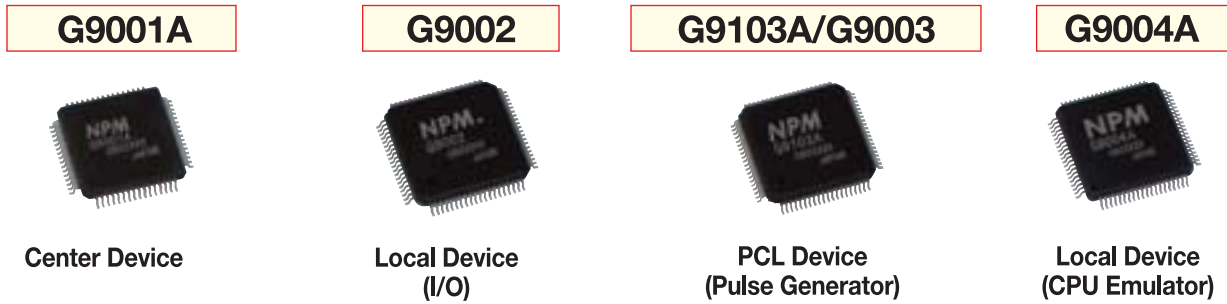# High-speed Serial Communications Chips in G Series

G9000 Series to Configure Motionnet® System with Less Wiring

Best Open Field Bus! I/O Chips, Pulse Generators and CPU Emulators are put on a Single Line from Center Device

G9001A	G9002	G9103A/G9003	G9004A
Center Device	Local Device (I/O)	PCL Device (Pulse Generator)	Local Device (CPU Emulator)

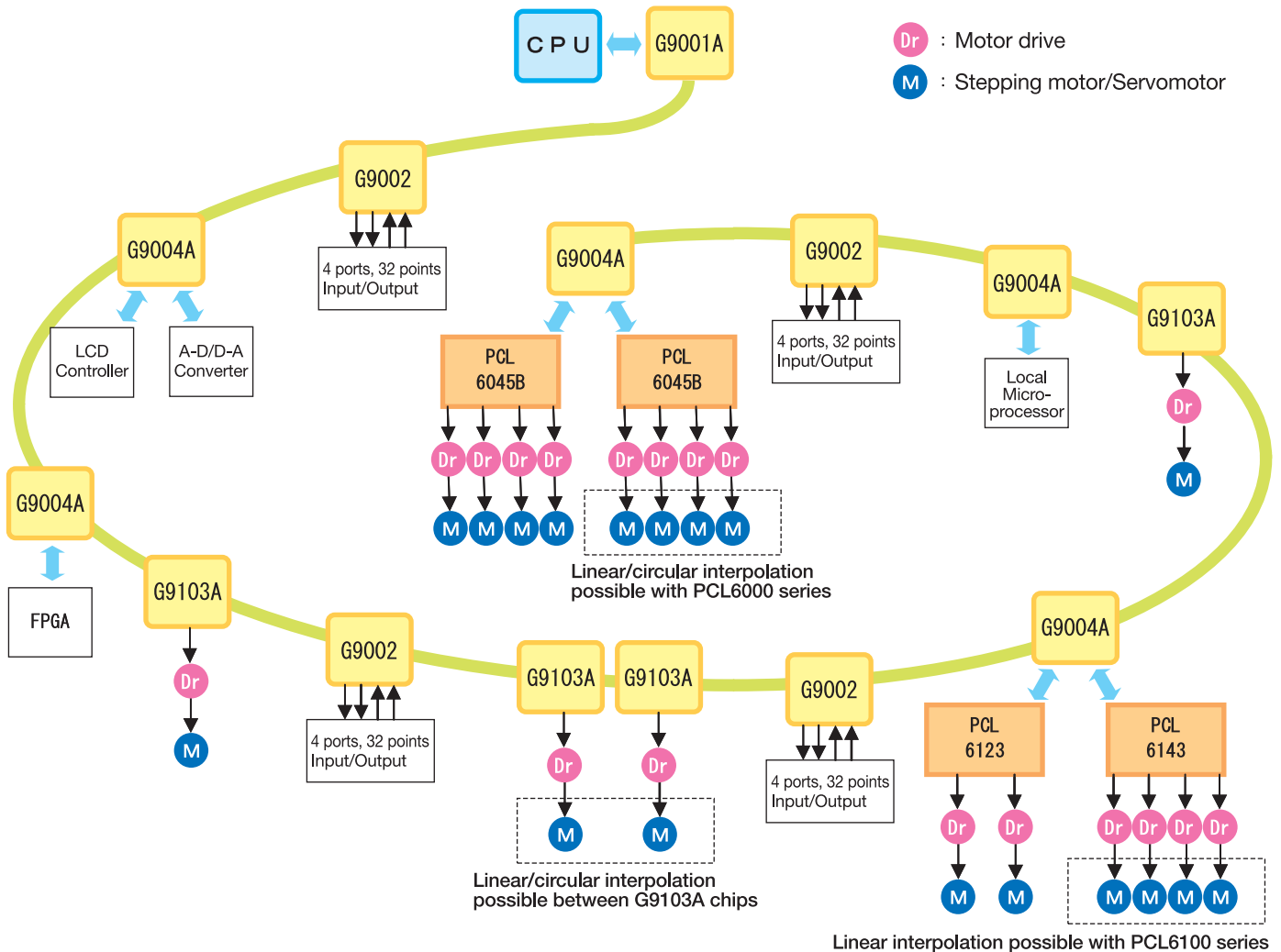**Motionnet®** is a high-speed serial communication system advocated by NPM.
Configured with 4 types of originally developed devices in G9000 series, the system satisfies requirements for factory automation by totally enabling remote control of input/output, motors, CPU emulators and message communication. In cyclic communication for input/output control, 4-byte data is constantly transferred in a maximum **15.1 μs** while it can be interrupted by a maximum 256-byte data for motor or device control.
Communication time can be calculated using the prescribed equation, thereby ensuring the real-time characteristic demanded for factory automation.
Motionnet® products are available as independent chips or the chip mounted boards and units which can be combined with user designed boards and units.

Maximum 64 local devices can be connected.

Motionnet®

Dr : Motor drive
M : Stepping motor/Servomotor

Linear/circular interpolation possible with PCL6000 series

Linear/circular interpolation possible between G9103A chips

Linear interpolation possible with PCL6100 series

Basic Specifications of High-speed Serial Communications Chips in G9000 Series

Name	Center Device	Local Device (I/O)	PCL Device (Pulse Generator)	Local Device (CPU Emulator)
Model	G9001A	G9002	G9103A／G9003	G9004A
CPU interface	Z80, 8086, 68000, H8, etc.	−	−	Z80, 6809, 8086, 68000, H8, etc.
Reference clock	80 MHz (or 40 MHz)			
Communication speed	Selected from 20, 10, 5 or 2.5 Mbps			
Communications protocol	NPM original			
Communications mode	Cyclic mode for I/O ports and status communication, transient mode for data communication (half-duplex)			
Interface	RS-485 + Pulse transformer			
Connection system	Multidrop system			
Error detection method	CRC12			
Features	• Wholly controls serial communication, thereby minimizing burden to CPU. • Cyclic transfer for I/O ports and transient transfer for data communication	• 32-bit I/O ports • Input/output direction selectable by every 8 bits • Tolerant buffer is used for interface, enabling it to connect to 5 V using few components.	• Provides the performance of 1 axis in NPM high-end multiaxial programmable pulse generators in PCL6000 series. • Tolerant buffer is used for interface, enabling it to connect to 5 V using few components. • Interpolation possible between multiple units of G9103A	• Enables control of remote devices by emulating CPU. • Enables data exchange from/to remote local devices.

Features (continued):

- A maximum 64 local devices can be connected to 1 serial line coming from the center device.
  Maximum 256 input/output control ports (2048 points), maximum 64 motion control axes and maximum 128 chip control devices
- Input/output and each device status communication time
  Input/output and each device information is automatically updated in the RAM of center device by every 1 cyclic communication
  With communication rate 20 Mbps (cyclic communication 15.1 μs/local device)
      0.12 ms with 8 local devices connected (I/O: 256 points)
      0.24 ms with 16 local devices connected (I/O: 512 points)
      0.49 ms with 32 local devices connected (I/O: 1024 points)
      0.97 ms with 64 local devices connected (I/O: 2048 points)
- Data communication time
  Command from CPU lets data communication interrupt cyclic communication.
      19.3 μs to send/receive 3-byte data (to write a moving amount to G9003)
      169.3 μs to send/receive 256-byte data
- Connection cable for serial communication
  Multidrop connection using a dedicated cable or LAN cable (Catetory 5)
- Remarks

	CPU Emulation Mode	Message Communication Mode
Data buffer length	128 words	128 words 1 word for system booking 127 words for message data
Data communication time	21.7 μs to transfer 5 words	169.3 μs to transfer 128 words
Control address space	64 bytes	
Communication data length	1 to 128 words/frame (1 word = 16 bits)	

Cable length	Max. 100 m (min. 0.6 m) with 32 local devices connected and communications rate 20 Mbps Max. 50 m (min. 0.6 m) with 64 local devices connected and communications rate 20 Mbps			
Package	64-pin QFP	80-pin QFP	80-pin QFP	80-pin QFP
Mold Dimensions (mm)	10 x 10	12 x 12	12 x 12	12 x 12
Supply voltage	+3.3 V ±10%	+3.3 V ±10%	+3.3 V ±10%	+3.3 V ±10%
Ambient Temparature	−40 ~ +85 ℃			

G9001A

RoHS Lead·Free

G9001A is the center device to configure **Motionnet**® high-speed serial communications system. It contains 256-byte RAM for I/O control and 512-byte RAM for data communication, so that it can control a maximum 64 local devices. One data device can perform a maximum 256-byte data communication.

Features

◆ **Minimizes burden to CPU**

The whole serial communications are controlled by G9001A.

◆ **Built-in large-capacity RAM**

Enables remote I/O control in the way to access memory.

◆ **Maximum 256-byte data is exchangeable.**

◆ **Accepts desired combinations of local devices.**

I/O device (G9002), programmable pulse generators (G9103A/G9003) and CPU emulator (G9004A) can freely be combined in a desired number up to 64.

● Automatically recognizes setting address and the port status of I/O device.
● Address area: 512-byte space but 8-byte space can be used depending on the use of input/output buffer.
● Communication data length: 1 to 128 words/frame (1 word = 16 bits)
● CPU interface: 4 types of interface circuits built in.

G9001A-mounted Boards & Unit

PPCI-L112
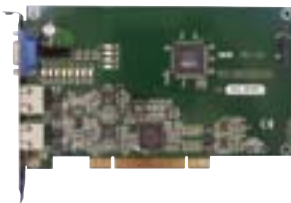
PCI Bus Center Board
(G9001A x 2)

NPMCMNET-I/O104

PC/104 Bus Center Board
(G9001A x 2)

MNET-PUSB3601

RoHS compliant

USB Center UNIT
(G9001A x 1)

G9002

RoHS Lead·Free

G9002 is the I/O control chips as a local device. Under the control of the center device G9001A, the 4-port 32-bit input/output signals are cyclically communicated between G9002 and G9001A.
The interface adopts a tolerant buffer, enabling it to connect to 5 V with minimum components.

Features

◆ **2048 I/Os can be under the control of the center device.**

64 units of G9002 connected to a single line

◆ **Setting address and port status of G9002 are automatically recognized by center device.**

● Number of general-purpose I/O ports: 4 (8 bits/port)
● Input or output and the logic can be set for each port.
● Communication mode: Cyclic

G9002-mounted Boards

MNET-340

Local Input Board
(32-bit input)

MNET-322

Local Input/Output Board
(16 bits each for input and output)

MNET-304

Local Output Board
(32-bit output)

G9103A

RoHS
Lead·Free

Soon on sale

G9103A is a 1-axis motor control PCL Device used as a local device. It provides the same performance as the high-end programmable pulse generators in PCL6000 series.
Use of multiple units enables circular interpolation between 2 motors or linear interpolation between 2 or more motors.
Various functions include overriding prevailing pulse rate and target position, elimination of triangular drive, backlach correction, suppression of vibration at cessation, progammed limit, diversified origin return sequences, inputting mechanical signals, and servomotor interface.
The status of general-purpose input/output ports and motor control information are cyclically communicated to/from the center device. Axis control commands and register parameters are read or written through data communication.

Features

◆ **64 axes can be controlled on a single line.**
By connecting 64 units of G9103A to the line

◆ **Circular interpolation between 2 desired axes or linear interpolation between 2 or more axes.**

◆ **Maximum output pulse rate: 6.66 Mpps**

◆ **Built-in 3 up/down counters**
• Two 28-bit and one 16-bit

◆ **Built-in 3 comparators**
Use of comparators and up/down counters in combination enables the following:
• Interrupt signal output and external output of comparison results
• Immediate stop or deceleration-stop
• Programmed limit
• Out-of-step detection
• Synchronization signal output

◆ **Overriding prevailing pulse rate and target position**

● Number of general-purpose input/output ports: 1 (8 bits); input or output can be defined for each bit.
● Communication data length: 1 to 4 words/frame (1 word = 16 bits)
● Communication mode: Cyclic for I/O port and transient for parameter transfer
● Pulse output mode: Selectable from 12 types of pulse signal output including 2-phase stepping motor excitation sequence
● 12 major operation modes
● Built-in 1-stage preregisters which enable writing of the next operation's parameters (moving amount, starting pulse rate, operating pulse rate, acceleration rate, deceleration rate, multiplication factor, ramping-down point, operating mode, S-curve sections in acceleration and deceleration and interpolation parameters) during present operation in progress.
● Manual pulser input terminal with functions to multiply by 32 and to divide by 2048
● 14 types of error factors and 13 types of event factors are available to initiate an interrupt signal (event factor can be selected by the register)

G9103A Interpolation Control Image   The maximum connection length is 100mm.

16
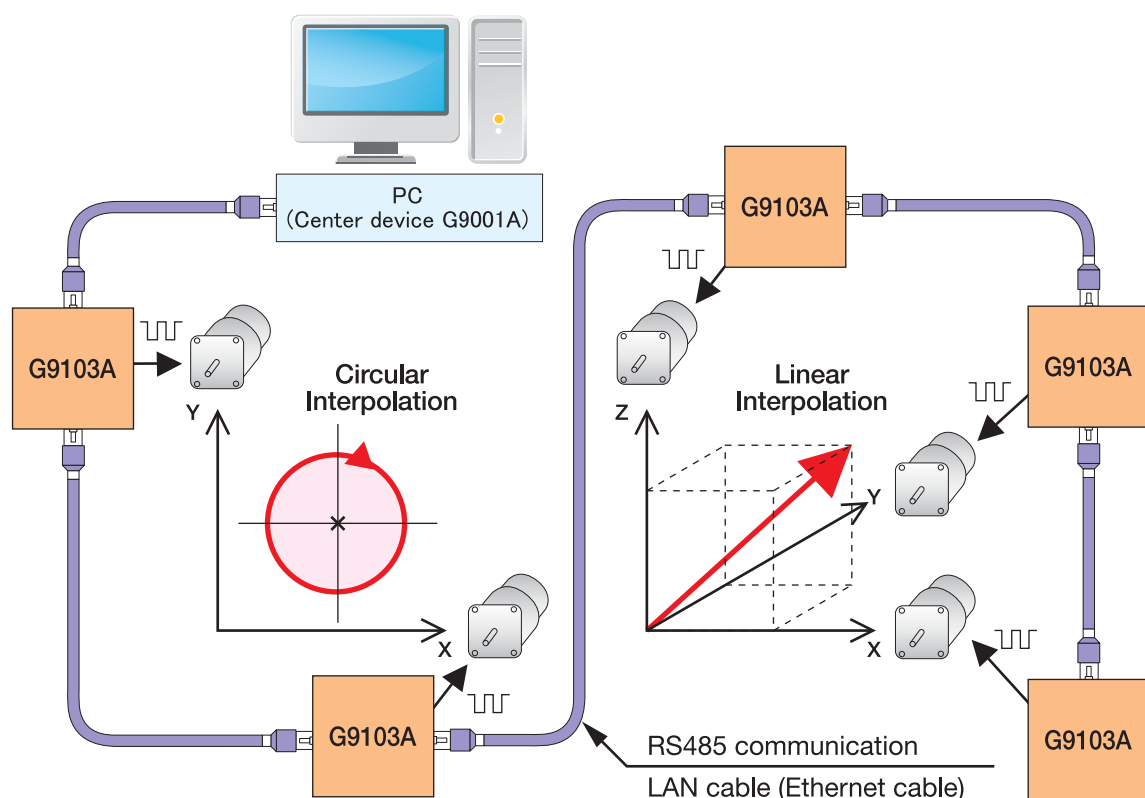
G9003

G9003 is the 1-axis motor cotrol programmable pulse generator used as a local device.
Various functions include overriding prevailing pulse rate and target position, elimination of triangular drive, backlach correction, suppression of vibration at cessation, programmed limit, diversified origin return sequences, inputting mechanical signals, and servomotor interface.
The status of general-purpose input/output ports and axis control information are cyclically communicated to/from the center device. Axis control commands and register parameters are read or written through data communication.

Features

◆ **64 axes can be controlled on a single line.**
By connecting 64 units of G9003 to the line

◆ **Maximum output pulse rate: 6.66 Mpps**

◆ **Built-in 3 up/down counters**
• Two 28-bit and one 16-bit

◆ **Built-in 3 comparators**
Use of comparators and up/down counters in combination enables the following:
• Interrupt signal output and external output of comparison results
• Immediate stop or deceleration-stop
• Programmed limit
• Out-of-step detection
• Synchronization signal output

◆ **Overriding prevailing pulse rate and target position**

● Number of general-purpose input/output ports: 1 (8 bits); input or output can be defined for each bit.
● Communication data length: 1 to 4 words/frame (1 word = 16 bits)
● Communication mode: Cyclic for I/O port and transient for parameter transfer
● Pulse output mode: Selectable from 12 types of pulse signal output including 2-phase stepping motor excitation sequence
● 12 major operation modes
● Manual pulser input terminal with functions to multiply by 32 and to divide by 2048
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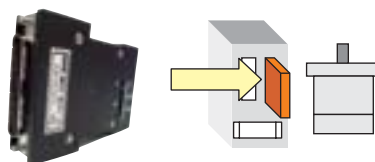### G9003-mounted Boards

MNET-M101-DUM

Local 1-axis Motion Control Board
Pulse train output type
Can control servomotor and stepping motor.

MNET-M3X1

RoHS compliant

Local 1-axis Motion Control Boards
Directly connectable to input/output connectors of motor drives of various manufacturers. Models vs. compatible motor drives are as follows:

MNET-M321-MIA
Panasonic AC servo drive MINAS A/AIII/A4

MNET-M331-J3
Mitsubishi Electric AC servo drive MR-J3

MNET-M341-S23
Yaskawa Electric AC servo drive ΣII/III/V

MNET-M351-SAN
Sanyo Denki AC servo drive Q

MNET-M361-VPS
Nikki Denso AC servo drive VPS

MNET-M371-AS
Orienal Motor α Step AS(C)

MNET-BCD4020FU/FB

RoHS compliant

Local 1-axis 2-phase Stepping Motor Drive
G9003 and stepping motor drive are incorporated into a board.

MNET-BCD4020FU
Unipolar, 1/16 microstep

MNET-BCD4020FB
Bipolar, 1/256 microstep

G9004A

Can control peripheral chips as a remote CPU.

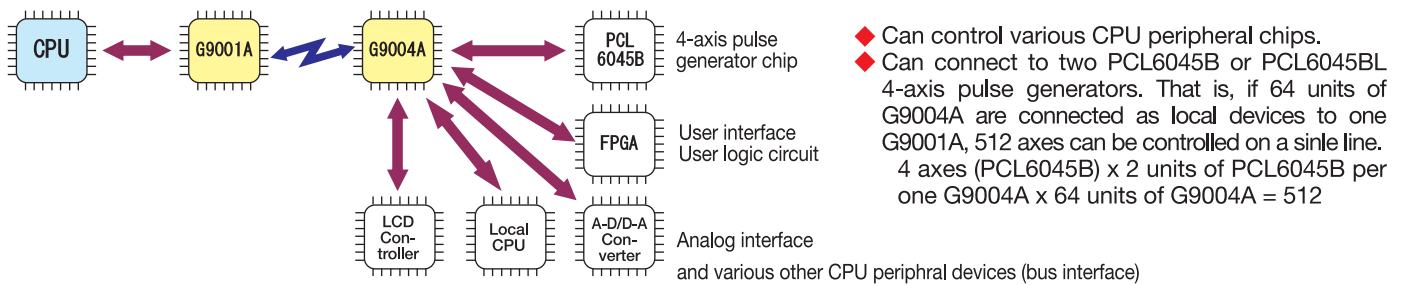G9004A is the CPU emulator used as a local device.
It can control various peripheral chips by performing like a local CPU. It can also communicate with an additional CPU installed in the local devices.
- According to commands sent from the center device, G9004A generates CPU terminal signals including control signals, address/data bus signals.
- Connecting CPU terminal signals to high-performance devices enables remote control from the center device.
- Device status information such as interrupt and FIFO is cyclically transferred to the center device and CPU terminal signals are transiently transferred through data communication.

Available as a local device or PCL-incorporated board.

Features

◆ **Can communicate a maximum 256-byte data.**
◆ **Up to 64 units can be connected to a single line.**
◆ **Communication failure detection circuit ensures safe operation (watchdog timer built in)**

Connection Example

CPU ⟷ G9001A ⟷ G9004A → PCL 6045B — 4-axis pulse generator chip

G9004A → FPGA — User interface / User logic circuit

G9004A → LCD Controller

G9004A → Local CPU

G9004A → A-D/D-A Converter — Analog interface

and various other CPU periphral devices (bus interface)

◆ Can control various CPU peripheral chips.
◆ Can connect to two PCL6045B or PCL6045BL 4-axis pulse generators. That is, if 64 units of G9004A are connected as local devices to one G9001A, 512 axes can be controlled on a sinle line.
  4 axes (PCL6045B) x 2 units of PCL6045B per one G9004A x 64 units of G9004A = 512

G9004A+PLC6143-mounted Boards

MNET-BCD5030A4	MNET-BCD4020FUA4
RoHS compliant	RoHS compliant

Local 4-axis 5-phase Stepping Motor Drive
G9004A, PCL6143 and 4-axis 5-phase stepping motor drive are incorporated into a board.

Local 4-axis 2-phase Stepping Motor Drive
G9004A, PCL6143 and 4-axis 2-phase stepping motor drive (unipolar 1/16 microstep) are incorporated into a board.

G9004A+PLC6045B-mounted Board

MNET-M204-DUM
RoHS compliant

Local 4-axis Motion Control Board
Pulse train output type
Can control servomotor and stepping motor.

Pulse Transformer NPT102F recommended for G9000 Series

DIL 4-pin surface-mounted small-sized pulse transformer featuring high dielectric strength (made by JPC).
It is most suitable for use in combination with G9000 series.

Primary inductance: 1000 µH ±30% 100 kHz 100mV
Winding ratio: N1:N2 = 1:1
Leakage inductance: 2.0 µH max.
Winding capacitance: 20 pF max.
DC winding resistance: N1 1.5 Ω, N2 1.5 Ω
ET product: 6V-µS min. PRF 1 kHz 3 V
Insulation resistance: 100 MΩ min. 1000 Vdc
Dielectric strength: 1500 Vac rms for 1 minute
Dimensions: 7.0 x 5.6 mm (mold)

Serial Communications Cable

For **Motionnet**® system, a slender 1-pair dedicated NPM cable or commercially available Ethernet LAN cable which ensures high-quality communication at high speed is recommended.
　Motionnet®-dedicated cable (1-pair)
　　The slender and flexible harness cable which can conveniently be laid is available with RJ connector, DF connector, RF and DF connectors or with no connector in 10 m long.
　　Wiring standard: STP cable equivalent to category 5
　　For details, refer to **Motionnet**® catalog.
　Commercially available LAN cable (4-pair)
　　Wiring standard: TIA/EIA-568-B, UTP/STP cable conforming to category 5 or higher