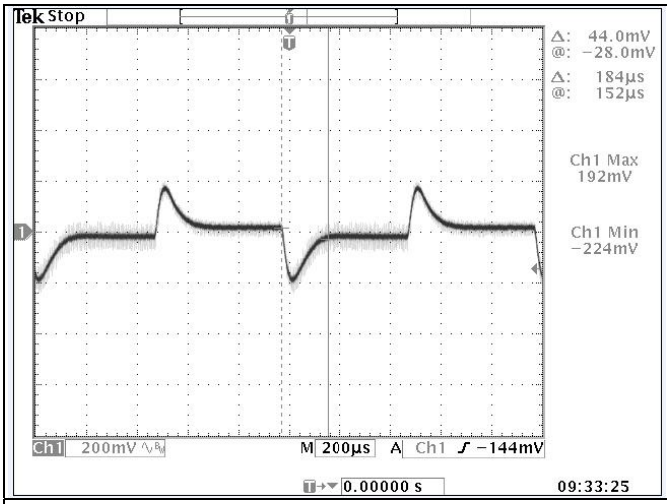


Efficiency vs. Load @ +25℃ Ambient, AET01CC18-L

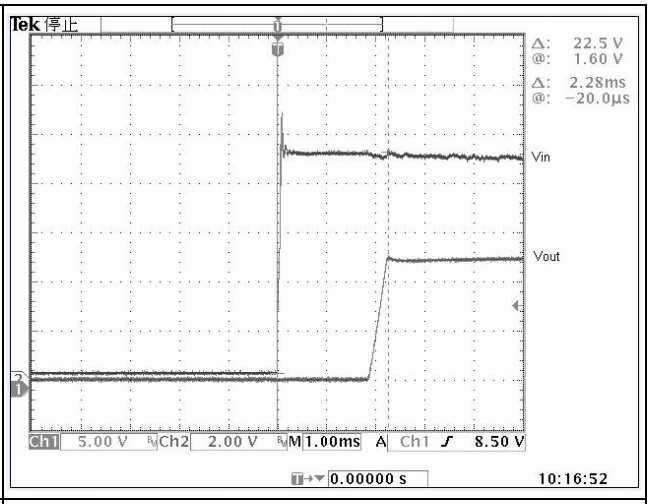


Efficiency vs. Load @ +25℃ Ambient, AET01CC36-L

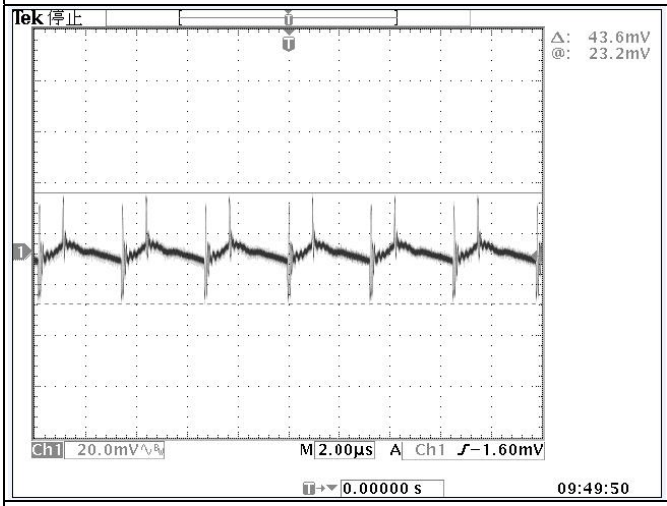
Performance Curves



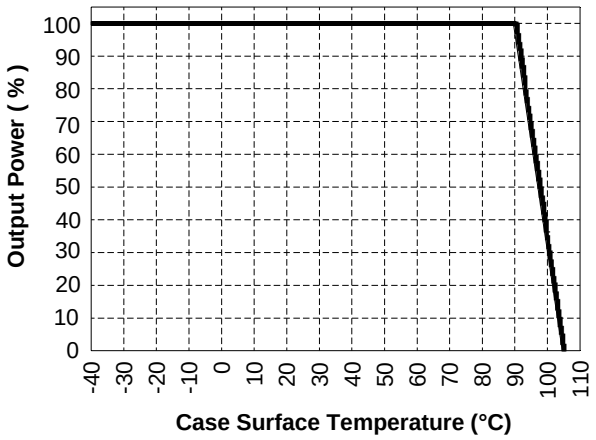
Transient Response – 50% to 100% load (AET06A18-L)



Start-Up Time (AET06A18-L)

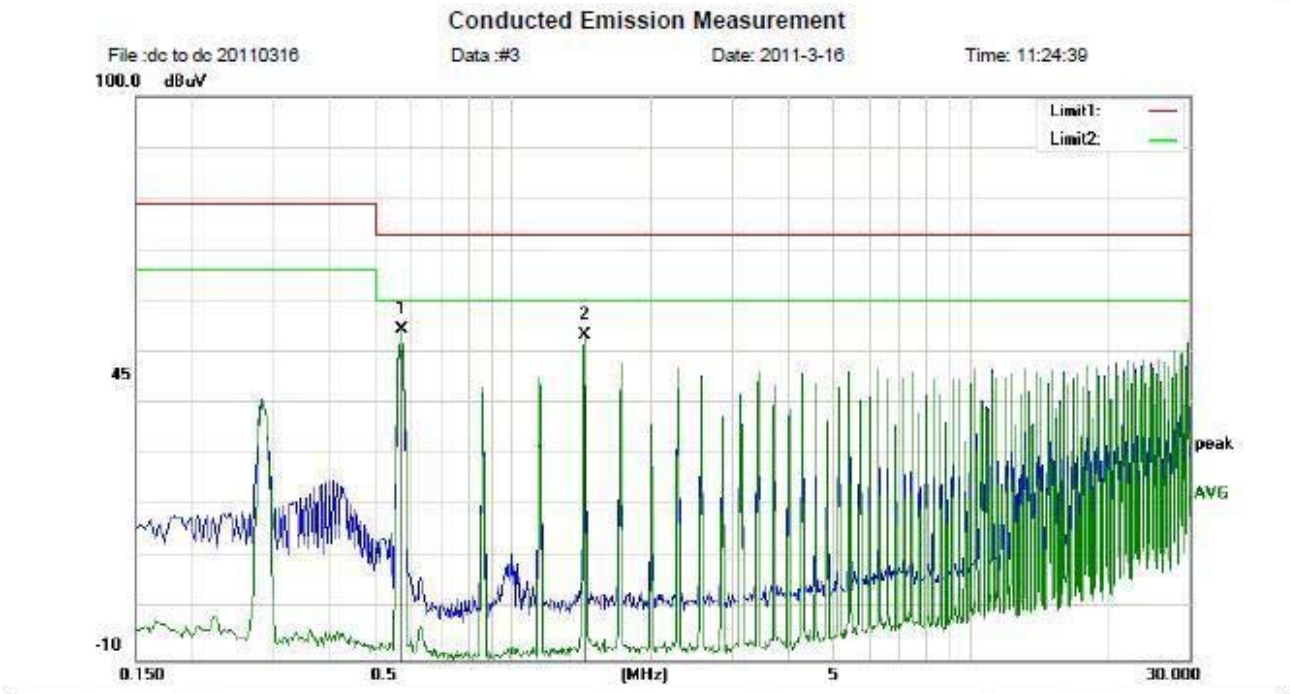


Ripple & Noise (AET06A18-L)



Power Derating

Conducted EMI Performance

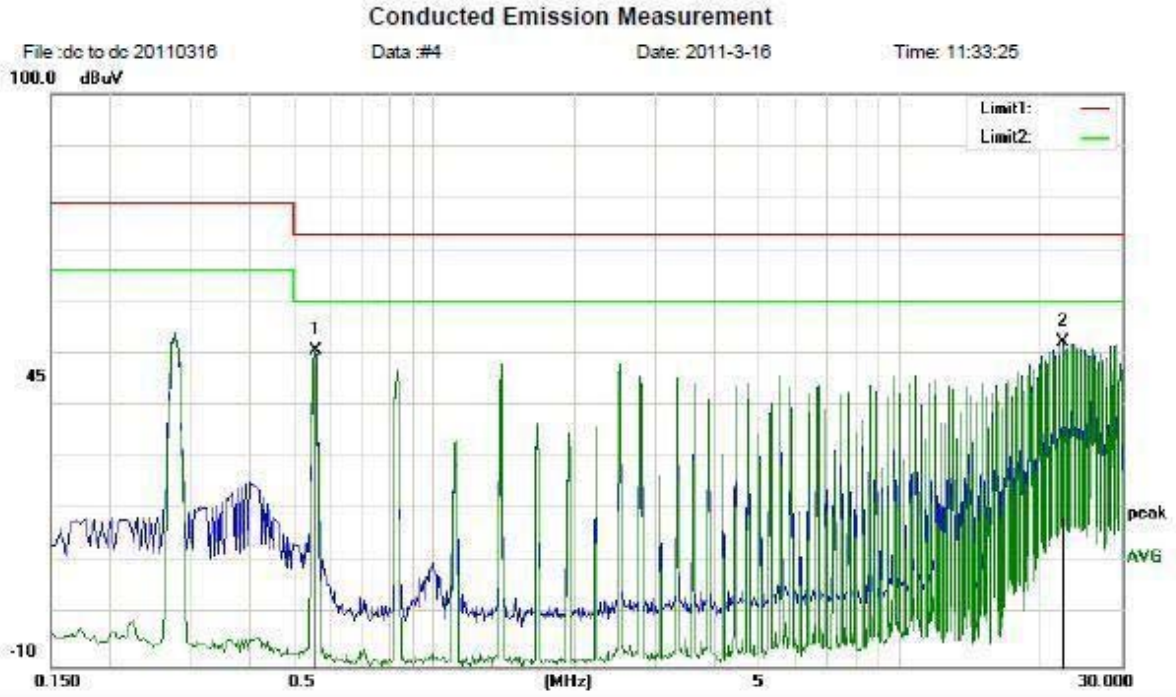


Site Chamber #1
Limit: (CE)EN55022 class A_QP
EUT: dc to dc converter
M/N: AET06A18-L
Mode: Full Load
Note:

Phase: L
Power: DC 24V

Temperature: 20
Humidity: 57 %
Test Result: Pass

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.5740	54.39	0.12	54.51	73.00	-18.49	peak	
2		1.4340	53.27	0.20	53.47	73.00	-19.53	peak	



Site Chamber #1
Limit: (CE)EN55022 class A_QP
EUT: dc to dc converter
M/N: AET06A18-L
Mode: Full Load
Note:

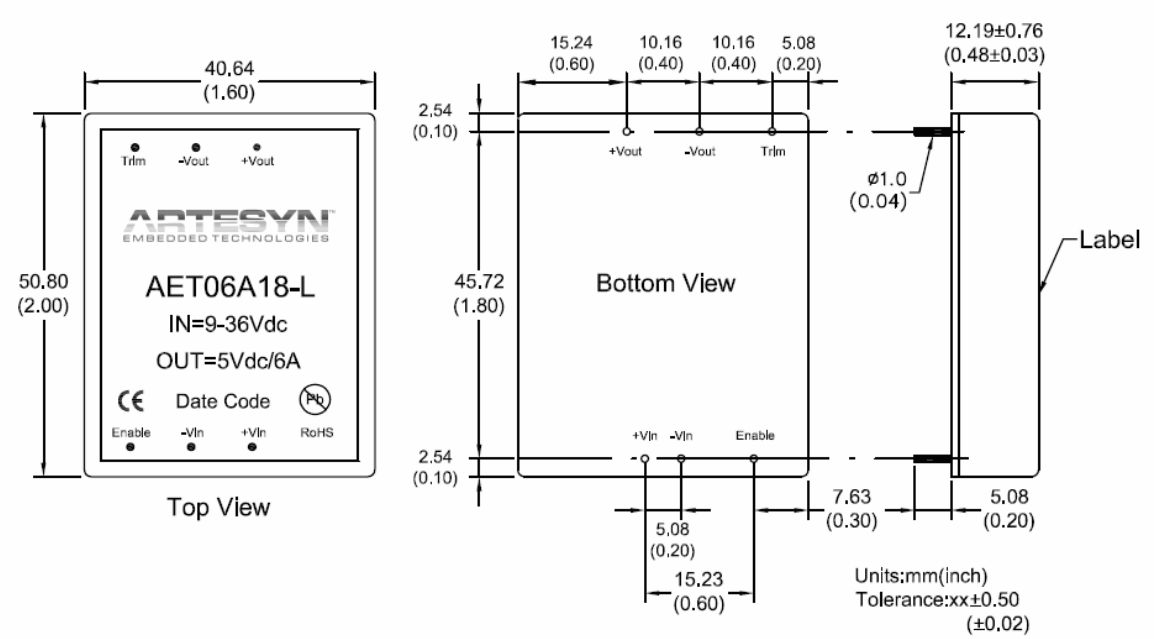
Phase: N
Power: DC 24V

Temperature: 20
Humidity: 57 %
Test Result: Pass

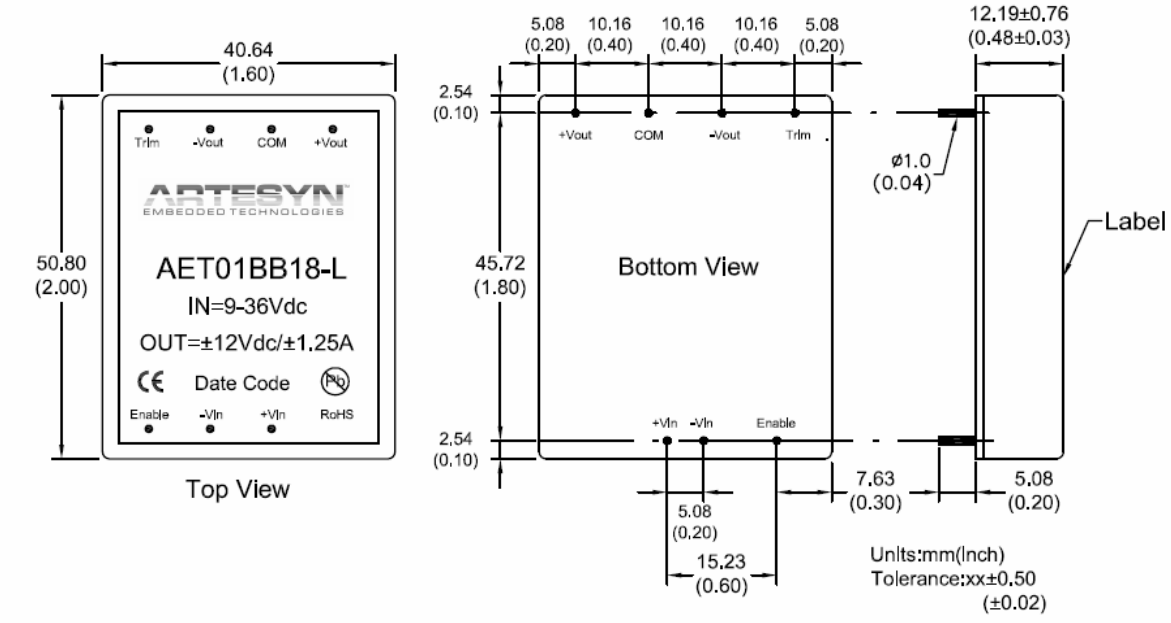
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.5580	50.40	0.12	50.52	73.00	-22.48	peak	
2	*	22.4260	51.20	1.07	52.27	73.00	-20.73	peak	

Mechanical Dimensions and Module Pin Assignment

Single Output



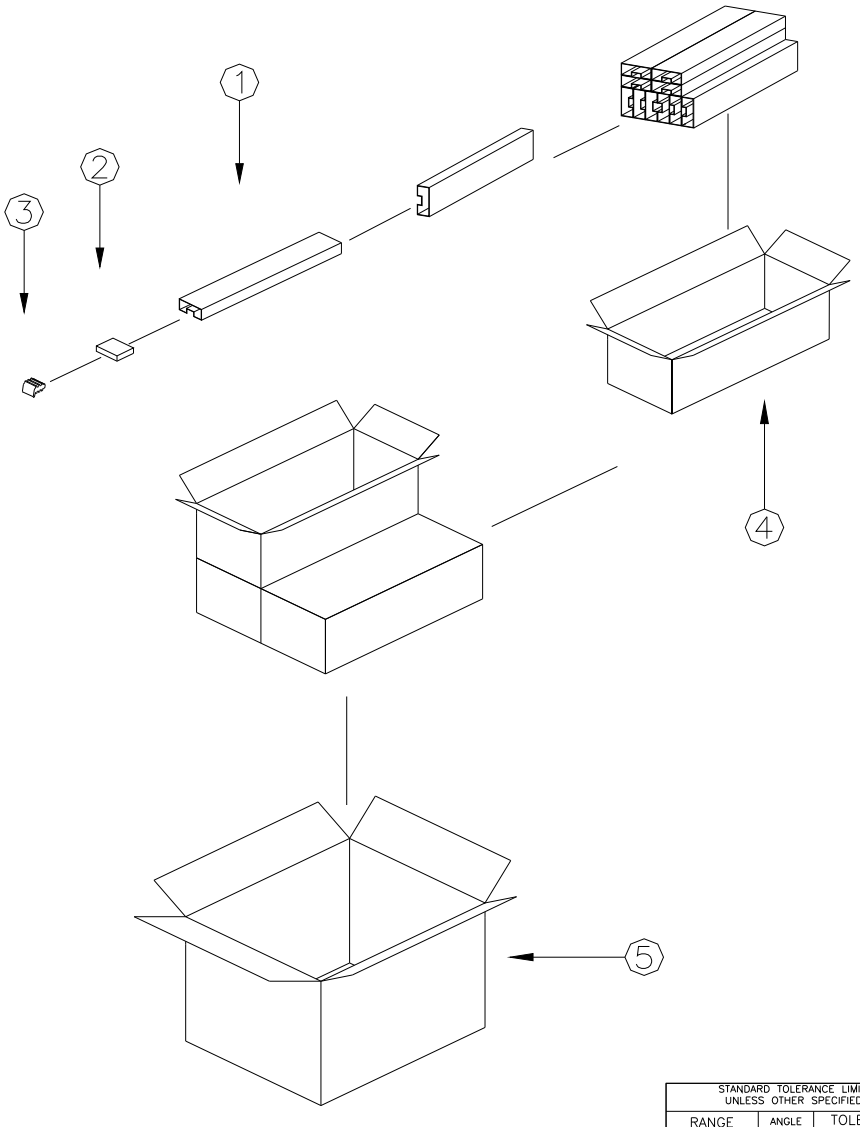
Dual Output



Package Information

REV	REF	DESCRIPTION	AUTH	DATE

1. PACKING TUBE: 360*53.4*21.4mm ; ONE TUBE = 8 PCS
2. PRODUCTS: AET SERIES
3. STOPPER
4. INNER CARTON: 388*159*115mm
   ONE INNER CARTON = 10 TUBES = 80 PCS
5. OUTER CARTON: 405*334*263mm
   ONE OUTER CARTON = 4 INNER CARTONS = 320 PCS



STANDARD TOLERANCE LIMITS UNLESS OTHER SPECIFIED.			THIRD ANGLE PROJECTION	
RANGE	ANGLE	TOLERANCE		
>0~3	±1°	±0.1		
>3~6	±2°	±0.15	UNIT:m/m	
>6~30	±3°	±0.18	SCALE	REV
>30~120	±5°	±0.20	1 : 1	A1

Recommended Lead-Free Wave Soldering Temperature Profile