FCD-155

STM-1/OC-3 Terminal Multiplexer

Transports LAN and TDM traffic over SDH/SONET networks

- Groomed LAN and legacy (TDM) traffic over SDH/SONET networks
- VLAN and point-to-multipoint switching
- Ethernet traffic mapped to one VC-3/VC-4/STS-1, up to 3 VC-3/STS-1, up to 63 VC-12 or 84 VT-1.5
- 4 or 8 × E1/T1 (G.703) or a single E3/T3 link on the PDH interface
- Channelized STM-1/OC-3 main link with fiber interface

FCD-155 is an STM-1/OC-3 SDH terminal multiplexer that transports LAN and traditional (TDM) traffic over SDH/SONET networks. When bandwidth granularity of the Ethernet channel is configured to 2 Mbps (VC-12) or 1.5 Mbps (VT-1.5), FCD-155 utilizes the SDH/SONET infrastructure for cost-effective connectivity.

Optional PDH interfaces include:

- 4- or 8-port E1 or T1 interfaces
- Single-port E3/T3 interface.

Optional Ethernet interface configurations include:

- 2-port bridging 10/100BaseT interface
- 6-port 10/100BaseT interface (two bridging and four transparent ports)
- Single-port Ethernet interface with 2-port bridging 10/100BaseT and 10/100/1000BaseT (RJ-45) or 1000BaseSX (SFP interface).

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NETWORK INTERFACE

The STM-1/OC-3 interfaces are user-configurable and provide a high-quality and high-availability link as well as performance monitoring of the traffic path.

The STM-1/OC-3 link is supplied with an SFP socket (see *Ordering*). It is strongly recommended to order this device with **original** RAD SFPs **installed**. This ensures that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFPs.

The user can define the following SDH/SONET clock sources:

- Internal
- Recovered from the STM-1/OC-3 interface, including automatic selection based on SSM (Synchronization Status Messaging)
- External E1.

FCD-155 features an optional 1+1 link protection mechanism (unidirectional MSP/APS) and SNCP path protection.

Maintenance capabilities include user-activated local loopbacks and remote loopbacks on the STM-1/OC-3 main link and PDH tributaries.

LAN INTERFACE

The 2-port 10/100BaseT or single-port Gigabit Ethernet interfaces include a built-in Ethernet bridge that supports VLAN according to IEEE 802.1Q and 802.1p.

The 4-port transparent LAN extension, without bridge functionality, creates total separation between customers, for security. The maximum frame length is 2 kb.

The 10/100BaseT LAN interface features autonegotiation for plug-and-play Ethernet connectivity and complies to IEEE 802.3/Ethernet V.2 standards. The interface also performs VLAN stacking.

An optional Gigabit Ethernet port connects of one LAN port to eight virtual groups. This option extends LAN over SDH/SONET networks with bridge functionality. The maximum frame length is 2 kb.

Ethernet traffic is mapped into SDH/SONET containers using VCAT and encapsulated with:

- Generic Framing Procedure (ITU-T G.7041, ANSI T1-105.02), framed mode
- Link Access Procedure for SDH/SONET (LAPS) protocols following draft recommendation ITU-T X.85/X.86.

Each user's Ethernet traffic can be mapped into SDH/SONET virtual containers in any of the following ways:

- Up to 63 x VC-12, or 84 x VT-1.5
- 3 x VC-3/STS-1
- 1 x VC-4.

Ethernet traffic can be switched to different bundles of virtually concatenated VCs (up to 8 bundles) according to a predefined group.

Link Capacity Adjustment Scheme (LCAS) is implemented in compliance with the G.7042 standard, which allocates bandwidth according to Ethernet traffic.

SDH/SONET media transport basic Ethernet packets of up to 1536 bytes for connection to MPLS networks.

The Ethernet interfaces interconnect SAN (Storage Area Networks) devices with Ethernet packets of up to 2 kb.

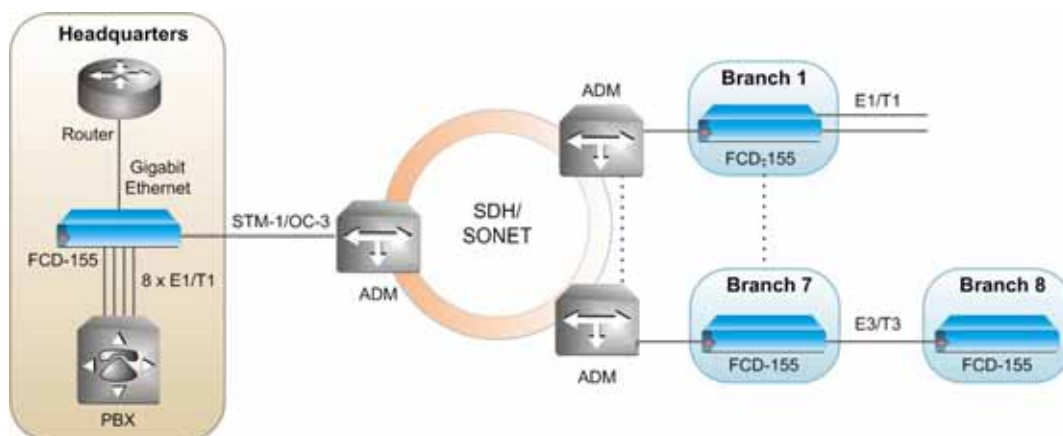Spanning Tree Protocol (STP) and Rapid Spanning Tree Protocol (RSTP) support Layer 2 ring applications.

Figure 1. ADM Application in a Corporate Environment

TDM INTERFACE

FCD-155 has an optional interface module containing 4 or 8 E1/T1 balanced interface ports that transfer data transparently in compliance with the G.703 standard. The unbalanced E1 interface is software selectable on the 8-port version. The 4-port version is jumper-selectable and requires an adapter cable (see *Ordering*).

An optional E3/T3 port transports unframed E3/T3 links over SDH/SONET.

TDM traffic is mapped into SDH/SONET VC-12/VC-11/VC-3 or SONET VT1.5/STS-1 containers that can be placed anywhere within the STM-1/OC-3 bandwidth.

MANAGEMENT

Remote units can be managed in any of the following ways:

- DCC using IP tunneling over OSI DCN based on ITU-T G.7712
- IP/PPP over DCC protocol
- Dedicated virtual group containing at least one VC-12/VT-1.5 channel
- Inside user traffic in a virtual group separated by the GFP Channel ID or VLAN tag
- Out-of-band, via direct connection to one of the LAN ports.

Status and diagnostic information is defined, configured, and monitored using one of the following methods:

- ASCII terminal connected to the V.24/RS-232 control port
- Telnet host via management platform or LAN port
- Network management station running RADview, the RAD SNMP network management application
- TFTP applications to update software and upload/download remote configurations
- ConfiguRAD via Web browser.

DIAGNOSTICS

FCD-155 has comprehensive diagnostic capabilities, including:

- Ethernet and SDH/SONET link monitoring
- Real-time alarms that alert the user of fault conditions. Alarms are reported to the management station and simultaneously relayed through a dry contact port.

GENERAL

An AC or DC power supply is provided with an alarm-activated fan for forced-air cooling.

FCD-155 is a compact standalone unit. One or two units can be installed side-by-side in a 19-inch rack using the optional rack-mount adaptor kit. One unit can be mounted on the wall using the optional wall-mount adapter kit (see *Ordering*).

FCD-RIC Products Comparison Table

Feature	RIC-155 (Ver. 1.0)	RIC-155GE (Ver. 2.0)	RICi-155GE (Ver. 2.0)	FCD-155 (Ver. 4.2)	FCD-155E (Ver 1.2)
Frame Size (Bytes)	64-1536	64–1664	64–9600	64-1536 2K for transparent 8 GbE	64-1536 2K for transparent 8 GbE
Ethernet Flows	No	No	Yes	No	No
QoS	802.3p	802.1p	802.1p Port-based	802.1p Port-based DSCP	802.1p Port-based DSCP
MEF Certification	No	No	MEF 9, MEF 14:EPL, EVPL	No	No
MAC Address Table	1,024	16,384	transparent	1024	1024
Number of Queues	N/A	4 (strict)	4 (strict)	4 (strict, WFQ 8,4,2,1)	4 (strict, WFQ 8,4,2,1)
Encapsulation	HDLC	HDLC	GFP (G.7041), LAPS (X.86)	GFP (G.7041), LAPS (X.86)	GFP (G.7041), LAPS (X.86)
Traffic Mapping	N/A	N/A	Port-based (All-in one bundling) User port + CE-VID User port + CE-VLAN priority	Port-based (All-in one bundling) User port + CE-VID	Port-based (All-in one bundling) User port + CE-VID
SDH/SONET Redundancy	No	No	APS 1+1	APS 1+1	APS 1+1 SNCP
Gigabit Ethernet Redundancy	No	No	Yes	Yes	Yes
Hot-Swappable Power Supplies	No	Yes	Yes	No	Yes
Power Supply Redundancy	No	Yes	Yes	No	Yes
Terminal/ADM Functionality	No	No	No	No	Yes
Number of E1/T1 Tributaries	N/A	N/A	N/A	4/8 E1 4/8 T1	8/21 E1 8/28 T1
Number of E3/T3 Tributaries	N/A	N/A	N/A	1 E3, 1 T3	1 E3, 1 T3
Possibility of E1/T1 and E3/T3 Combination	N/A	N/A	N/A	N/A	Yes

Specifications

STM-1/OC-3 MAIN LINK (NETWORK)

Number of Ports
1 (second link available for redundancy)

Bit Rate
155.52 Mbps ±20 ppm

SFP Socket
Characteristics: See the *SFP Data Sheet*
SPF options: See *Ordering*

Timing
Internal clock
Recovered from the STM-1/OC-3 interface
External clock from PDH tributary

Compliance
SDH: ITU-T G.957
SONET: GR-253-core

Framing
SDH: ITU-T G.707, G.708, G.709
SONET: ANSI T1.105-1995, GR-253-core

Line Code
NRZ

LAN INTERFACE (OPTION)

Port Types
2 or 6 10/100BaseT ports
1 GbE

Compatibility
Relevant sections of IEEE 802.3u, 802.3x,
802.1D and 802.1Q

LAN Table
2,048 MAC addresses (2U) and 8,182
(GbE) with selectable automatic aging time

Data Rate
10BaseT: 10 Mbps
100BaseT: 100 Mbps
1000BaseT: 1000Mbps (Gigabit Ethernet)
Autonegotiation

Connectors (per port)
RJ-45, shielded
SFP socket (for transceivers, see *Ordering*)

E1/T1 PDH INTERFACE (OPTION)

Number of Ports
4 E1, 4 T1, 8E1, or 8 T1

Compatibility
ITU-T Rec. G.703, unframed

Nominal Data Rate
E1: 2.048 Mbps
T1: 1.554 Mbps

Line Code
E1: HDB3
T1: B8ZS

Impedance
E1: 120Ω balanced or 75Ω unbalanced
T1: 100Ω balanced

Maximum Line Attenuation
36 dB (LTU mode)
12 dB (DSU mode)

Timing
Source clock is recovered from the receive
signal coming from the remote E1/T1 side

Locked to the SDH/SONET interface clock

Connectors
4-ports: RJ-45, shielded
8-ports: 44-pin, D-type, female

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E3/T3 PDH INTERFACE (OPTION)

Number of Ports
1

Compatibility
ITU-T Rec. G.703, unframed

Data Rate
E3: 34.368 Mbps
T3: 44.736 Mbps

Framing
Unframed

Line Code
E3: HDB3
T3: B3ZS

Line Impedance
75Ω

Connector
Two BNC female

Timing
Source clock is recovered from the receive
    signal from the remote E3/T3 side
Locked to the SDH/SONET interface clock

MANAGEMENT PORTS

CONTROL Port
Interface: V.24/RS-232
Connector: 9-pin D-type, female
Format: Asynchronous
Baud rate: 0.3–115.2 kbps
Selectable word format:
    7 or 8 bits, no parity, 7 bit odd or even
    parity

Out-of-Band Access
Single Ethernet port FCD-155 version:
MNG ETH port

Other FCD-155 versions:
ETH 1 and ETH 2 ports (through internal
Ethernet switch)

INDICATORS

General
PWR (green) – Power
TST (yellow) – Test
MAJ ALM (red) – Major alarm
MIN ALM (red) – Minor alarm
LOC SYNC LOSS (red) – Local loss of
    synchronization on the STM-1/OC-3
    links
REM SYNC LOSS (red) – Remote loss of
    synchronization on the STM-1/OC-3
    links

ETH, MNG, GbE (per port)
LINK (green) – LAN link integrity
ACT (yellow) – LAN data activity

E1/T1 PDH Interface (per port)
SIG LOSS (red) – E1 link signal loss
AIS (red) – AIS on E1 link

E3/T3 PDH Interface
SIG LOSS (red) – E3/T3 link signal loss

STM-1/OC-3 Main Links
SIG LOSS (red) – STM-1/OC-3 link signal
    loss
ON LINE (green) – STM-1/OC-3 link is
    active (indicator is on) or on standby
    (indicator is flashing)

GENERAL

Power
AC: 100 to 240 VAC ±10%,
    50 to 60 Hz
DC: -48 VDC (-40 to -72 VDC)

Power Consumption
30W

Alarms
Last 100 alarms are time-stamped, stored,
and available for retrieval

Alarm Relay Port
Operation: normally open,
    normally closed, using different pins
Connector: 9-pin, D-type, female

Physical
Height: 4.4 cm (1.7 in)
Width: 21.5 cm (8.5 in)
Depth: 30.0 cm (11.8 in)
Weight: 2.4 kg (5.3 lb)

Environment
Temperature: 0° to 70°C (32° to 158°F)
Humidity: Up to 90%, non-condensing

Ordering

STANDARD CONFIGURATIONS

FCD-155/AC/6U/4E1

FCD-155/AC/6U/8E1

FCD-155/AC/2U

FCD-155/AC/2U/4E1

FCD-155/48/6U/4E1

FCD-155/AC/6U

FCD-155/AC/2U/8E1

FCD-155-PACK1

SPECIAL CONFIGURATIONS

FCD-155/*/&/$

Note: SFP transceivers are not included in the chassis for the uplink and/or the fiber GbE interfaces (see SFP Transceivers).

Legend

* Power supply:

AC	100 to 240 VAC
48	-48 VDC

& LAN interface:

2U	2 bridging 10/100BaseT ports
6U	2 bridging and 4 transparent 10/100BaseT ports
GE	1 10/100/1000BaseT (GbE) port, copper interface and SFP socket

$ PDH interface:

4E1	4 × E1 G.703 ports
4T1	4 × T1 G.703 ports
8E1	8 × E1 G.703 ports
8T1	8 × T1 G.703 ports
E3	1 × E3 G.703 port
T3	1 × T3 G.703 port

Notes:

1. The 4 x E1 port option is delivered with a balanced E1 interface.

2. To convert the interface from balanced to unbalanced, use converter cable CBL-RJ45/2BNC/E1/X.

FCD-155-PACK1

Software key for activating the IP tunneling management option

SFP TRANSCEIVERS

(For redundancy, order two SFP transceivers)

STM-1/OC-3 Uplink/*

*	**SFP-1**	STM-1/OC-3, 1310 nm multimode VCSEL, LC connector
	SFP-2	STM-1/OC-3, 1310 nm single mode laser (S1.1), LC connector
	SFP-3	STM-1/OC-3, 1310 nm, single mode laser, long haul (L1.1), LC connector
	SFP-4	STM-1/OC-3, 1550 nm single mode laser, long haul (L1.2), LC connector
	SFP-11	STM-1/OC-3, electrical interface, mini-BNC coaxial connector
	SFP-18a	STM-1/OC-3, Tx – 1310, Rx – 1550, 9/125 single mode (single fiber), laser (WDM), LC connector
	SFP-18b	STM-1/OC-3, Tx – 1550 Rx – 1310, 9/125 single mode (single fiber), laser (WDM), LC connector
	SFP-19a	STM-1/OC-3, Tx – 1490 Rx – 1570, 9/125 single mode (single fiber), laser (WDM), LC connector
	SFP-19b	STM-1/OC-3, Tx – 1570 Rx – 1490, 9/125 single mode (single fiber), laser (WDM), LC connector

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GbE User/#

 # SFP-5 GbE, 850 nm multimode VCSEL

SFP-6 GbE, 1310 nm single mode laser (LX-SM)

SFP-7 GbE, 1550 nm single mode laser, long haul LX-H (ZX)

SFP-8D GbE, 1310 nm single mode laser, long haul (LX-H)

Note: It is strongly recommended to order this device with original RAD SFPs installed. This ensures that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFPs.

SUPPLIED ACCESSORIES

AC power cord (when AC power supply is ordered)

DC adapter plug (when DC power supply is ordered)

CBL-DB9F-DB9M-STR
Control port cable

OPTIONAL ACCESSORIES

CBL-RJ45/2BNC/E1/X
Cable for converting a balanced E1 interface to an unbalanced E1 interface. Contains one RJ-45 balanced connector and two unbalanced BNC coaxial connectors.

CBL-MINIBNC-BNC
Cable for adapting two mini-BNC connectors to two full-sized BNC connectors (for SFP-11)

CBL-G703-8/^
8E1/8T1 interface cables for the DB-44 port connector (one cable required per interface):

Legend

^ Connector:

RJ45 splits into 8 E1/T1 balanced RJ-45 connectors

RJ45/X splits into 8 E1/T1 balanced RJ-45 connectors (cross-cable)

COAX splits into 8 pairs of E1 unbalanced BNC male connectors

OPEN 8 × 4 unterminated free leads 2m (6.6 ft)

RM-35/@
Hardware kit for mounting one or two metal FCD-155 units in a 19-inch rack

Legend

@ Rack mount kit (Default=both kits):

P1 For mounting one unit

P2 For mounting two units

WM-35
Hardware kit for mounting one unit on the wall

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