

SPIRENT TECH-X FLEX

COPPER/DSL COMBO MODULE

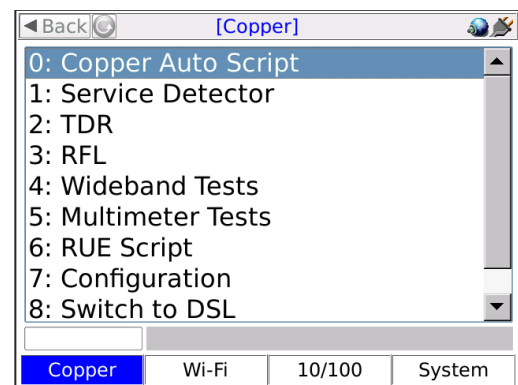
Spirent's Tech-X Flex® Copper/DSL Combo Module provides the complete test capability for copper access networks. Comprehensive copper testing and ADSL to VDSL2 testing in a single module allows a unified solution reducing time and capital equipment costs.

FEATURES & BENEFITS

- Comprehensive copper testing and ADSL to VDSL2 testing in a single module allows a unified solution reducing time and capital equipment costs.
- Wideband testing to 30MHz ensures services up to VDSL2 can be properly provisioned and diagnosed
- Advanced Impulse Noise Capture provides detailed analysis which can be used to pinpoint the source of service affecting electrical noise
- DSL Chipset Interoperability provides a single solution to test against multiple DSLAMs that may exist in the service provider's network
- MOS scores and Stream Expert Analysis allow testing and troubleshooting of IP Video quality issues
- xTU-C and router replacement feature allows full featured on-premise CPE testing

Tech-X Flex enables field technicians to qualify both copper access network-based POTS connections, as well as, ADSL 2/2+ and VDSL/VDSL 2 standards-based service offerings using a single integrated module.

Having a single module ensures maximum flexibility when it comes to maintaining copper access services in your network. For DSL services—by emulating the xTU-R (customer modem)—the Flex enables field technicians to sync with a DSLAM to separate network issues from in-house problems. The xTU-C (network DSLAM) emulation capability allows the technician to validate whether the customer modem is operating properly. In addition, it offers a variety of automated test suites to ensure rapid service qualifications for newly deployed services.



**SPIRENT TECH-X FLEX
COPPER/DSL COMBO MODULE**

IP/ATM TESTING

The field technician should attempt to verify connectivity to the Internet service provider (ISP) using various IP measurements such as IP ping. By using a URL in a ping or Traceroute test, the technician is assured the customer can reach the desired IP address and that the domain name server (DNS) works properly. Tests such as Traceroute identify where excessive delay is introduced or how far the customer’s traffic can traverse the network before a failure.

DSL EXPERT ANALYSIS

ADSL 2/2+ and VDSL/VDSL2 standards provide Management Information Bases (MIBs) for service technicians to obtain expert diagnostics on the source of low data rates. This can be done without interpreting hundreds of individual results. Using the DSL Expert Diagnostics option, a technician receives a report indicating disturbers such as bridged taps, missing micro filters, WB noise (e.g., T1, HDSL) and how they directly impact the data rate. Results are provided in plain text for immediate action by field personnel.

This option guides troubleshooting activities. The field technician avoids wasting time on problems that do not impact the data rate, thereby minimizing MTTR. The Tech-X Flex diagnostics option eliminates the need for each dispatched technician to be an expert at these new technologies. Fault isolation is performed quickly and reliably.

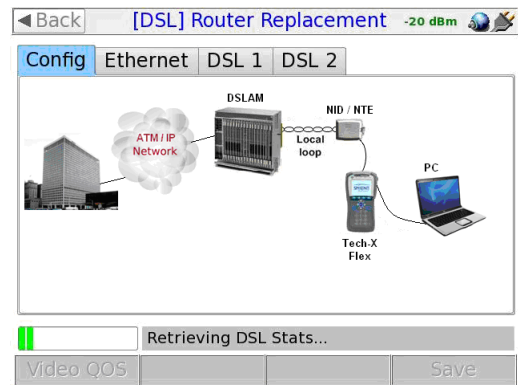
| Link Info | | Atten/Insertion Loss | Loop Topology |
|-------------------|--------------------|----------------------|---------------|
| CO Modem Detected | Yes | | |
| Link established | Yes | | |
| ADSL Standard | G.993.2 | | |
| CO Chipset | Conexant | | |
| | Rate | Up | Down |
| | Max Data(Kbps) | N/A | 75173 |
| | Expert Ideal(Kbps) | 65168 | 150908 |
| | ADSL2+ Rt(Kbps) | 1468 | 25372 |

InHomeTest

ROUTER REPLACEMENT FEATURE

The Router Replacement feature allows the Tech-X Flex to function as a simple DSL gateway/router, providing an interface between the DSL link and a downstream Ethernet device such as a computer. With this feature, the downstream device should have full connectivity with the provider network, including access to the Internet as applicable, through the Tech-X Flex unit.

Testing at the DSL gateway/router location allows emulation of a router/gateway in order to validate the connectivity up to that point and verify a suspect gateway/router.



BONDED xDSL

This test feature provides a simulated analysis of a bonded xDSL line, a line where two pairs are used to transport separate “halves” of a single DSL service. In this architecture, the two signals are aggregated at each end, providing a much higher bandwidth than would be possible with one pair alone. The Bonded xDSL feature allows the user to establish company specific pass/fail thresholds to ensure Bonded pairs meet the required services parameters.

Upon completion of the Bonded xDSL test, the Tech-X Flex provides an analysis of each pair and estimates of the upstream and downstream data rates that can be achieved on the bonded pairs.

| Bonded xDSL Test Summary | | | |
|--------------------------------|--------|--------|----------|
| DS Parameter | Pair 1 | Pair 2 | Analysis |
| Data Rate (Kbps) | 50400 | 50400 | Pass |
| SNR Margin (dB) | 19.1 | 19.5 | Pass |
| Attenuation (dB) | 2.5 | 2.5 | Pass |
| Estimated Bonded Service Rates | | | |
| | UP | DOWN | |
| Data Rate (Kbps) | 6400 | 80640 | |

Pair1 Pair2



DSL AUTO TEST—DSL LINK SCRIPT

The DSL Link Script is a quick test suite for comparing certain synchronization parameters with established thresholds in order to quickly evaluate line performance. The parameters evaluated include:

- Data rate (downstream)
- SNR margin
- Attenuation
- Relative capacity

When the script runs, it retrieves the most current versions of these parameters and compares them to the set thresholds.

| [DSL] DSL Link Script | |
|-----------------------|-------|
| Data Rate (Kbps) | 24952 |
| SNR Margin (dB) | 31.8 |
| Attenuation (dB) | 2.2 |
| Relative Capacity (%) | 33 |

Save

IP VIDEO QUALITY ANALYSIS

The Tech-X Flex supports both Active and Passive Video Testing. In “Active” testing the test set emulates a multicast endpoint and performs all actions necessary to start and/or join the stream. Depending on the location of the test set, this type of testing can provide the most comprehensive view of the actual subscriber experience. “Passive” testing is the case, where the test set is connected between two existing endpoints and passively monitors the video traffic between them.

IP video testing support includes:

- Subjective quality assessment of viewer experience using MOS scores for audio and video
- Comprehensive statistics on multimedia transport streams using the Stream Expert Analysis
- Video channel change times

| [DSL] Video QoS | | |
|-----------------|-------------|------------------------|
| Plot | MOS | Stream/Expert Analysis |
| IP Address | 239.255.1.1 | |
| Port | 3002 | |
| V MOS | 4.26 | |
| A MOS | 4.75 | |
| A/V MOS | 4.26 | |

Test in progress

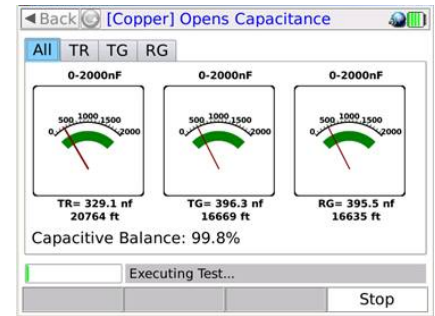
Stream Transport Stop Test Save Start

WIDEBAND COPPER TESTING

Time Domain Reflectometer (TDR): Tech-X Flex provides a high precision TDR so that load coils, bridged taps and faults can be found with ease. Fully functional and simple to operate, this TDR reduces time spent trying to locate the fault.

Other TDR highlights include:

- High resolution graphical display for easy fault finding and analysis
- Isolation of faults 20,000 feet away
- Auto detection of faults such as opens, short, bridged taps, and more
- Zero dead-zone to find close-in faults
- Dual and cross talk operation modes for those situations where different techniques are required



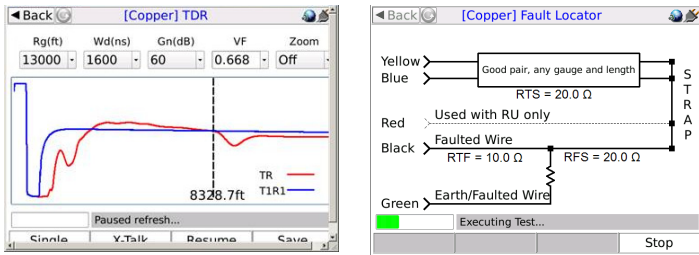
Multimeter (DVOM): Voltage, current, resistance, and capacitance (opens) measurements can be performed to determine loop length, capacitive and resistive balance, current and battery voltage. Furthermore, the Tech-X Flex identifies faults such as opens, shorts, battery crosses, bad splices, and more.

Wideband service testing to 30MHz: With the increasing push to provide high-speed services for Triple Play deployments happening worldwide, network operators are opting for an ADSL2+ or VDSL2 delivery of these services in an FTTN environment. To qualify and troubleshoot the copper pair for its suitability to carry VDSL2 requires a test set capable of testing over the full 30MHz frequency band. Tech-X Flex provides this capability as standard in its single copper test module. These tests include insertion loss, longitudinal balance, weighted and impulse noise measurements.

Advanced Impulse Noise Detection: Impulse Noise problems are common to service providers everywhere yet there are very few tools that can be used to get to the source of the problem and those that do exist are usually prohibitively expensive for field technicians to carry around. Typically, the only commonly available tool was an impulse noise counter which is able to indicate the presence of impulse noise. This is of limited use to the technician because it doesn’t identify the source of the noise, so it alone has limited value in the customer with reliable service. However, the Tech-X Flex has the ability to make an impulse noise capture in the frequency or time domain once an event has occurred. This helps greatly in being able to identify the source of the problem and therefore rid the customer of their problem.

SPIRENT TECH-X FLEX COPPER/DSL COMBO MODULE

Resistance Fault Locator (RFL): RFL analysis finds high-resistance faults that normally cannot be found by a TDR. Loop resistance, insulation resistance, and accurate location of ground and battery faults are easily found with a touch of a button. An automated Kupfmuller analysis feature is also included to locate double leg faults that normally require two separate measurements. This is a real time saver yet extremely simple to use



Installation of Voice Services: Various features such as drawing dial-tone, C-Message noise, VF loss and DVOM tests enable field technicians to ensure the voice (e.g. POTS) service meets service criteria after the copper pair has been conditioned. Various test numbers such as quiet termination, milliWatt and “drop battery” can be stored in the unit for automatic dialing before the measurement is made. Using the built-in speaker, the field technician can listen to various tones being received.

In-Band Controllable Remote Unit: The Tech-X Flex has an optional Remote Unit, simplifying field testing of wideband insertion loss measurements. Once placed on the correct pair, the remote unit reduces truck rolls and time consumed waiting for other technicians to complete a job. This unit can be remotely configured via the line under test and DTMF tones to perform various measurements. For example, the Remote Unit can be instructed to send wideband tones for the Tech-X Flex to receive. Lastly, once the trouble has been fixed, the field technician remotely configures a through mode and immediately places the customer back in service.

Installation of Voice Services: Various features such as drawing dial-tone, C-Message noise, VF loss and DVOM tests enable field technicians to ensure the voice (e.g. POTS) service meets service criteria after the copper pair has been conditioned. Various test numbers such as quiet termination, milliWatt and “drop battery” can be stored in the unit for automatic dialing before the measurement is made. Using the built-in speaker, the field technician can listen to various tones being received.

In-Band Controllable Remote Unit: The Tech-X Flex has an optional Remote Unit, simplifying field testing of wideband insertion loss measurements. Once placed on the correct pair, the remote unit reduces truck rolls and time consumed waiting for other technicians to complete a job. This unit can be remotely configured via the line under test and DTMF tones to perform various measurements. For example, the Remote Unit can be instructed to send wideband tones for the Tech-X Flex to receive. Lastly, once the trouble has been fixed, the field technician remotely configures a through mode and immediately places the customer back in service.

COPPER AUTO TEST SCRIPTS

Auto Test Scripts provides access to a set of automatic scripts that run a sequence of tests, designed to quickly qualify a Copper Access connection. There are two types of test scripts—*Primary Test Script* and *Advanced Test Script*.

The *Primary Test Script* provides a series of multimeter tests to test and/or qualify a line for POTS voice services. The script should be run with the tip (A), ring (B), and ground (E) leads connected and all legs unterminated at the far end.

| | TR | RG | TG |
|-------------|--------|--------|--------|
| AC Voltage | 0.2 V | 0.1 V | 0.1 V |
| DC Voltage | 0.0 V | 0.0 V | 0.0 V |
| Capacitance | 226 nF | 225 nF | 221 nF |
| Cap. Bal. | 98 % | | |
| Insul. Res. | OVR | OVR | OVR |
| Rect. Loop | No | | |

The *Advanced Test Script* provides a series of multimeter tests generally designed to test and/or qualify a line for wideband service delivery, such as VDSL. The script should be run with the tip (A), ring (B), and ground (E) leads connected and all legs unterminated at the far end.

| | | | |
|---------------------------------|----------------------------|-----|-----|
| Insul. Res. | OVR | OVR | OVR |
| Rect. Loop | No | | |
| Bridge Tap | Possible BT/Short @ 6876 m | | |
| Load Coils | 0 | | |
| Pwr Influence | 90.0 dBm | | |
| WB Long Bal. | 36.4 dB | | |
| VF Noise | UR | | |
| Impulse Noise 1, V2-20K8 Filter | 0 | | |
| Impulse Noise 2, G Filter | 0 | | |

TECHNICAL SPECIFICATIONS—DSL

| | | | |
|-------------------------------|--|---|--|
| Line Modulations | <ul style="list-style-type: none"> • ANSI T1.413 Issue 2 • ADSL G.DMT (G.992.1/2 Annex A) • ADSL 2 (G.992.3/4 Annex A) • ADSL 2+ (G.992.5 Annex A) | <ul style="list-style-type: none"> • Reach-Extended ADSL 2 (G.992.3 Annex L) • G.Lite (G.992.2) • VDSL (G.993.1) • VDSL2 (G.993.2) | |
| Emulations | <ul style="list-style-type: none"> • xTU-R | <ul style="list-style-type: none"> • xTU-C | |
| IP Encapsulations | <ul style="list-style-type: none"> • PPPoE (RFC 2516) • PPPoA/LLC (RFC 2364) | <ul style="list-style-type: none"> • PPPoA/VC-Mux (RFC 2364) • Bridged Ethernet | |
| Authentications | <ul style="list-style-type: none"> • 802.1x | | |
| IP Connectivity Tests | <ul style="list-style-type: none"> • ICMP Ping • TraceRoute | <ul style="list-style-type: none"> • Name Server Lookup • ISP Authentication | |
| ATM Connectivity Tests | <ul style="list-style-type: none"> • ATM F4 OAM Loopback | <ul style="list-style-type: none"> • ATM F5 OAM Loopback | |
| Line Results | <ul style="list-style-type: none"> • Data Mode • Line Format • DSLAM Vendor | <ul style="list-style-type: none"> • Modem State • Modem Error Condition • Output Power | |
| Up/Downstream Results | <ul style="list-style-type: none"> • Line Rate Actual • Line Rate Max • Line Rate Capacity • Fast Bit Rate • Interleaved Bit Rate • Noise margin (dB) • Attenuation (dB) • Link Uptime • Correctable FEC Errors • Uncorrectable CRC Errors | <ul style="list-style-type: none"> • Interleave Path HEC Errors • Loss of Signal • Severely Errored Seconds • Errored Seconds • Severe Errors • Loss (dBm) • Power • Signal Attenuation (dBm/Hz) • Received Blocks • Transmitted Blocks | <ul style="list-style-type: none"> • Corrected Blocks • Uncorrected Blocks • Interleaved Delay • Interleaved Depth • HEC Error Count • Total HEC Count • KLO • Impulse Noise |

SPIRENT TECH-X FLEX
COPPER/DSL COMBO MODULE

| TECHNICAL SPECIFICATIONS—WIDEBAND COPPER | | | | |
|--|--|---|---|--|
| | RANGE | RESOLUTION | ACCURACY | ADDITIONAL INFORMATION |
| DC Voltage | 0 – ±300V | 0.1V | ±2% ±1 digit | Impedance: 100 kΩ |
| AC Voltage | 0 – 250V | 0.1V | ±2% ±1 digit | Impedance: 100 kΩ |
| Resistance | 0 – 2 kΩ 2 – 20 kΩ 20 – 200 kΩ 200 k – 2 MΩ 2 M – 20 MΩ | 1Ω 10Ω 100Ω 1 kΩ 10 kΩ | ±2% ±1Ω ±2% ±10Ω ±2% ±100Ω ±2% ±1 kΩ ±2% ±10 kΩ | |
| Insulation Resistance | 10 – 100 kΩ 100 kΩ – 1 MΩ 1 MΩ – 10 MΩ 10 MΩ – 100 MΩ 100 MΩ – 2 GΩ | 100Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ | ±2% ±2% ±2% ±2% ±5% | Voltages: 30, 50, 95, 250, 500V (all ±) |
| Loop Resistance | 0 – 10 kΩ | 1Ω | ±2% ±1Ω | Voltages: +/-95V |
| Open/Capacitance Meter | 0 – 2000 nF | 0.1 nF | ±2% ±1 digit | |
| Loop Current | 0 – 150 mA | 1 mA | 2% ±1 digit | Load: 430Ω |
| VF TESTS | | | | |
| Noise Metallic | 0 – 90 dBmC | 1 dB | ±2 dB | Filter: C Message |
| VF Longitudinal Balance | 300 Hz – 4 kHz 0 – 65 dB 65 – 80 dB | 0.1 dB 0.1 dB | ±1.0 dB ±2.0 dB" | Impedance: 600Ω |
| PI Noise Balance | 0 – 90 dBm | 0.1 dB | ±2 dB | C-message, Psophometric, and D filter support |
| VF Receive Tones | 300 Hz – 4 kHz -40 dBm – +10 dBm | 0.1 dB | ±2Hz ±1.0 dB | Output level: 0 dBm from remote device Impedance: 600Ω |
| VF Transmit Tones | 300 Hz – 4 kHz -30 dBm – +10 dBm | 0.1 dB | ±2Hz ±1.0 dB | Impedance: 600Ω |
| VF SNR | 300 Hz – 4 kHz 0 – 90 dB | 0.1 dB | ±2Hz ±1.0 dB | Requires Spirent's Remote Unit |
| WIDEBAND TESTS | | | | |
| WB Longitudinal Balance | 10 kHz – 30 MHz 0 – 50 dB | 0.1 dB | ±5.0 dB | Impedance: 100Ω or 135Ω |
| Wideband Insertion Loss | 10 kHz – 30 MHz 0 – 90 dB | 0.1 dB | ±1.0 dB | Output Level: 0 dBm from remote device Impedance: 100Ω or 135Ω |
| WB Weighted Noise | Varies according to the selected filter, see Supported Noise Filters | 0.1 dB | ±1 dB | Impedance: E and F Filters: 135Ω All other: 100Ω |
| WB SNR | 10 kHz – 30 MHz 0 – 50 dB | 0.1 dB | ±1.0 dB | Requires Spirent's Remote Unit |
| WB Impulse Noise | Varies according to the selected filter, see Supported Noise Filters | 0.1 dB | ±1.0 dB | Impedance: E and F Filters: 135Ω All other: 100Ω <ul style="list-style-type: none"> • Time duration up to 24 hours • Maximum of 8 noise events recorded per second • Triggered Capture to display details in spectral or time domain |
| Power Spectral Density (18 MHz Test) | | 0.1 dBm 4.3125 kHz | | |
| Power Spectral Density (30 MHz Test) | +20 to – 140 dBm/Hz | 0.1 dBm 8.625 kHz | ±1.0 dB | Impedance: 100Ω, 135Ω or Hi-Z Resolution specs are with zoom enabled |
| Time Domain Reflectometry (TDR) | 300 ft. / 100m 1,300 ft. / 400m 3,000 ft. / 1km 6,500 ft. / 2km 13,000 ft. / 4km 26,000 ft. / 8km | 0.2 ft. / 0.05m 0.7 ft. / 0.2m 1.6 ft. / 0.5m 3.3 ft. / 1.0m 6.4 ft. / 2.0m 9.7 ft. / 3.0m | ±2% of range or better | Vertical Sensitivity: 90 dB in steps of 6 dB Selectable Pulse Widths of 5, 34, 235 and 1600 ns. Resolution specs are with zoom enabled Other features include: AutoTDR Single, Dual and X-Talk modes |

TECHNICAL SPECIFICATIONS—WIDEBAND COPPER (CONTINUED)

| | RANGE | RESOLUTION | ACCURACY | ADDITIONAL INFORMATION |
|--------------------------------|---|------------|--------------------------------|--|
| Resistance Fault Locator (RFL) | Location Range: 0 – 39,000 ft./12km Resistance fault range: 0– 20 MΩ | | 3-wire: ±0.2% 4-wire: ±0.2% | Murray and Kupfmuller techniques available |
| Remote Unit | | | | <ul style="list-style-type: none"> • Open Pair • Short Pair • In-service/Through mode • Pair to ground • Tone Generation (70 Hz to 2.5 MHz) • Output Level: 0dBm |

SUPPORTED NOISE FILTERS—WIDEBAND COPPER

| FILTER | POWER RANGE (dBm)* | MINIMUM THRESHOLD (dBm)* | FREQUENCY RANGE | ADDITIONAL NOTES |
|-----------|--------------------|--------------------------|------------------------------------|---|
| (None) | 65 – 110 | 35 | Up to 30 MHz | Available for general purpose analysis of the line. |
| E | 30 – 110 | 0 | As specified by IEEE Std. 743-1995 | Typically used for DDS and ISDN services. |
| F | 40 – 110 | 10 | As specified by IEEE Std. 743-1995 | Typically used for HDSL services. |
| G | 50 – 110 | 20 | As specified by IEEE Std. 743-1995 | Typically used for ADSL services. |
| A2+ | 55 – 110 | 25 | 20 kHz – 2.2 MHz | Typically used for ADSL2+ services. |
| V2-20K8 | 60 – 110 | 30 | 25 kHz – 8.5025 MHz | Available for different VDSL/VDSL2 bands and band plans, as appropriate. |
| V2-20K12 | 60 – 110 | 30 | 25 kHz – 12.0025 MHz | |
| V2-20K17 | 60 – 110 | 30 | 25 kHz – 17.0025 MHz | |
| V2-20K30 | 65 – 110 | 35 | 25 kHz – 0.0025 MHz | |
| V2-640K17 | 60 – 110 | 30 | 640 kHz – 17.6 MHz | The V2-640K17 filter extends its lower range to 400 kHz for impulse noise testing only. |
| V2-17M25 | 60 – 110 | 30 | 17.6 MHz – 25 MHz | |
| V2-17M30 | 60 – 110 | 30 | 17.6 MHz – 30 MHz | |
| V2-25M30 | 65 – 110 | 25 | 25 MHz – 30 MHz | |

*The Minimum threshold indicates the absolute minimum threshold that you can set for the Impulse Noise test, for the respective filter. While these values are provided for flexibility, it is generally recommended that you use values within the normal Power range instead, because a lower value makes it more likely that ordinary noise will be mistaken for impulse noise. The lower the value, the more skill is required of the operator to properly interpret results.

SPIRENT TECH-X FLEX COPPER/DSL COMBO MODULE

| ORDERING INFORMATION | | |
|----------------------|--|--|
| PRODUCT NUMBER | PRODUCT NAME | DESCRIPTION |
| T5000 | Tech-X Flex | With 10/100 Ethernet interface for IP Ping, Traceroute, DHCP/Static Addressing. |
| T5624 | Combined ADSL/VDSL2 and WB Copper Module | ADSL to VDSL2 xTU-R modem emulation and WB Copper test functionality to 30MHz. Including DVOM/VF, TDR, RFL, PSD and WB measurements in a single module |
| T5006 | DSL Expert Analysis | Automatic loop and in-home fault analysis. |
| T5015-UG | xTU-C Option | Enables xTU-C Emulation for ADSL thru VDSL2 sync. Requires T5624. |
| T5003 | IP Video Option | Provides IP Video set-top box emulation with results such as VMOS, type of video codec, channel change time, packet loss, latency, jitter, out-of-order & duplicate packets, I/B/P frame counts, etc.. |
| T5645 | Copper Far End Unit (FEU) | A remote device used in conjunction with the Tech-X Flex Copper module, to provide Shorts, Grounds, Opens, Termination, Tones on a cable pair for testing at a distant location. |

SPIRENT SERVICES

Spirent Global Services provides a variety of professional services, support services and education services—all focused on helping customers meet their complex testing and service assurance requirements. For more information, visit the Global Services Website at www.spirent.com/gs or contact your Spirent sales representative.

AMERICAS 1-800-SPIRENT • +1-818-676-2683 • sales@spirent.com

EUROPE AND THE MIDDLE EAST +44 (0) 1293 767979 • emeainfo@spirent.com

ASIA AND THE PACIFIC +86-10-8518-2539 • salesasia@spirent.com