The world’s fastest Plastic Optical Fiber

New product introduction

AGC Electronics
Asahi Glass Co., Ltd.
In the house, there are almost **copper wires**.
About Optical Fibers

Core / Cladding:
- **Core** : Light path
- **Cladding** : Keep light inside (Reflect)

Cross-section:
- Core and Cladding: two different materials with different refractive index

Side View:
- Light travels through the core with interfacial reflection

**Proprietary**

★ Silica Fiber: Core and Cladding is made from Silica
★ Plastic Optical Fiber: Core and Cladding is made from Plastic

Various Optical Fibers with different structures and materials
Optical Fiber Comparison

Silica Glass Optical Fiber (GOF)

- **Single Mode (SM)**
  - Core: 8 um
  - Clad: 125 um

- **Multi Mode (MM)**
  - Core: 50, 62.5 um (GI)
  - Clad: 125 um

Plastic Optical Fiber

- **PMMA type**
  - SI (Step Index)
  - Core: 980 um (SI)
  - Outer Diameter: 1000 um

- **Perfluorinated type**
  - GI (Grated Index)
  - Core: 120 um (GI)
  - Outer Diameter: 500 um

Two kinds of Optical Fiber: GOF and POF
Future Trends in High-Definition Image Transmission

The display becomes ultra-high-density ⇒ High Speed Optical Fiber required in near future
About Fontex

 Derived from Italian words meaning “fountain of light”

 Plastic Optical Fiber with High Speed and Robust!

(1) More transparent than Acrylic polymer at wide band of wavelengths
(2) More robust than Silica fiber for bending
(3) 10Gbps x 100m transmission. Higher potential than Silica.
(4) Lower Power Consumption than Copper cable, Noise Free, small and light

High speed, Low power consumption and Easy handling
Since 1994, Professor Koike of Keio University and AGC have promoted joint research program to develop a super high-speed graded-index (GI) optical fiber with AGC’s transparent Perfluorinated Polymer "Cytop"

As a result of this joint research, AGC has been brought a fluororesin-based plastic optical fiber (POF) to the market.

AGC participates in a research project titled “Plastic optical fiber for world’s highest data transmission speed,” which was initiated by Professor Yasuhiro Koike of Keio University and decided to secure a grant from the “Funding Program for World-Leading innovative R&D on Science and Technology” effective March 9, 2010.

Base polymer

“Cytop”: AGC’s unique polymer
Transparent, C-H bond free, Perfluorinated polymer

Plastic Optical Fiber

C-F bond is transparent between 650nm and 1300nm

Plastic fiber available for low-cost long wavelength laser
Double Cladding Structure

No fiber Breakage + No light leaks even in tight bends

Cross section of fiber

FONTEX works if bent, kinked, knotted, bundled.
③ High Speed Capability

Launched Pulse

FONTEX

Output Pulse (Reduced pulse spread)

10Gbps x 100m

Multiple assessment

BER is good

Low differential mode delay

Eye diagram shows minimal distortion

FONTEX is capable of 10Gbps over 100 m
Advantage over Copper Cable

- Copper need high power for high-speed data transmission
- Data center consume power and 45% of power consumption is for cooling (air conditioner)
- Copper needs protection against noise
- Data center building require high load capacity for heavy Cu Cables.

### Comparison Table

<table>
<thead>
<tr>
<th></th>
<th>FONTEX</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g/m)</td>
<td>8</td>
<td>100</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Speed (Gbps)</td>
<td>≥10</td>
<td>≤10</td>
</tr>
<tr>
<td>Power (W) At 10Gx10m</td>
<td>0.3～0.5</td>
<td>7～10</td>
</tr>
</tbody>
</table>

Lower power consumption and smaller cable by FONTEX
### Advantage of FONTEX

At Short distance, high speed (10Gbps, ≤100m) for Consumer Use

<table>
<thead>
<tr>
<th></th>
<th>Copper</th>
<th>Wireless</th>
<th>Silica Fiber</th>
<th>FONTEX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed</strong></td>
<td>△</td>
<td>△</td>
<td>◎</td>
<td>◎</td>
</tr>
<tr>
<td><strong>Power Consumption</strong></td>
<td>△</td>
<td>△</td>
<td>○</td>
<td>○</td>
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<tr>
<td><strong>Noise</strong></td>
<td>△</td>
<td>×</td>
<td>◎</td>
<td>◎</td>
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<tr>
<td><strong>Bending</strong></td>
<td>○</td>
<td>—</td>
<td>△~×</td>
<td>◎</td>
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FONTEX, the best for high-speed, Consumer use
**Summary**

- **High capacity, low power consumption and easy handling**
  - The world’s fastest Plastic Optical Fiber

- **Production and supply**
  - Supply: Start from July 2010
  - Product: Optical fibers and cables for 10Gbps
  - Production: ACG Keihin plant (Yokohama Japan)
    Modify existing facility for FONTEX

- **Application**
  - Interconnection and Inner connection for TVs and Displays (3D, 4k/2k, 8k/4k, etc.),
  - Interconnection for PCs and peripherals
  - Inner connection for Mobile devices
  - Interconnection for Data Center equipments
  - Interconnection for networking equipments and Medical devices in the Hospitals

“FONTEX”, for High capacity and low power consumption
R&D project, with a budget of ¥100Billion, sponsored by Cabinet Office. World class 30 Japanese researchers are selected to grant.

With Prof. Shinya Yamanaka (the researcher of induced pluripotent stem (iPS) cells) and Mr. Koichi Tanaka (the winner of the Nobel Prize in Chemistry in 2002), Prof. Yasuhiro Koike of Keio Univ. (the inventor of high speed Plastic Optical Fiber (POF)) received a research grant from this funding program for his research project titled “Plastic optical fiber for world’s highest data transmission speed”.

AGC participate in this Prof. Koike’s project, as one of core members with Toshiba, SONY, etc., to aim at achieving a further ultra-high transmission speed (40 Gbps or above) on a volume production level. AGC also strive to develop an optical communication system for each application including cables and connectors.

For its ease of handling and flexibility, FONTEX has been regarded as the best solution for increasing needs of high-definition, big-screen TVs, and high-speed PCs.

Optical data transmission with POF is moving forward
Transmission test at 40Gbps x 100m
(Tested by Univ. of Southern California and Keio Univ.)

Transmission of 40 Gb/s DPSK and OOK at 1.55 μm through 100 m of Plastic Optical Fiber (ECOC 2008)

Source: “Transmission of 40 Gb/s DPSK and OOK at 1.55μm Through 100 m of Plastic Optical Fiber“
S. R. Nuccio (1, 3), L. Christen (1), X. Wu (1), S. Khaleghi (1), O.Yilmaz (1), A. E. Willner (1), Y. Koike (2)
1: Dept. of Electrical Engineering, Univ. of Southern California, USA
2: Faculty of Science and Technology, Keio University, Japan
3: The Aerospace Corporation, USA

Successful data transmission at 40Gbps x 100m by FONTEX
Fluororesin: high-speed transmission

Potential transmission rate delivered from material dispersion

FONTEX is promising to be faster than MM Silica

Source: Prof. Koike of Keio Univ.
The best POF for further ultra-high speed data transmission (40Gbps or above)

- Interconnection and Inner connection for next generation TVs and Displays (3D, 4k/2k, 8k/4k, etc.),
- Interconnection for PCs and peripherals
- Interconnection for data center equipments

A further ultra-high speed POF at a transmission speed of 40 Gbps or above.
- Optical communication system for each application including cables and connectors.

Strive to develop for a volume production level!

Maximize the potential of Fluororesin