ISO/IEC 14165-116 :2005-08 (E)

Information technology_- Fibre channel_- Part_116: 10_Gigabit Fibre Channel (10GFC)

Contents

FOREWORD - - - - 9

INTRODUCTION - - - - 10

1 Scope - - - - 11

2 Normative references - - - - 11

3 Definitions and conventions - - - - 12
3.1 Definitions 12
3.2 Editorial Conventions 12
3.2.1 General 12
3.2.2 Hexadecimal notation 12
3.2.3 Transmission rate abbreviations 13
3.2.4 Acronyms and other abbreviations 14
3.2.5 Special symbols 15
3.3 Keywords 15
3.4 Notation 16
3.4.1 State diagram conventions 16

4 Structure and concepts - - - - 19
4.1 Overview 19
4.2 10GFC structure 20
4.2.1 FC-3 general description 20
4.2.2 FC-2 general description 20
4.2.3 FC-1 general description 21
4.2.4 FC-0 general description 22

5 Functional characteristics - - - - 23
5.1 General characteristics 23
5.2 10GFC physical variant nomenclature 23

6 Optical interface specification - - - - 24
6.1 General 24
6.2 850 nm Parallel (4 lane) PMD, type 1200-MX-SN4P-I 24
6.2.1 Overview 24
6.2.2 PMD MDIO function mapping 24
6.2.3 PMD functional specifications 25
6.2.4 Operating ranges 27
6.2.5 PMD to MDI optical specifications for 1200-MX-SN4P-I 27
6.2.6 Optical measurement requirements 30
6.2.7 Environmental specifications 31
6.2.8 Environment 31
6.2.9 PMD labeling requirements 32
6.3 850 nm Serial PMD, type 1200-MX-SN-I 32
6.3.1 General 32
6.3.2 Optical specifications 32
6.3.3 Jitter, measurement and safety specifications 33
6.4 850 nm CWDM (four wavelength) PMD, type 1200-MX-SN4-I 34
6.4.1 Overview 34
6.4.2 Wavelength-division multiplexed-lane assignments 34
6.4.3 Operating ranges 34
6.4.4 Transmitter optical specifications 34
6.4.5 Receive optical specifications 34
6.4.6 Eye Safety 35

6.5 1 310 nm Serial PMD, type 1200-SM-LL-L . . . 36
6.5.1 General . . . 36
6.5.2 Optical specifications . . . 36
6.5.3 Jitter, measurement and safety specifications . . . 36
6.6 1 310 nm CWDM (four wavelength) PMD, type 1200-X-LC4-L . . . 37
6.6.1 General . . . 37
6.6.2 Optical specifications . . . 37
6.6.3 Jitter, measurement and safety specifications . . . 37

7 Optical interface receptacle specification . . . 38
7.1 General . . . 38
7.2 Optical interface connector . . . 38
7.3 Optical receptacle . . . 38
7.4 Optical plug . . . 38

8 Optical interface cable plant specifications . . . 40
8.1 Overview . . . 40
8.2 Fibre optic cable plant model . . . 40
8.2.1 Optical fibre connection . . . 40
8.2.2 Medium dependent interface (MDI) . . . 40
8.3 Characteristics of the fiber optic cabling . . . 41
8.3.1 General . . . 41
8.3.2 Optical fiber and cable . . . 41
8.3.3 Cable plant optical return loss . . . 41
8.3.4 Connectors and splices . . . 41

9 newFC-1 and 10GFC Levels . . . 44
9.1 Definitions and nomenclature . . . 44
9.2 Overview . . . 44
9.3 Byte lane ordering . . . 44
9.4 XGMII control characters and ordered set translation . . . 46
9.4.1 General . . . 46
9.4.2 FC-1 to XGMII translation tables . . . 46
9.4.3 Unsupported FC-1 ordered sets . . . 47
9.4.4 Reserved codes . . . 48
9.4.5 10GFC error character . . . 48
9.5 XAUI idle characters . . . 48
9.6 Ordered set mapping from XGMII to XAUI interface . . . 49
9.7 10GFC Level functions . . . 49
9.7.1 General . . . 49
9.7.2 Ordered set translation . . . 50
9.7.3 Link fault signalling . . . 50
9.7.4 10GFC primitive sequence qualification state diagram . . . 50
9.7.5 XGMII and FC-1 primitive sequence interaction . . . 52
9.8 FC-1 level rules, requirements and functions . . . 52
9.8.1 General . . . 52
9.8.2 FC-1 link fault and error indications . . . 52
9.8.3 FC_Port state machine . . . 53
9.8.4 Arbitrated loop functions . . . 53
9.8.5 Inter-frame gap (IFG) rules . . . 53
9.8.6 XGMII primitive sequence ||Q|| rules . . . 54
9.8.7 XGMII primitive signal ||P|| rules . . . 55
9.8.8 EOF handling . . . 55
9.8.9 10GFC Errors (/E/) . . . 56

10 10 gigabit media independent interface (XGMII) . . . 57
10.1 General . . . 57

10.2 Overview . . . 57
10.2.1 General . . . 57
10.2.2 XGMII characteristics . . . 57
10.2.3 Rate of operation . . . 57
10.2.4 Byte lane connections . . . 57
10.3 XGMII data stream . . . 58
10.3.1 General . . . 58
10.3.2 Inter-frame gap (IFG) . . . 58
10.3.3 Preamble and start of frame (SOF) . . . 59
10.3.4 Data frame size . . . 59
10.3.5 Data ||CRC|| . . . 59
10.3.6 End of frame ||EOF|| . . . 59
10.4 XGMII fault Indications . . . 59

11 XGMII extender sublayer (XGXS) and 10 gigabit attachment unit interface (XAUI) . . . 60
11.1 General . . . 60
11.2 XGXS and XAUI rate of operation . . . 60

12 8B/10B physical coding sublayer (PCS) and physical medium attachment (PMA) sublayers . . . 61
12.1 General . . . 61
12.2 Overview . . . 61
12.3 Rate of operation . . . 61
12.4 Ordered set mapping between XGMII and 8B/10B PCS . . . 61
12.4.1 General . . . 61
12.4.2 8B/10B encoding . . . 61
12.4.3 Data skew and multiple clock domain operation . . . 61
12.5 8B/10B PCS to XGMII mapping . . . 62
12.5.1 Reserved codes . . . 62
12.5.2 Invalid characters . . . 62
12.5.3 Terminate ||T|| . . . 62
12.5.4 Error /E/ . . . 63
12.6 Transmit and Receive state diagrams . . . 63

13 Physical coding sublayer (PCS) for 64B/66B . . . 65
13.1 General . . . 65
13.2 Single lane 64B/66B bit encoding . . . 65

14 10 gigabit sixteen bit interface (XSBI) . . . 66

15 Port management . . . 67

Annex A (informative) **Cable plant employing cross-connects . . . 68**
A.1 Characteristics of fiber optic cabling . . . 68

Annex B (normative) **10GFC to SONET mapping . . . 70**

Annex C (informative) **FC-AL-2 to 10GFC mapping . . . 71**
C.1 General . . . 71
C.2 Overview . . . 71
C.3 FC-AL-2 mapping . . . 71
C.3.1 General . . . 71
C.3.2 Unsupported FC-1 ordered sets . . . 71
C.4 Concerns about FC-AL-2 operation . . . 71
C.5 Forcing LPSM to Point-to-Point Mode . . . 72

Annex D (informative) **8B/10B PCS State Diagrams . . . 74**

D.1 General . . . 74
D.2 Overview . . . 74
D.3 Transmit source state diagram . . . 74
D.3.1 General . . . 74
D.3.2 Send data state . . . 74
D.3.3 Transmission errors . . . 75
D.3.4 Primitive signal ||P|| transmission . . . 75
D.3.5 Primitive sequence ||Q|| transmission . . . 75
D.3.6 Idle pattern ||I|| generation . . . 75
D.4 PCS receive state diagram . . . 76
D.4.1 General . . . 76
D.4.2 Reception Error . . . 76
D.4.3 Primitive sequence ||Q|| and primitive signal ||P|| reception . . . 77
D.4.4 Idle pattern reception . . . 80

Annex E (normative) **XAUI and 8B/10B PCS test patterns** . . . **81**
E.1 general . . . 81
E.2 High frequency test pattern . . . 81
E.3 Low frequency test pattern . . . 81
E.4 Mixed frequency test pattern . . . 81
E.5 Continuous jitter test pattern (CJPAT) . . . 81

BIBLIOGRAPHY . . . 84