

# ISO/IEC 14776-153:2015-02 (E)

## Information technology - Small Computer System Interface (SCSI) - Part 153: Serial Attached SCSI - 2.1 (SAS-2.1)

---

Contents	Page
FOREWORD .....	10
INTRODUCTION .....	12
General .....	12
SCSI standards family .....	12
1 Scope .....	14
2 Normative references .....	14
3 Terms, definitions, symbols, abbreviations, keywords, and conventions .....	16
3.1 Terms and definitions .....	16
3.2 Symbols and abbreviations .....	28
3.2.1 Abbreviations .....	28
3.2.2 Units .....	30
3.2.3 Symbols .....	30
3.2.4 Mathematical operators .....	31
3.3 Keywords .....	32
3.4 Editorial conventions .....	33
4 General .....	34
4.1 Physical links and phys .....	34
4.2 Phy test functions .....	34
5 Physical layer .....	35
5.1 Physical layer overview .....	35
5.2 Conventions for defining maximum limits for S-parameters .....	35
5.3 Compliance points .....	36
5.4 Interconnects .....	45
5.4.1 SATA connectors and cable assemblies .....	45
5.4.2 SAS connectors and cables .....	46
5.4.3 Connectors .....	49
5.4.4 Cable assemblies .....	94
5.4.5 Backplanes .....	118
5.5 TxRx connection characteristics .....	119
5.5.1 TxRx connection characteristics overview .....	119
5.5.2 TxRx connection general characteristics .....	120
5.5.3 Passive TxRx connection S-parameter limits .....	120
5.5.4 Passive TxRx connection characteristics for untrained 1.5 Gbit/s, 3 Gbit/s, and 6 Gbit/s .....	122
5.5.5 Passive TxRx connection characteristics for trained 1.5 Gbit/s, 3 Gbit/s, and 6 Gbit/s .....	123
5.5.6 TxRx connection characteristics for active cable assemblies .....	124

5.6 Test loads .....	126
5.6.1 Test loads overview .....	126
5.6.2 Zero-length test load .....	127
5.6.3 TCTF test load .....	129
5.6.4 Low-loss TCTF test load .....	133
5.6.5 Reference transmitter test load .....	134
5.7 Transmitter device and receiver device electrical characteristics .....	139
5.7.1 General electrical characteristics .....	139
5.7.2 Transmitter device and receiver device transients.....	139
5.7.3 Eye masks and the jitter transfer function (JTF) .....	140
5.7.4 Transmitter device characteristics .....	144
5.7.5 Receiver device characteristics.....	155
5.7.6 Spread spectrum clocking (SSC) .....	170
5.7.7 Non-tracking clock architecture .....	173
5.8 READY LED signal electrical characteristics .....	173
5.9 Out of band (OOB) signals .....	175
5.9.1 OOB signals overview.....	175
5.9.2 Transmitting OOB signals .....	176
5.9.3 Receiving OOB signals .....	178
5.9.4 Transmitting the SATA port selection signal.....	179
Annex A (normative) – Jitter tolerance pattern (JTPAT) .....	180
Annex B (normative) – SASWDP.....	182
Annex C (informative) – StatEye.....	190
Annex D (informative) – Signal performance measurements .....	232
Annex E (informative) – Description of the included Touchstone models.....	253
Annex F (informative) – Mini SAS 4x active cable assembly power supply and voltage detection circuitry .....	259
Annex G (informative) – SAS icons .....	260
Bibliography .....	262