EVERY CONNECTION COUNTS

SMARTER SENSORS FOR SMARTER VEHICLES

Multi-Coil Resolver (MCR)
for the Automotive Industry
TE CONNECTIVITY’S SENSOR SOLUTIONS BUSINESS UNIT IS ONE OF THE LEADING SUPPLIERS OF SENSORS AND MODULES FOR AUTOMOTIVE TRANSMISSION APPLICATIONS. THE UPGRADE OF EXISTING TRANSMISSIONS TO HYBRID TRANSMISSIONS USING POWER ELECTRIC MOTORS, MAINLY THE SYNCHRONOUS TYPE, LEADS TO AN INCREASE OF ALL REQUIREMENTS IN TERMS OF ELECTRIC MACHINES PERFORMANCE, WHICH REQUIRES NEW TECHNOLOGICAL DEVELOPMENTS. THE WIDE PRODUCT AND PROCESS PORTFOLIO OF TE SENSOR SOLUTIONS OFFERS AN IDEAL BASE FOR THE DEVELOPMENT AND PRODUCTION OF SUCH ROBUST AND RELIABLE SOLUTIONS.

The Multi-Coil Resolver (MCR) is designed to determine synchronous electric motor rotor position by scanning magnetic fields. This MCR can withstand rotation speeds above 20,000 RPM and operates in a temperature range within -40°C up to +150°C. Depending on the various specifications, specific adaptations may increase these values.

This innovative layout also guarantees a competitive cost and makes it possible to standardize the assembling process. As a result, it can be fitted to large diameter machines featuring numerous permanent magnets – being installed between the thermal engine and the gearbox, to separate electrical machines mounted parallel to the transmission or to another axle for instance.

TE Connectivity’s Sensor Solutions developed the MCR technology as a product platform, capable to provide several ranges of speeds and shaft diameters in accordance with customer requirements.
APPLICATION
■ Angular position sensor for electric motors for HEV- and EV cars

DESCRIPTION
■ Analog output signal
■ Platform product based on poolpairs of the e-motor (speed)
■ Please see product specification 108-90819 for more details

PERFORMANCE
■ Temperature range -40°C to +150°C
■ High rotational speed
■ Accurate measurement of angular rotor position and speed
■ Shock and vibration robust
■ Robust against eccentricity
■ Very high signal-noise ratio
■ High reliability (no active components)
■ Customized cable assembly and connector interface

ADVANTAGES OF TE SOLUTION
■ Fault-tolerant with eccentricity (static/dynamic) through patented winding scheme
■ Fault-tolerant against external fields through patented winding scheme
■ Flexible adaption of shaft diameter through smart tooling concept
■ Different fixation designs of stator possible
■ Different inner diameter of rotor possible

AVAILABLE SPEED NUMBERS
■ 2-/ 3-/ 4-/ 5-/ 6-/ 8-/ 10-/ 12-speed

AVAILABLE PLATFORMS
■ x05/ x07/ x11 platform

MCR XX YY - ZZ e.g. MCR605-11

Speed numbers, e.g. 4, 6, 10, ...
Inner diameter stator [mm/10]
Customer specific features

nomenclature
**General Definition**

**SIGNAL**

![Signal Diagram](image)

**RECOMMENDED OPERATION CONDITIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Symbol</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature</td>
<td>For lifetime = 600h</td>
<td>$T_a$</td>
<td>-40</td>
<td>140</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td></td>
<td>$T_s$</td>
<td>-40</td>
<td>80</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td></td>
<td>$U_{EXC}$</td>
<td>7</td>
<td></td>
<td>$V_{rms}$</td>
<td></td>
</tr>
<tr>
<td>Excitation Frequency</td>
<td></td>
<td>$f$</td>
<td>10</td>
<td></td>
<td></td>
<td>kHz</td>
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</tbody>
</table>

**MAXIMUM RATING**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Symbol</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Temperature*</td>
<td>&lt;100h over lifetime</td>
<td>$T_{a,peak}$</td>
<td>-40</td>
<td></td>
<td>150</td>
<td>°C</td>
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</tbody>
</table>

* Peak temperature test need to be performed in application condition

**ANALOG INPUT**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
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<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Impedance</td>
<td>@10kHz, 7 V, with Rotor</td>
<td>$</td>
<td>Z_{exc}</td>
<td>$</td>
<td>96</td>
<td>(120)</td>
</tr>
</tbody>
</table>

**ANALOG OUTPUT**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Symbol</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine Output Impedance</td>
<td>@10kHz, 7 V, with Rotor</td>
<td>$</td>
<td>Z_{sin}</td>
<td>$</td>
<td>200</td>
<td>(250)</td>
</tr>
<tr>
<td>Cosine Output Impedance</td>
<td></td>
<td>$</td>
<td>Z_{cos}</td>
<td>$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values in all tables are typical values.
## SIGNAL PERFORMANCE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
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<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformation Ratio</td>
<td>@ 10 kHz, 7 V</td>
<td>TR&lt;sub&gt;0&lt;/sub&gt;′</td>
<td>0.2574</td>
<td>(0.286)</td>
<td>0.3146</td>
<td>-</td>
</tr>
<tr>
<td>Phase Shift</td>
<td></td>
<td>ϕ</td>
<td>-15°</td>
<td>(0)</td>
<td>15°</td>
<td>dag</td>
</tr>
<tr>
<td>Rotor Angle Offset</td>
<td>Reference Rotor</td>
<td>Δα&lt;sub&gt;e&lt;/sub&gt;′</td>
<td>-12°</td>
<td>(0)</td>
<td>12°</td>
<td>dag</td>
</tr>
<tr>
<td>Span of Angular Error</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values in all tables are typical values

′<sub>e</sub> means electrical minutes
Example: MCR 605 Diameters
YOUR ADVANTAGE

■ Next level customer support
  ● Design in support
  ● Sensor function
  ● Cable assembly
  ● Connector definition
  ● Manufacturing competence

■ One Stop Shopping Solution

■ TE Connectivity has a global footprint and customer support for every kind of question regarding to your products

CONTACT

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