



P-DUKE POWER

FEC60 Series

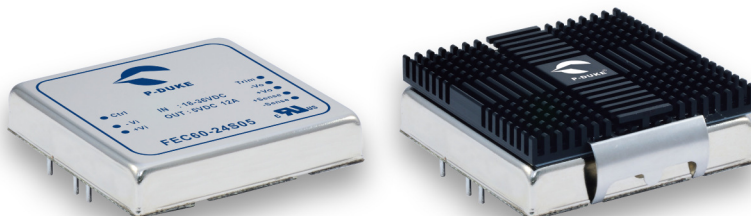
DC-DC Converter
Up to 60 Watts

3

YEARS
WARRANTY

ROHS
COMPLIANT

REACH
COMPLIANT



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



Railway

c US

CB CE

1600
VDC
Isolation
Voltage

2 : 1
Input
Range

6
sided
Shielding

NO
Min. Load
Required

REMOTE
ON
OFF

OCP

OTP

OVP

SCP

UVP

PART NUMBER STRUCTURE

FEC60 -

48

S

05

-

N

HC

Series Name

Input
Voltage
(VDC)

Output
Quantity

Output
Voltage
(VDC)

Remote On/Off
Option

Assembly Option

24:18~36
48:36~75

S:Single

3P3:3.3
05:5
12:12
15:15
24:24

☐: Positive logic
N: Negative logic

☐: None
HC: Heat-sink with Clamp

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

Model Number	Input Range	Output Voltage	Output Current @Full Load	Input Current @ No Load	Efficiency	Maximum Capacitor Load
	VDC	VDC	A	mA	%	μF
FEC60-24S3P3	18 ~ 36	3.3	14	100	89	36000
FEC60-24S05	18 ~ 36	5	12	130	90	20400
FEC60-24S12	18 ~ 36	12	5	50	90	3550
FEC60-24S15	18 ~ 36	15	4	50	90	2300
FEC60-24S24	18 ~ 36	24	2.5	50	89	885
FEC60-48S3P3	36 ~ 75	3.3	14	80	89	36000
FEC60-48S05	36 ~ 75	5	12	90	91	20400
FEC60-48S12	36 ~ 75	12	5	30	90	3550
FEC60-48S15	36 ~ 75	15	4	30	90	2300
FEC60-48S24	36 ~ 75	24	2.5	30	90	885

INPUT SPECIFICATIONS						
Parameter	Conditions			Min.	Typ.	Max. Unit
Operating input voltage range	24Vin(nom) 48Vin(nom)			18 36	24 48	36 75 VDC
Start up voltage	24Vin(nom) 48Vin(nom)					18 36 VDC
Shutdown voltage	24Vin(nom) 48Vin(nom)			14.5 31	15.5 32	17.5 35.5 VDC
Start up time	Constant resistive load	Power up				20 ms
		Remote ON/OFF				20 ms
Input surge voltage	100 ms, max.	24Vin(nom) 48Vin(nom)				50 100 VDC
Input filter				Pi type		
Remote ON/OFF	Referred to –Vin pin	Positive logic (Standard) Negative logic (Option) Input current of Ctrl pin Remote off input current	DC-DC ON DC-DC OFF DC-DC ON DC-DC OFF	-0.5	4.0	mA mA
						Open or 3 ~ 12VDC Short or 0 ~ 1.2VDC Short or 0 ~ 1.2VDC Open or 3 ~ 12VDC

OUTPUT SPECIFICATIONS						
Parameter	Conditions			Min.	Typ.	Max. Unit
Voltage accuracy				-1.0		+1.0 %
Line regulation	Low Line to High Line at Full Load			-0.2		+0.2 %
Load regulation	No Load to Full Load			-0.5		+0.5 %
Voltage adjustability		24Vout Others		-10 -10		+20 +10 %
Ripple and noise	Measured by 20MHz bandwidth	3.3Vout, 5Vout 12Vout, 15Vout 24Vout			75 100 200	mVp-p
Temperature coefficient				-0.02		+0.02 %/°C
Transient response recovery time	25% load step change				250	μs
Over voltage protection		3.3Vout 5Vout 12Vout 15Vout 24Vout		3.7 5.6 13.8 16.8 30.0		5.4 7.0 17.5 20.5 33.0 VDC
Over load protection	% of Iout rated					150 %
Short circuit protection				Continuous, automatic recovery		

GENERAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Isolation voltage	1 minute Input to Output Input(Output) to Case	1600 1600			VDC
Case grounding				Connect case to -Vin with decoupling Y Cap	
Isolation resistance	500VDC	1			GΩ
Isolation capacitance				1500	pF
Switching frequency		270	300	330	kHz
Safety approvals	IEC/ UL/ EN60950-1			UL:E193009 CB: UL(Demko)	
Case material				Nickel-coated copper	
Base material				FR4 PCB	
Potting material				Epoxy (UL94 V-0)	
Weight				60g (2.11oz)	
MTBF	MIL-HDBK-217F, Full load			4.089 x 10 ⁵ hrs	

ENVIRONMENTAL SPECIFICATIONS

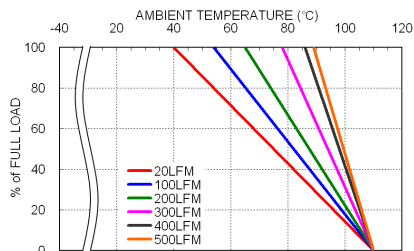
Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating ambient temperature	Without derating With derating	-40 +40		+40 +110	°C
Maximum case temperature				+110	°C
Over temperature protection			+120		°C
Storage temperature range		-55		+125	°C
Thermal impedance	Without heat-sink With heat-sink		10.5 8.4		°C/W
Thermal shock				MIL-STD-810F	
Vibration				MIL-STD-810F	
Relative humidity				5% to 95% RH	

EMC SPECIFICATIONS

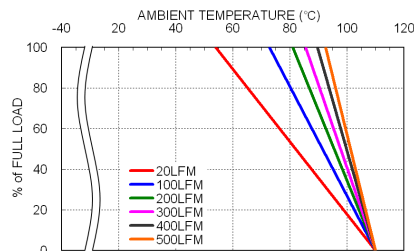
Parameter	Conditions	Level
EMI	EN55032 With external components	Class A, Class B
ESD	EN61000-4-2 Air ± 8kV and Contact ± 6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3 10 V/m	Perf. Criteria A
Fast transient	EN61000-4-4 ± 2kV	Perf. Criteria A
Surge	EN61000-4-5 ± 1kV With an external input filter capacitor (Nippon chemi-con KY series, 220μF/100V)	Perf. Criteria A
Conducted immunity	EN61000-4-6 10 Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8 100A/m continuous; 1000A/m 1 second	Perf. Criteria A

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

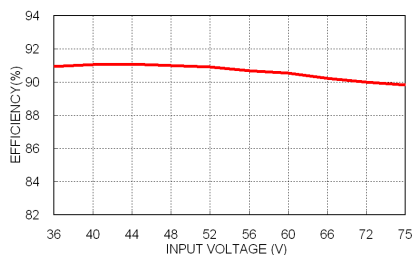
CHARACTERISTIC CURVE



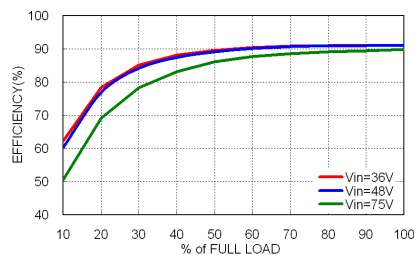
FEC60-48S05 Derating Curve



FEC60-48S05 Derating Curve With Heat-sink



FEC60-48S05 Efficiency vs. Input Voltage



FEC60-48S05 Efficiency vs. Output Load

FUSE CONSIDERATION

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

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.

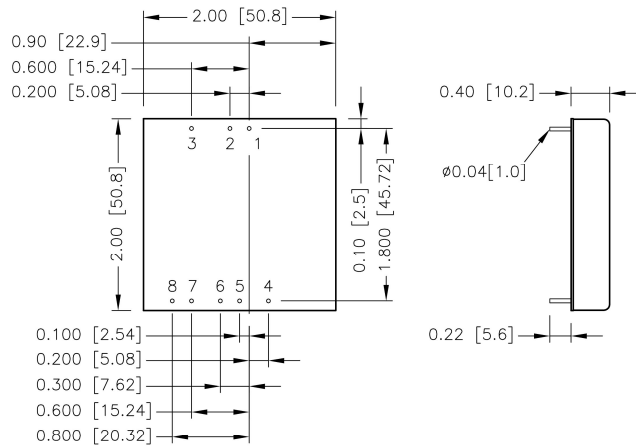
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

Model	Fuse Rating (A)	Fuse Type
FEC60-24S□□	6.3	Slow-Blow
FEC60-48S□□	3.15	Slow-Blow

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

MECHANICAL DRAWING



BOTTOM VIEW

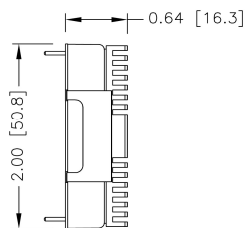
PIN CONNECTION

PIN	SINGLE
1	+Vin
2	-Vin
3	Ctrl
4	-Sense
5	+Sense
6	+Vout
7	-Vout
8	Trim

1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]
x.xxx±0.01 [x.xx±0.25]
3. Pin pitch tolerance ±0.01 [0.25]
4. Pin dimension tolerance ±0.004[0.10]

HEAT-SINK OPTIONS

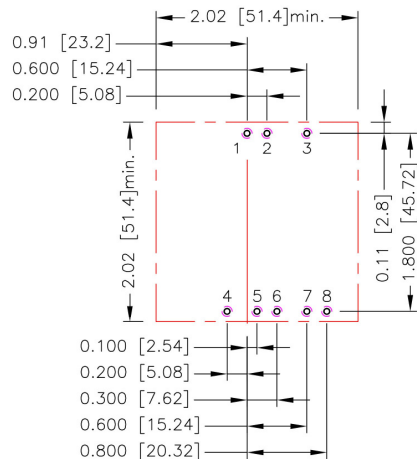
-HC (Heat-sink with clamps)



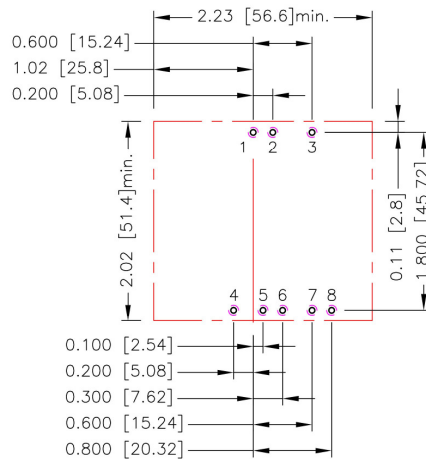
* All dimensions in inch [mm]

RECOMMENDED PAD LAYOUT

Standard



-HC



All dimensions in inch[mm]
 Pad size(lead free recommended)
 Through hole 1.2.3.4.5.6.7.8: $\varnothing 0.051[1.30]$
 Top view pad 1.2.3.4.5.6.7.8: $\varnothing 0.064[1.63]$
 Bottom view pad 1.2.3.4.5.6.7.8: $\varnothing 0.102[2.60]$

THERMAL CONSIDERATIONS

The power module operates in a variety of thermal environments.

However, sufficient cooling should be provided to help ensure reliable operation of the unit.

Heat is removed by conduction, convection, and radiation to the surrounding Environment.

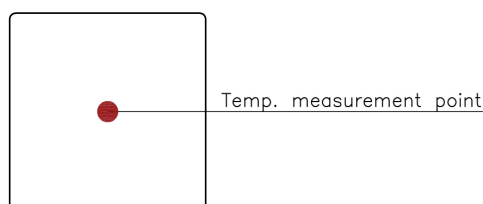
Proper cooling can be verified by measuring the point as the figure below.

The temperature at this location should not exceed 110°C.

When Operating, adequate cooling must be provided to maintain the test point temperature at or below 110°C.

Although the maximum point Temperature of the power modules is 110°C, you can limit this Temperature to a lower value for extremely high reliability.

- Thermal test condition with vertical direction by natural convection (20LFM).



TOP VIEW

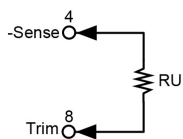
OUTPUT VOLTAGE ADJUSTMENT

Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of the module. This is accomplished by connecting an external resistor between the Trim pin and either the +Sense or -Sense pins. With an external resistor between the Trim and -Sense, the output voltage set point increases. With an external resistor between the Trim and +Sense, the output voltage set point decreases. The external Trim resistor needs to be at least 1/16W resistors.

EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

Trim-up



☐ S3P3

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.630
RU (k Ω)	57.930	26.165	15.577	10.283	7.106	4.988	3.476	2.341	1.459	0.753

☐ S05

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.050	5.100	5.150	5.200	5.250	5.300	5.350	5.400	5.450	5.500
RU (k Ω)	36.570	16.580	9.917	6.585	4.586	3.253	2.302	1.588	1.032	0.588

☐ S12

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	12.120	12.240	12.360	12.480	12.600	12.720	12.840	12.960	13.080	13.200
RU (k Ω)	367.910	165.950	98.636	64.977	44.782	31.318	21.701	14.488	8.879	4.391

☐ S15

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	15.150	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500
RU (k Ω)	404.180	180.590	106.060	68.796	46.437	31.531	20.883	12.898	6.687	1.718

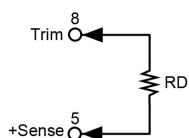
☐ S24

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	24.240	24.480	24.720	24.960	25.200	25.440	25.680	25.920	26.160	26.400
RU (k Ω)	1275.226	606.613	383.742	272.306	205.445	160.871	129.032	105.153	86.581	71.723

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	26.640	26.880	27.120	27.360	27.600	27.840	28.080	28.320	28.560	28.800
RU (k Ω)	59.566	49.435	40.864	33.516	27.148	21.577	16.660	12.290	8.380	4.861

OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down



□□S3P3

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.970
RD (k Ω)	69.470	31.235	18.490	12.117	8.294	5.745	3.924	2.559	1.497	0.647

□□S05

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	4.950	4.900	4.850	4.800	4.750	4.700	4.650	4.600	4.550	4.500
RD (k Ω)	45.533	20.612	12.306	8.152	5.660	3.999	2.812	1.922	1.230	0.676

□□S12

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	11.880	11.760	11.640	11.520	11.400	11.280	11.160	11.040	10.920	10.800
RD (k Ω)	460.990	207.950	123.600	81.423	56.118	39.249	27.199	18.162	11.132	5.509

□□S15

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	14.850	14.700	14.550	14.400	14.250	14.100	13.950	13.800	13.650	13.500
RD (k Ω)	499.820	223.410	131.270	85.204	57.563	39.136	25.974	16.102	8.424	2.282

□□S24

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	23.760	23.520	23.280	23.040	22.800	22.560	22.320	22.080	21.840	21.600
RD (k Ω)	838.174	376.787	222.991	146.094	99.955	69.196	47.225	30.747	17.930	7.677