

SG “Reduced Pair Gigabit Ethernet PHY” Industrial Environment



- Wiring tailored to machinery, therefore limited use of terminated cables
- Installation of cables and connectors by low-skilled workers
- Installation location may be difficult to access
- Re-use of existing cabling due to high plant lifetime
- Long distances to be covered,
e.g. between production and foreman's office
- Industrial environmental requirements to be fulfilled,
e.g. temperature range, EMC (provide a CESD robustness > 4kV), etc.
- Energy and Data on same cable, therefore PoE to be supported

SG “Reduced Pair Gigabit Ethernet PHY” Industry Requirements



New PHY to support

- Gigabit on 4-wire
- Full integration into Auto-negotiation to automatically select connection params, fixed setting of the 4-Wire Gigabit mode shall also be possible
- Standard properties according to IEEE Std 802.3-2008 1000BASE-X
 - Support operation over 100 meters of copper balanced cabling with Bit Error Ratio of less than or equal to 10^{-10} (CAT 5e STP)
- PHY delay constraints to support high precision time synchronization
 - Constant delay, so that no Link Up Event or Restart of the system shall change the receive neither the transmit delay of the PHY
 - TX Delay (MII) < 80ns, RX Delay (MII) < 120ns
- Fast Link Down Detection <1ms including unidirectional links for non-seamless redundancy
- Power Consumption equal or below 8-wire GBit PHY



SG “Reduced Pair Gigabit Ethernet PHY” Industry Requirements



New PHY to support (added 2012-10-30)

- Operating Temperature Range: -40°C to + 85°C
- Detection of all kinds of cable breaks and/or cable shortcuts (regardless of the cable length) and activation of LinkDown in all cases

Examples for existing Cable Data

Electrical data	PB FC STANDARD CABLE GP	IE FC TP STANDARD CABLE GP 2X2
Damping ratio per length	0.0025 dB/m at 9.6 kHz / maximum 0.0040 dB/m at 38.4 kHz / maximum 0.022 dB/m at 4 MHz / maximum 0.042 dB/m at 16 MHz / maximum 	0.052 dB/m at 10 MHz / maximum 0.195 dB/m at 100 MHz / maximum 
Impedance	150 Ω Nominal value 270 Ω at 9.6 kHz 185 Ω at 38.4 kHz 150 Ω for frequency range 3 MHz ... 20 MHz	100 Ω for frequency range 1 MHz ... 100 MHz
Relative symmetrical tolerance	10% of the surge impedance at 9.6 kHz, 38.4 kHz and 3 MHz ... 20 MHz	15 % of the surge impedance at 1 MHz ... 100 MHz
Near-end crosstalk per length	-	0.5 dB/m at 1 MHz ... 100 MHz
Shield resistance per length / maximum	9.5 Ω /km	-
Capacity per length / at 1 kHz	28.5 pF/m	-
Transfer impedance / at 10 MHz	-	10 m Ω /m
Loop resistance per length / maximum	110 Ω /km	115 Ω /km
Operating voltage	100 V RMS	100 V RMS
Mechanical data		
Number of electrical wires	2	4
Design of the electrical connection / FastConnect	Yes	Yes
Outer diameter	0.65 mm of the inner conductor 2.55 mm of the wire insulation 5.4 mm of the inner sheath of the cable 8 mm of the cable sheath	0.64 mm of the inner conductor (AWG22 core) 1.5 mm of the wire insulation 3.9 mm of the inner sheath of the cable 6.5 mm of the cable sheath
Symmetrical tolerance of outer diameter / of cable sheath	0.4 mm	0.2 mm
Connector	PROFIBUS connector	IE FC RJ45 PLUG 2X2 according to IEC 60603-7-3 Clause 6.5