# EPM12V2
## Non-isolated DC-DC converter

### Product features

- Non-isolated DC-DC converter
- 3 - 14.4 Vdc input voltage range
- Efficiency up to 91%
- Operating ambient temperature from -40 °C to +90 °C
- Short circuit protection and remote ON/OFF function
- Programmable output voltage from 0.6 - 5.5 Vdc
- EN62368 safety approval

### Engineering tools

- EPM12V2 Evaluation kit available (2 options)
- PN: EPM12V2-P-EVK (Positive logic version) Includes evaluation board with EPM12V2 sample
- PN: EPM12V2-N-EVK (Negative logic version) Includes evaluation board with EPM12V2 sample
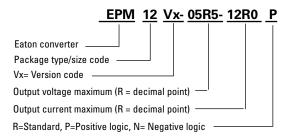- EPM12V2 Evaluation kit user guide

### Applications

- Industrial
  - Automation & testing equipment
  - Displays
  - Lighting
  - IoT
  - Power Supply
- Energy
  - Solar and wind inverters
  - Battery management
- Medical
  - Hospital & home care equipment
  - Inventory tracking
  - Diagnostics
- Telecom
  - Networking and telecommunications
  - Infrastructure

### Environmental compliance

RoHS

### Ordering part number

**EPM 12 Vx- 05R5- 12R0 P**

Eaton converter

Package type/size code

Vx= Version code

Output voltage maximum (R = decimal point)

Output current maximum (R = decimal point)

R=Standard, P=Positive logic, N= Negative logic

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## Specifications

| | Parameter | Conditions | | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|---|---|---|
| **Input** | Input voltage range | | | 3 | 12 | 14.4 | Vdc |
| | Start-up voltage | 0%~100% load | | | | 3 | Vdc |
| | VULO | | | 2.6 | | | V |
| | Remote ON/OFF | Positive | DC-DC ON DC-DC OFF | Open or 1.6 V ≤ Von/off ≤ 5.5 V Short to Gnd or 0 V ≤ Von/off ≤ 0.6 V | | | |
| | | Negative | DC-DC ON DC-DC OFF | Short to Gnd or 0 V ≤ Von/off ≤ 0.6 V 1 V ≤ Von/off ≤ 5.5 V | | | |
| **Output** | Efficiency | Vo = 5 Vdc | | | 91 | | % |
| | | Vo = 3.3 Vdc | | | 88 | | % |
| | | Vo = 2.5 Vdc | | | 86 | | % |
| | | Vo = 1.8 Vdc | | | 82.5 | | % |
| | | Vo = 1.2 Vdc | | | 77 | | % |
| | | Vo = 0.6 Vdc | | | 65 | | % |
| | Output voltage trim[1] | | | 0.6 | | 5.5 | Vdc |
| | Minimum load | | | 0 | | | % |
| | Line regulation | LL-HL | | | | ±0.4 | % |
| | Load regulation | 10-100% Load | | | | ±0.2 | % |
| | Voltage accuracy | | | | ±0.3 | | % |
| | Operating frequency | 100% Load at nominal Vin | | | 800 | | kHz |
| | Ripple & noise[2] | Vo ≤ 1.2 Vdc | | | 30 | | mVp-p |
| | | Vo > 1.2 Vdc | | | 3% Vo | | mVp-p |
| | Power good | Overvoltage threshold for PGOOD ON | | | 116.5 | | % |
| | | Overvoltage threshold for PGOOD OFF | | | 120 | | % |
| | | Undervoltage threshold for PGOOD ON | | | 91 | | % |
| | | Undervoltage threshold for PGOOD OFF | | | 87 | | % |
| | | PGOOD low sink current @VPGOOD = 0.2 V | | | 100 | | µA |
| **Environment** | Operating temperature | With derating | | -40 | | +90 | °C |
| | Storage temperature | | | -55 | | +125 | °C |
| | Relative humidity | | | | | 95 | %RH |
| | Vibration | | | MIL-STD-202G | | | |
| **Function** | Short circuit protection | | | Continuous, automatic recovery | | | |
| | Safety | | | EN 62368-1 | | | |
| | MTBF | MIL-HDBK217F | | 1132 | | | khours |
| **Frequency synchronization** | Synchronization frequency range[3] | | | | 800 | 840 | kHZ |
| | High-level input voltage | | | 2 | | | V |
| | Low-level input voltage | | | | | 0.8 | V |
| | Input current, SYNC | | | | 1 | | µ A |
| **Physical** | Dimension | | | 0.480 (L) x 0.480 (W) x 0.122 (H) | | | inches |
| | Weight | | | 0.8 | | | g |
| | Case material | | | Open frame | | | |
| | Cooling method | | | Free air convention | | | |
| **EMC** | EMI | EN 55032 | | Class A | | | |
| | ESD | EN61000-4-2 Air ± 8 kV Contact ± 8 kV | | Criteria B | | | |
| | Fast transient | EN 61000-4-4, ±2 kV | | Criteria B | | | |
| | Surge | EN 61000-4-5, ±2 kV | | Criteria A | | | |

1. The output voltage range is limited by Vin. (Vout ≤ Vin − 2 Vdc)
2. The ripple & noise are measured with 47 µF + 47 µF + 0.1 µF capacitor at 20 MHz BW.
3. SYNC frequency must be greater than operating frequency, externally tie SYNC to GND if synchronization functionality not required.
4. All specifications valid at nominal input voltage, full load and +25 °C after warm-up time unless otherwise stated.
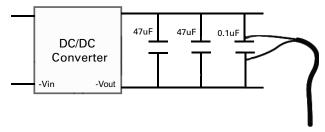5. The product information and specifications are subject to change without prior notice.
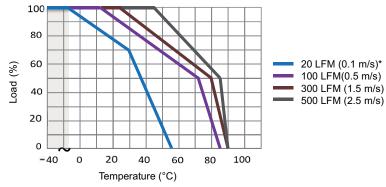
## Selection guide

| Part number | Input voltage | Output voltage | Output current @ full load | Input current @ no load | Efficiency[1] typical | Capacitive load[2] maximum | ON/OFF Logic |
|---|---|---|---|---|---|---|---|
| EPM12V2-05R5-12R0P | 3 - 14.4 Vdc | 0.6 - 5.5 Vdc | 12 A | 30 mA | 91% | 200 μF | Positive |
| EPM12V2-05R5-12R0N | 3 - 14.4 Vdc | 0.6 - 5.5 Vdc | 12 A | 30 mA | 91% | 200 μF | Negative |

1. The no load input current is test by 0.6 V output.

2. The efficiency is test by nominal input, 5 Vout and full load @ +25 °C.

3. The capacitive load is test by minimum input and constant resistive load

4. All specifications valid at 12 V input, full load and +25 °C after warm-up time unless otherwise stated.

## Measure method



## Derating curve



The derating curve was measured at 12 V input and 5 V output.

* The derating curve is at 7 V input and 5 V output

## Output voltage vs. input voltage

## Application information

### Output voltage trim



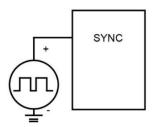Trim resistor equation

$$\text{Rtrim (k}\Omega) = \frac{12K}{Vo-0.6}$$

| Output voltage | Calculated Rtrim (kΩ) |
|---|---|
| 5.0 V | 2.727 |
| 3.3 V | 4.444 |
| 2.5 V | 6.316 |
| 1.8 V | 10 |
| 1.5 V | 13.3 |
| 1.2 V | 20 |
| 0.6 V | ∞ (Open) |

### Power good

Power good monitor output. This open-drain output goes low during overcurrent, short-circuit, UVLO, overvoltage and undervoltage, overtemperature, or when the output is not regulated (such as a pre-bias output). An external pullup resistor to VDD or to an external rail is required. Included is a 20-µs deglitch filter. PGOOD pin can be connected through a pullup resistor suggested value 100 kΩ) to a source of 5 Vdc or lower.

### Synchronization

The module switching frequency can be synchronized to a signal with an external frequency within a specified range. Synchronization can be done by using the external signal applied to the SYNC pin of the module, with the converter being synchronized by the rising edge of the external signal. The electrical specifications table specifies the requirements of the external SYNC signal. If the SYNC pin is not used, the module should free run at the default switching frequency. If synchronization is not being used, connect the SYNC pin to GND.
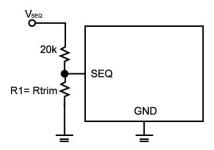


### Output voltage sequencing

The SEQ pin can be used when master-slave power-supply tracking is required.
The voltage applied to the SEQ pin should be scaled down by the same ratio as used to scale the output voltage down to the reference voltage of the module. This is accomplished by an external resistive divider connected across the sequencing voltage before it is fed to the SEQ pin.
The minimum recommended delay between the ON/OFF signal and the sequencing signal is 10 ms to ensure that the module output is ramped up according to the sequencing signal. This ensures that the module soft-start routine is completed before the sequencing signal is allowed to ramp up.
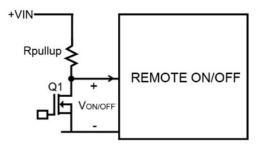When an analog voltage is applied to the SEQ pin, the output voltage tracks this voltage until the output reaches the set-point voltage. The final value of the SEQ voltage must be set higher than the set-point voltage of the module. The output voltage follows the voltage on the SEQ pin on a one-to-one basis. By connecting multiple modules together, multiple modules can track their output voltages to the voltage applied on the SEQ pin.
To initiate simultaneous shutdown of the modules, the SEQ pin voltage is lowered in a controlled manner. The output voltage of the modules tracks the voltages below their setpoint voltages on a one-to-one basis. A valid input voltage must be maintained until the tracking and output voltages reach ground potential.



The SEQ pin can be used when master-slave power-supply tracking is required
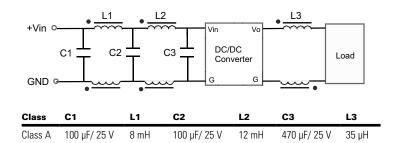
### Remote ON/OFF



Logic type active mode
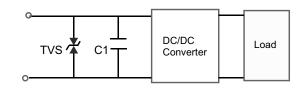
Positive Logic
  DC/DC ON : Q1 OFF
  DC/DC OFF : Q1 ON

Negative Logic
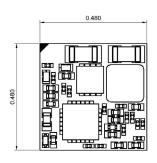  DC/DC ON : Q1 ON
  DC/DC OFF: Q1 OFF

## EMC filtering circuit
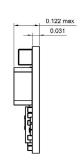


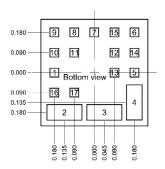| Class | C1 | L1 | C2 | L2 | C3 | L3 |
|---|---|---|---|---|---|---|
| Class A | 100 µF/ 25 V | 8 mH | 100 µF/ 25 V | 12 mH | 470 µF/ 25 V | 35 µH |

## ETF and surge circuit



| TVS | C1 |
|---|---|
| Eaton P4SMA13CA | 10000 µF 25 V |

## Mechanical dimension and pinning - inches



Projection: Third angle projection
Tolerance: ± 0.01
Pad 1&5~12 = 0.04 x 0.04
Pad 2~4 = 0.07 x 0.157

Recommended pad layout



Pad 1 & 5~17 = 0.041" x 0.041"
Pad 2&4 = 0.165" x 0.074"

## Marking

EPM12V2-
05R5-12R0N
XXX

xxx= lot code

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | On/Off | 10 | PGOOD |
| 2 | Vin | 11 | SYNC |
| 3 | GND | 12 | VS- |
| 4 | Vout | 13 | SIG_GND |
| 5 | VS+ (Sense) | 14 | NC |
| 6 | TRIM | 15 | NC |
| 7 | GND | 16 | NC |
| 8 | NC | 17 | NC |
| 9 | SEQ | | |

NC = no connection

**Packaging- Inches**



User Direction of Unreeling
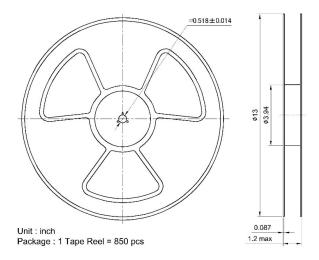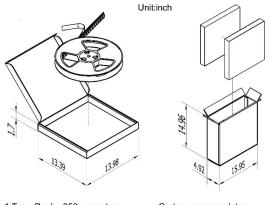
1).10 sprocket hole pitch cumulative tolerance ±0.008 inch.
2).All dimensions meet EIA-481-2A requirements.
3).Component loader per 13" reel : 850  pcs.
4).All dimensions = ±0.004 inch.



Unit : inch
Package : 1 Tape Reel = 850 pcs

1 Tape Reel = 850 converters

Carton accommodates
2 boxes 1700 converters per carton

# General information

### Pick and place

The 12 A open frame modules use an open frame construction and are designed for a fully automated pick and place assembly process.

### MSL rating

The 12 A Open frame modules have a MSL rating of 3.

### Storage and handling

The recommended storage environment and handling procedures for moisture-sensitive surface mount packages is detailed in J-STD-033 (Handling, packing, shipping and use of moisture/reflow sensitive surface mount devices).

Moisture barrier bags (MBB) with desiccant are required for MSL ratings of 3 or greater. These sealed packages should not be broken until time of use. Once the original package is broken, the floor life of the product at conditions of 30 °C and 60% relative humidity 168 hours varies according to the MSL rating (see J-STD-033). The shelf life for dry packed SMT packages will be a maximum of 12 months from the bag seal date, when stored at the following conditions: < 40 °C, < 90% relative humidity.

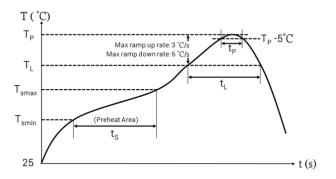### Post solder cleaning and drying considerations

To avoid contamination on the soldering pads extra care has to be taken when handling the boards. Clean soldering surfaces do not generate as many gases when the flux reduce the metal oxides or react with contaminants during the soldering process.

### Nozzle

The module weight has been kept to a minimum by using open frame construction. Variables such as nozzle size, tip style, vacuum pressure and placement speed should be considered to optimize this process.

### Lead-free reflow profile

Power systems will comply with J-STD-020 (Moisture/reflow sensitivity classification for nonhermetic solid state surface mount devices) for both Pb-free solder profiles and MSL classification procedures. This standard provides a recommended forced-air-convection reflow profile based on the volume and thickness of the package. The suggested Pb-free solder paste is Sn/Ag/Cu (SAC). The recommended linear reflow profile using Sn/Ag/Cu solder is shown. Soldering outside of the recommended profile requires testing to verify results and performance.



| Profile | Pb-free assembly |
| --- | --- |
| Average ramp-up rate ($T_{smax}$ to $T_p$) | 3 °C/s max. |
| Preheat Temperature Min. ($T_{smin}$) Temperature Max. ($T_{smax}$) $T_s$ ($T_{smin}$ to $T_{smax}$) | 150 °C 200 °C 60-120 s |
| Temperature ($T_p$) | 245°C |
| Time maintained above Temperature ($T_L$) Time ($t_l$) | 217°C 60-150 s |
| Time within 5°C of the specified Peak temperature ($T_p$) | 20-40 s |
| Ramp down rate ($T_P$ to $T_L$) | 6 °C/s max |
| Time 25 °C to peak temperature | 8 minutes max. |

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