Murata Power Solutions' 50mV and 100mV base-mounted current shunts are designed for measuring dc currents from 5A to 1200A. These precision shunts (+/-0.25% accuracy) connect directly to MPS's DCA5-20PC Series of dc ammeters. Installation is straightforward; simply connect the load circuit to the shunt’s threaded studs and the shunt’s mV Kelvin-outputs to the digital ammeter’s input terminals.

All models feature a rugged phenolic base that provides 750V isolation to the shunt’s brass terminals, allowing for direct attachment to metal surfaces. A highly stable (+/-15ppm/°C) manganin sensing-element provides a wide –40 to +60°C operating temperature range. Please see the DCA5-20PC data sheet for additional ammeter-related information and detailed connection diagrams.

To ensure that the manganin sensing element does not exceed 125°C under worst case operating conditions, please read and follow the guidelines in the mounting and derating sections of this data sheet. Tighten all connections on the shunt per the torque specifications given in the mechanical dimensions and selection guide on page 3. Please note, the user is responsible for selecting the correct wire sizes (gauge) and wire type for the given application.

2. Mounting Considerations: All shunts should be mounted with their resistance blades in a vertical position to allow for natural convection cooling (see Figure 1). Forced-air cooling must be provided when vertical mounting is impractical, or in installations where the shunt is installed in a confined location. The shunt’s manganin blades must never be allowed to exceed +125°C; doing so will cause permanent damage to the shunt.

Shunts must be installed in a manner that protects them from damage due to thermal expansion forces produced by high- or short-circuit currents. In most cases, shunts are weaker than their external-circuit connections, so provisions for additional wiring-flexibility may be required in high current and/or high-vibration applications.

Whenever practical, all shunts should be connected in the grounded side (normally the ‘chassis’) of the dc supply. However, these shunts must be connected in the grounded side of the circuit when the dc supply exceeds 750 volts (the rated limit for the shunt’s phenolic insulating base). When more than one wire is to be connected to each end of a shunt, the wires must be evenly distributed between both terminals (see Figure 1).

3. Lead Extensions: The shunt’s Kelvin outputs (i.e., their 50mV or 100mV
output signal) should not exceed 24 inches in length (61cm), assuming 22AWG (0.5mm²) wire is used. If longer leads are necessary, the additional voltage drops in the leads must be taken into consideration as they will degrade accuracy and stability. However, MPS’s DCA5 series dc ammeters feature a calibration potentiometer that can be used to compensate for some additional losses when long leads are employed; contact MPS for calibration information.

4. Continuous-Operation Derating: If continuous operation is required, a shunt must only be allowed to carry 2/3 of its maximum nameplate amperage. The 2/3 derating factor provides an adequate safety margin for convection cooled shunts operating in an ambient temperature of +25°C. The following two sections contain additional derating that is required when shunts will be exposed to higher operating temperatures or pulsed (intermittent) currents.

5. Temperature Derating: If the shunt is to be operated at ambient temperatures above +25°C, the maximum continuous current must be further derated from the 2/3 value previously noted.

To find the maximum permissible continuous current (Ie) at an elevated temperature (Te), one must first calculate the maximum allowable power dissipation (Pe) at Te, using the following formulas:

\[ Pe = P_a \times \left[ 1 - \frac{(T_e - 25°C)}{100°C} \right] \]

Where

- \( P_a \) = Maximum power dissipation at the elevated temperature Te
- \( T_e \) = Elevated temperature

Example: How much current can a 150 Amp 50mV shunt safely carry at an ambient temperature of +100°C?

\[ T_e = +100°C \]
\[ P_a = 0.667(150A \times 0.050V) = 5.0 \text{ Watts} \]
\[ P_e = 5.0W \times \left[ 1 - \left( \frac{100-25}{100} \right) \right] = 5.0W \times 0.75 = 1.25W \]
\[ R = 0.00033 \text{ Ohms} \]

Lastly, use the formula \( I_e = \sqrt{\frac{P_e}{R}} \) to find the maximum derated continuous-current at \( T_e = +100°C \):

\[ I_e = \sqrt{\frac{1.25W}{0.00033\Omega}} = 61.5A \]

6. Intermittent (Pulsed) Operation: Shunts that will not be exposed to continuous operation at 2/3 rated current can be operated at levels close to, or even above, their nameplate ratings for portions of short periods of time (5 minutes maximum) at 25°C ambient.

The following formulas can be used to calculate the maximum pulsed-current (Ipuls) for a given shunt:

\[ Ipuls = \sqrt{P_{puls}/R} \]

Where

\( P_{puls} = Pa/K_1 \)
\( K_1 = \sqrt{D} \)
\( D = \text{Ratio of ON TIME to ON TIME + OFF TIME} \)

\( P_a = 0.667 \times \text{shunt's rated power at 25°C ambient} \)

\( K_1 = \text{Pulsed-operation rating factor (the square root of D)} \)
\( R = \text{Shunt's resistance (see selection guide for values)} \)

Example: An 800 Amp 50mV shunt will be operated for 15 seconds each minute. What is the maximum current this shunt can carry during the 15-second ON time?

\[ D = \frac{15}{60} = 0.25 \]
\[ K_1 = \sqrt{0.25} = 0.5 \]
\[ P_a = 0.667 \times (800A \times 0.050V) = 26.7 \text{ Watts} \]
\[ P_{puls} = \frac{P_a}{K_1} = 53.4 \text{ Watts} \]

\( R = 0.0000625 \Omega \)

\[ Ipuls = \sqrt{\frac{53.4W}{0.0000625\Omega}} = 924A \]

Figure 2. Typical Low-Side Shunt Connections

Figure 3. Typical High-Side Shunt Connections
MECHANICAL SPECIFICATIONS

5 through 150 Amps

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Rated Current/Output</th>
<th>Resistance (Ωs at 25˚C)</th>
<th>Torque Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3020-01097-0</td>
<td>5A/50mV</td>
<td>0.01</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
<tr>
<td>3020-01107-0</td>
<td>10A/100mV</td>
<td>0.01</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
<tr>
<td>3020-01098-0</td>
<td>20A/50mV</td>
<td>0.0025</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
<tr>
<td>3020-01096-0</td>
<td>50A/50mV</td>
<td>0.001</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
<tr>
<td>3020-01099-0</td>
<td>100A/50mV</td>
<td>0.0005</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
<tr>
<td>3020-01108-0</td>
<td>100A/100mV</td>
<td>0.001</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
<tr>
<td>3020-01100-0</td>
<td>150A/50mV</td>
<td>0.00033</td>
<td>36-40 in-lbs (4.1-4.5Nm)</td>
</tr>
</tbody>
</table>

- 8-32 Kelvin output screws (all shunts): 14-15 in-lbs (1.58-1.69Nm)
- Tolerances ±0.030 (0.8) unless otherwise specified
- Number of resistance elements may vary from that shown in drawing

200 through 500 Amps

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Rated Current/Output</th>
<th>Resistance (Ωs at 25˚C)</th>
<th>Torque Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3020-01101-0</td>
<td>200A/50mV</td>
<td>0.00025</td>
<td>14-15 ft-lbs (19.0-20.3Nm)</td>
</tr>
<tr>
<td>3020-01102-0</td>
<td>300A/50mV</td>
<td>0.000167</td>
<td>14-15 ft-lbs (19.0-20.3Nm)</td>
</tr>
<tr>
<td>3020-01103-0</td>
<td>500A/50mV</td>
<td>0.0001</td>
<td>14-15 ft-lbs (19.0-20.3Nm)</td>
</tr>
</tbody>
</table>

- 8-32 Kelvin output screws (all shunts): 14-15 in-lbs (1.58-1.69Nm)
- Tolerances ±0.030 (0.8) unless otherwise specified
- Number of resistance elements may vary from that shown in drawing
50mV and 100mV Base-mounted DC Shunts

### MECHANICAL SPECIFICATIONS (continued)

#### 800 through 1200 Amps

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Rated Current/Output</th>
<th>Resistance (Ωs at 25°C)</th>
<th>Torque Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3020-01104-0</td>
<td>800A/50mV</td>
<td>0.0000625</td>
<td>32-35 ft-lbs (43.4-47.5Nm)</td>
</tr>
<tr>
<td>3020-01105-0</td>
<td>1000A/50mV</td>
<td>0.00005</td>
<td>32-35 ft-lbs (43.4-47.5Nm)</td>
</tr>
<tr>
<td>3020-01106-0</td>
<td>1200A/50mV</td>
<td>0.0000417</td>
<td>32-35 ft-lbs (43.4-47.5Nm)</td>
</tr>
</tbody>
</table>

- 8-32 Kelvin output screws (all shunts): 14-15 in-lbs (1.58-1.69Nm)
- Tolerances ±0.030 (0.8) unless otherwise specified
- Number of resistance elements may vary from that shown in drawing

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This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
Refer to: [https://www.murata-ps.com/requirements/](https://www.murata-ps.com/requirements/)

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