

**SERIES:** PRF20 | **DESCRIPTION:** DC-DC CONVERTER

**FEATURES**

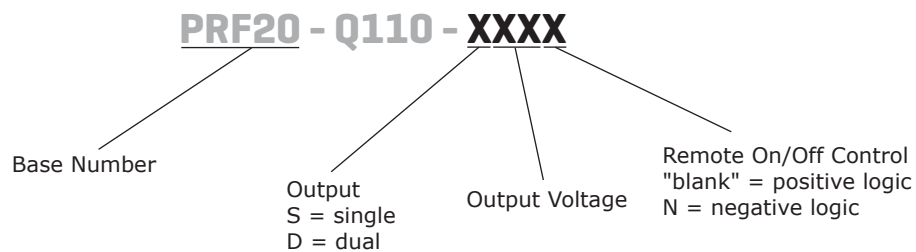
- up to 20 W isolated output
- 4:1 input range (43~160 V)
- smaller package
- single/dual regulated outputs
- meets European EN50155 railway standard
- 2,250 Vdc isolation
- continuous short circuit, over current protection, over voltage protection
- built-in remote on/off
- wide operating temperature range (-40~85°C)
- efficiency up to 90%



| MODEL          | input voltage |             | output voltage | output current |          | output power | ripple and noise <sup>1</sup> | efficiency |
|----------------|---------------|-------------|----------------|----------------|----------|--------------|-------------------------------|------------|
|                | typ (Vdc)     | range (Vdc) | (Vdc)          | min (mA)       | max (mA) | max (W)      | max (mVp-p)                   | typ (%)    |
| PRF20-Q110-S5  | 110           | 43~160      | 5              | 0              | 4000     | 20           | 75                            | 88.5       |
| PRF20-Q110-S12 | 110           | 43~160      | 12             | 0              | 1670     | 20           | 100                           | 90         |
| PRF20-Q110-S15 | 110           | 43~160      | 15             | 0              | 1330     | 20           | 100                           | 89.5       |
| PRF20-Q110-D12 | 110           | 43~160      | ±12            | 0              | ±833     | 20           | 100                           | 89         |
| PRF20-Q110-D15 | 110           | 43~160      | ±15            | 0              | ±667     | 20           | 100                           | 88.5       |

Note: 1. Ripple and noise are measured at 20 MHz BW by and 1µF ceramic capacitor across each output.

**PART NUMBER KEY**



## INPUT

| parameter               | conditions/description                     | min                             | typ      | max | units      |
|-------------------------|--|---------------------------------|----------|-----|------------|
| operating input voltage |  | 43                              | 110      | 160 | Vdc        |
| under voltage shutdown  | power up<br>power down                     |                                 | 40<br>38 |     | Vdc<br>Vdc |
| surge voltage           | for maximum of 100 ms                      |                                 |          | 200 | Vdc        |
| start-up time           | single output models<br>dual output models |                                 | 15<br>25 |     | ms<br>ms   |
| CTRL <sup>1</sup>       | positive logic                             | models ON (open or 3.5~75 Vdc)  |          |     |            |
|                         |  | models OFF (0~1.2 Vdc)          |          |     |            |
|                         | negative logic                             | models ON (0~1.2 Vdc)           |          |     |            |
|                         |  | models OFF (open or 3.5~75 Vdc) |          |     |            |
| filter                  | pi filter                                  |                                 |          |     |            |

Note: 1. Open collector refer to -Vin.

## OUTPUT

| parameter                  | conditions/description                            | min | typ | max   | units |
|----------------------------|---|-----|-----|-------|-------|
| maximum capacitive load    | 5V output model                                   |     |     | 5600  | μF    |
|                            | 12V output model                                  |     |     | 1000  | μF    |
|                            | 15V output model                                  |     |     | 1000  | μF    |
|                            | ±12V output model                                 |     |     | ±680  | μF    |
|                            | ±15V output model                                 |     |     | ±350  | μF    |
| line regulation            | from high line to low line                        |     |     | ±0.2  | %     |
| load regulation            | from full load to no load                         |     |     | ±0.5  | %     |
|                            | single output models<br>dual output models        |     |     | ±1    | %     |
| cross regulation           | dual output models, load cross variation 10%/100% |     |     | ±5    | %     |
| voltage accuracy           |   |     |     | ±1.5  | %     |
| adjustability <sup>2</sup> |   |     | ±10 |       | %     |
| switching frequency        |   |     | 250 |       | KHz   |
| transient response         | 25% load step change                              |     |     | 250   | μs    |
| temperature coefficient    |   |     |     | ±0.03 | %/°C  |

Note: 2. Output trimming available on single output models only

## PROTECTIONS

| parameter                | conditions/description                   | min | typ | max | units |
|--------------------------|--|-----|-----|-----|-------|
| short circuit protection | continuous                               |     |     |     |       |
| over current protection  |  | 110 |     | 160 | %     |
| over voltage protection  | protected by internal zener or TVS clamp |     |     |     |       |
|                          | 5V output model                          |     | 6.2 |     | Vdc   |
|                          | 12V output model                         |     | 15  |     | Vdc   |
|                          | 15V output model                         |     | 18  |     | Vdc   |
|                          | ±12V output model                        |     | ±15 |     | Vdc   |
|                          | ±15V output model                        |     | ±18 |     | Vdc   |

## SAFETY AND COMPLIANCE

| parameter            | conditions/description                               | min   | typ | max | units |
|----------------------|--|-------|-----|-----|-------|
| isolation voltage    | input to output for 1 minute                         | 2,250 |     |     | Vdc   |
| isolation resistance |  | 1000  |     |     | MΩ    |
| safety approvals     | UL60950-1  |       |     |     |       |
| EMI/EMC              | EN55022 class A, EN50155 (external circuit required) |       |     |     |       |
| RoHS                 | 2011/65/EU   |       |     |     |       |

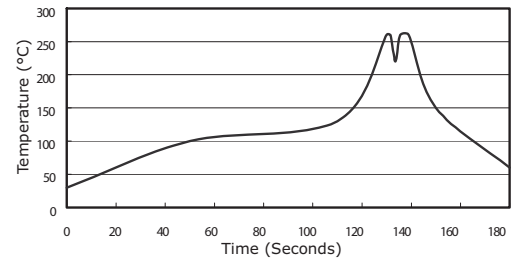
## ENVIRONMENTAL

| parameter             | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curve     | -40 |     | 85  | °C    |
| storage temperature   |                        | -55 |     | 125 | °C    |
| humidity              | non-condensing         |     |     | 95  | %     |
| case temperature      |                        |     |     | 105 | °C    |
| vibration             | EN50155 (EN61373)      |     |     |     |       |

## SOLDERABILITY

| parameter      | conditions/description     | min | typ | max | units |
|----------------|----------------------------|-----|-----|-----|-------|
| wave soldering | see wave soldering profile |     |     | 260 | °C    |

- Notes:
1. Soldering materials: Sn/Cu/Ni
  2. Ramp up rate during preheat: 1.4°C/s (from 50°C to 100°C)
  3. Soaking temperature: 0.5°C/s (from 100°C to 130°C), 60±20 seconds
  4. Peak temperature: 260°C, above 250°C for 3~6 seconds
  5. Ramp down rate during cooling: -10°C/s (from 260°C to 150°C)



## MECHANICAL

| parameter     | conditions/description                       | min | typ | max | units |
|---------------|--|-----|-----|-----|-------|
| dimensions    | 2.00 x 1.00 x 0.40 (50.8 x 25.4 x 10.2 mm)   |     |     |     | inch  |
| case material | black coated copper with non-conductive base |     |     |     |       |
| weight        |  |     | 35  |     | g     |

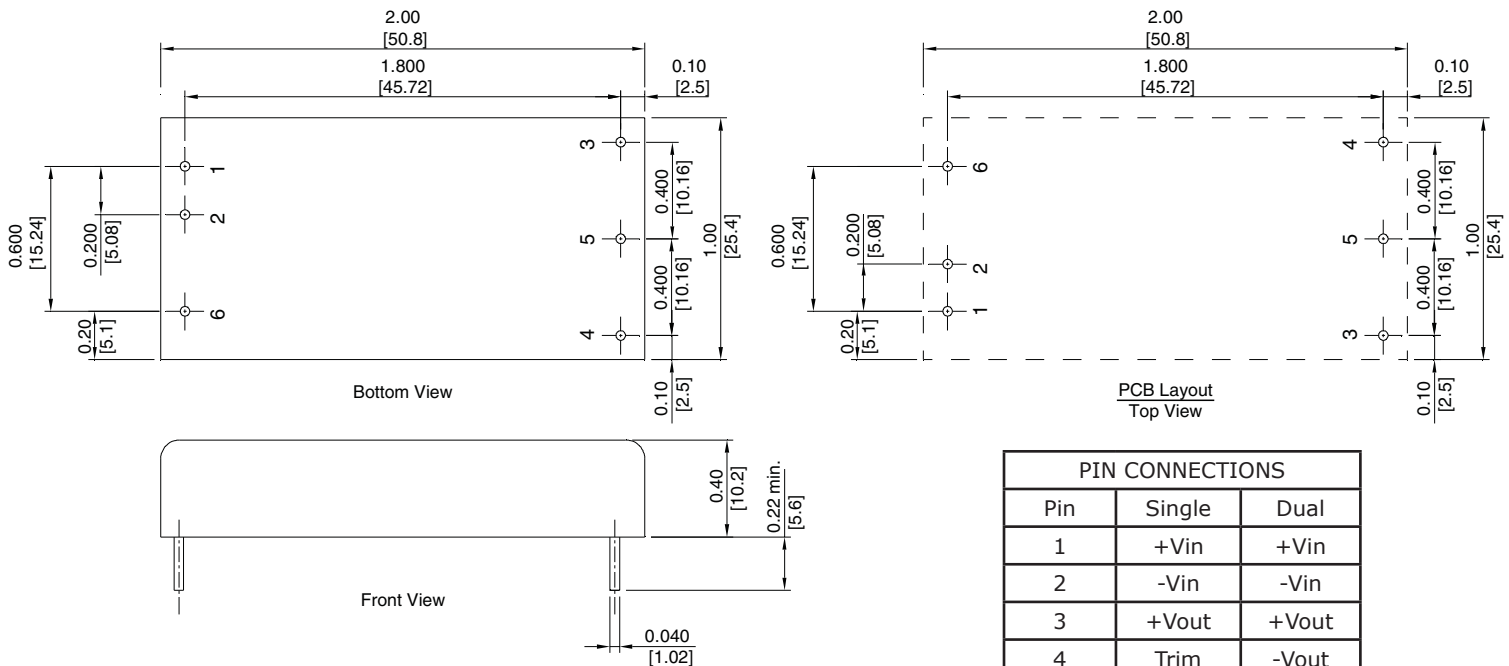
## MECHANICAL DRAWING

units: inch[mm]

tolerance: X.XX = ±0.02[±0.5]

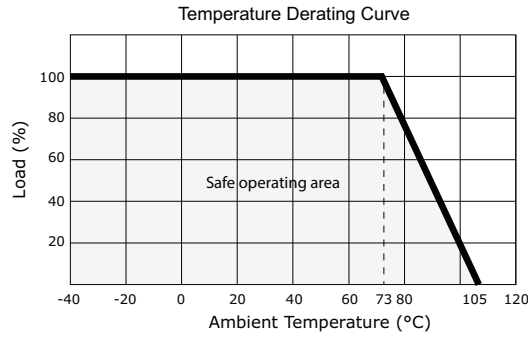
X.XXX = ±0.010[±0.25]

1.3 mm Plated Through hole  
2.5 mm Pad Size



| PIN CONNECTIONS |               |        |
|-----------------|---------------|--------|
| Pin             | Single        | Dual   |
| 1               | +Vin          | +Vin   |
| 2               | -Vin          | -Vin   |
| 3               | +Vout         | +Vout  |
| 4               | Trim          | -Vout  |
| 5               | -Vout         | common |
| 6               | Remote ON/OFF |        |

## DERATING CURVES



## EMC RECOMMENDED CIRCUIT

EN50155(EN50121-3-2)

Figure 1

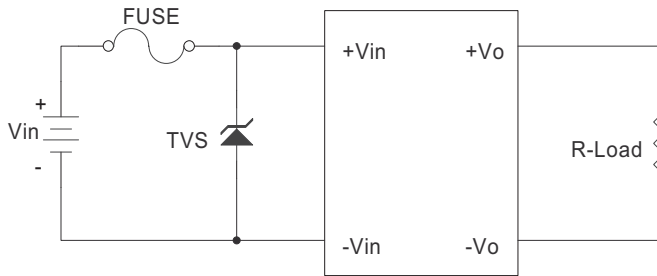


Table 1

|                     |
|---------------------|
| External components |
| 3A time delay fuse  |
| TVS                 |

## TEST CONFIGURATION

Figure 2

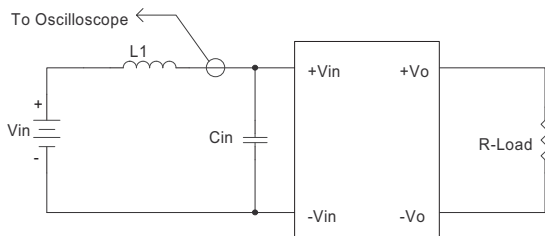


Table 2

|                     |                             |
|---------------------|-----------------------------|
| External components |                             |
| Lin                 | 12μH                        |
| Cin                 | 22μF, ESR < 0.2Ω at 100 KHz |

Note: Input reflected-ripple current is measured with an inductor L1 to simulate source impedance.

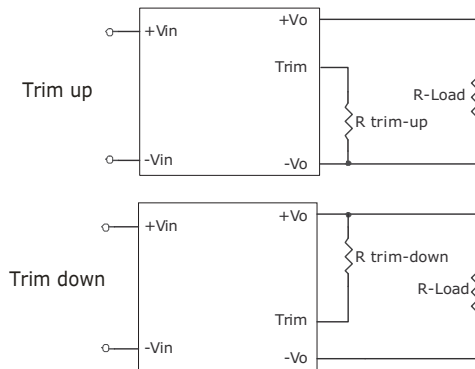
## APPLICATION NOTES

### Output Voltage Trimming

Leave open if not used.

**Figure 3**

Application Circuit for Trim pin



Formula for Trim Resistor

$$R_{trim - up} = \left( \frac{V_r \times R1 \times (R2 + R3)}{(V_o - V_{o, nom}) \times R2} \right) - R_t \text{ (K}\Omega\text{)}$$

$$R_{trim - down} = R1 \times \left( \frac{V_r \times R1}{(V_{o, nom} - V_o) \times R2} - 1 \right) - R_t \text{ (K}\Omega\text{)}$$

Note:  $R_{trim-up}$  is the external resistor in  $K\Omega$   
 $R_{trim-down}$  is the external resistor in  $K\Omega$   
 $V_{o, nom}$  is the nominal output voltage  
 $V_o$  is the desired output voltage  
 $R1, R2, R3, R_t$ , and  $V_r$  are internal (see table 3).

**Table 3**

| Vout (Vdc) | R1 (KΩ) | R2 (KΩ) | R3 (KΩ) | Rt (KΩ) | Vr (V) |
|------------|---------|---------|---------|---------|--------|
| 5          | 2.32    | 2.32    | 0       | 8.2     | 2.5    |
| 12         | 6.8     | 2.4     | 2.32    | 22      | 2.5    |
| 15         | 8.06    | 2.4     | 3.9     | 27      | 2.5    |

## REVISION HISTORY

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| rev. | description     | date       |
|------|-----------------|------------|
| 1.0  | initial release | 02/12/2014 |

The revision history provided is for informational purposes only and is believed to be accurate.



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