

# FCD-155E

## STM-1/OC-3 Add-Drop Multiplexer



- STM-1/OC-3 PDH/Ethernet add/drop multiplexer for grooming LAN and legacy (TDM) traffic over SDH/SONET networks
- Ethernet traffic mapped to 1 VC-3/VC-4/STS-1, up to 3 VC-3/STS-1, up to 63 VC-12 or 84 VT-1.5
- 1+1 MSP/APS redundancy
- PDH interface for 8 or 21 E1 (G.703), 8 or 28 T1 (G.703), 1 E3/T3, or 1 E3/T3 with 21/28 E1/T1 ports
- 10/100BaseT interface with VLAN support and point-to-multipoint switching capability

FCD-155E is an STM-1/OC-3 add/drop 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-155E utilizes the SDH/SONET infrastructure for cost-effective connectivity.

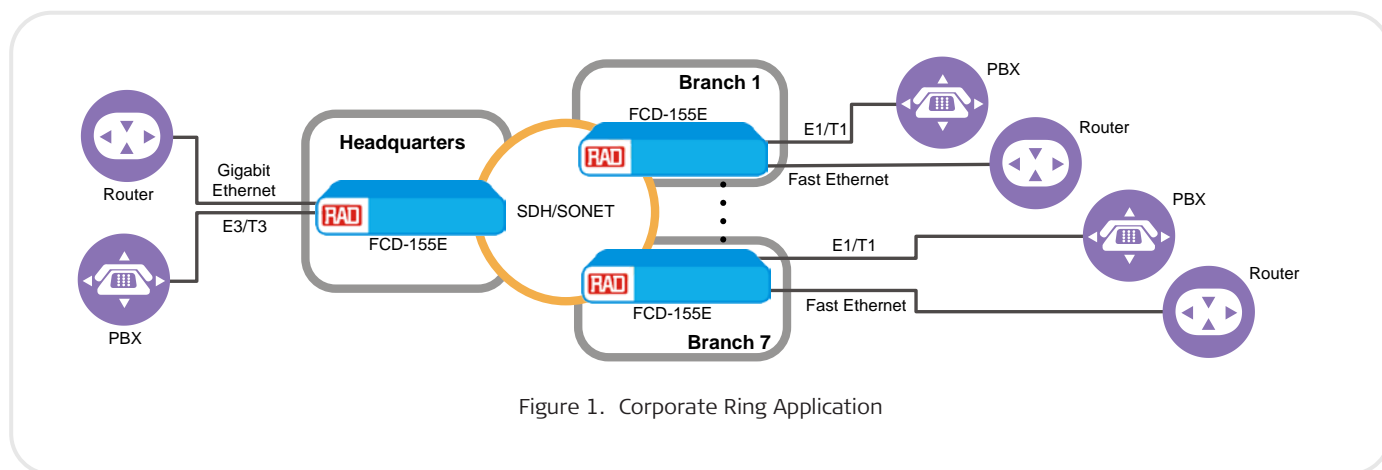
Optional PDH interface modules include:

- 8- or 21-port E1
- 8- or 28-port T1
- Single-port E3/T3
- Single-port E3 with 21-port E1

Single-port T3 with 21-port E1 or 28-port T1

Optional Ethernet interface configurations include:

- 2-port bridging 10/100BaseT
- 6-port 10/100BaseT (two bridging and four transparent ports).



### 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 will ensure 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
- Station clock.

FCD-155E features an optional ADM configuration mechanism with SNCP path protection.

Optional 1+1 link protection mechanism (unidirectional MSP/APS) and SNCP path protection are also available.

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

### ETHERNET INTERFACE

The 2-port 10/100BaseT interface includes 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 features VLAN stacking.

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 × VC-12, or 84 × VT-1.5
- 3 × VC-3/STS-1
- 1 × 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 supported in compliance with the G.7042 standard, which allocates bandwidth according to Ethernet traffic.

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

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

## TDM INTERFACES

FCD-155E has an optional interface module consisting of 8 or 21 balanced E1 or 8 or 28 T1 ports that transfer transparent data in compliance with G.703. The unbalanced E1 interface is software-selectable.

An optional E3/T3 interface module transports unframed E3/T3 data over SDH/SONET.

Another optional interface module combines E3 or T3 with 21 E1 ports, or T3 with 28 T1 ports.

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 AND SECURITY

Remote units can be managed in the following ways:

- Via DCC based on IP/PPP protocols
- Via a dedicated virtual group containing at least one VC-12/VT-1.5 channel
- Inside the user traffic in a virtual group, separated from the user traffic 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
- Web Based element manager.

## MONITORING AND DIAGNOSTICS

FCD-155E has comprehensive diagnostic capabilities, including:

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

## ARCHITECTURE

AC or DC power supplies are provided with an alarm-activated fan for forced-air cooling. They are available in redundant and mixed AC/DC power supply configurations.

FCD-155E is a compact 1U high 19-inch unit that can be mounted in a 19-inch rack with the optional rack-mount kit (see *Ordering*).

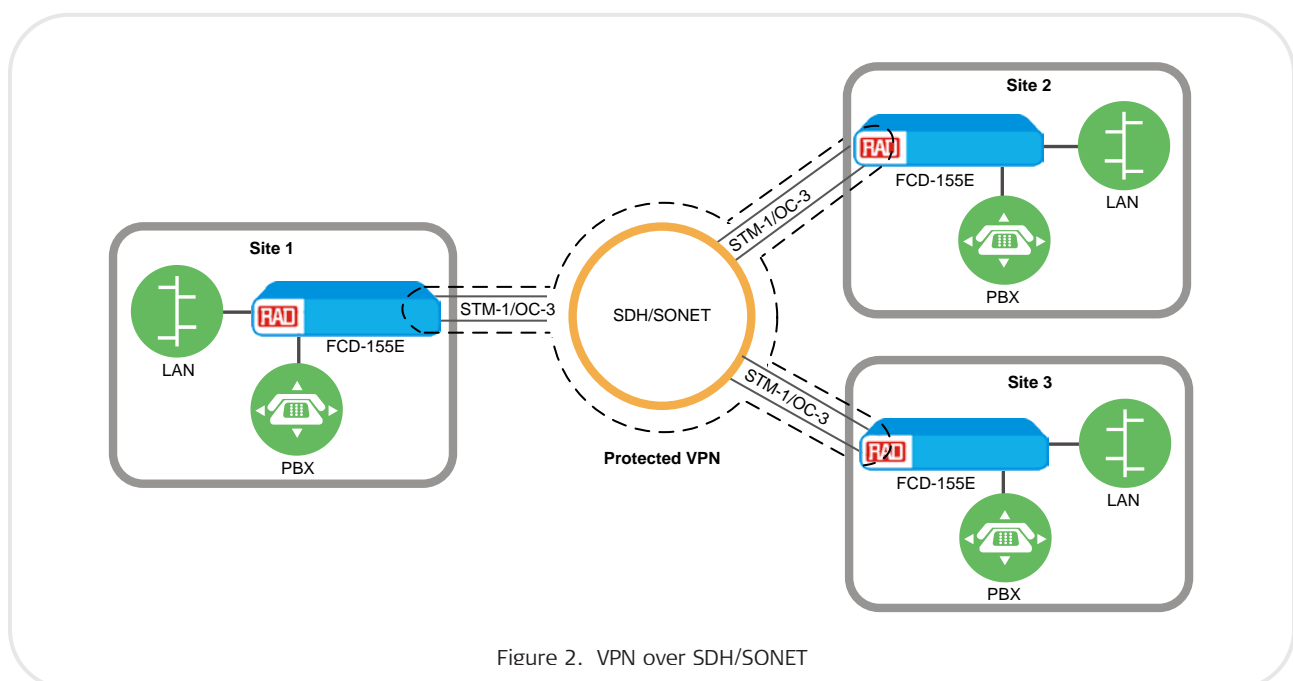


Figure 2. VPN over SDH/SONET

# FCD-155E

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### Specifications

#### STM-1/OC-3 NETWORK INTERFACE

##### Number of Ports

1 (second link available for redundancy or ring support)

##### Bit Rate

155.52 Mbps  $\pm$ 20 ppm

##### SFP Transceivers

Characteristics: See *Table 1*

Options: See *Ordering*

##### Timing

Internal clock

Recovered from the STM-1/OC-3 interface

External clock from PDH tributary

Station clock

##### 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

#### ETHERNET INTERFACE (OPTIONAL)

##### Number of Ports

2 or 6 10/100BaseT ports

##### Compatibility

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

##### LAN Table

2,048 MAC addresses with selectable automatic aging time

##### Data Rate

10BaseT: 10 Mbps

100BaseT: 100 Mbps

Autonegotiation

##### Connectors (per port)

RJ-45, shielded

Table 1. SFP Interface Characteristics

	Transceiver	Wavelength [nm]	Fiber Type [ $\mu$ m]	Transmitter Type	Connector Type	Input Power [dBm]		Output Power [dBm]		Typical Max. Range	
						(min)	(max)	(min)	(max)	[km]	[miles]
STM-1/OC-3 Uplink	SFP-1	1310	62.5/125 multimode	LED	LC	-30	-14	-20	-14	2	1.2
	SFP-2	1310	9/125 single mode	Laser	LC	-28	-8	-15	-8	15	9.3
	SFP-3	1310	9/125 single mode	Laser	LC	-34	-10	-5	0	40	24.8
	SFP-4	1550	9/125 single mode	Laser	LC	-34	-10	-5	0	80	49.7
	SFP-11	Copper uplink	Coaxial cable 75 $\Omega$	-	Mini-BNC	-	-	-	-	0.135*	0.08*
	SFP-18A	Tx - 1310 Rx - 1550	9/125 single mode (single fiber)	Laser (WDM)	LC	-28	-8	-5	0	40	24.8
	SFP-18B	Tx - 1550 Rx - 1310	9/125 single mode (single fiber)	Laser (WDM)	LC	-28	-8	-5	0	40	24.8
	SFP-19A	Tx - 1490 Rx - 1570	9/125 single mode (single fiber)	Laser (WDM)	LC	-30	-8	0	+5	80	49.7
	SFP-19B	Tx - 1570 Rx - 1490	9/125 single mode (single fiber)	Laser (WDM)	LC	-30	-8	0	+5	80	49.7

\* Using RG59 B/U.

**E1/T1 PDH INTERFACE****Number of Ports**

8 E1, 21 E1, 8 T1, or 28 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**

8 E1, 8 T1: DB-44

21 E1, 28 T1: DB-62

**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**

2 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****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-155E version:

NG ETH port

Other FCD-155E versions:

ETH 1 and ETH 2 ports (through internal Ethernet switch)

**DIAGNOSTICS****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

**INDICATORS****System**

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 (per port)**

LINK (green) – LAN link integrity

ACT (yellow) – LAN data activity

**E1/T1 PDH Interface (per port)**

LOS (red) – Link signal loss

AIS (red) – Alarm indication signal on link

**E3/T3 PDH Interface**

LOS (red) – E3/T3 link signal loss

**STM-1/OC-3 Main Links**

LOS (red) – STM-1/OC-3 link signal loss

ON LINE (green) – STM-1/OC-3 link is active (indicator is on) or standby (indicator is blinking)

**Station Clock**

ON (green) – Station clock port is connected

LOS (red) – Station clock signal loss

**GENERAL****Power**

100 to 240 VAC ±10%, 50 to 60 Hz

-48 VDC (-40 to -72 VDC)

+24VDC

**Power Consumption**

30W

**Physical**

Height: 4.4 cm (1.7 in)

Width: 44.0 cm (17.3 in)

Depth: 25.4 cm (10.0 in)

Weight: 4.1 kg (9.0 lb)

**Environment**

Temperature: -10° to 60°C (14° to 140°F)

Humidity: Up to 90%, non-condensing

# FCD-155E

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### Ordering

#### RECOMMENDED CONFIGURATIONS

##### FCD-155E/48R/2U/21E1

Redundant DC power supply, 2 bridging 10/100BaseT ports, 21 × E1 ports

##### FCD-155E/AD/2U/21E1

Redundant 100 to 240 VAC and -48 VDC power supply, 2 bridging 10/100BaseT ports, 21 × E1 ports

##### FCD-155E/AD/6U/8E1

Redundant 100 to 240 VAC and -48 VDC power supply, 2 bridging and 4 transparent 10/100BaseT ports, 8 × E1 ports

##### FCD-155E/48R/6U

Redundant DC power supply, 2 bridging and 4 transparent 10/100BaseT ports

##### FCD-155E/AC/6U/21E1

100 to 240 VAC power supply, 2 bridging and 4 transparent 10/100BaseT ports, 21 × E1 ports

##### FCD-155E/AC/2U/21E1

100 to 240 VAC power supply, 2 bridging 10/100BaseT ports, 21 × E1 ports

##### FCD-155E/AC/2U/8E1

100 to 240 VAC power supply, 2 bridging 10/100BaseT ports, 8 × E1 ports

##### FCD-155E/48/2U/8E1

-48 VDC power supply, 2 bridging 10/100BaseT ports, 8 × E1 ports

##### FCD-155E/48R/6U/21E1E3

Redundant DC power supply, 2 bridging and 4 transparent 10/100BaseT ports, 1 × E3 ports and 21 × E1 ports

##### FCD-155E/ACR/2U/21E1

Redundant AC power supply, 2 bridging 10/100BaseT ports, 21 × E1 ports

#### SPECIAL CONFIGURATIONS

Please contact your local RAD partner for additional configuration options.

#### SFP TRANSCEIVERS

(For redundancy, order two SFP transceivers)

##### STM-1/OC-3 Uplink

**SFP-1** STM-1/OC-3, 1310 nm multimode LED, 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-4D** STM-1/OC-3, 1550 nm single mode laser, long haul (L1.2), LC connector, DDM

**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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## SUPPLIED ACCESSORIES

**CBL-MINIBNC-BNC**

Cable for adapting two mini-BNC connectors to full sized BNC connectors (supplied with SFP-11)

AC power cord (when AC power supply is ordered)

DC adapter plug (when DC power supply is ordered)

**RM-34**

Hardware for mounting one unit in a 19-inch rack

## OPTIONAL ACCESSORIES

**CBL-DB9F-DB9M-STR**

Control port cable

**FCD-155E-PS/AC**

100-240 VAC power supply module

**FCD-155E-PS/48**

-48 VDC power supply module

**CBL-G703-8/^**

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

*Legend*

<sup>^</sup> Connector type:

**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)

**CBL-G703-14/#**

14E1/14T1 interface cable for the DB-62 port connector

**CBL-G703-28/#**

Two CBL-G703-14/# interface cables for the DB-62 port connector, to provide 21E1/28T1 capacity

*Legend*

**#** Connector type:

**RJ45** splits into 14 E1/T1 balanced RJ-45 connectors

**COAX** splits into 14 pairs of E1 unbalanced BNC male connectors

**OPEN** 14 × 4 unterminated free leads 2m (6.6 ft)

**PATCH** for connection to 2 Telco connectors, 2m (6.6 ft)

**OP-A-ADAPTOR-28RJ**

Patch panel, two CBL-G703-14/Patch cables are not included.

**OP-A-ADAPTOR-21BNC-FCD155E**

Patch panel, includes two CBL-G703-14/Patch cables.

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