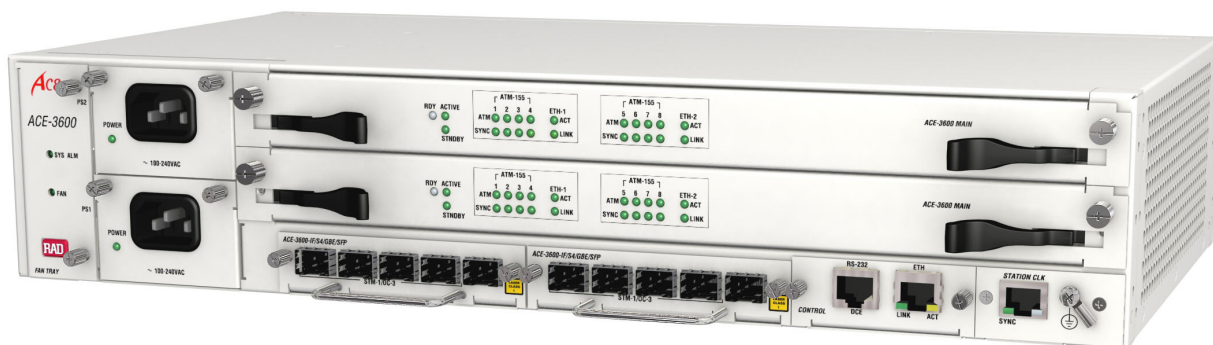




ACE-3000 Family

ACE-3600

RNC-Site Gateway



3G and HSDPA traffic
backhauling over
packet-switched
networks

ACE

- Pseudowire emulation of up to four protected STM-1/OC-3c (ATM) links over Gigabit Ethernet
- Advanced pseudowire connectivity verification using VCCV-BFD messages
- End-to-end fault propagation between legacy and packet-switched networks
- Full ATM switching, scheduling, policing and shaping for separation of HSDPA and voice services
- Full system redundancy and modular hot-swappable architecture for replacing the interface, power and main modules while maintaining service continuity

ACE-3600 is an advanced carrier-class gateway, designed for cost-effective backhauling of 3G voice and HSDPA data traffic over next-generation core PSNs (packet-switched networks), including Layer-2, MPLS or IP.

Typically located at the 3G RNC site, the unit interconnects with the RNC and converts up to four STM-1/OC-3c (ATM) links to virtual pseudowire (PW) connections that are established over a packet-switched network, using its Gigabit Ethernet interface.

ATM OVER PACKET CAPABILITIES

ACE-3600 establishes up to 1024 data pseudowire (PW) connections over a packet-switched network.

The following encapsulation methods are supported according to RFC 4717:

- 1:1 VC/VP – Each VCC/VPC is mapped to a single pseudowire (PW) connection
- N:1 VC/VP – Several VCs or VPs can be encapsulated to a single PW connection.

ACE-3600 allows single or multiple ATM cells to be encapsulated per Ethernet frame.



ACE-3600

RNC-Site Gateway

Over L2 and L3 networks, ACE-3600 uses various encapsulation types: VLANs (virtual LANs), dynamic and static MPLS label assignment, and MPLS in IP.

USING THE LABEL DISTRIBUTION PROTOCOL (LDP)

ACE-3600 uses the MPLS label distribution protocol (LDP) to automatically assign and distribute pseudowires and tunnel labels between MPLS peers.

Note: The LDP functionality requires a software license. For more information, refer to the Ordering section.

ATM SWITCHING AND POLICING CAPABILITIES

ACE-3600 provides full ATM switching capabilities, including scheduling and shaping of ATM-based traffic.

Operators can assign each virtual connection (VC) or virtual path (VP) to a service class, define the QoS parameters and shape the ATM egress traffic. ATM traffic policing allows operators to discard, tag or count non-conformant cells per configuration.

ACE-3600 allows establishing up to 1024 VP and VC connections with full UNI/NNI VPI and VCI ranges.

QUALITY OF SERVICE (QOS) OVER PSN

Over packet-switched networks, QoS is provided according to the network type:

- L2 network – outgoing pseudowire packets are assigned a dedicated VLAN ID according to 802.1Q and marked for priority using 802.1p bits
- MPLS network – outgoing pseudowire packets are assigned to a specific MPLS tunnel and marked for priority using EXP bits
- IP network – outgoing pseudowire packets are marked for priority using ToS or DSCP bits.

CLOCK SYNCHRONIZATION

ACE-3600 provides robust clock synchronization and flexible timing modes, including:

- Interface-based synchronization – the clock is recovered from the RX traffic of a selected interface, in accordance with G.823 and depending on the network's SLA
- Unicast clock distribution – the master clock is distributed with a dedicated stream towards up to 512 remote PSN peers
- Multicast clock distribution – the master clock is distributed towards the PSN using a single IP multicast clock stream (IGMPv2 host).

GENERIC ROUTING ENCAPSULATION (GRE)

ACE-3600 encapsulates MPLS packets over GRE to establish point-to-point tunnel connection over an IP network. This tunneling service is used to transfer MPLS packets over an IP network without using the IP addressing scheme.

HOT-SWAPPABLE MODULES WITH STM-1/OC-3C AND GIGABIT ETHERNET INTERFACES

ACE-3600 includes up to two interface modules, each including up to four STM-1/OC-3c UNI interfaces and one Gigabit Ethernet interface.

The STM-1/OC-3c interfaces map physical layer and ATM cells into STM-1/OC-3c according to ITU I.432.

The Gigabit Ethernet interface is used for packet-switched link (PW) connection and inband management access.

Both the GbE and STM-1/OC-3c interfaces utilize industry-standard hot-swappable SFP transceivers that allow using different fiber optic port types.

INTERFACE MODULE REDUNDANCY

The two interface modules support Automatic Protection Switching (APS) according to G.841 Annex B, to ensure a fail-safe, continuous operation of the STM-1/OC-3c and Gigabit Ethernet interfaces.

To allow reliable and uninterrupted service over packet-switched networks, the Gigabit Ethernet ports support the 1:1 and 1+1 automatic protection switching modes according to IEEE 802.3ad.

When two interface modules are installed, the second module always operates as the redundant protection module.

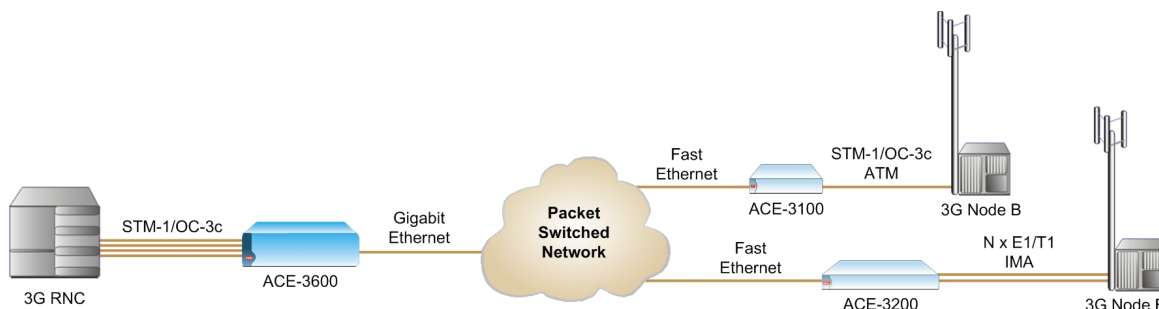


Figure 1. 3G Backhaul over a Packet-Switched Network

MAIN MODULES

The main module of ACE-3600 serves as the core processing component of the unit, and can be replaced when necessary.

SYSTEM REDUNDANCY

ACE-3600 allows two identical main modules to work in redundancy mode, which protects the unit's data matrix and main CPU in cases of unexpected module reset. One main module is set as the active module, while the second is in standby mode, ready to work in place of the active one at any moment.

OAM AND DIAGNOSTICS

Comprehensive monitoring and diagnostic capabilities include:

- Pseudowire connectivity check
- External and internal physical loopbacks on STM-1/OC-3c ports
- Cell test towards the ATM connections.

ACE-3600 periodically verifies the connectivity status of pseudowire connections, using VCCV-BFD messages according to the 'draft-ietf-bfd-base' requirements.

If a failure is detected, a notification is sent to both the remote peer and the ATM connection of the specific PW. This allows complete monitoring over the pseudowire connections in real-time

ATM and PSN port alarms are forwarded over the packet-switched network from end to end. This includes the mapping of:

- Packet-switched network alarms to ATM alarms
- ATM alarms over the PSN to the remote customer equipment (CE)
- Physical failures of ATM ports, over the packet-switched network towards both the local and remote CE.

For conventional ATM cross-connects (XCs), OAM is supported according to ITU I.610 requirements:

- F4 and F5 OAM
- Configurable OAM mode per connection point
- Segment/intermediate mode for user connections and end-to-end mode for the management connection
- AIS and RDI cell detection and generation upon physical layer and ATM layer failures

- CC cell generation and LOC state detection per VP/VC
- Loopback location ID and configurable loopback source ID per device.

Performance monitoring is provided by Ethernet and IP-layer network condition statistics, such as packet sequence errors (loss or misorder) and packet delay variation (jitter), which are monitored and stored by the device.

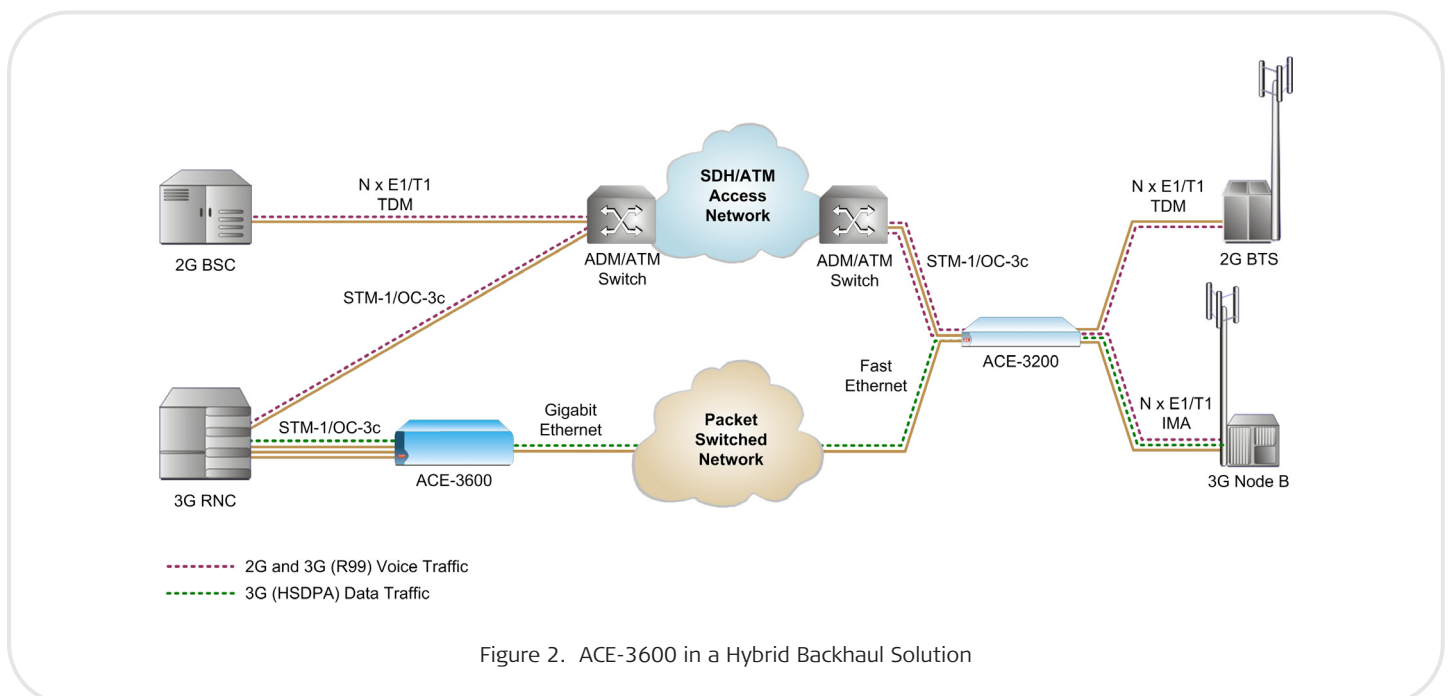
ACE-3600 collects statistics per physical port and per VCC for 15-minute intervals. Statistics for the last 6 hours are stored in the device and can be retrieved at the network management station.

For diagnostics purposes, ACE-3600 maintains a cyclic event log file that stores up to 4096 time-stamped events. In addition, an internal system log agent can send all reported events to a centralized repository or remote server.

MANAGEMENT

ACE-3600 can be managed using different access methods, via:

- Dedicated RS-232 or 10/100BaseT ports



ACE-3600

RNC-Site Gateway

- Dedicated VC defined on any ATM port
- Gigabit Ethernet uplink port, using IP-based connection (raw IP or over PW).

The following applications can be used for management:

- Menu-driven terminal utility via an ASCII terminal connection
- Telnet via an IP-based connection
- Secure Shell (SSH) via any secure client/server application
- ConfiguRAD, Web-based element management tool via an IP-based connection
- RADview-EMS, RAD's CORBA-based element management access system, providing a dedicated PC/Unix-based GUI for controlling and monitoring the unit from a network management station.

The unit can be managed by and report to up to 16 different users simultaneously. Accounts of existing and new users can be defined/changed remotely, using a dedicated RADIUS server.

ACE-3600 allows retrieval of the current date and time from a centralized location, by synchronizing with an SNTP (System Network Timing Protocol) server.

Software upgrades and configuration files can be downloaded/uploaded to/from ACE-3600 via TFTP or XMODEM.

ADVANCED SECURITY FEATURES

ACE-3600 supports the Secure Socket Layer (SSL) protocol for enabling secure Web access to the unit. If enabled, the SSL protocol encrypts the data between the TCP and HTTP Web layers.

Telnet-like management can be secured using a Secure Shell (SSH) client/server program. Instead of sending plain-text ASCII-based commands and login requests over the network, SSH provides a secure communication channel.

In addition, ACE-3600 supports SNMP version 3, providing secure access to the device by authenticating and encrypting packets transmitted over the network.

MODULAR ARCHITECTURE

The modular architecture of ACE-3600 allows hot-swappable modules to be replaced in the field while maintaining uninterrupted service. The unit is fully accessible from the front panel.

The unit's full hardware redundancy features (fans, power supplies, modules) ensure a fail-safe, continuous operation, making ACE-3600 ideal for carriers and service providers.

Extending the reach of cellular networks over next-generation Ethernet networks

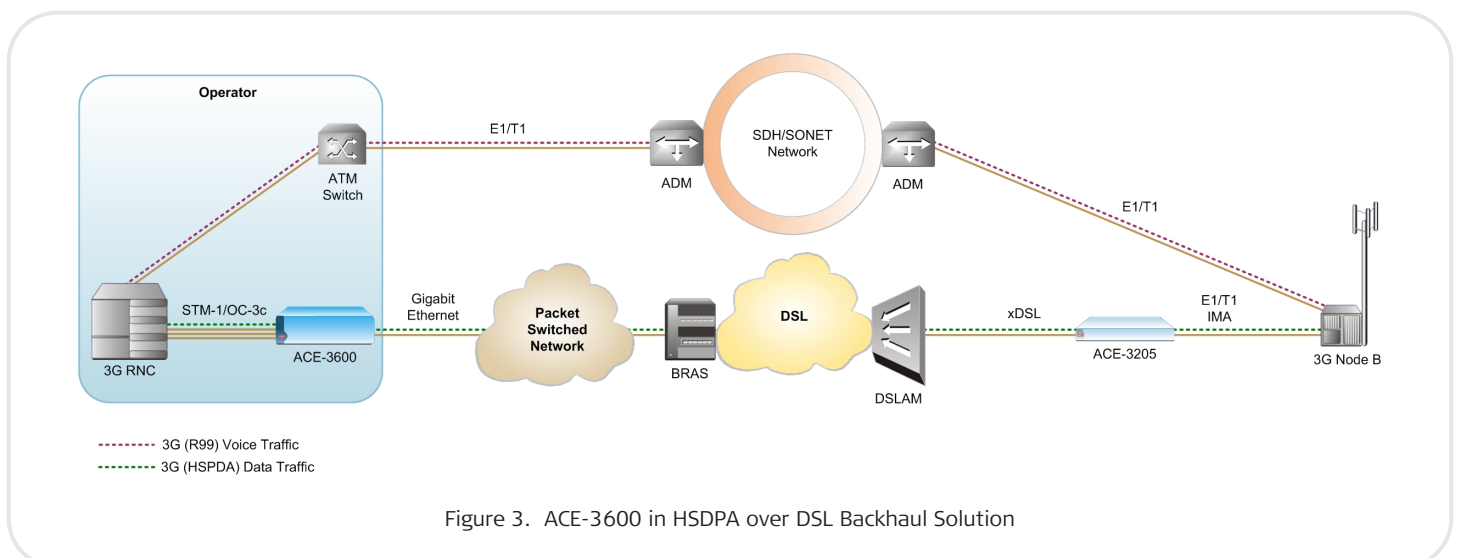


Figure 3. ACE-3600 in HSDPA over DSL Backhaul Solution

Specifications

INTERFACE MODULES

Number of Modules

Up to 2 per unit

STM-1/OC-3C INTERFACE

Number of Ports

Up to 8 in total, 4 per single interface module (4+4 in APS mode)

Data Rate

155 Mbps

Operation Mode

SDH or SONET, ATM UNI

Compliance

Physical layer and ATM mapping into STM-1/OC-3 according to I.432

Automatic protection switching (APS) according to G.841 Annex B (1+1, bidirectional)

Jitter Tolerance

Output: according to G.825
Tolerance: according to G.823
Transfer: according to G.783

Fiber Optic Interface Type

Small Form-Factor Pluggable (SFP): single mode, multimode LED, short haul or long haul laser

GIGABIT ETHERNET INTERFACE

Number of Ports

2 in total, 1 per single interface module

Data Rate

1000 Mbps

Compliance

IEEE 802.3z, 802.1Q, 802.1p

Max. Frame Size

1600 bytes

Operation Mode

Full-duplex

Connector

Fiber optic via SFP transceiver

Note: The STM-1/OC-3c and Gigabit Ethernet ports require SFP transceivers that are fitted into the empty cage.

SFPs

For full details, see the SFP Transceivers data sheet at www.rad.com

Note: 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.

ETHERNET CONTROL PORT

Type

100BaseTX, full-duplex

Compliance

IEEE 802.3

Connector

RJ-45

TERMINAL CONTROL PORT

Type

RS-232/V.24 (DCE)

Data Rate

9.6, 19.2, 38.4, 57.6 or 115.2 kbps, user-configurable

Connector

RJ-45 (RJ-45 to DB-9 adapter cable is supplied)

STATION CLOCK INTERFACE

Type

Balanced E1, unbalanced E1 (via an adapter cable) or T1

Impedance

Balanced E1: 120Ω
Unbalanced E1: 75Ω (via an adapter cable)
T1: 100Ω

Connector

RJ-45

GENERAL

Fan Tray

Field-replaceable, two independent cooling fans

Power

One or two hot-swappable AC or DC:
AC: 100 to 240 VAC, 47–63 Hz
DC: -48 VDC nominal (-41 to -71 VDC)

Note: AC and DC power supplies cannot be installed together in the same unit.

Power Consumption

AC: 120 VA max
DC: 80W max

LED Indicators

POWER (green/red) –
Green: power supply is OK
Red: power supply failure
SYS ALM (green/red) –
Green: no system alarm is detected
Red: at least one system alarm has been detected
FAN (green/red) –
Green: all the fans are working properly
Red: at least one fan is not working properly
RDY (green) –
On: self-test completed successfully
Blinking: self-test failed
ACTIVE (green) –
On: this main module is in Active mode
Off: this main module is not in Active mode
STANDBY (green) –
On: this main module is in Standby mode
Off: this main module is not in Standby mode
ATM-155 SYNC 1–4, 5–8 (green) –
On: the port's physical link is synchronized
Off: the port's physical link is not synchronized
Blinking: RDI has been detected
ATM-155 ATM 1–4, 5–8 (green) –
On: ATM cells are being received or transmitted
Off: ATM cells are not being received or transmitted

ACE-3600

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ETH 1/2 LINK (green) -

- On: Gigabit Ethernet link is detected
- Off: Gigabit Ethernet link is not detected

ETH 1/2 ACT (green) -

- On: Frames are being received or transmitted
- Off: Frames are not being received or transmitted

MNG-ETH LINK (green) -

- On: Ethernet link is detected
- Off: Ethernet link is not detected

MNG-ETH ACT (yellow) -

- On: ETH frames are being received or transmitted
- Off: ETH frames are not being received or transmitted

STATION CLK SYNC (green) -

- On: E1/T1 physical link is synchronized
- Off: E1/T1 physical link is not synchronized

Environment

Temperature:

Operating: 0°-50°C (32°-122°F)

Storage: -20°-70°C (-4°-158°F)

Humidity: Up to 90%, non-condensing

Physical




Height: 8.74 cm (3.4 in / 2U)

Width: 44.0 cm (17.3 in)

Depth: 25.0 cm (9.0 in)

Weight: 8.0 kg (17.6 lb)

ACE-3000 Product Family Comparison Table

Features			
	ACE-3600	ACE-3402	ACE-3400
E1/T1 traffic aggregation			✓
STM-1/OC-3c traffic aggregation	✓	✓	✓
Channelized STM-1/OC-3 traffic aggregation		✓	✓
E1/T1 ports			32 or 63 via patch panels
ATM-155 ports	Up to 8, 4 per module	Up to 3, 1 per module	Up to 3, 1 per module
SFPs for ATM-155 ports	✓		
Fast Ethernet ports	1 for OOB* management only	1 for OOB* management only	1 for OOB* management only
Gigabit Ethernet ports	Up to 2, 1 per module	Up to 2, 1 per module	Up to 2, 1 per module
SFPs for GbE ports	✓	✓	✓
SFPs for FE ports			
PSN clock distribution	✓	✓	✓
APS on ATM-155 ports	✓	✓	✓
Ethernet redundancy	✓	✓	✓
System redundancy	✓	✓	✓
BSC/RNC-site gateway	✓ (RNC only)	✓ (BSC/RNC)	✓ (BSC/RNC)
Max. ATM VCCs	1024	1024	1024
Max. data PW links	1024	512	512
Max. remote PSN peers	512	256	256
Modular unit	✓	✓	✓
Power supply	Single/dual, hot-swappable	Single/dual, hot-swappable	Single/dual, hot-swappable
Physical width	17.3"	17.3"	17.3"
Physical height	2U	2U	3U

* OOB = out-of-band

ACE-3600

RNC-Site Gateway

Ordering

ACE-3600/#

Legend

- # Power supply type and redundancy:
- AC Single 100 to 240 VAC
 - DC Single -48 VDC
 - ACR Dual 100 to 240 VAC
 - DCR Dual -48 VDC

ACE-MC/*

ACE-3600 main module (main card)

Legend

- * Main module type:
- 155-4/PACK-1** STM-1/OC-3c to GbE traffic

Note: For full system redundancy, order two main module units.

ACE-IF-GbE/+/@

ACE-3600 interface module

Legend

- + STM-1/OC-3c ports:
- S4** Four STM-1/OC-3c ports (four empty SFP cages)
- @ GbE port:
- SFP** One GbE port (empty SFP cage)

Note: For interface redundancy (APS), order two interface modules. The fiber optic STM-1/OC-3c and Gigabit Ethernet ports require SFP transceivers that are fitted into the empty cage. For more information, refer to Optional Accessories and to the SFP Transceivers data sheet, available on RAD's Web site.

SUPPLIED ACCESSORIES

AC power cord or a DC power connection kit (as ordered)

RM-36

Hardware kit for mounting one ACE-3600 unit into a 19-inch rack

CBL-RJ45/D9/F/STR

Control port adapter cable (RJ-45 to DB-9)

OPTIONAL ACCESSORIES

SFP Transceivers

- SFP-1** 1310 nm, multimode LED, up to 2 km (1.2 miles), LC
- SFP-2** 1310 nm, single mode laser, up to 15 km (9.3 miles), LC
- SFP-3** 1310 nm, single mode laser, up to 40 km (24.8 miles), LC
- SFP-4** 1550 nm, single mode laser, up to 80 km (49.7 miles), LC
- SFP-5** 1000BaseSX GbE, LC connector
- SFP-6** 1000BaseLX10 GbE, LC
- SFP-9G** 1000BaseT GbE, RJ-45

Note: For the complete and detailed list, refer to the SFP Transceivers data sheet. It is strongly recommended to order ACE-3600 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 ACE-3600 units using non-RAD SFPs.

CBL-LC/#/E

LC to SC/ST/FC fiber optic converter cable for operation with multimode or single mode fibers. The cable is 2 meters (6.5 ft) long.

- # Connector type:
- SC SC connector
 - ST ST connector
 - FC FC connector
- E Fiber type:
- NM Multimode fiber
 - SM Single mode fiber

CBL-RJ45/2BNC/E1/X

Adapter cable for converting a balanced E1 RJ-45 station clock connector to a pair of BNC connectors (if unbalanced E1 station clock source is used)

ACE-PS/*

ACE hot-swappable power supply unit (for replacement)

- * Power supply type:
- AC 100 to 240 VAC
 - DC -48 VDC

ACE-FTC/ACE-3600

Fan tray card (for replacement)

ACE-MC-SW/!

Software upgrade pack

- ! Software pack type:
- LDP LDP functionality