As connected industrial technologies continue to proliferate and evolve, 5G networks will transform Industrial 4.0 wireless infrastructure with advanced connectivity. The Fifth Generation of Cellular Connectivity, 5G, will transform a myriad of Industrial IoT (IIoT) applications with unprecedented levels of connectivity. 5G connectivity will significantly contribute in many ways, such as enabling faster processing, improving workplace safety, increasing operational effectiveness, and lowering the factory’s carbon footprint. In addition, the broad coverage, ultra-fast speed, and reliable connectivity of 5G networks will significantly improve various industrial applications from extreme remote deployments to smart private factories.

**Industrial Applications with 5G Connectivity**

- Smart City
- Smart Manufacturing
- Healthcare
- Kiosk & Retail
- Energy & Utility
- Automotive Industry
- Security

**5G Ready Module**

The Dual-SIM 5G cellular network module (DTB-M2BK) enables Premio's industrial computers to reap the benefits of 5G wireless connectivity. 5G networks provide blazing-fast wireless connectivity for industrial computers with speeds up to 100x faster than 4G LTE.

Integrating 5G connectivity with rugged edge computers enables hardened industrial hardware to tap into enhanced mobile broadband (eMBB), ultra-reliable low latency communication (uRLLC), and massive machine-to-machine communications (mMTC). As a result, industrial computers with 5G cellular networks can utilize and benefit the full potential of disruptive Industry 4.0 technologies such as AI, IIoT, AR, VR, 3D printing, robotic process automation, cloud computing, advanced data analytics, and more.

**Benefits from 5G Module:**

- Global 5G Coverage for the Rugged Edge
- Dual SIM Network Redundancy and GNSS Positioning
- Expandable Modular Designs
- True Industrial-grade Design
Pinpoint Satellite Navigation

In addition to location tracking, some complex industrial applications often require tracking and positioning, such as a telemetric vehicle system. Therefore, the 5G modems can also support dual-frequency GNSS (Global Navigation Satellite System) with GPS, Glonass, Beidou, and Galileo for position tracking anywhere in the world.

Advanced Thermal Design for Extended Temperatures

The 5G modules have a unique industrial design for performance and thermal efficiency. Premio’s industrial 5G modules allow extreme temperature industrial deployments ranging from -25° up to 70° for the modules for extremely cold and hot environments. To control the module’s temperature amid industrial deployments effectively, Premio utilizes highly conductive multi-layers thermal pads and heatsinks to cool down the internal components. The heatsinks are made from aluminum and copper heat pipes to dissipate heat away from the 5G module to the extruded heavy-metal external chassis of the rugged edge computers.

Just Plug and Play! Expandable Modular Designs

Premio’s Dual-SIM 5G module is designed to be integrated directly into Premio industrial fanless computers. The 5G module acts as a carrier board that supports 5G modems in the M.2 form factor and communicates via the PCIe 3.0 / USB 3.1 Gen.2 SuperSpeed interface. The modular design provides an easy plug and play option for immediate 5G connectivity on Premio computers. Additionally, the 5G module does not require any additional setup when integrated into Windows or Linux operating systems.
5G Spectrums: Not All Bands are Created Equal

5G network has a broad EMF spectrum which divides 5G connectivity into three main types based on their radio wave spectrum, coverage, and latency.

**Low-band Spectrum**
5G networks with frequencies under 1 GHz and can reach hundreds of square miles for nationwide coverage. Low-band 5G networks are 20% faster than 4G LTE with a download speed of around 250 Mbps.

**Mid-band Spectrum**
5G networks with a frequency spectrum of 1-6 GHz or what is known as Sub-6 GHz. Mid-band 5G networks focus around metropolitan areas with speed around six times faster than 4G LTE, ranging from 125-900 Mbps.

**High-band Spectrum (mmWave)**
5G mmWave frequency bands are ten times faster than 4G LTE. With a spectrum range of 24-50 GHz, 5G mmWave low-latency speed can reach up to 10Gbps of data rates. High-band 5G networks have coverage just over a kilometer which are centered around dense urban areas.

<table>
<thead>
<tr>
<th></th>
<th>Low-band 5G</th>
<th>Mid-band 5G (Sub-6 GHz)</th>
<th>High-band 5G (mmWave)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMF Spectrum</strong></td>
<td>&lt; 1GHz</td>
<td>1-6 GHz</td>
<td>24-50 GHz</td>
</tr>
<tr>
<td><strong>Latency Speed</strong></td>
<td>≈ 250 Mbps</td>
<td>125-900 Mbps</td>
<td>Up to 10 Gbps</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Nationwide</td>
<td>Metropolitan Areas</td>
<td>Dense Urban Areas</td>
</tr>
<tr>
<td></td>
<td>Hundreds of Miles²</td>
<td>Several Miles²</td>
<td>Less than a Mile</td>
</tr>
<tr>
<td><strong>Comparison to 4G LTE</strong></td>
<td>20% Faster</td>
<td>6x Faster</td>
<td>10x Faster</td>
</tr>
</tbody>
</table>
Advanced Industrial Connectivity
Premio Dual-SIM 5G module improves industrial automation with advanced 5G connectivity. Upgrading your industrial applications from 4G to 5G networks will benefit from optimized connectivity that covers five key functional drivers:

1. Enhanced mobile broadband (eMBB), Superfast Broadband

5G enhanced mobile broadband refers to faster data rates (up to 10 Gbps), higher throughput, more capacity, and wide coverage areas. In addition, 5G network eMBB will be instrumental in improving various functions, including ultra-HD and 360° video streaming, AR, and VR.

2. Ultra-reliable low latency communication (uRLLC)

Ultra-reliable, low-latency communication refers to the increased speed and quality of the network for mission-critical applications that require uninterrupted, real-time data exchange without compromising the connection reliability. For instance, compared to 4G, 5G network’s uRLLC reduced the latency time from 20ms down to <1ms with 99.999% reliability. This provides a crucial real-time experience for applications such as autonomous driving, robot-enabled remote surgery, and factory automation.

3. Massive machine-type communications (mMTC)

5G also supports massive machine-to-machine-type communications that enable the connection to a large number of machines and devices in a wide area that involves the generation, transmission, and processing of data with zero human intervention. With massive multiple-input multiple-output (MIMO) and beamforming, mid Band to high Band 5G network will benefit from a big boost with a 100-fold increase in the number of connections at once. This key 5G benefit provides a huge potential for industrial IoT applications where sensors and devices communicate in real-time in a closed private network environment. Premio’s 5G modules support 4x4 MIMO with 4x MHF4 on-board connectors for Sub-6 GHz frequencies antennas (shared with GNSS).

4. Security

Another critical driver that increases companies’ interest in 5G is the improved privacy and security of the 5G network. Companies can build private 5G networks for their own applications. For instance, by creating a private network in a smart factory, companies can take full advantage of 5G network eMBB, uRLLC, and mMTC. While having more precise network controls of their connected assets and applications can help increase the security from an external attacker that targets and exploits the vulnerability of the public network.

5. Power Efficiency

Despite the robust performance of 5G networks, it will offer better energy consumption and lower costs compared to previous cellular network generations. Connected 5G devices will intelligently detect how to control their energy usage during the active or idle state. 5G is capable of decreasing 90% of the core network consumption by allocating energy usage in an efficient manner. Premio’s 5G module is equipped with Dynamic Power Reduction (DPR) feature with control over software to reduce power consumption.
Premio Rugged Edge Computers with 5G Compatibility

RCO-6000-CFL SERIES
- RCO-6000-CFL
- RCO-6000-CFL-2C (RCO-6122PE)
- RCO-6000-CFL-4N-2060S
- RCO-6000-CFL-4NH
- RCO-6000-CFL-8NS

RCO-6000-CML SERIES
- RCO-6000-CML
- RCO-6000-CML-2C
- RCO-6000-2C-2PWR
- RCO-6000-2C-2PWR
- RCO-6000-20-2060S

Global Coverage with Trusted Modules
Premio supports the following 5G module modems in order to provide maximum worldwide coverage:

<table>
<thead>
<tr>
<th>5G Module</th>
<th>Thales</th>
<th>SIMCom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>MV31-W</td>
<td>SIM8202G-M2</td>
</tr>
<tr>
<td>Form Factor</td>
<td>M.2 (PCIe 3.0/USB 3.1)</td>
<td>M.2 (PCIe 3.0/USB 3.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency Bands</th>
<th>mmWave [optional]</th>
<th>Sub-6G</th>
<th>LTE-FDD</th>
<th>LTE-TDD</th>
<th>LTE-LAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n257, n258, n260, n261</td>
<td>n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n41, n66, n71, n77, n78, n79</td>
<td>B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B32, B46, B48</td>
<td>B34, B38, B39, B40, B41, B42, B48</td>
<td>B34, B38, B39, B40, B41, B42, B43, B48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satellite Navigation</th>
<th>GNSS</th>
<th>GNSS</th>
</tr>
</thead>
</table>

| Operating Systems | Microsoft Windows and Linux | Microsoft Windows and Linux |

| Special Features | - LTE Cat. 20 Fallback | - Optional eSIM on module | LTE Cat. 20 Fallback |