

# HAE100 SERIES



Standard

Terminal Block

### APPLICATIONS

Wireless Network  
Telecom/ Datacom  
Industry Control System  
Distributed Power Architectures  
Semiconductor Equipment

### FEATURES

- OUTPUT CURRENT UP TO 25A
- 2:1 WIDE INPUT VOLTAGE RANGE
- HIGH EFFICIENCY UP TO 93%
- NO MINIMUM LOAD
- SOFT-START
- ADJUSTABLE OUTPUT VOLTAGE
- UNDER-VOLTAGE LOCKOUT
- INPUT REVERSE PROTECTION
- INDUSTRY STANDARD HALF-BRICK FOOTPRINT
- SIX-SIDED CONTINUOUS SHIELD
- INPUT TO OUTPUT BASIC INSULATION
- BUS TERMINAL BLOCK OPTION

### OPTIONS

- Positive logic remote ON/OFF
- Pin length
- Terminal block
- Heat-sink
- Terminal block with EMC filter

### DESCRIPTION

HAE100-SERIES DC/DC converters provide up to 100 watts of output power in an industry standard half-brick package and footprint. All models feature a wide input range and adjustable output voltage.

## TECHNICAL SPECIFICATION

All specifications are typical at nominal input, full load and 25°C otherwise noted

OUTPUT SPECIFICATIONS		
Output power		100Watts, max.
Voltage accuracy	Full load and Vin, nom	±1%
Voltage adjustability (Note 7)		+10%, -20%
Minimum load		0%
Line regulation	LL to HL at FL	See table
Load regulation	No Load to Full Load	See table
Remote sense (Note 8)		10% of Vout, nom
Ripple and noise	20MHz bandwidth	See table
Temperature coefficient		±0.02%/°C, max.
Transient response recovery time	25% load step change	200µS
Over voltage protection threshold	(Hiccup) 115% ~ 130% of Vout, nom	
Over current protection threshold		110% ~ 140% of Iout Rated
Short circuit protection		Hiccup, automatic recovery
INPUT SPECIFICATIONS		
Input voltage range	12V nominal input	9 – 18VDC
	24V nominal input	18 – 36VDC
	48V nominal input	36 – 75VDC
Start-up voltage	12V nominal input	8.5VDC
	24V nominal input	17.5VDC
	48V nominal input	35.5VDC
Shutdown voltage	12V nominal input	7.5VDC
	24V nominal input	16VDC
	48V nominal input	34VDC
Input filter		Pi type
Input surge voltage 100mS max	12V nominal input	36VDC
	24V nominal input	50VDC
	48V nominal input	100VDC
Input reverse protection (Note 9)		Parallel diode
Start up time	Pin, nom and constant resistive load	Power up 25mS, typ. Remote ON/OFF 25mS, typ.
	Remote ON/OFF (Note 6) (Negative logic) (Standard)	DC-DC ON Short or 0V < Vr < 1.2V DC-DC OFF Open or 3V < Vr < 12V
(Positive logic) (Option)	DC-DC ON	Open or 3V < Vr < 12V
	DC-DC OFF	Short or 0V < Vr < 1.2V
Input current of Remote control pin	Vin(nom)	-0.5mA ~ 1mA
Remote off input current	Vin(nom)	3mA

GENERAL SPECIFICATIONS		
Efficiency		See table
Isolation voltage	Input to Output (Basic insulation)	2250VDC, min.
	Input (Output) to Case	1600VDC, min.
Isolation resistance		109ohms, min.
Isolation capacitance		2500pF, max.
Switching frequency		300KHz, typ.
Design meet safety standard		IEC60950-1, UL60950-1, EN60950-1
Case material		Metal
Base material		FR4 PCB
Potting material		Silicon (UL94-V0)
Dimensions		2.40 X 2.28 X 0.50 Inches (61.0x57.9x12.7 mm)
Weight		97g (3.42oz)
MTBF (Note 1)	BELLCORE TR-NWT-000332	1,010 x 106 hrs
	MIL-HDBK-217F	7,416 x 104 hrs

ENVIRONMENTAL SPECIFICATIONS		
Operating ambient temperature (Note10)	Without Heat-sink	-40°C ~ +35°C (without derating) +35°C ~ +77°C (with derating)
	With Heat-sink (0.24" Height)	-40°C ~ +50°C (without derating) +50°C ~ +82°C (with derating)
Operating ambient temperature (Note10)	Without Heat-sink	-40°C ~ +30°C (without derating) +30°C ~ +81°C (with derating)
	With Heat-sink (0.24" Height)	-40°C ~ +44°C (without derating) +44°C ~ +85°C (with derating)
Maximum case temperature		105°C
Over temperature protection		115°C
Storage temperature range		-55°C to +125°C
Thermal impedance (Note 11)	without Heat-sink	6.7°C/watt
	with 0.24" Height Heat-sink	5.4°C/watt
	with 0.45" Height Heat-sink	4.7°C/watt
Thermal shock		MIL-STD-810F
Vibration		MIL-STD-810F
Relative humidity		5% to 95% RH

EMC CHARACTERISTICS (Note 12)		
EMI	EN55022	Class A
ESD	EN61000-4-2	Air Contact ± 8KV ± 6KV Perf. Criteria A
	Radiated immunity	EN61000-4-3 10 V/m Perf. Criteria A
Fast transien	EN61000-4-4	± 2KV Perf. Criteria A
Surge	EN61000-4-5	± 1KV Perf. Criteria A
Conducted immunity	EN61000-4-6	10 Vr.m.s Perf. Criteria A





Model Number	Input Range	Output Voltage	Output Current		Line Regulation	Load Regulation	Output <sup>(4)(5)</sup> Ripple & Noise	Input Current		Eff <sup>(4)</sup> (%)
			Min. load	Full load				No Load <sup>(3)</sup>	Full Load <sup>(2)</sup>	
HAE100-12S3P3	9 – 18 VDC	3.3 VDC	0 mA	25 A	7 mV	10 mV	75 mVp-p	200 mA	7.768 A	90
HAE100-12S05	9 – 18 VDC	5 VDC	0 mA	20 A	10 mV	15 mV	75 mVp-p	210 mA	9.311 A	91
HAE100-12S12	9 – 18 VDC	12 VDC	0 mA	8.4 A	24 mV	30 mV	100 mVp-p	210 mA	9.385A	91
HAE100-12S15	9 – 18 VDC	15 VDC	0 mA	6.7 A	30 mV	38 mV	100 mVp-p	210 mA	9.358A	91
HAE100-12S24	9 – 18 VDC	24 VDC	0 mA	4.2 A	48 mV	48 mV	200 mVp-p	100 mA	9.492A	90
HAE100-12S28	9 – 18 VDC	28 VDC	0 mA	3.6 A	56 mV	56 mV	200 mVp-p	100 mA	9.492A	90
HAE100-12S48	9 – 18 VDC	48 VDC	0 mA	2.1 A	96 mV	72 mV	300 mVp-p	100 mA	9.492A	90
HAE100-24S3P3	18 – 36 VDC	3.3 VDC	0 mA	25 A	7 mV	10 mV	75 mVp-p	90 mA	3.841 A	91
HAE100-24S05	18 – 36 VDC	5 VDC	0 mA	20 A	10 mV	15 mV	75 mVp-p	185 mA	4.554 A	93
HAE100-24S12	18 – 36 VDC	12 VDC	0 mA	8.4 A	24 mV	30 mV	100 mVp-p	185 mA	4.590A	93
HAE100-24S15	18 – 36 VDC	15 VDC	0 mA	6.7 A	30 mV	38 mV	100 mVp-p	185 mA	4.577 A	93
HAE100-24S24	18 – 36 VDC	24 VDC	0 mA	4.2 A	48 mV	48 mV	200 mVp-p	85 mA	4.641A	92
HAE100-24S28	18 – 36 VDC	28 VDC	0 mA	3.6 A	56 mV	56 mV	200 mVp-p	85 mA	4.641A	92
HAE100-24S48	18 – 36 VDC	48 VDC	0 mA	2.1 A	96 mV	72 mV	300 mVp-p	85 mA	4.641A	92
HAE100-48S3P3	36 – 75 VDC	3.3 VDC	0 mA	25 A	7 mV	10 mV	75 mVp-p	80 mA	1.920 A	91
HAE100-48S05	36 – 75 VDC	5 VDC	0 mA	20 A	10 mV	15 mV	75 mVp-p	90 mA	2.277 A	93
HAE100-48S12	36 – 75 VDC	12 VDC	0 mA	8.4 A	24 mV	30 mV	100 mVp-p	90 mA	2.295A	93
HAE100-48S15	36 – 75 VDC	15 VDC	0 mA	6.7 A	30 mV	38 mV	100 mVp-p	90 mA	2.288 A	93
HAE100-48S24	36 – 75 VDC	24 VDC	0 mA	4.2 A	48 mV	48 mV	200 mVp-p	40 mA	2.320A	92
HAE100-48S28	36 – 75 VDC	28 VDC	0 mA	3.6 A	56 mV	56 mV	200 mVp-p	40 mA	2.320A	92
HAE100-48S48	36 – 75 VDC	48 VDC	0 mA	2.1 A	96 mV	72 mV	300 mVp-p	40 mA	2.320A	92

**Note**

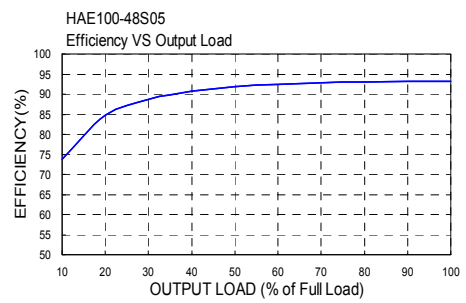
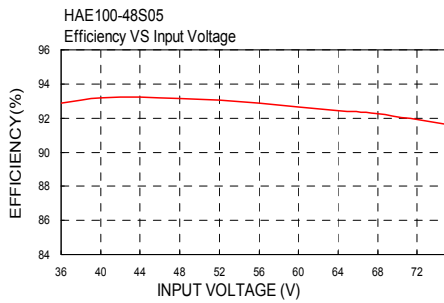
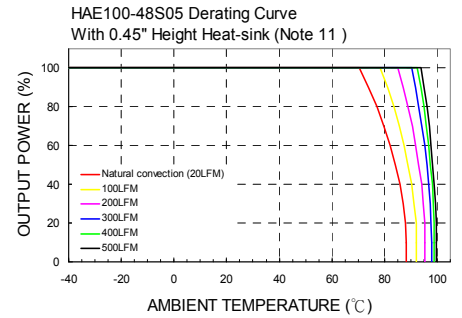
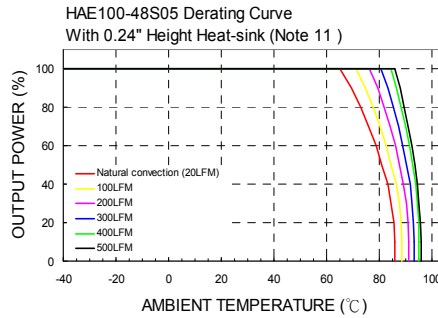
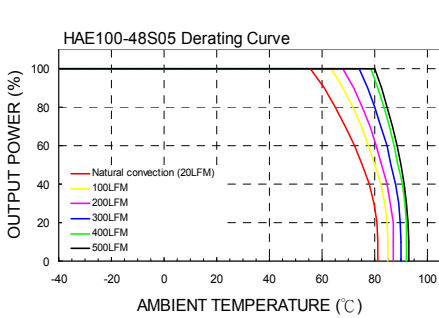
- BELLCORE TR-NWT-000332. Case 1: 50% Stress, Temperature at 40°C.  
MIL-HDBK-217F Notice2 @Ta=25°C, Full load(Ground, Benign, controlled environment).
- Maximum value at nominal input voltage and full load.
- Typical value at nominal input voltage and no load.
- Typical value at nominal input voltage and full load.
- The ripple and noise of output voltage 48V is measured with a 2.2μF/100V X7R MLCC;  
The ripple and noise of other output voltage is measured with a 4.7μF/50V X7R MLCC.
- The remote ON/OFF control pin voltage is referenced to -Vin. The positive logic and pin length (DIM.) are optional.  
To order positive logic ON-OFF control of standard product add the suffix -P (Ex: HAE100-48S05-P).
- Output voltage is adjustable for 10% trim up or -20% trim down of nominal output voltage by connecting a single resistor between TRIM and +SENSE pins for trim up or between TRIM and -SENSE pins for trim down. To calculate the value of the resistor Ru and Rd for a particular output voltage uses the following equation:

$$R_U = \left( \frac{V_{OUT}(100 + \Delta\%) - (100 + 2\Delta\%)}{1.225\Delta\% - \Delta\%} \right) K\Omega$$

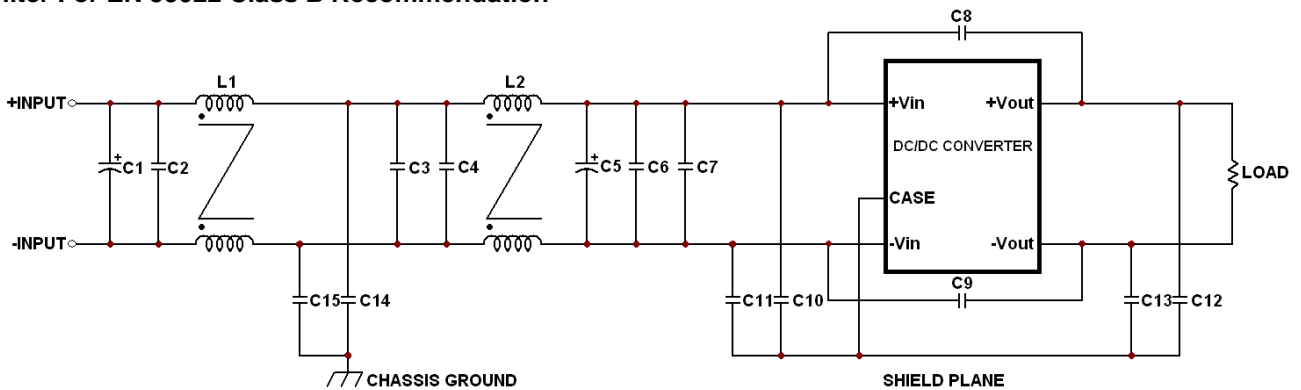
$$R_D = \left( \frac{100}{\Delta\%} - 2 \right) K\Omega$$

- Maximum output deviation is +10% inclusive of remote sense. If remote sense is not being used, the +SENSE should be connected to its corresponding +OUTPUT and likewise the -SENSE should be connected to its corresponding -OUTPUT.
- Internal fusing is not included, so we suggest to use an input line fuse.
- Test condition with vertical direction by natural convection (20LFM).
- Heat-sink is optional and P/N: 7G-0021A-F, 7G-0022A-F, 7G-0023A-F, 7G-0024A-F.
- The HAE100 series meets EMC characteristics only with external components connected before the input pin to the converter. If customer only need to meet EN61000-4-4, EN61000-4-5, an external input filter capacitor is required  
The filter capacitor Power Mate suggest: Nippon chemi-con KY series, 220μF /100V, ESR 48mΩ
- CASE GROUNDING : When you connect the case pin and the four screw bolts to shield plane, the EMI could be better reduced.





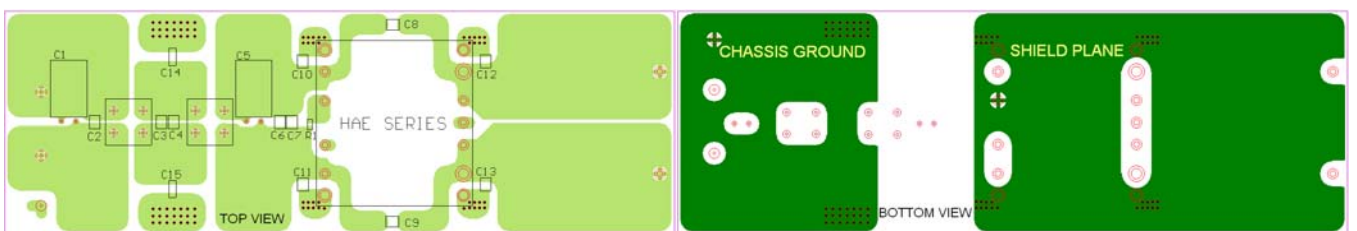
**EMI Filter For EN 55022 Class B Recommendation**



**Recommended Filter for EN55022 Class B Compliance**

The components used in the above figure, together with the manufacturers' part numbers for these components, are as follows:

	C1,C5	C2,C3,C4,C6,C7	C8	C9	C10,C11,C12,C13	C14,C15	L1	L2
HAE100-12SXX	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
HAE100-24SXX	100µF/50V	4.7µF/50V 1812 MLCC	1000pF/3KV 1808 MLCC	1000pF/3KV 1808 MLCC	10nF/2KV 1812 MLCC	1000pF/3KV 1808 MLCC	Common Choke PMT-073 305µH	Common Choke PMT-073 305µH
HAE100-48SXX	100µF/100V	2.2µF/100V 1812 MLCC	1000pF/3KV 1808 MLCC	4700pF/3KV 1812 MLCC	10nF/2KV 1812 MLCC	1000pF/3KV 1808 MLCC	Common Choke PMT-064 1400µH	Common Choke PMT-072 156µH

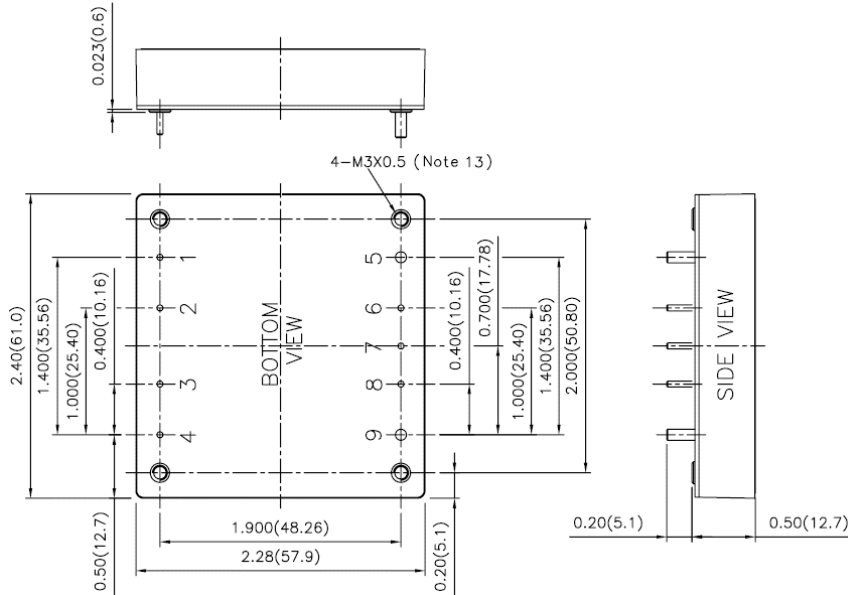


**Recommended EN55022 Class B Filter Circuit Layout**



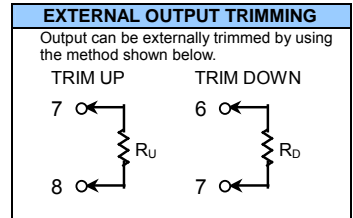


**Mechanical Drawing**



- Pin 1,2,3,4,6,7,8. DIA. 0.040 (1.02mm)  
Pin 5,9. DIA. 0.080 (2.03mm)
- All dimensions in inches (mm)
- Tolerance :x.xx±0.02 (x.x±0.5)  
x.xxx±0.01 (x.xx±0.25)
- Pin pitch tolerance ±0.01 (0.25)
- Pin dimension tolerance ±0.004(0.1)

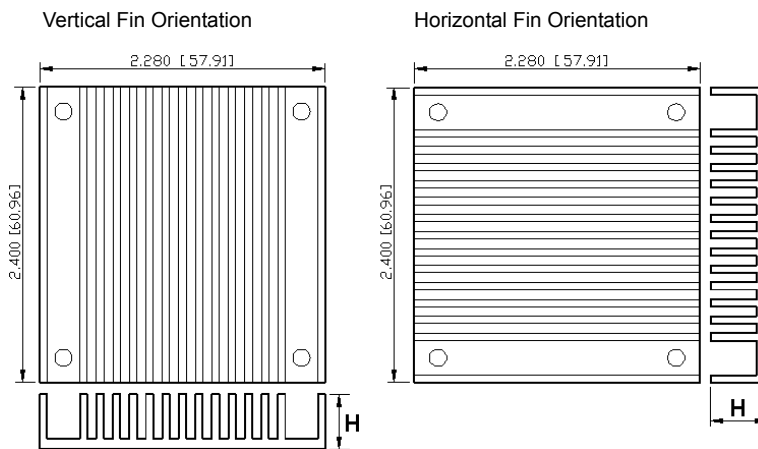
PIN CONNECTION		
PIN	Define	Diameter
1	- INPUT	0.04 Inches
2	CASE	0.04 Inches
3	CTRL	0.04 Inches
4	+ INPUT	0.04 Inches
5	- OUTPUT	0.08 Inches
6	- SENSE	0.04 Inches
7	TRIM	0.04 Inches
8	+ SENSE	0.04 Inches
9	+ OUTPUT	0.08 Inches



**Product Option**

Product option		Suffix	Product option		Suffix
Negative remote ON/OFF logic	0.20" pin length	-	Heat-sink	H= 0.24" Vertical	7G-0023A-F - HS2
	0.145" pin length	- L		H= 0.45" Vertical	7G-0021A-F - HS
	0.11" pin length	- K		H= 0.24" Horizontal	7G-0022A-F - HS1
Positive remote ON/OFF logic	0.20" pin length	- P	Terminal Block	H= 0.45" Horizontal	7G-0024A-F - HS3
	0.145" pin length	- S		Without EMC filter	- T
	0.11" pin length	- M		With EMC filter	- TF

**Heat Sink Type (Suffix-HS)**



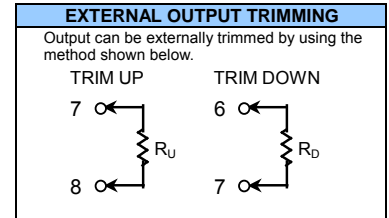
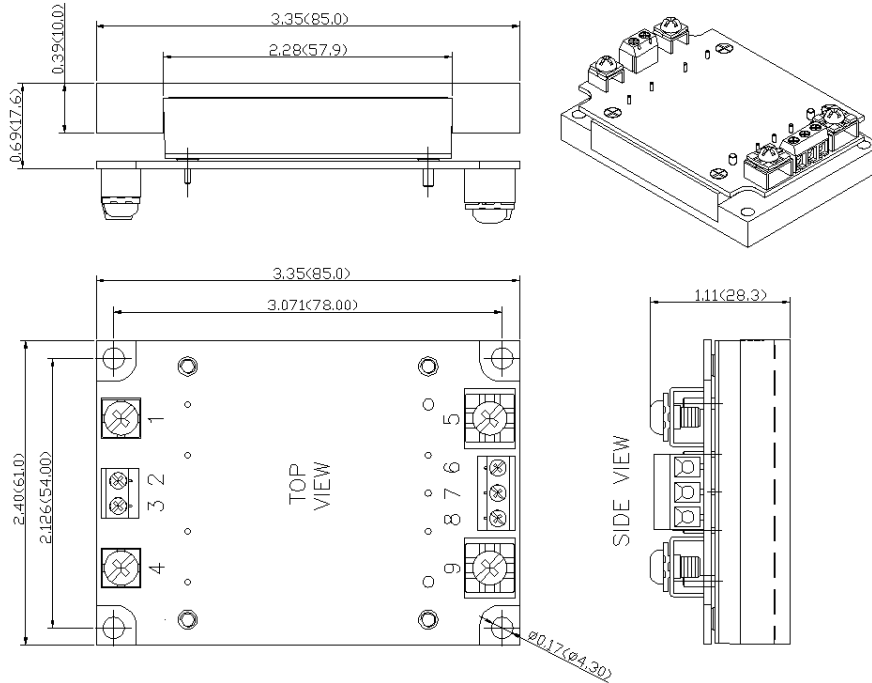


**Terminal Block Type**

Note : Terminal Block without EMC Filter (Suffix-T) and Terminal Block with EMC Filter (Suffix-TF)

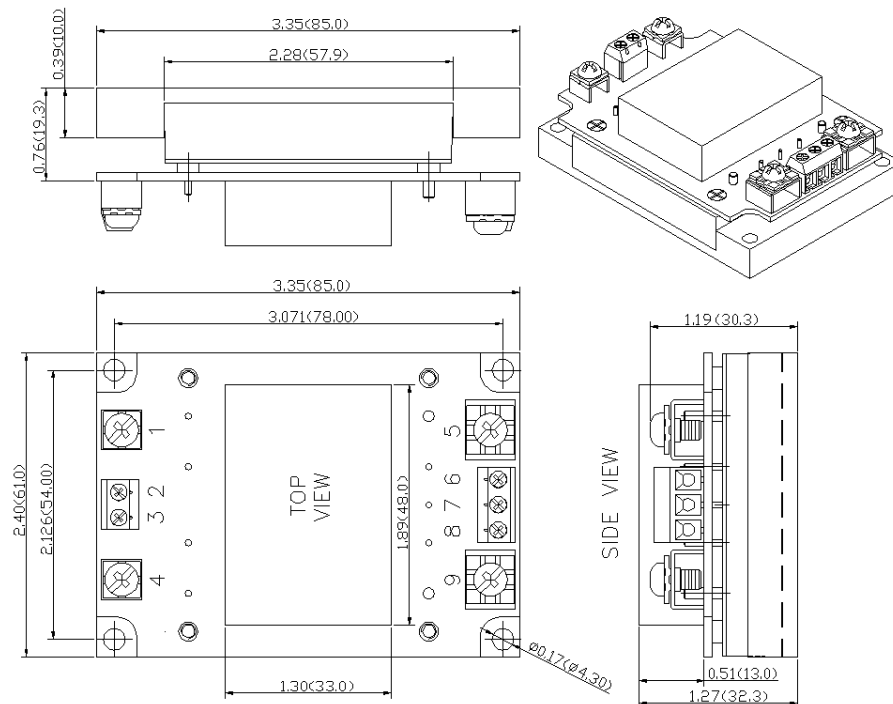
The terminal block type of HAE100 can meet the EMC characteristics with an EMC filter. Followings are the mechanical drawings for reference. Pin assignments are same as standard type.

1) Terminal Block without EMC Filter (Suffix-T)



TERMINAL CONNECTION		
Terminal	Define	wire range
1	- INPUT	14 AWG to 16 AWG
2	CASE	14 AWG to 18 AWG
3	CTRL	14 AWG to 18 AWG
4	+ INPUT	14 AWG to 16 AWG
5	- OUTPUT	10 AWG to 12 AWG
6	- SENSE	14 AWG to 18 AWG
7	TRIM	14 AWG to 18 AWG
8	+ SENSE	14 AWG to 18 AWG
9	+ OUTPUT	10 AWG to 12 AWG

2) Terminal Block with EMC Filter (Suffix-TF)



All dimensions in inches (mm)  
Tolerance : x.xx±0.02 (x.x±0.5)  
x.xxx±0.01 (x.xx±0.25)

