

HST-3000

Ethernet Service Interface Module (SIM)



Key Features

- Supports Electrical and Optical Ethernet testing in a single module
- Performs traffic generation up to interface line rate and supports automated RFC2544 at Layers 2 to 4 (Eth/IP/TCP/UDP)
- Layer 2/3/4 multiple streams option facilitates Class of Service testing
- New *J-Proof* testing generates and analyzes a wide variety of control plane messages to verify proper switching and routing through transparent Ethernet networks
- Enables Ethernet OAM, PBB/PBT, MPLS, VLAN, QinQ, and IP testing
- IPv6 option enables installation and troubleshooting of IPv6 networks
- Dual-port 'Thru Mode' configuration enables live traffic analysis
- PPPoE protocol support for emulation of data traffic in the last mile
- Simplified user interface facilitates ease-of-use and minimizes technicians' learning curves
- Supports VoIP and IP Video testing

The HST-3000 platform with the Ethernet Service Interface Module (SIM) equips technicians who install and troubleshoot next-generation networks and legacy services. This single ruggedized modular platform enables testing for carrier grade data, VoIP, and IP Video (IPTV) services — optimized for field use.

Introducing next-generation Ethernet/IP-based services over carrier-grade Metro Ethernet networks increases both the complexity and costs for service providers. These networks facilitate service aggregation and work in concert with different network infrastructures and tunneling technologies (VLAN, MAC-in-MAC, and MPLS) that provide common Quality of Service (QoS), traffic engineering, redundancy, and scalability across the service infrastructure. The JDSU HST-3000, equipped with the Ethernet SIM and mainframe's VoIP and IP Video options, addresses the broad requirements for 7-layer testing in a rugged, modular platform that is ideal for field use.

Carrier-grade Metro Ethernet networks are emerging as key components in business (VoIP, Disaster Recovery, Video Conferencing, etc.) and consumer (triple-play) service delivery. Triple-play networks, which transmit voice, video, and data traffic, present a unique set of challenges. Service providers for these network environments now must deliver a service with the Quality of Experience (QoE) requirement, rather than delivering a simple Layer 2 or Layer 3 pipe. Provider Backbone Transport (PBT) in conjunction with new Ethernet OAM standards, extend the capabilities of Ethernet to transform it into a true carrier-class technology.

For Ethernet and other tests, the HST-3000 offers customizable applications that create operational efficiencies that lower operating costs and improve customer service. These applications offer repeatable functionality helping technicians ramp up quicker and resolve more issues daily, resulting in reduced training costs and repeat rates. It also offers an outdoor-readable color screen, robust memory capacity, and advanced processing capabilities.

Product Features

| Summary Settings | |
|----------------------|------------------------|
| 1 - Test | Layer 2 Traffic |
| 2 - RFC 2544 Mode | Disable |
| 3 - Auto Negotiation | On |
| 4 - Source Type | Def. 00:80:16:45:22:72 |
| 5 - Loop Type | Unicast |
| 6 - Destination MAC | 00:00:0C:CC:CC:CC |
| 7 - Tx Payload | BERT |
| 8 - Frame Length | 512 |
| 9 - Encapsulation | None |
| 0 - Load | 100 % |

Figure 1 Layer 2 Traffic Summary Results

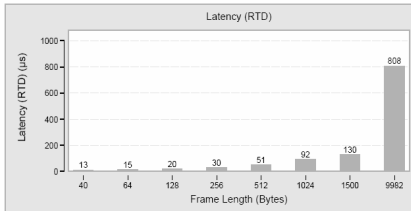
Installation and Troubleshooting of Layer 2, 3, and 4 Services

The HST-3000 enables technicians to quickly turn up and maintain Ethernet networks following a workflow for application-centric testing (see Figure 3). As part of traditional Layer 2/Layer 3/Layer 4 (L2/L3/L4) testing, the HST-3000 can verify end-to-end connectivity, measure bit error rate (BER), and determine whether throughput, utilization, frame loss, packet jitter, and round-trip delay (RTD) characteristics meet service level agreements (SLAs). It can perform Ethernet tests at line rates from 10 Mb/s to 1 Gb/s. It can also verify the full transparency of L2 networks by generating and analyzing a large number of control plane messages, which the user can customize. With operation, administration, and maintenance (OAM), users can verify the link connectivity, insert alarms, and initiate loopbacks.

RFC2544 Automation for Asymmetric and Symmetric Links

The installation and SLA verification of small business and satellite services may employ asymmetric last mile circuits. With the ability to perform RFC2544 testing for asymmetric rates as well as symmetric rates, the engineer can fully exercise both uplink and downlink speeds in one simple, easy test and with minimal configuration. The HST-3000 provides the ability to asymmetrically test either the upstream link to the remote HST, the downlink link from the remote HST, or test asymmetric rates in both directions. This capability enables automated testing to verify latency, throughput, packet jitter, frame loss and RTD from the Core Metro Network where multi-service enabling servers reside down to the subscriber premises.

Latency (RTD) Test Results:



| Pkt Length (Bytes) | Delay (µs) | Measured Rate (Mbps) | Measured Rate (%) | Measured Rate (pkts/sec) | Pause Detected |
|--------------------|------------|----------------------|-------------------|--------------------------|----------------|
| 40 | 12.7 | 100.00 | 99.996 | 148803 | No |
| 64 | 14.8 | 100.00 | 99.996 | 122544 | No |
| 128 | 20.0 | 100.00 | 99.996 | 75298 | No |
| 256 | 30.3 | 100.00 | 99.995 | 42515 | No |
| 512 | 50.7 | 100.00 | 99.999 | 22727 | No |
| 1024 | 91.7 | 100.00 | 99.998 | 11770 | No |
| 1500 | 129.8 | 99.99 | 99.995 | 8127 | No |
| 9982 | 808.2 | 100.00 | 100.000 | 1248 | No |

Figure 2 RFC2544 Latency (RTD) Test Results Report



Figure 3 Workflow for Application Centric Turn-up

Cable Diagnostics

On electrical Ethernet circuits, the HST-3000 can display the link speed, link status, cable status, media delivery index/media delivery index crossed (MDI/MDI-X), and distance to fault with one press of a button. To verify connectivity on fiber lines, the HST-3000 Ethernet SIM reports the wavelength and level of the optical signal. These features allow technicians to quickly sectionalize physical layer problems.

Bidirectional Monitoring/Thru Mode

The dual ports (both optical and electrical) on the HST-3000 Ethernet SIM enable technicians to gain access to circuits under test to perform in-service monitoring in both directions. Not only does this simplify sectionalization of the network, it also allows for the analysis of live customer traffic without the use of a splitter.

PBB/PBT, Ethernet OAM, QinQ and MPLS Tunneling Technologies

Various mechanism and tunneling technologies exist today that let providers effectively deliver carrier-grade Ethernet services across their networks, while maintaining a specified CoS. These technologies are grouped into categories:

- Native Ethernet protocol extensions (IEEE-based)—VLAN tags (often referred to as 802.1q/p) and QinQ (often referred to as VLAN stacking or 802.1ad) techniques
- PBB/MAC-in-MAC (IEEE 802.1ah), PBB-TE (802.1Qay), and Ethernet OAM (IEEE 802.1ag/ITU Y.1731)
- Encapsulations by IP MPLS networks

The HST-3000 enables the installation and maintenance of these technologies.

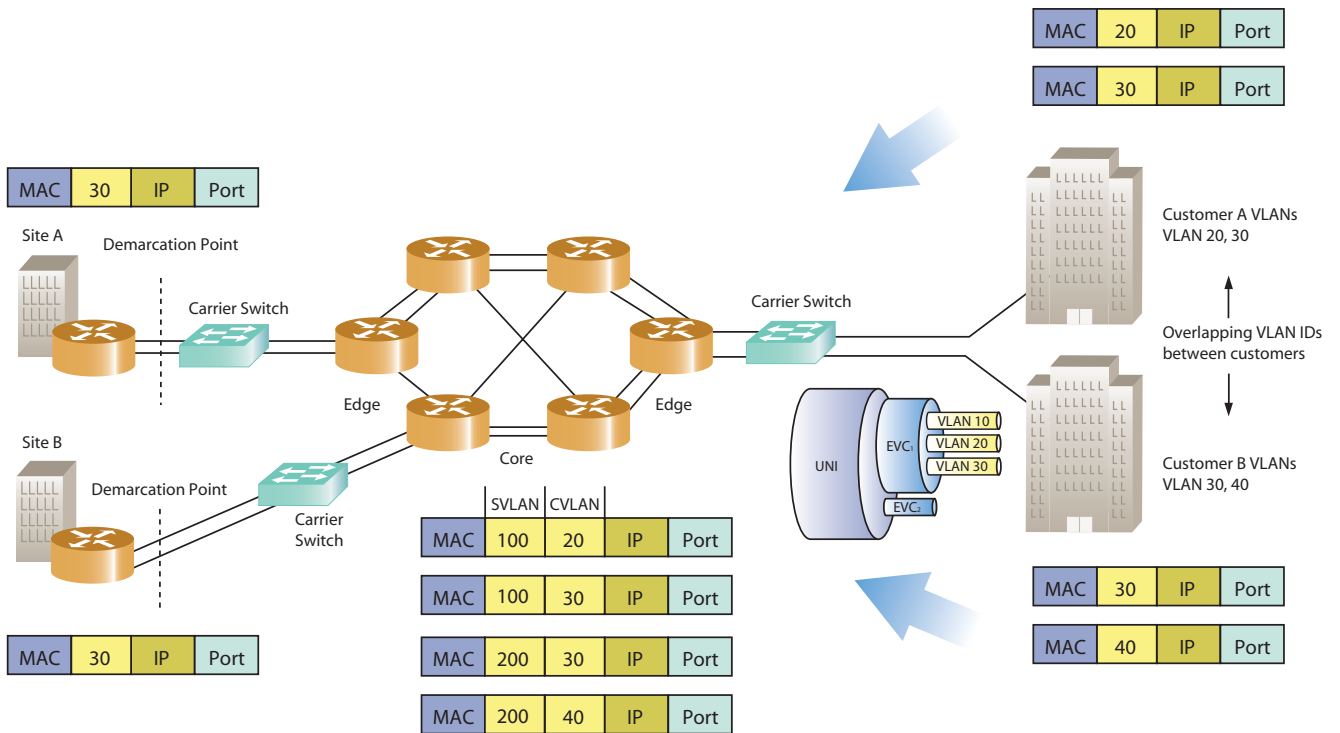


Figure 4 VLAN Stacking in the Network

J-Proof (Layer 2 Transparency) Testing Option

When delivering Ethernet services across a broad geographic area, service providers are, at times, forced to lease an interconnect facility to attain the required connectivity. Best practices include performing Ethernet connectivity, Ethernet BERT, and frequently an RFC2544 test to establish that the circuit conforms to the purchased SLA. The RFC2544 test will specifically verify throughput, latency, and frame loss. With the J-Proof feature, service providers can confirm the provisioning of transparent Ethernet forwarding, which enables the passing of the control plane messaging needed to manage and configure remotely located elements from end-to-end.

Provider Backbone Bridging (PBB) and Provider Backbone Bridging with Traffic Engineering/Transport (PBB-TE/PBT) Option

PBB/PBB-TE is an enhancement to Ethernet (IEEE 802.1ah/802.1Qay) developed to meet the scalability requirements of metro/aggregation networks. By adding a Backbone Tag (B-TAG), operators can aggregate and maintain large numbers of links and services. The HST-3000 PBB/PBB-TE test suite lets users terminate or monitor a PBB/PBB-TE trunk or generate and analyze traffic with Backbone MAC/VLAN ID (B-MAC/B-VID) and Service ID (I-SID).

Ethernet OAM Option

Ethernet Operation, Administration, and Maintenance (OAM) helps service providers monitor and troubleshoot Ethernet services. With the HST/MTS Ethernet Service Layer OAM test suite, customers can monitor the status of a link, automatically identify open links, and generate loopback and linktrace messages for path verification and discovery. The test suite complies with ITU Y.1731/IEEE 802.1ag Connectivity Check (CCM/ETH-CC), Loopback (LBM/ETH-LB), and Linktrace (LTM/ETH-LT) messages. With Link Layer OAM (IEEE 802.3ah Ethernet First Mile), users can discover peer devices, monitor alarms, and provide link-level loopback capability.

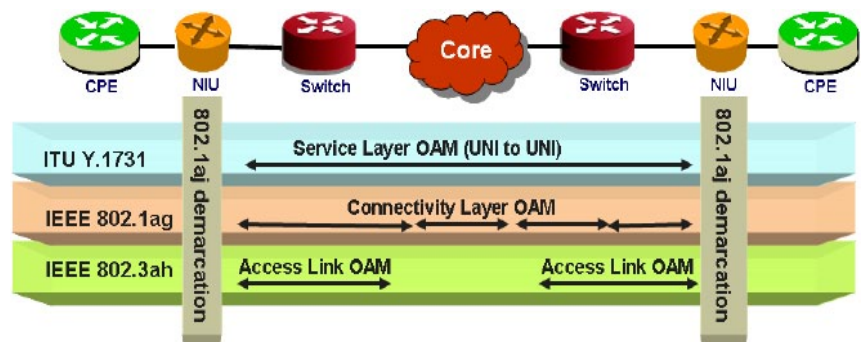


Figure 5 Layer 2 Traffic Summary Results

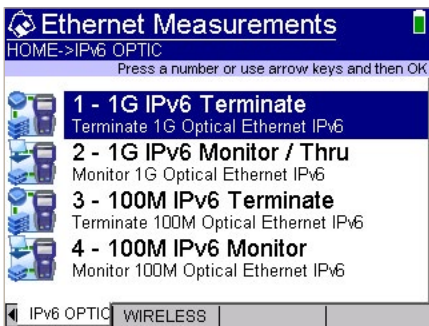


Figure 6 HST-3000 IPv6 Applications

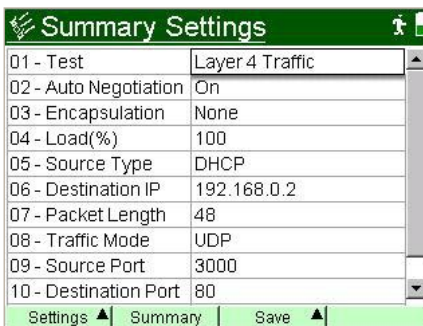


Figure 7 HST-3000 Layer 4 Application Setup

Multiple Streams Option

Many service providers are beginning to deploy different classes of service in order to offer tiered services to customers or to prioritize traffic and effectively manage triple-play networks. These deployments lead to new challenges where the latency and loss may be acceptable for regular traffic, but the higher priority traffic does not meet its required SLA.

In order to test these new networks, technicians can use the Multiple Streams option at Layers 2, 3, and 4 for the HST-3000 Ethernet SIM to oversubscribe the network elements and determine if the various SLAs are met. This determination is accomplished using multiple different traffic streams, with differing encapsulation and priorities schemes, and by sending more traffic through the network than the network can handle. The network elements should drop the lower priority traffic and allow higher priority traffic to pass to the far end at the expense of the lower priority traffic.

IPv6 Option

IPv6 was developed as a way to address the limitations of IPv4: insufficient address space for everything over IP, complexity of address resolution, lack of data security, and lack of adequate QoS measurement.

IPv6 features an auto-configuration facility, defined in RFC2461, which greatly simplifies address configuration. In “stateless” mode, an IPv6 host will automatically configure itself with a unique link-local address, which enables it to communicate locally on its own subnet. For communication over the Internet, the local router provides the host with a global address. Both transactions are completely transparent to the user, resulting in a truly plug-and-play environment. IPv6 also supports manual address configuration and DHCPv6 using a “stateful” address configuration when network administrators require tighter control over IP address allocation. The IPv6 option on the HST-3000 Ethernet SIM supports all three configuration schemes for IPv6 traffic testing for 10/100/GigE networks.

The IPv6 option also features Monitor/Thru mode testing in which the HST-3000 gathers and analyzes live IPv4 and IPv6 traffic.

Layer 4 (TCP/UDP) Option

Providers want to improve their managed services to meet the ever growing carrier-grade Ethernet requirements. Along with their capability to deliver the Layer 3 services, carriers must be able to measure Layer 4 end-to-end performance and ensure that SLAs are being met. Providers require a field-portable test set that supports end-to-end testing at Layers 2 through 4. The new Layer 4 option gives technicians the added ability to measure throughput, loss, and delay performance statistics. With this option, technicians can configure valid Transmission Control Protocol/User Datagram Protocol (TCP/UDP) source and destination ports, and payloads up to the full line rate or generate multiple streams with Layer 4 traffic to allow for prioritization on source and destination ports. Technicians can also perform cable diagnostics and RFC2544 tests with Layer 4 traffic application.

VoIP Option

The HST-3000 with the VoIP option can validate VoIP service connectivity, feature availability, and voice quality. In addition, it provides a comprehensive set of features, including signaling, IP ping, packet statistic, and trace route analysis to identify, diagnose, and sectionalize VoIP network and equipment problems.

IP Video Option

The HST-3000 IP Video option is a video test suite specifically for field technicians who provision or install IP Video services that carry video program content. Test access includes the 2-wire asymmetric digital subscriber line (ADSL) interface or the Ethernet 10/100 interface at the DSL modem or various fiber (FTTx) residential gateway. The test suite includes set top box (STB) emulation with signaling support for broadcast video (IGMP) and video on demand (VoD) (RTSP). Video transport stream analysis is provided as well as video QoS measurements, including packet jitter, packet loss, IGMP latency, and program clock reference (PCR) jitter analysis.

Flexible and Rugged Design

The HST-3000 incorporates a rugged, weather-resistant design and long battery life that are ideally suited for use in the field. Standard Ethernet, USB, and serial ports offer flexibility for easily downloading software and offloading captured test data. Highly configurable, technicians with differing responsibilities can use the HST-3000 to perform a wide variety of tests. The HST-3000 is based on a modular platform, allowing for the addition of upgrades and options in the field. This flexibility also allows for the support of future growth in new technologies and advanced options to accommodate the changing needs of versatile technicians.

Specifications

Test Interfaces

Optical Ethernet/IP

100/1000 Mb/s Dual SFP ports

Electrical Ethernet/IP

10/100/1000 Mb/s Dual RJ45 ports

Test Modes

Terminate

Monitor/Thru (bidirectional monitor)

Ethernet (Layer 2)

Duplex modes Full, half

Flow control Supported

Traffic generation Constant, ramp, bursty

Payload ATP, BERT

Frame length 64-1526 bytes, user-defined, undersized, jumbo, random

MAC addressing Configurable source and destination MAC addresses

Frame format 802.3 or DIX

ARP mode Enable, disable

VLAN settings ID, priority

QinQ settings TPID, customer VLAN ID, customer VLAN priority, service provider VLAN ID, service provider priority, and service provider, DEI bits

MPLS settings Label, priority, TTL, MPLS Ethertype (Unicast or Multicast), # MPLS Labels (1 or 2)

J-Proof (Layer 2 Transparency Settings) Frames 1 through 20

Protocol STP, RSTP, MSTP, LLDP, GMRP, GVRP, CDP, VTP or user-defined

Number of Frames Transmitted 1 to 100

MAC-in-MAC Settings Backbone Source MAC Address Type, Backbone Destination Address, Backbone Tag, VLAN ID, Priority, DEI Bit, I-Tag, I-Tag Priority, I-Tag DEI Bit, I-Tag UCA Bit, I-Tag Service ID

MAC-in-MAC Filters B-Tag VLAN ID, B-Tag DEI Bit, I-Tag Priority, I-Tag DEI Bit, I-Tag UCA Bit, I-Tag Service ID, Customer Frame Filter

Ethernet OAM Settings

OAM Type 802.1.ag/Y.1731

Service Layer OAM Continuity Check Messages (CCM) Loss of Continuity Threshold, CCM Rate, CCM Type, MEG ID, Peer MEG End ID, MD Level, Peer MEG End ID

Service Layer OAM Alarm Indication Signal (AIS) MD Level,

AIS Rate

Service Layer OAM Loopback Message (PING) MD Level,

LBM Type

Service Layer OAM LTM/LTR (Trace route) MD Level

Link Layer OAM Local Config Active/passive, Vendor OUI, Vendor-specific info., Max PDU size, Link Events, Remote Loopback, Variable Retrieval

Link Layer OAM Defects Link Fault, Dying Gasp, Critical Event

Link Layer OAM Events Symbol Period Window, Symbol Period Threshold, Frame Window, Frame Threshold, Frame Period Window, Frame Period Threshold, Frame Second Summary Window, Frame Second Summary Threshold

Bit error testing patterns PRBS (223-1, 231-1, and inverted selections), all Ones, all Zeros, user-defined

Framed pattern test per NCITS TR-25:1999 CRPAT, CJPAT, CSPAT

Traffic filtering MAC source address, MAC destination address, Frame type/length, VLAN ID, VLAN Priority, SVLAN ID, SVLAN Priority, MPLS Label, MPLS Priority

IP Version 4 (Layer 3) Specifications

Traffic generation Constant, ramp, bursty

Data mode IPoE, PPPoE

IP addressing Configurable source and destination IP addresses, TOS/DSCP

Traffic filtering Source IP address, destination IP address, TOS/DSCP, VLAN ID, VLAN Priority, SVLAN ID, SVLAN Priority, MPLS Label, MPLS Priority

IP Version 6 (Layer 3)

Traffic generation Constant, ramp, bursty

IP addressing Stateless autoconfiguration, Stateful autoconfiguration, Manual

Traffic filtering Source IP address, Source prefix, Destination IP, Destination Prefix Traffic Class Type, VLAN ID, VLAN Priority, SVLAN ID, SVLAN Priority

TCP/UDP (Layer 4)

Traffic mode TCP, UDP

Port addressing Source, Destination

Multiple Streams

Number of streams 8

Stream modes Layer 2, Layer 3, Layer 4

Encapsulations VLAN ID, VLAN Priority, SVLAN ID, SVLAN Priority

Cable Testing

Optical Power measurement, SFP Vendor Name

CAT-5 cable Link speed, link status, crossover/straight, distance to fault, pin mapping, pair length, polarity, skew

Power over Ethernet Indicates if the power supply responds to Class 1 power requests

Key Results

Link status Optical power measurement, Link active Frame detected, Sync obtained

Configuration status Auto-negotiation link configuration ACK, Auto-negotiation link advertisement status, DHCP lease time, Destination MAC address when using ARP

Link status Bandwidth utilization, Frame rate Rx/Tx L1, L2, L3, L4 Mb/s Round-trip delay, Service disruption time

Link counts Total received and transmitted frames, pause frames, VLAN frames, unicast frames, multicast frames, broadcast frames, frame length (bins), Errored counts, FCS errored frames, runts, jabbers, undersized frames, OOS frames, lost frames, IP checksum errors, ATP payload error

Conformance with RFC2544 Throughput test Latency test, Frame loss test Back-to-back frame test Packet Jitter test*

*Not in RFC2544 specification

Physical

Size (h x w x d) 241 x 114 x 70 mm (9.5 x 4.5 x 2.75 in)

Weight (with battery) 1.23 kg (2.7 lb)

Operating temperature 5.5 to 50°C (22 to 122°F)

Storage temperature -40 to 65.5°C (-40 to 150°F)

Battery life 10 hrs. typical usage

Charging time 7 hrs. from full discharge to full charge

Operating humidity 10 to 80% relative humidity

Storage humidity 10 to 95% relative humidity

Display 3.8" diagonal, 1/4 VGA, Color Active Matrix with backlight (readable in direct sunlight)

Ordering Information
General

| | |
|-----------------|---|
| Ruggedness | Survives 91 cm (3 ft) drop to concrete on all sides |
| Water-resistant | Splashproof (may be used in heavy rain) |
| Language | English, German, French, Spanish, Italian, Chinese, Turkish |
| Keypad | Typical 12-button keyboard |

Base Unit

| | |
|-------------|---|
| HST3000-NG | HST-3000 Mainframe without Copper (Color) |
| HST3000C-NG | HST-3000 Copper Mainframe (Color) |

Available SIMS (Modules)

| | |
|------------------------|---|
| HST3000-CUCE | Copper only SIM, CE Marked |
| HST3000-AR2A-T1 | ADSL2+ T1 (ATU-R, Annex A) |
| HST3000-AR2A | ADSL1/2/2+ (ATU-R, Annex A) |
| HST3000-AR2B | ADSL1/2/2+ (ATU-R, Annex B) |
| HST3000-AR2B-T1 | ADSL2+ T1 (ATU-R, Annex B) |
| HST3000-CAR2A | ADSL1/2/2+ with Copper (ATU-R, Annex A) |
| HST3000-CAR2A-T1 | Copper, ADSL2+ T1 (ATU-R, Annex A) |
| HST3000-CAR2B | ADSL1/2/2+ with Copper (ATU-R, Annex B) |
| HST3000-CAR2B-T1 | Copper, ADSL2+ T1 (ATU-R, Annex B) |
| HST3000-CARB | Annex B Copper/ATU-R |
| HST3000-CARCA | Copper and ATU-R/C Dual Mode, AoPOTS |
| HST3000-CARCB | Copper and ATU-R/C Dual Mode, AoISDN |
| HST3000-CARCE | Copper and ATU-R (Annex A), CE Marked |
| HST3000-WB2 | Wide Band 2 (up to 30 MHz) Copper Test |
| HST3000-VDSL-CNXT | VDSL with Connexant Chipset |
| HST-3000-VDSL-CNXT-WB2 | VDSL and Copper (up to 30 MHz) with Connexant Chipset |
| HST3000-VDSL-IK | VDSL with Ikanos Chipset |
| HST-3000-VDSL-IK-WB2 | VDSL and Copper (up to 30 MHz) with Ikanos Chipset |
| HST3000-INF-VDSL | VDSL with Infineon Aware Chipset |
| HST-3000-INF-VDSL-WB2 | VDSL and Copper (up to 30 MHz) with Infineon Aware Chipset |
| HST3000-ETH | 10/100/1000 Ethernet |
| HST3000-CT1 | T1 and Copper |
| HST3000-DC | Datacom |
| HST3000-E1 | E1 |
| HST3000-E1-DC | E1/Datacom |
| HST3000-4WLL | 4-Wire Local Loop |
| HST3000-T1 | Dual TX/RX Bantam T1 Interface and T1 |
| HST3000-T3 | Dual TX/RX Bantam T1 Interface, and Dual RX/Single TX BNC DS3 Interface/and DS3 |
| HST-BRA | ETSI (Euro) ISDN BRA |
| HST3000-BRI | ISDN BRI |
| HST3000-CSHCE | G.SHDSL and Copper |
| HST-GSH | G.SHDSL |
| HST3000-GSHCE | 2-Wire G.SHDSL |
| HST3000-CSH4 | Copper, 4-Wire G.SHDSL (STU-R/C, Annex A/B) |
| HST3000-BLK | Blank |

Software Options

| | |
|-------------------|---|
| HST3000-BLUETOOTH | Bluetooth Wireless |
| HST3000S-WEB | Web Browser |
| HST3000-REMOP | Remote Operation |
| HST3000-SCRIPT | Scripted Test |
| HST3000-DSL2 | ADSL2 and ADSL2+ |
| HST3000S-IP | Advanced IP Suite—PING and Through Mode Support |
| HST3000S-IP-Video | IP Video Analysis |
| HST3000S-VMOS | Video MOS Analysis |
| HST3000-MSTV | Microsoft IPTV Video Analysis |
| HST3000-VT100 | VT100 Emulation |
| HST3000S-VOIP | VoIP Software Analysis |
| HST3000S-H.323 | H.323 VoIP Signaling |
| HST3000S-MGCP | SCCP MGCP VoIP Signaling |
| HST3000S-MOS | VoIP Mean Opinion Score |
| HST3000S-SCCP | SCCP VoIP Signaling |
| HST3000S-SIP | SIP VoIP Signaling |
| HST3000-UNISTIM | VoIP Signaling Call Controls for UNISTIM |
| HST3000-OPTETH | Optical Ethernet |
| HST3000-IPV6 | IPv6 |
| HST3000-MPLS | MPLS |
| HST3000-MSTR | Multiple Streams |
| HST3000-TCPUDP | TCP/UDP |
| HST3000-FTP | FTP |
| HST3000-WBTONES | WB TMS |
| HST3000-PCMTIMS | TIMS (PCM) |
| HST3000-PCMSIG | Signaling (PCM) |
| HST3000-SPE | Spectral Noise |
| HST3000-RFL | RFL |
| HST3000-TDR | TDR |
| HST3000-PRI | ISDN PRI (NC Standard) |
| HST3000-ST | Basic Rate ISDN S/T (ANSI) |
| HST3000-T1DDS | DDS-T1 |
| HST3000-TxIMP | Transmission Impairments |
| HST3000-FR | Frame Relay |
| HST3000-PS | Pulse Shape |

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