



# P-DUKE POWER

## FEC15 Series

DC-DC Converter  
Up to 15 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

REMOTE  
ON  
OFF

OCP

OVP

SCP

### PART NUMBER STRUCTURE

| FEC15 -     | 48                              | S               | 05                                | - | M3                                                                                                                | P                                                                        | HC                                                          |
|-------------|---------------------------------|-----------------|-----------------------------------|---|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|
| Series Name | Input Voltage (VDC)             | Output Quantity | Output Voltage (VDC)              |   | Operating Temp. Options                                                                                           | Remote On/Off Options                                                    | Assembly Options                                            |
|             | 12:9~18<br>24:18~36<br>48:36~75 | S:Single        | 3P3:3.3<br>05:5<br>12:12<br>15:15 |   | <input type="checkbox"/> :Standard<br>-40~+100°C<br>With derating<br>M3:M3 Version<br>-55~+100°C<br>With derating | <input type="checkbox"/> :No pin<br>P:Positive logic<br>N:Negative logic | <input type="checkbox"/> : None<br>HC: Heat-sink with Clamp |
|             |                                 | D:Dual          | 05:±5<br>12:±12<br>15:±15         |   |                                                                                                                   |                                                                          |                                                             |

## 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 |
|--------------|-------------|----------------|---------------------------|-----------|-------------------------|------------|------------------------|
|              |             |                | Min. Load                 | Full Load |                         |            |                        |
|              | VDC         | VDC            | mA                        | mA        | mA                      | %          | μF                     |
| FEC15-12S33  | 9 ~ 18      | 3.3            | 0                         | 4000      | 30                      | 79         | 10200                  |
| FEC15-12S05  | 9 ~ 18      | 5              | 15                        | 3000      | 25                      | 82         | 7050                   |
| FEC15-12S12  | 9 ~ 18      | 12             | 0                         | 1250      | 25                      | 86         | 1035                   |
| FEC15-12S15  | 9 ~ 18      | 15             | 0                         | 1000      | 20                      | 86         | 705                    |
| FEC15-12D05  | 9 ~ 18      | ±5             | 0                         | ±1500     | 20                      | 83         | ±1020                  |
| FEC15-12D12  | 9 ~ 18      | ±12            | 0                         | ±625      | 30                      | 86         | ±495                   |
| FEC15-12D15  | 9 ~ 18      | ±15            | ±10                       | ±500      | 35                      | 84         | ±165                   |
| FEC15-24S33  | 18 ~ 36     | 3.3            | 0                         | 4000      | 15                      | 80         | 10200                  |
| FEC15-24S05  | 18 ~ 36     | 5              | 15                        | 3000      | 10                      | 84         | 7050                   |
| FEC15-24S12  | 18 ~ 36     | 12             | 0                         | 1250      | 20                      | 85         | 1035                   |
| FEC15-24S15  | 18 ~ 36     | 15             | 10                        | 1000      | 15                      | 85         | 705                    |
| FEC15-24D05  | 18 ~ 36     | ±5             | 0                         | ±1500     | 15                      | 84         | ±1020                  |
| FEC15-24D12  | 18 ~ 36     | ±12            | 0                         | ±625      | 25                      | 86         | ±495                   |
| FEC15-24D15  | 18 ~ 36     | ±15            | 0                         | ±500      | 25                      | 86         | ±165                   |
| FEC15-48S33  | 36 ~ 75     | 3.3            | 0                         | 4000      | 10                      | 81         | 10200                  |
| FEC15-48S05  | 36 ~ 75     | 5              | 0                         | 3000      | 20                      | 83         | 7050                   |
| FEC15-48S12  | 36 ~ 75     | 12             | 10                        | 1250      | 15                      | 87         | 1035                   |
| FEC15-48S15  | 36 ~ 75     | 15             | 0                         | 1000      | 15                      | 86         | 705                    |
| FEC15-48D05  | 36 ~ 75     | ±5             | 0                         | ±1500     | 10                      | 85         | ±1020                  |
| FEC15-48D12  | 36 ~ 75     | ±12            | 0                         | ±625      | 15                      | 88         | ±495                   |
| FEC15-48D15  | 36 ~ 75     | ±15            | 0                         | ±500      | 15                      | 87         | ±165                   |

\* The output requires a minimum loading on the output to maintain specified regulation. Operation under no-load condition will not damage these devices, however they may not meet all listed specification.

## INPUT SPECIFICATIONS

| Parameter                     | Conditions              |                           | Min.      | Typ.                | Max. | Unit |    |
|-------------------------------|-------------------------|---------------------------|-----------|---------------------|------|------|----|
| Operating input voltage range |                         | 12Vin(nom)                | 9         | 12                  | 18   | VDC  |    |
|                               |                         | 24Vin(nom)                | 18        | 24                  | 36   |      |    |
|                               |                         | 48Vin(nom)                | 36        | 48                  | 75   |      |    |
| Start up time                 | Constant resistive load | Power up                  | 20        |                     |      | ms   |    |
| Input surge voltage           | 100 ms, max.            | 12Vin(nom)                | 36        |                     |      | VDC  |    |
|                               |                         | 24Vin(nom)                | 50        |                     |      |      |    |
|                               |                         | 48Vin(nom)                | 100       |                     |      |      |    |
| Input filter                  |                         |                           | Pi type   |                     |      |      |    |
| Remote ON/OFF (Option)        | Referred to –Vin pin    | Positive logic            | DC-DC ON  | Open or 3.5 ~ 12VDC |      |      | mA |
|                               |                         |                           | DC-DC OFF | Short or 0 ~ 1.2VDC |      |      |    |
|                               |                         | Negative logic            | DC-DC ON  | Short or 0 ~ 1.2VDC |      |      |    |
|                               |                         |                           | DC-DC OFF | Open or 3.5 ~ 12VDC |      |      |    |
|                               |                         | Input current of Ctrl pin | -0.5      | +1.0                |      |      |    |
|                               |                         | Remote off input current  | 20        |                     |      | 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 | -0.5  |      | +0.5  | %                              |
| Load regulation                  | Min. Load to Full Load             | -0.5  |      | +0.5  | %                              |
|                                  | Single                             | -1.0  |      | +1.0  | %                              |
|                                  | Dual                               |       |      |       |                                |
| Cross regulation                 | Asymmetrical load 25%/100% FL      | -5.0  |      | +5.0  | %                              |
| Ripple and noise                 | Measured by 20MHz bandwidth        |       | 50   |       | mVp-p                          |
|                                  | Single                             |       | 75   |       |                                |
|                                  | Dual                               |       |      |       |                                |
| Temperature coefficient          |                                    | -0.02 |      | +0.02 | %/°C                           |
| Transient response recovery time | 25% load step change               |       | 250  |       | μs                             |
| Over voltage protection          | Zener diode clamp                  |       | 3.9  |       | VDC                            |
|                                  | 3.3Vout                            |       | 6.2  |       |                                |
|                                  | 5Vout                              |       | 15   |       |                                |
|                                  | 12Vout                             |       | 18   |       |                                |
|                                  | 15Vout                             |       |      |       |                                |
| Over load protection             | % of lout rated                    |       |      | 150   | %                              |
| Short circuit protection         |                                    |       |      |       | Continuous, automatic recovery |

**GENERAL SPECIFICATIONS**

| Parameter             | Conditions               | Min. | Typ. | Max. | Unit                         |
|-----------------------|--------------------------|------|------|------|------------------------------|
| Isolation voltage     | 1 minute                 | 1600 |      |      | VDC                          |
|                       | Input to Output          | 1600 |      |      |                              |
|                       | Input(Output) to Case    |      |      |      |                              |
| Isolation resistance  | 500VDC                   | 1    |      |      | GΩ                           |
| Isolation capacitance |                          |      |      | 300  | pF                           |
| Switching frequency   | Single                   | 450  | 500  | 550  | kHz                          |
|                       | Dual                     | 270  | 300  | 330  |                              |
| Safety approvals      | IEC/ EN/ UL 62368-1      |      |      |      | UL:E193009<br>CB: UL(Demko)  |
| Case material         |                          |      |      |      | Nickel-coated copper         |
| Base material         |                          |      |      |      | Non-conductive black plastic |
| Potting material      |                          |      |      |      | Epoxy (UL94 V-0)             |
| Weight                |                          |      |      |      | 27g (0.95oz)                 |
| MTBF                  | MIL-HDBK-217F, Full load |      |      |      | 2.318 x 10 <sup>6</sup> hrs  |

**ENVIRONMENTAL SPECIFICATIONS**

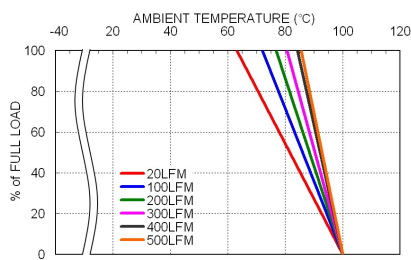
| Parameter                     | Conditions        | Min. | Typ. | Max. | Unit         |
|-------------------------------|-------------------|------|------|------|--------------|
| Operating ambient temperature | Standard          | -40  |      | +100 | °C           |
|                               | M3                | -55  |      | +100 |              |
| Maximum case temperature      |                   |      |      | 100  | °C           |
| Storage temperature range     |                   | -55  |      | +125 | °C           |
| Thermal impedance             | Without heat-sink |      | 12   |      | °C/W         |
|                               | With heat-sink    |      | 10   |      |              |
| Thermal shock                 |                   |      |      |      | MIL-STD-810F |
| Vibration                     |                   |      |      |      | MIL-STD-810F |
| Relative humidity             |                   |      |      |      | 5% to 95% RH |

## EMC SPECIFICATIONS

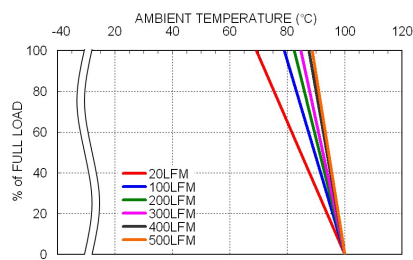
| Parameter                      | Conditions  |                                                                                                  | Level            |
|--------------------------------|-------------|--------------------------------------------------------------------------------------------------|------------------|
| EMI                            | EN55032     | With external components                                                                         | Class A, Class B |
| EMS                            | EN55024     |                                                                                                  |                  |
| ESD                            | EN61000-4-2 | Air $\pm 8\text{kV}$ and Contact $\pm 6\text{kV}$                                                | Perf. Criteria B |
| Radiated immunity              | EN61000-4-3 | 10 V/m                                                                                           | Perf. Criteria A |
| Fast transient                 | EN61000-4-4 | $\pm 2\text{kV}$                                                                                 | Perf. Criteria B |
| Surge                          | EN61000-4-5 | With an external input filter capacitor<br>(Nippon chemi-con KY series, 220 $\mu\text{F}$ /100V) | Perf. Criteria B |
|                                |             | $\pm 1\text{kV}$                                                                                 |                  |
| 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.

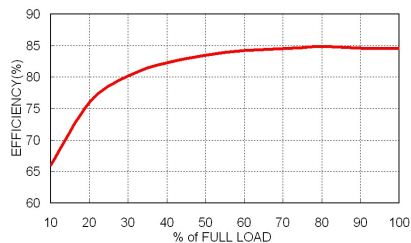
## CHARACTERISTIC CURVE



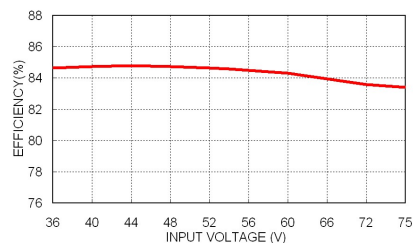
FEC15-48S05 Derating Curve



FEC15-48S05 Derating Curve With Heat-sink



FEC15-48S05 Efficiency vs. Output Load



FEC15-48S05 Efficiency vs. Input Voltage

## 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.

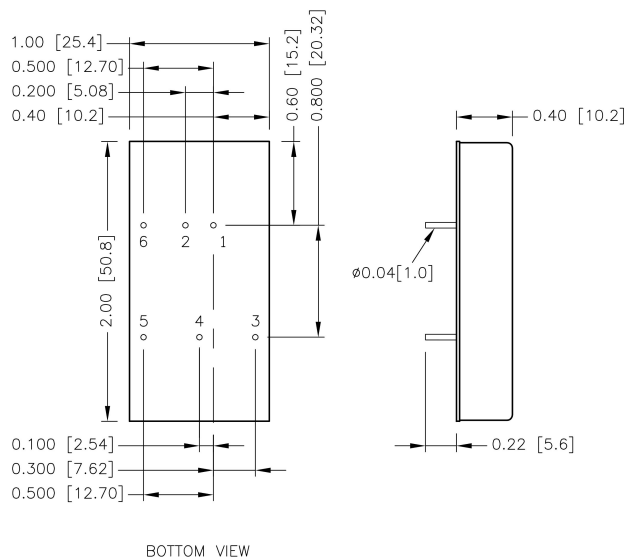
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

| Model                   | Fuse Rating (A) | Fuse Type |
|-------------------------|-----------------|-----------|
| FEC15-12S□□、FEC15-12D□□ | 3.15            | Slow-Blow |
| FEC15-24S□□、FEC15-24D□□ | 1.6             | Slow-Blow |
| FEC15-48S□□、FEC15-48D□□ | 1.0             | 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



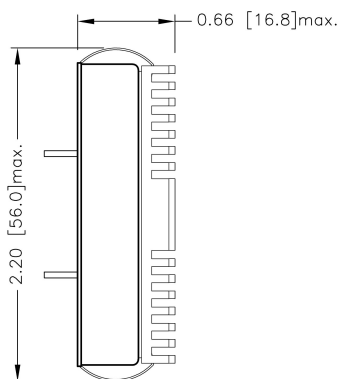
### PIN CONNECTION

| PIN | SINGLE         | DUAL           |
|-----|----------------|----------------|
| 1   | +Vin           | +Vin           |
| 2   | -Vin           | -Vin           |
| 3   | +Vout          | +Vout          |
| 4   | No pin         | Common         |
| 5   | -Vout          | -Vout          |
| 6   | Ctrl(Optional) | Ctrl(Optional) |

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

## HEAT-SINK OPTIONS

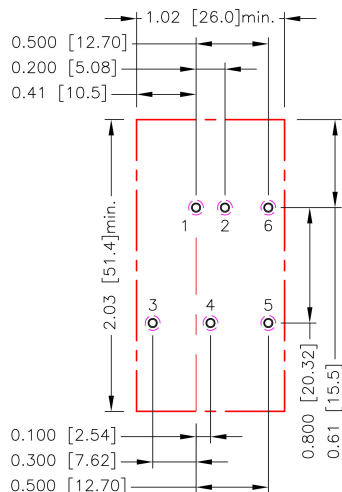
-HC (Heat-sink with clamps)



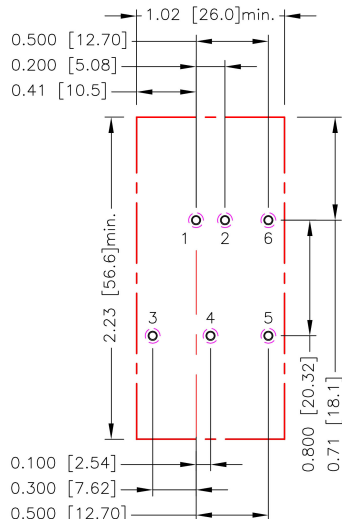
\* All dimensions in inch [mm]

## RECOMMENDED PAD LAYOUT

### Standard



### -HC



All dimensions in inch[mm]  
 Pad size(lead free recommended)  
 Through hole 1.2.3.4.5.6:  $\varnothing 0.051[1.30]$   
 Top view pad 1.2.3.4.5.6:  $\varnothing 0.064[1.63]$   
 Bottom view pad 1.2.3.4.5.6:  $\varnothing 0.102[2.60]$

## 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.

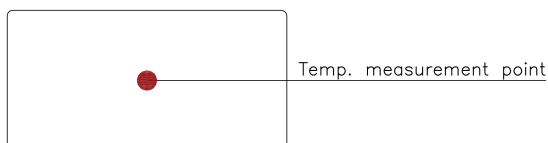
Proper cooling can be verified by measuring the point as the figure below.

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