Motorola’s MPXY8000 Series Tire Pressure Monitoring Sensors

Motorola Sensor Products Division Transportation & Standard Products Group

May 2003
Organizational Focus

Semiconductor Products Sector

Technology and Manufacturing
- Technology Focus
  - CMOS
  - RF CMOS
  - SMARTMOS
  - BiCMOS
  - Bipolar
  - GaAs
  - Memories

Efficiency and Speed

“Go-to-Market” Organizations

Communications and Networking
- Market Focus
  - Mobile Clients
  - Network Infrastructure
  - Network Edge Devices

Standard Products
- Market Focus
  - Transportation
  - Standard Products
  - MCU
  - Analog
  - DSP
  - Sensors

Architectures

Tools and Platforms–Metrowerks

Profitable, High Growth

Profitable Growth and Cash
Motorola’s Sensor Business History

- 1980: Uncompensated Bipolar Pressure Sensors
- 1985: Uncompensated Bipolar Pressure Sensors
- 1990: Compensated Bipolar Pressure Sensors, Integrated Pressure Sensors
- 2000: 20 Years in 2000 Celebration
- 2005: Shipped over 300 million Pressure Sensors, Shipped over 40 million Acceleration Sensors, Pressure Sensor Portfolio Expands with Tire Pressure Monitor

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# Pervasiveness

<table>
<thead>
<tr>
<th>Microcontrollers and Microprocessors</th>
<th>Sensors</th>
<th>Analog</th>
<th>Digital Signal Processors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automotive</strong></td>
<td>![Automotive Image]</td>
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<tr>
<td><strong>Consumer</strong></td>
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<td><strong>Consumer Networking</strong></td>
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</tbody>
</table>
Sensor Product Families

**Inertial Sensors**
- Automotive Occupant Safety
- Vibration Monitoring
- Sports Diagnostics
- Anti-theft Devices
- Appliance Balance
- Earthquake Detection
- Game Pads
- Inclinometer
- Pedometer

**Pressure Sensors**
- Tire Pressure Monitoring
- Blood Pressure
- Barometer/Altimeter
- Engine Control
- HVAC Applications
- Respiratory Applications
- Process Control
- Drug Delivery for Inhalers
- Industrial Control
- Water Level
Sensor Products Division

Vision:

To be the preeminent supplier of silicon solutions for sensing real time change in transportation and standard products.

Key Strategies:

- Maximize operational excellence to drive profitable growth and accelerated share.
- Use automotive expertise to propel economies of scale and quality for standard products.
- Leverage technology expertise in micro-machining for embedded solutions.
- Engage with universities / institutes for breakaway technology.
MPXY8000 Series Tire Pressure Monitoring (TPM) Sensors
Why the Need for Tire Pressure Monitoring?

Regulations
• In the US, the TREAD Act

Safety
• Proper tire inflation reduces blowouts
• Proper tire inflation mitigates hydroplaning
• Proper tire inflation reduces braking distance and improves handling

Cost Saving
• Increases tire life with proper tire inflation. Tires are a major cost for commercial vehicles such as tractor trailers
• Improves gas mileage.
TREAD Act

• Application:
  – Passengers cars, trucks, MPV & buses with a Gross Vehicle Weight Rating (GVWR) of 10000 pounds or less, except those vehicles with dual axis

• Compliance options:
  – Option 1: Direct TPMS, 25% deflation, single or each tire
  – Option 2: Indirect TMS, 30% deflation, single tire only

• Phase in schedule & min quantity required:
  – Year #1 01Nov03 to 31Oct04: 10% min with either option 1 or 2
  – Year #2 01Nov04 to 31Oct05: 35% min with either option 1 or 2
  – Year #3 01Nov05 to 31Oct06: 65% min with either option 1 or 2

• Long Term Requirements
  – After 31Oct06, 100% with option 1 only (pending revision March2005)

• Full text available at:
Automotive TAM for Cars/Light Trucks with TPM Systems

Source for Worldwide TAM #: DRI World car industry forecast report March2002, Table W2COMB, Car & light truck sales

Cars/Light Trucks # of Cars/Light Trucks Equiped with TPMS

Source for Worldwide TAM #: DRI World car industry forecast report March2002, Table W2COMB, Car & light truck sales
MPXY8000 Series Sensor Features

- Dedicated pressure & temperature sensor
- Single die MEMS surface micromachined P-cell
- CMOS PIDR73% process: builds upon established IDR73% process
- 2.1-3.6V operating voltage
- Low power consumption for extended battery life
- Integrated low frequency oscillator with MCU wake up
- 8 bit digital output
- SSOP pressure sensor package with integrated media protection
- Optimized for MC68HC908RF2 interfacing
- Ideal for integration with existing Remote Keyless Entry (RKE) systems
MPXY8000 Series: Silicon

Close-up of the Pressure Transducer
MPXY8000 Series: Package

- Small footprint requires reduced board space
- Integrated media protection filter
- Durable polymer package material
- Available in Tape & Reel for mass production
- Proven assembly process be used for other Motorola pressure sensor products
MPXY8000 Series: Standard Devices

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Range</th>
<th>Trim points</th>
<th>Best P-accuracy</th>
<th>Best T-accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPXY8020A</td>
<td>0-637.5 kPa</td>
<td>250 &amp; 450 kPa</td>
<td>+/-7.5kPa</td>
<td>+/-4°C</td>
</tr>
</tbody>
</table>

Special Transfer Functions available on request

Samples Available Now!
TPM System Description

MPXY8020A Series CMOS P & T

MCU + RF

Pressure & Temperature Sensor
Battery
Crystal
Antenna (Backside)

RKE Transmitter
RSM
RSM
RSM
RSM

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Motorola’s TPMS Chipset

TPM Remote Sensing Module

MPXY8020A
- Pressure Sensor
- Temperature Sensor
- Power Control
- Wake Up Timer

MC68HC908RF2
- PLL UHF Trans
- HC08
- 2K Flash LV
- Internal Clock Generator
- Timer
- Low Volt Detect
- RAM

Remote Keyless Entry (RKE)

MC68HC908RF2

3 volt battery

MC33591
MC9S12DP256

RKE & TPM Receiver

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## Benefits of Going with Motorola and the MPXY8000 Series TPM Sensors

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<th>Benefit</th>
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<td>Low power consumption due to CMOS capacitive transducer and on-chip power management features</td>
<td>• Less drain on the battery -&gt; longer module lifetime</td>
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<tr>
<td>• Motorola offers a complete chip set for a TPMS-RKE system with integrated components</td>
<td>• Eliminates the need for an additional TPM specific receiver</td>
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<tr>
<td>• Motorola has experience in key competencies for this application, and also has established manufacturing capacity installed.</td>
<td>• Time to market, and peace of mind.</td>
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<td>• Less drain on the battery -&gt; longer module lifetime</td>
<td>• Do not need roll detection to conserve battery life</td>
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<td>• The integration of components (MCU and RF) results in a cost savings from parts count and board space reduction. This also allows for a smaller module.</td>
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TPM Sensor Roadmap

**MPXY8000 Series**
- CMOS Pressure & Temperature Sensor
- Digital Output, Power Management
- Optimized for MC68HC908RF2 Interface

**MPXY8100 Series**
- CMOS Pressure & Temperature Sensor + RF
- Integrated State Machine (no MCU required)
- Integrated RF PLL stage
- Very Low Energy Consumption,
  FMVSS138 compliant

**3rd Generation Series**
- CMOS Pressure & Temperature Sensor + RF
- SPI Interface for low cost MCU Interface
- Integrated RF PLL stage
- Very Low Energy Consumption
  Provides Flexibility

**Battery Less Solution**
- To be defined

**2003**
- **2005**
- **2006**
- **2008**

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Motorola’s TPM Strategy Assets

• Highly integrated products:
  – Signal conditioned digital sensor
  – On-chip power management
• Multiple Process Technologies:
  – MEMS sensor
  – Analog Mixed Signal
  – High density logic
  – RF
• Integrated Media Protection
• Promising roadmap:
  – Further integration
  – Design expertise
• Unique RF expertise
• High Volume Manufacturing Capacity Already Installed
• Proven Automotive Supplier
Summary

• Builds upon a 20-year legacy of sensor solutions
• Provides a necessary solution to meet TREAD Act
• Pressure and temperature sensor and interface circuit with wake-up feature, all on a single chip
• Low Power consumption
• Motorola offers a complete chip set for a TPMS-RKE system with integrated components saving board space and allow part count reduction
• Robust package that offers excellent resistance against common automotive media
More Motorola TPM Sensor/System Information

Visit us at: www.motorola.com.semiconductors for:

- Tire Pressure Monitoring Sensor Family Brochure (BR1564/D)
- Motorola Sensors Selector Guide (SG1010/D)
- TPMS Demonstration Kit (AN1943/D)
- Motorola Tire Pressure Monitor System Demo (AN1951/D)
- High Accuracy Digital Tire Pressure Gauge (AN1953/D)
For More Product Information:

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