

60 Watts

- EN50155 for Rail Applications
- Ultra wide 12:1 (9-75V and 14-160V input)
- EN50121-3-2 Class A Emissions for Rail Applications without Additional Components
- Single output
- -40 to 105°C Operation
- Remote on/off and +10%/-20% Output Trim
- 3 Year warranty



The Ultra wide 12:1 QAE60U series of single output DC/DC converters come in a 1/4 brick package. With a nominal input of 36 and 72V and outputs from 5 to 53V. The QAE60U series has both EN50155 and EN50121-3-2 approvals for rail applications. The units operate from -40 to +105°C and come complete with remote on/off function and output trim. All models have a Fidus 3 year warranty.

Dimensions:

2.28 x 1.45 x 0.5" (57.9 x 36.8 x 12.7mm)

Models & Ratings

Model Number	Input Voltage	Output Voltage	Output Current	No Load Current	Maximum Capacitive Load	Efficiency
QAE60-36S05U	9-75V	5V	12.00A	20mA	24000uF	89%
QAE60-36S12U		12V	5.00A	30mA	4200uF	89%
QAE60-36S15U		15V	4.00A	30mA	2700uF	90%
QAE60-36S24U		24V	2.50A	20mA	1100uF	90%
QAE60-36S28U		28V	2.15A	20mA	780uF	90%
QAE60-36S48U		48V	1.25A	20mA	260uF	91%
QAE60-36S53U		53V	1.14A	20mA	220uF	91%
QAE60-72S05U	14-160V	5V	12.00A	15mA	24000uF	89%
QAE60-72S12U		12V	5.00A	20mA	4200uF	89%
QAE60-72S15U		15V	4.00A	20mA	2700uF	89%
QAE60-72S24U		24V	2.50A	15mA	1100uF	90%
QAE60-72S28U		28V	2.15A	15mA	780uF	90%
QAE60-72S48U		48V	1.25A	15mA	260uF	90%
QAE60-72S53U		53V	1.14A	15mA	220uF	90%

Notes

1. For under voltage protection pin add **-V**, for under voltage protection pin and bus pin add **-K**. For positive enable logic add **P** or leave blank for default negative switching logic. For heatsink options add **HS, HS1, HS2, HS3** or **TH** (without threaded holes) if 3rd party heat sink is to be used.
2. Series diode or mosfet required for reverse polarity protection
3. Input fuse required: 36V 12A fast acting, 72V 8A fast acting

Input

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Input voltage range	9	36	75	VDC	36V Nominal
	14	72	160		72V Nominal
Start up voltage			9	VDC	36V Nominal
			14		72V Nominal
Shut down voltage	7.3	7.7	8.1	VDC	36V Nominal
	10	11	12		72V Nominal
Startup time		75	100	ms	
Input filter					Pi type
Input transient voltage	8.1			VDC	36V Nominal. 100ms max
	12				72V Nominal. 100ms max
Input surge voltage			100	VDC	36V Nominal. 1s max
			185		72V Nominal. 1s max
Remote ON/OFF Negative logic (standard)	0		1.2	VDC	Or short for ON
	3		12		Or open for OFF
Remote ON/OFF Positive logic (add -P)	3		12	VDC	Or open for ON
	0		1.2		Or short for OFF
Control pin current	-0.5		1	mA	
Remote off input current		3		mA	

General					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	89		91	%	See Model & Ratings table
Isolation 36V Nominal	2250			VDC	Input to output
	1600				Input to base-plate
Isolation 72V nominal	3000			VAC	Input to output
	1500				Input to base-plate
Isolation resistance	1000			M Ohm	At 500VDC
Isolation capacitance			1000	pF	
Switching frequency	160	180	200	kHz	
Power density			36.3	W/In ³	
MTBF		7.381		MHrs	As per MIL-HDBK-217F, 25°C GB
Weight			64	g	
Case material	Aluminium base-plate with plastic case				
Potting material	Silicone (UL94 V-0)				
Safety approvals	IEC/ EN/ UL 62368-1 (UL: E193009)				
Standards	EN50155, EN45545-2				

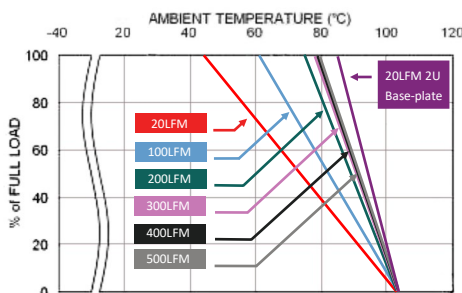
Output					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	5		53	VDC	See Model & Ratings table
Set point accuracy			±1	%	
Line regulation			±0.1	%	Low line to High line
Load regulation			±0.1	%	0 to 100% load change
Output voltage adjustability	-20		±10	%	Trim and remote sense see application note
Remote sense			±10	%	If sense lines not used they must be connected to Vout
Ripple & Noise (20MHz bandwidth)		75		mV pk-pk	5V -1uF/25V X7R MLCC & 22uF/25V electrolytic cap
		100			12/15V -22uF/25V X7R MLCC
		200			24/28V -4.7uF/50V X7R MLCC
		300			48-53V -2.2uF/100V X7R MLCC
Overvoltage protection	120		135	%	Automatic recovery
Overload protection	120		140	%	Automatic recovery
Short circuit protection					Continuous with automatic recovery
Transient response		250	±4	us	For a 25% load change
Output voltage trim	See applications pages 3 and 4				

EMC: Emissions		
	Standard	Notes & Conditions
Conducted	EN50121-3-2, EN55032 A/B	See application note
Radiated	EN50121-3-2, EN55032 A/B	See application note

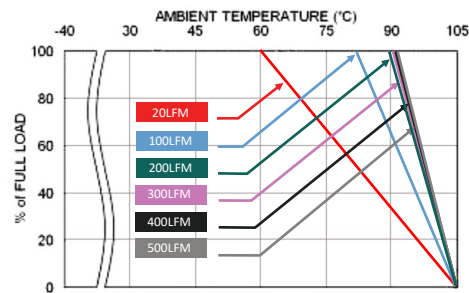
EMC: Immunity			
	Standard	Criteria	Notes & Conditions
ESD	EN61000-4-2	A	Air ±8kV, Contact ±6kV
Radiated	EN61000-4-3	A	20V/m
EFT/Burst	EN61000-4-4	A	2kV: 36V Nominal external input capacitor required: 2x in parallel 220uF/100V 76V Nominal external input capacitor required 2x in parallel 150uF/200V
Surges	EN61000-4-5	A	2kV: 36V Nominal external input capacitor required: 2x in parallel 220uF/100V 76V Nominal external input capacitor required 2x in parallel 150uF/200V
Conducted	EN61000-4-6	A	10Vrms
Magnetic fields	EN61000-4-8	A	100A/m continuous. 1000A/m 1 sec

Environmental

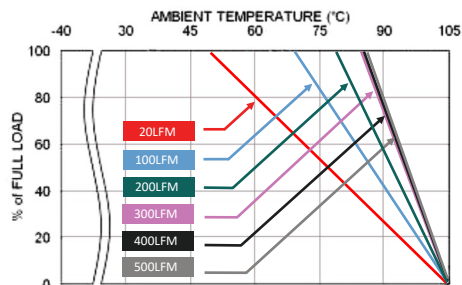
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating temperature	-40		105	°C	Base-plate temp. See de-rating curve
Max case temp			105	°C	
Over temp protection			110	°C	
Storage temperature	-55		125	°C	
Max Case temperature			105	°C	
Thermal impedance		8.27		°C/W	DC-DC module
		2.43			Mounted on base-plate
		7.4			0.24" heatsink
		6.16			0.5" heatsink
Humidity	5		95	% RH	Non-condensing
Thermal shock and vibration	EN61373,MIL-STD-810F				
Temperature coefficient	-0.02		+0.02	%/°C	



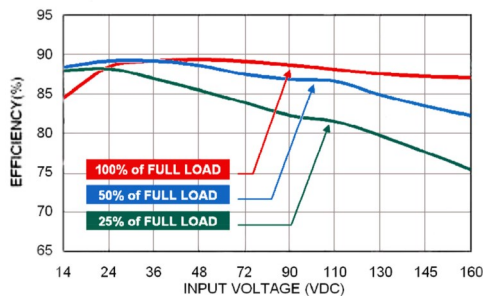
QAE60-72S05U Derating Curve
(See Thermal Considerations)



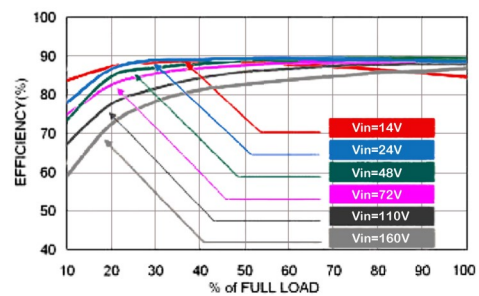
QAE60-72S05U Derating Curve
With 0.5" Height Heat-sink
(See Thermal Considerations)



QAE60-72S05U Derating Curve
With 0.24" Height Heat-sink
(See Thermal Considerations)

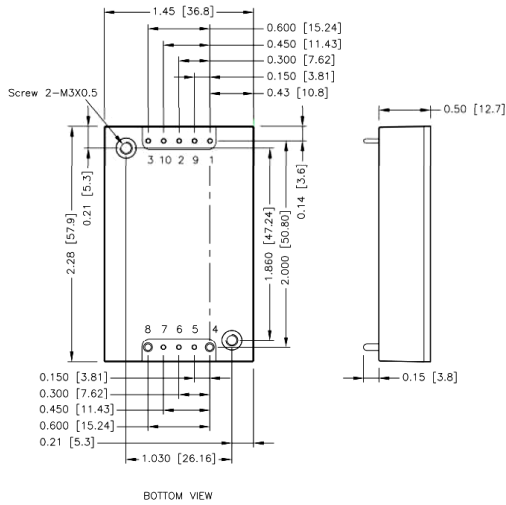


QAE60-72S05U Efficiency vs. Input Voltage



QAE60-72S05U Efficiency vs. Output Load

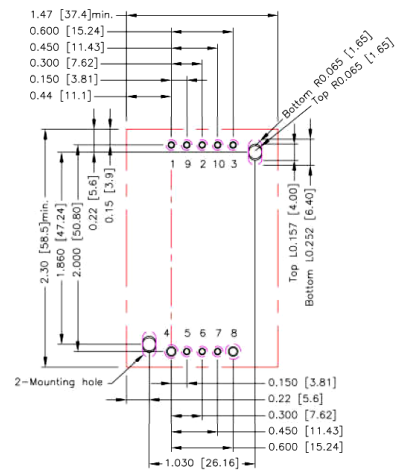
Mechanical Details



BOTTOM VIEW

Pin	Single
1	-Vin
2	CTRL
3	+Vin
4	-Vout
5	-Sense
6	Trim
7	+Sense
8	+Vout
9	Bus
10	UVLO

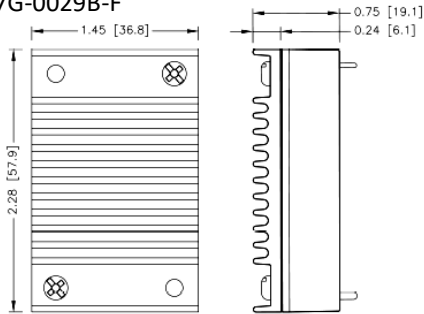
Suggested pad layout



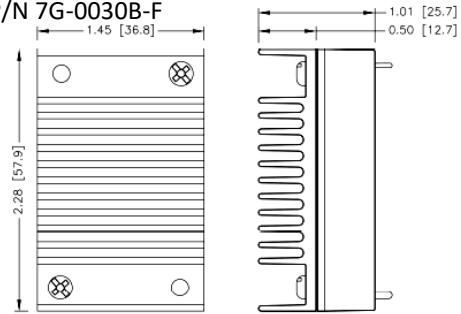
Notes

- All dimensions shown in inches [mm]
- Through hole 1,2,3,5,6,7: $\varnothing 0.051$ [1.3]
- Through hole 4,8: $\varnothing 0.75$ [1.9]
- Through hole mounting $\varnothing 0.126$ [3.2]
- Top view pad 1,2,3,5,6,7 $\varnothing 0.064$ [1.63]
- Top view pad 4,8 $\varnothing 0.094$ [2.38]
- Top view pad of mounting: Groove R0.065[1.6]L0.157[4]
- Bottom view pad 1,2,3,5,6,7: $\varnothing 0.102$ [2.6]
- Bottom view pad 8: $\varnothing 0.15$ [3.8]
- Bottom view pad 4: $\varnothing 0.13$ [3.3]
- Bottom view pad of mounting: Groove R0.065[1.6]L0.252[6.4]

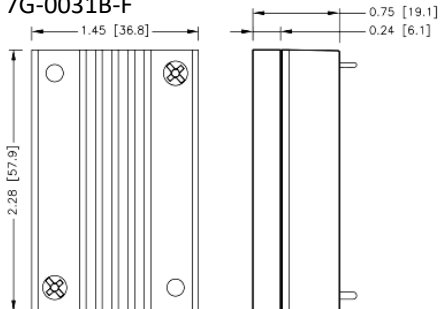
HS P/N 7G-0029B-F



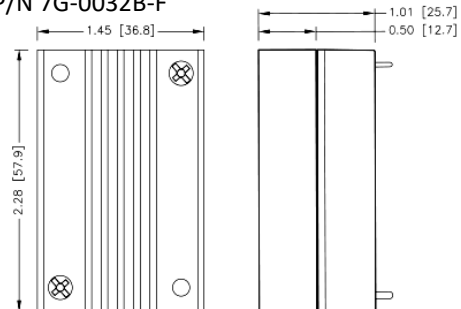
HS1 P/N 7G-0030B-F



HS2 P/N 7G-0031B-F



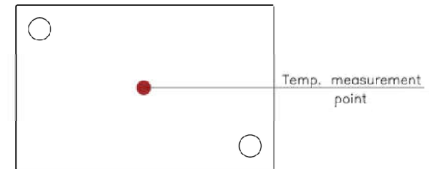
HS3 P/N 7G-0032B-F



Application notes

Thermal Considerations

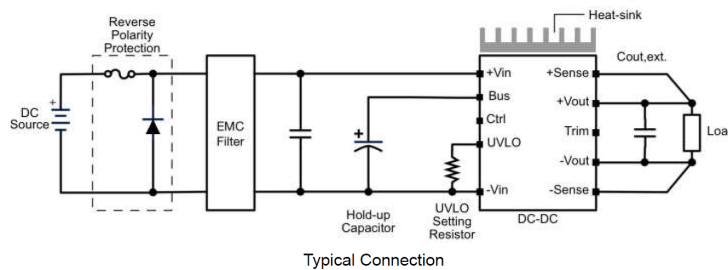
Sufficient cooling should be provided to ensure reliable operation. Sufficient cooling is monitored by measuring the temperature of the centre point on the bottom of the unit as shown. This temperature should not exceed max case temperature.



Thermal conditions (from which graphs are derived) utilise 20LFM from above.

Base-plate dimension 19" x 3.5 x 0.063" (height is EIA standard 2U)

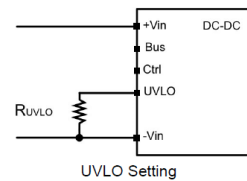
Heatsink can be ordered separately; 7G-0029B-F, 7G-0030B-F, 7G-0031B-F and 7G-0032B-F



Typical Connection

Undervoltage lock out

The ultra wide input QAE60U allows the under voltage lock out to be set higher than the default, by placing a resistor between the -Vin and UVLO pin. Use the equations and constants from the table below for the relevant product variant, to set the UVLO and corresponding shut down and start up voltages.



Part no	A	B	C
QAE60-36XXU	48000	8273	0.96
QAE60-72XXU	120000	12500	2.4

$$V_{start-up} = 1.25 \left(\frac{A(R_{uvlo} + B)}{R_{uvlo} \times B} + 1 \right)$$

$$V_{shutdown} = V_{start-up} - C$$

QAE60-36XXU Examples

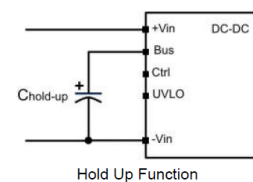
Nominal Input	12V	24V	36V	48V
Start up	8.46V	13.36V	20.56V	27.76V
Shut down	7.5V	12.4V	19.6V	26.8V
UVLO resistor	Open	12.35kΩ	4.98kΩ	3.12kΩ

QAE60-72XXU Examples

Nominal Input	24V	36V	48V	72V	96V	110V
Start up	14.8V	22V	29.2V	43.6V	58V	66.4V
Shut down	12.4V	19.6V	26.8V	41.2V	55.6V	64V
UVLO resistor	96.77kΩ	17.14kΩ	9.40kΩ	4.94kΩ	3.35kΩ	2.82kΩ

Hold up

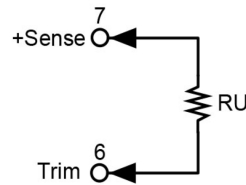
Use the Bus pin to increase hold up time, commonly used to satisfy S2 and C2 described in EN50155. Using the bus pin will reduce layout area, additional capacitance and reduce inrush current. For more information please contact sales with your require-



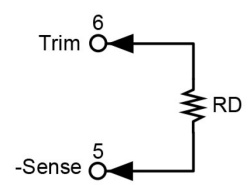
Trim Tables

Output voltage trim function allows the user to increase or decrease the output voltage set point. The module may be connected with an external resistor (R_{trim}) between TRIM pin and either +Vsense or -Vsense. By adjusting R_{trim}, the output voltage can be changed by +10% or -20% of nominal the output voltage.

Trim up (RU)



Trim Down RD



$$RU = \left(\frac{5.11V_{out}(100 + \Delta\%)}{1.225\Delta\%} - \frac{511 + 10.22\Delta\%}{\Delta\%} \right) k\Omega$$

$$RD = \left(\frac{511}{\Delta\%} - 10.22 \right) k\Omega$$

Use the equations to specify the trim up or the trim down resistor values. The resistor should be 1/8W or rated power

5V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	5.05	5.10	5.15	5.20	5.25	5.30	5.35	5.40	5.45	5.50	Volts
RU	1585.35	797.994	535.542	404.316	325.58	273.09	235.596	207.456	185.605	168.109	kOhms

12V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	Volts
RU	4534.55	2287.19	1538.08	1163.52	938.78	788.956	681.939	601.676	539.25	489.309	kOhms

15V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50	Volts
RU	5798.49	2925.42	1967.73	1488.89	1201.58	1010.04	873.229	770.619	690.812	626.966	kOhms

24V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40	Volts
RU	9590.32	4840.11	3256.7	2465	1989.98	1673.3	1447.1	1277.45	1145.5	1039.94	kOhms

28V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	28.28	28.56	28.84	29.12	29.40	29.68	29.96	30.24	30.52	30.80	Volts
RU	11275.58	5691.08	3829.58	2898.83	2340.38	1968.08	1702.151	1502.705	1347.58	1223.48	kOhms

48V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80	Volts
RU	19701.9	9945.94	6693.96	5067.97	4092.38	3441.99	2977.42	2628.99	2357.99	2141.19	kOhms

53V OUTPUT TRIM UP

ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	53.53	54.06	54.59	55.12	55.65	56.18	56.71	57.24	57.77	58.30	Volts
RU	21808.437	11009.651	7410.056	5610.259	4530.38	3810.461	3296.233	2910.562	2610.596	2370.623	kOhms

TRIM DOWN (ALL VOLTAGES)

ΔV%	1	2	3	4	5	6	7	8	9	10	%
RD	500.78	245.28	160.113	117.53	91.98	74.947	62.78	53.655	46.558	40.88	kOhms
ΔV%	11	12	13	14	15	16	17	18	19	20	%
RD	36.235	32.363	29.088	26.28	23.847	21.718	19.839	18.169	16.675	15.33	kOhms