Robust High Speed Communications Technology over POF on Airborne applications
Agenda

• The Opportunity
• Standardization
• Performance
• Product Portfolio
The Opportunity
Plastic Optical Fiber (POF) in automotive

- KDPOF overpasses the limit of 100 Mbps over POF
- Automotive industry is demanding links of up to 3 and 5 Gbps
- All ADAS & Infotainment over POF:
  - Scalability
  - Secure and cost effective
- KDPOF tech. provides the solution for future Infotainment and ADAS systems
- Reusing already qualified:
  - Connectors
  - Optoelectronics
  - Cables
- KDPOF is working today with leading car makers and supplier to define next generation Vehicle Area Networks

ADAS: Advanced Driver Assistance Systems
1 Gbps POF advantages

- EMC problems free, is the main advantage
  - Yazaki EMC measurements demonstrate the EMS/EMI performance of the PHY and connector (FOT)
    - > 140 V/m
    - CISPR 25 - Class 5
- POF is a very reliable cable. Compared with COAX and STP.
- Low weight
- Predictable price, and competitive price compared with COAX in big volumes
- Good bending performance
- Availability of early products
- POF is an already automotive qualified media
- New POF products and IEEE standard will operate from -40°C to 105°C
Plastic Optical Fiber (POF) in Industry

- Using the same fibre and components KDPOF extends the reach and speed over POF.
- Profinet or Ethernet IP now running at 100 Mbps over POF increase they reach up to more than 130 m maintaining the industrial link budget.
Plastic Optical Fiber (POF) in UAV

- Lighter weight
- Portability
- Ruggedness
- Reduced need for shielding
- High safety levels
- Lower cost (easier installation and maintenance)

- Potential for degradation in a nuclear environment
- Limited high temperature operational point to 105ºC
- Up to now was limited in speed and length. Now reaches 1 Gbps and 40m
# POF for Defense/Airborne applications

<table>
<thead>
<tr>
<th>Application Category</th>
<th>System</th>
<th>Benefits of POF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications</td>
<td>Intrusion Detection Optical Communications (IDOC) system</td>
<td>Allows nonencrypted system EMI/EMP immunity. Improved security</td>
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<tr>
<td>Surveillance Submarines</td>
<td></td>
<td>Ability to hold up in corrosive sea environment High Sensitivity</td>
</tr>
<tr>
<td>UAV</td>
<td>Timbercon’s products</td>
<td>Covert operation EMI/EMP Immunity</td>
</tr>
<tr>
<td>Radar</td>
<td>Phased array</td>
<td>Weight savings Capability to exploit parallelism of array</td>
</tr>
<tr>
<td>Shipboard</td>
<td>Information system Damage control system (in tandem with sensor network)</td>
<td>Weight/space savings Low cost EMI/RFI immunity Ability to hold up in corrosive sea environment High data rate No spark hazard Ability to service live cable</td>
</tr>
</tbody>
</table>

*Based on RAND Note N-2866-RC*
POF on UAV for signal paths

Security

- No electromagnetic fields are produced, eliminating the possibility of eavesdropping. Copper needs a conduit to eliminate this problem, enhancing the weight savings of POF.

Ruggedness

- POF is immune to short circuits and is resistant to chemical and nuclear effects. POF can also be run in dump and highly corrosive environments.

Maintenance

- Because POF carries no current, live cable may be service.

Installation

- Because POF does not produce heat or sparks, cable can be run in small, closed areas (including ammunition magazines or fuel points), with no special provisions for fire or explosion hazards.
Standardization
Standardization

- ETSI TS 105 175-1-1 Published in Dec 2013: POF application requirements for HN.
  - ETSI has approved an application requirements document:
    - How to use POF in home networking environment.
  - Linked to VDE v 0885-763 and CENELEC 50173-1 and 50173-4: European norm.
  - Linked to ETSI TS 105 175-1.
  - Standardization done in collaboration with Orange.

- IEEE is currently standardized as a new Ethernet PHY layer for Gigabit over POF: 1000BASE-RH.
  - Target applications: Automotive, Professional and Consumer
  - Speed: 1 Gbps over 40 meters or 15 meters with 4 in-line connectors

- ISO is currently being under standardization on TC22/SC31-32
Performance
Performance: Adaptive Bit Rate

Adaptive Bit Rate

Gigabit applications

Long reach applications
Performance: bending (single-core POF)

• TEST SETUP:
  • LED OMA: 0 dBm.
  • LED ER: 10 dBo
  • POF Length: 50 m
  • Temperature: 27 °C
  • BER: $10^{-12}$
  • Bending: 90 ° / bend

Typical Bending performance @ 25°C for GH4002
Components
Fiber and Connectors

1: Header connector (PCB)
2: W/H connector
3: In-line connector
4: Sub-wire

- Reduced size header connector
- Reduced loss of optical power in coupling
- POF cable

<POINTS>
- SMD mounting
- High-speed compatibility
## Integrated Circuits Portfolio

<table>
<thead>
<tr>
<th>Market</th>
<th>Product</th>
<th>Data Interfaces</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>KD1011</td>
<td>RGMII, RMII, MII</td>
<td>Industrial grade and temperature range: -40°C to 85°C&lt;br&gt;Optimized for long reach (100 Mbps, &gt;100 m) applications</td>
</tr>
<tr>
<td></td>
<td>KD1012</td>
<td>SGMII, SerDes 100BASE-X</td>
<td></td>
</tr>
<tr>
<td>Automotive</td>
<td>KD105x</td>
<td>Ethernet (xGMII)&lt;br&gt;P2P video (DVP)</td>
<td>Optimized for automotive quality grade, temperature range (-40°C to 105°C) and EMC Wake-up capability&lt;br&gt;Real Time (time stamping, PTP, SyncE) support&lt;br&gt;Full duplex over single POF operation mode&lt;br&gt;ASIL&gt;3 safety grade</td>
</tr>
</tbody>
</table>
Products for the Industrial/Professional markets

KD1011

- RGMII interface
- PHY and MAC operation
- 100BASE-FX backwards compatibility
- Industrial temperature grade

KD1012

- RGMII & SGMII interface. SFP ready
- 100BASE-FX backwards compatible
- Industrial temperature grade
Optical Transceiver

• AVAGO Technologies analog POF transceiver provides the system designer with the ability to implement Gigabit Ethernet over 2.2mm jacketed standard POF

• Features
  • Similar form factor to the well-known RJ45 connector
  • Easy bare fiber termination solution for 2.2mm jacket POF
  • EMI/ EMC robust
  • Operating temperature range -40°C to 85°C
  • Single 3.3V power supply operation
  • Integrated optics to efficiently focus light for fiber coupling