



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

UL US CB CE UK CA

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 Options | Assembly Options |
| | 24:18~36 48:36~75 | S:Single | 3P3:3.3 05:5 12:12 15:15 | | <input type="checkbox"/> : Positive logic N: Negative logic | <input type="checkbox"/> : 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 |
| FEC60-48S3P3 | 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 |

| 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 Remote ON/OFF | 20 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) DC-DC ON DC-DC OFF Negative logic (Option) DC-DC ON DC-DC OFF Input current of Ctrl pin Remote off input current | -0.5 | 4.0 | Open or 3 ~ 12VDC Short or 0 ~ 1.2VDC Short or 0 ~ 1.2VDC Open or 3 ~ 12VDC +1.0 | mA mA |

| 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 | | | -10 | | +10 | % |
| Ripple and noise | Measured by 20MHz bandwidth | 3.3Vout, 5Vout 12Vout, 15Vout | | 75 100 | | 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 | | 3.7 5.6 13.8 16.8 | | 5.4 7.0 17.5 20.5 | 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/ EN/ UL62368-1 | | | | 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

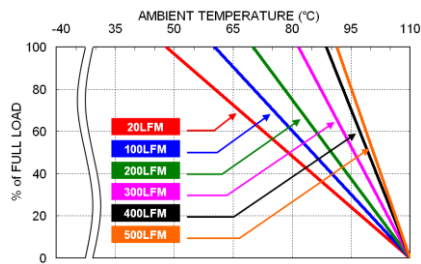
| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|-------------------------------------|------------|-------------|-------------|--------------|
| Operating ambient temperature | Without derating With derating | -40 +40 | | +40 +110 | °C |
| Maximum case temperature | | | | 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

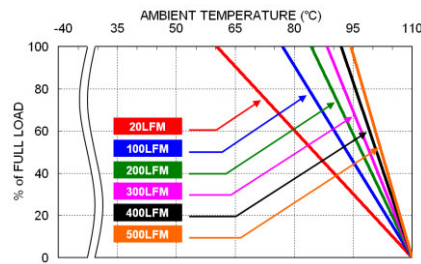
| Parameter | Conditions | Level |
|--------------------------------|--|------------------|
| EMI | EN55032 With external components | Class A, Class B |
| EMS | EN55035 | |
| ESD | EN61000-4-2 Air ± 8kV and Contact ± 6kV | Perf. Criteria A |
| Radiated immunity | EN61000-4-3 10 V/m | Perf. Criteria 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.

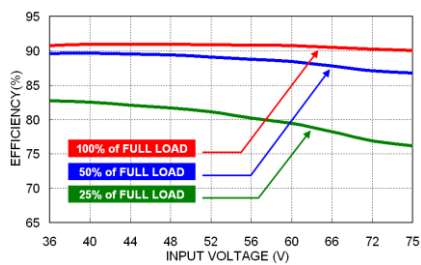
CHARACTERISTIC CURVE



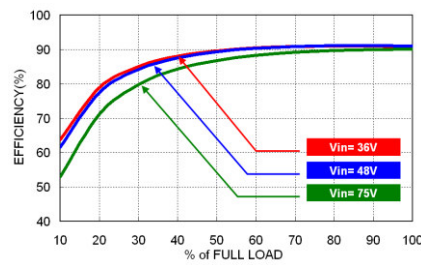
FEC60-48S05 Derating Curve



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.

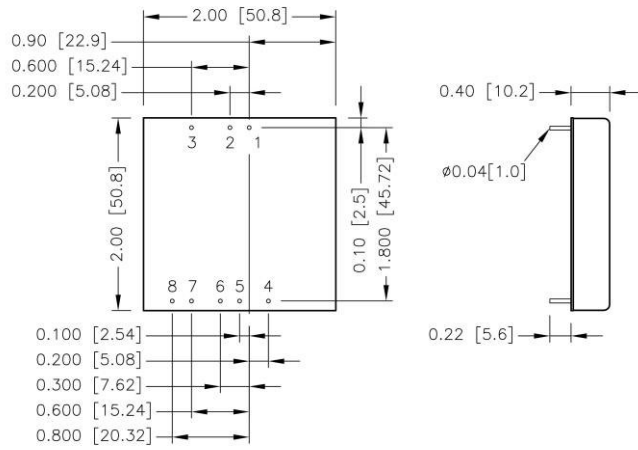
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

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

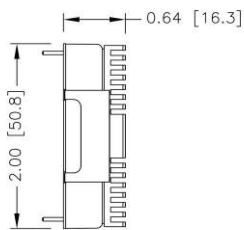
PIN CONNECTION

| PIN | DEFINE |
|-----|--------|
| 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 dimension tolerance ±0.004[0.10]

HEAT-SINK OPTIONS

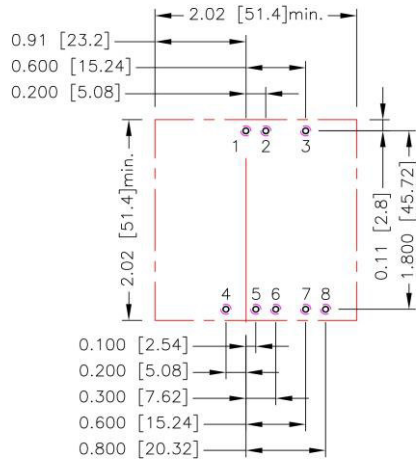
-HC (Heat-sink with clamps)



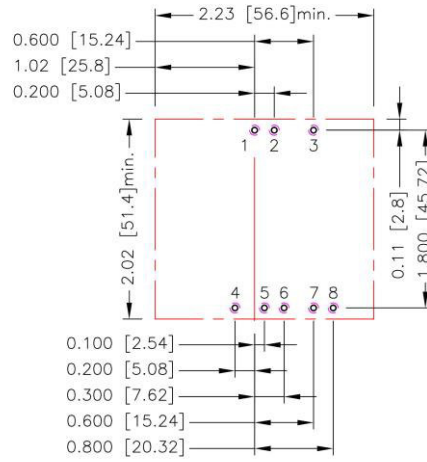
* All dimensions in inch [mm]

RECOMMENDED PAD LAYOUT

Standard



-HC

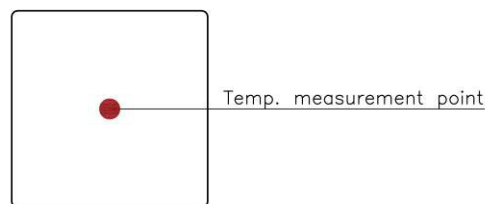


All dimensions in inch[mm]
 Pad size(lead free recommended)
 Through hole 1.2.3.4.5.6.7.8: $\varnothing 0.051[1.30]$
 Top view pad 1.2.3.4.5.6.7.8: $\varnothing 0.064[1.63]$
 Bottom view pad 1.2.3.4.5.6.7.8: $\varnothing 0.102[2.60]$

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 "Maximum case temperature". When operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature". You can limit this temperature to a lower value for extremely high reliability.

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



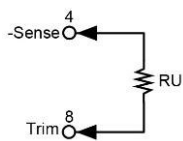
TOP VIEW

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

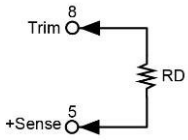
| ΔV (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 12.120 | 12.240 | 12.360 | 12.480 | 12.600 | 12.720 | 12.840 | 12.960 | 13.080 | 13.200 |
| RU (k Ω) | 367.910 | 165.950 | 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 |

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 |