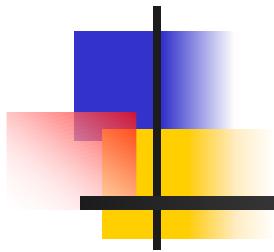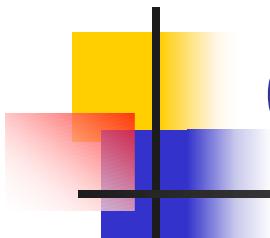# TS-1000 implementation and the harmonization with EFM

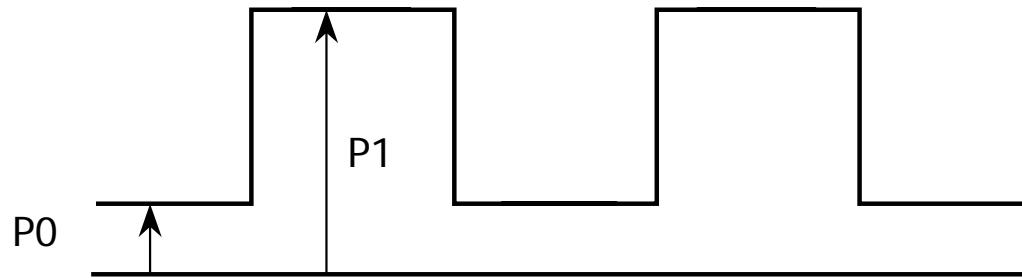Makoto Kadowaki

NEC Corporation

contents

- Comparison of the ER between IEEE and TTC

- An actual optical transceiver satisfying TTC TS-1000 class S spec

- Typical data example of extinction ratio and receive sensitivity

Comparison of the ER between IEEE and TTC   1

$$ER=10\log(P1/P0)$$

- ER stability is strongly dependent on mechanism of APC.

- If APC is conventional type (i.e. only LD bias is compensated), ER will change according to the mark density of transmission data.

- The mark density of 4B/5B line coding will vary from 40% to 60%.

- Pseudo-random pattern is almost equal to 50% mark density.

Estimated ER when using conventional (LD bias only compensated) APC

	Pseudo-random	4B/5B("1"=40%)
	8.2dB	6.6dB
ER	7.2dB	6dB
	XdB	YdB

$$Y = 10\log\left[1 + \frac{10^{X/10}-1}{1+0.1(10^{X/10}-1)}\right]$$

# An actual optical transceiver satisfying TTC TS-1000 class S spec (1)

Single fiber bi-directional transceiver module
- Integrating 1.3mm/1.5mm WDM function
- Small Form Factor (2x5) implementation
- 10 to 155 Mbps continuous-mode transmitter / receiver
- Signal Detect (S.D.) function
- Single power supply voltage of +3.3V
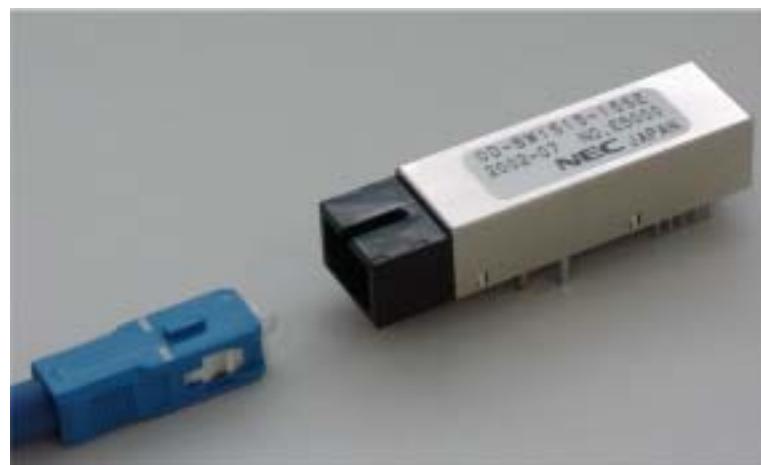
An actual optical transceiver satisfying TTC TS-1000 class S spec (2)

Parameter	Unit	1.5µm transmit / 1.3µm receive	1.3µm transmit / 1.5µm receive
Bit rate	Mbps	10 ~ 155.52	
Laser Diode type	-	MLM-LD	
Center wavelength	nm	1480 ~ 1580	1260 ~ 1360
Spectral width (RMS)	Nm	<6.0	<7.7
Mean output power	dBm	-14 ~ -8	
Extinction ratio	dB	> 8.2	
Overload	dBm	-8	
Sensitivity	dBm	-30	
Optical input Signal Detect (S.D.)	-	Normal Operation = High Level Fault Condition = Low Level	
Transmitter disable function (TDis)	-	Optical output enable = Low Level Optical output disable = High Level	
Ambient Temperature	ºC	0 ~ +70	
Power Supply Voltage	V	3.3(+/-5%)	
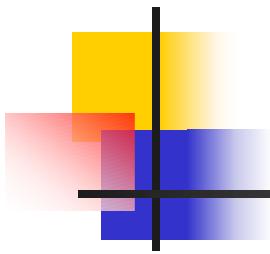
Typical data example of extinction ratio and receive sensitivity

Item	Unit	TTC	IEEE	Remarks
Code		PRBS23-1	EFM test pattern(*)	
Extinction ratio	dB	11.1	11.1	
Receive sensitivity	dBm	-36.0	-33.9	BER=1E-12

Note * IEEE802.3ah Table60-11-Example of Unbalanced pattern