



IP Telephony Test System Abacus 5000

Spirent Communications IP Telephony Test Systems

Spirent Communications delivers IP Telephony test systems that help you manage the challenges of VoIP development and deployment.

Spirent's Abacus 5000 is a cost-effective, flexible and scalable IP Telephony test system, with integrated Analog, TDM and Ethernet interfaces for comprehensive testing of converged IP Telephony network elements.

Product Overview

Abacus 5000 is a fully integrated IP and PSTN Telephony test system in a single platform. Abacus 5000 test methodology allows users to objectively measure Voice Quality (MOS, PSQM, PSQM+, PESQ) under real-world voice stream load generation. Other test methodologies are functional testing, capacity, performance and interoperability.

Abacus 5000 Media Payload formats include tones, WAV, Video (H.261 and H.263 encoding), CODEC variants G.711, G.726, G.723.1, G.729A/B encoding and decoding. Abacus 5000 Protocols include Analog FXO (loop start/ground start), SS7, CAS, MF R1/R1.5/R2, ISDN PRI, GR-303, V5.1/V5.2, RTP, H.323, SIP, MGCP, Megaco, clear channel signaling, and Fax with T.30 and T.38.

The Abacus 5000 platform supports Analog (ECG3), TDM (PCG3), T3/E3 and G.747 (TCG3), and IP Telephony (ICG3) in a single unit.

Abacus 5000 Benefits

- Simplifies the testing of converged IP Telephony and PSTN networks and services.
- Performs synchronized and complex test scenarios to help ISPs, ITSPs, IP-PBX, IP gateway, server, router and switch manufacturers migrate or converge into IP Telephony
- Achieves overall cost savings by eliminating the need for multiple Analog, TDM or IP Telephony testing devices
- Achieves higher network reliability and interoperability of IP Telephony network elements

Scalability and Versatility

The multipurpose Abacus 5000 delivers all of your test needs — load handling, functionality, and interoperability testing — in one affordable package.

Abacus 5000 is available in three cPCI chassis form factors:

- 4-slot portable chassis
- 3-slot rack mountable chassis
- 13-slot rack mountable chassis

Abacus 5000 circuit generators include:

- 10/100/1000Base-T Ethernet (ICG3) subsystem for call generation, supports Fax, RTP, H.323, SIP, MGCP, Megaco, and Clear Channel signaling
- TDM subsystem (PCG3) for call generation and switching, supports T1, E1, CAS and MF R1/R1.5/R2, ISDN PRI, GR-303, V5.1/V5.2, SS7, Fax, and Clear Channel signaling
- T3 subsystem (TCG3) for call generation and switching, supports T3, E3, G.747, CAS and MF R1/R1.5/R2, ISDN PRI, GR-303, V5.1/V5.2, SS7, Fax, and Clear Channel signaling
- Analog FXO (ECG3) subsystem for call generation, supports loop start and ground start

Applications

Abacus 5000 flexibility and scalability allows users to test:

- Performance of Media Gateways and Media Gateway Controllers (softswitches)
- Capacity of signaling and media processing for IP Telephony equipment
- Network information accuracy of Registration servers
- SIP signaling call setup of Proxy servers
- Signaling handling of TDM and IP-PBXs
- Call accounting, voice messaging, and conferencing servers
- IP Telephony Switches and routers

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Abacus 5000 13-slot rack-mountable chassis

Voice Quality Measurements

Abacus 5000 is a Voice Quality Performance measurement tool that allows users to objectively measure Voice Quality over Analog, TDM and IP Telephony networks.

PSQM and PSQM+ Measurements

- Send multiple standard and user-defined audio files using either G.711 over TDM, or as analog signals over analog lines, or in encoded format in RTP streams
- Encode and decode using G.711 μ -Law, G.711 A-Law, G.723.1, G.726, and G.729AB CODECs
- Real time PSQM/PSQM+ measurements with stop/freeze triggers
- Conversion to Mean Opinion Score (MOS) values
- Capture and analysis of received audio signals

PESQ Measurements:

- Simultaneous PESQ measurements on all channels
- Simultaneously mix traffic with speech or tones

System Controller (SC3)

Communicate with both the user's PC (10/100Base-T) and the Circuit Generator (CG) subsystems.



System Controller

Circuit Generator Subsystems

- Internet Protocol Signaling and Traffic Generator (ICG3)
- T1 & E1 Call Generator with Channel Associated Signaling (PCG3)
- Enhanced Analog Subscriber Call Generator (ECG3)

IP Signaling and Media Traffic Generator (ICG3 Subsystem)

ICG3 Overview

The Abacus 5000 ICG3 subsystem provides one 10/100/1000 Ethernet port for generating and terminating IP Telephony signaling and media traffic.



ICG3 front card

When performing call generation, the ICG3 subsystem simulates multiple IP telephones and/or gateways generating the call signaling and delivering the signaling and/or media traffic to a system under test. The ICG3 subsystem executes endpoint registration requests, thus allowing to measure the capacity of servers.

T1 & E1 Call Generator (PCG3 Subsystem)

PCG3 Overview

The Abacus 5000 PCG3 subsystem provides TDM call generation and switching functionality. The PCG3 subsystem supports 4 or 14 full-duplex T1 or E1 circuits.



PCG3 front card

In call generation mode, the PCG3 subsystem executes a call setup/teardown for each channel and executes a media script that includes transmission and reception of audio signals and files. When performing switching, it routes a call from one channel to another channel on the Abacus 5000 system, based on the number dialed by the SUT.

Channel associated signaling (CAS) is one of many types of signaling supported by the PCG3. The T1/E1 (PCG3) subsystem for call generation and switching supports Fax, SS7, MF R1/R1.5/R2, ISDN PRI, GR-303, V5.1/V5.2, and Clear Channel signaling.

Abacus 5000 supports the ANSI, ETSI/ITU-T, Chinese and Japanese SS7 Options.

T3 Call Generator (TCG3 Subsystem)

TCG3 Overview

The Abacus 5000 TCG3 subsystem provides TDM call generation and switching functionality. The TCG3 subsystem can be configured to provide one PCM circuit (672 channels) at the T3 rate, one PCM circuit (480 channels) at the E3 rate, or one PCM circuit (630 channels) at the T3 rate (G.747 mode).



The TCG3 supports the same functions on its channels as the PCG3 subsystem.

Enhanced Analog Subscriber (ECG3 Subsystem)

ECG3 Overview

The Abacus 5000 ECG3 subsystem emulates analog telephony functionality. The ECG3 subsystem provides 14 circuits that emulate the subscriber side of an analog two wire-circuit. Each channel on ECG3 can be configured to be an originating or a terminating channel (calling or called party).



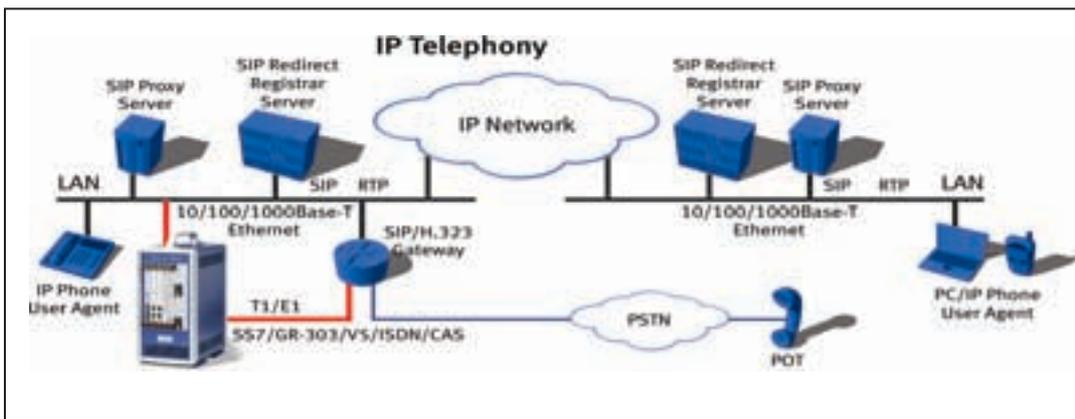
ECG3
front
card

The ECG3 subsystem simulates call setup/tear down for each channel. The Analog FXO (ECG3) subsystem for call generation supports loop start and ground start.

Abacus 5000 Features at a Glance

- IP Telephony: call generation using SIP, H.323, MGCP, and Megaco/H.248 protocols
- PSTN: TDM call generation and switching, Analog FXO call generation
- One to 13 IP Telephony cards, each with one auto sensing 10/100/1000 Ethernet port
- One to thirteen TDM or Analog cards
- Built-in protocol decoding and display
- Send/receive tones, speech, video using G.711 (μ A-Law), G.723.1, G.726, G.729AB, H.261, and H.263 CODECs
- Flexible Windows-based scripting
- Detailed call error reports with failed sequences or messages
- Generation and termination of up to 3,328 simultaneous calls with RTP media per system, 256 per port
- Generation of up to 182 simultaneous analog channels per system, 14 channels per subsystem
- Generation of up to 5460 simultaneous TDM channels per system, 14 channels per subsystem
- Generation of up to 13,312 simultaneous IP signaling only calls per system, 1,024 per port
- Generation call setups at rates as per “Abacus 5000 Analog/TDM/VoIP Measurements” table shown at end of data sheet
- Generation of thousands of end-point registrations
- Verification that a speech path is established and retained for the duration of the call
- Measurements of lost packets, out of order packets, jitter, BHCA, and call completions
- Data analyzer supports continuous recording of data into memory, with trigger capabilities to record before and after an error occurs.
- Protocol development functionality to configure, add or remove individual messages
- Send bearer capacity information within ‘speech’ using H.323
- Up to 65K H.323 Registrations

Testing SIP to PSTN or PSTN to SIP with Abacus 5000



Test Steps for Testing SIP to PSTN or PSTN to SIP

1. Simulate multiple User Agents or PC/IP Phones by setting up and tearing down multiple calls.
2. Stress the SIP Proxy and Outbound Proxy Server capabilities by simulating multiple requests from multiple UAs.
3. Stress the SIP Registrar and Redirect Server capabilities.
4. Simulate media traffic to a system under test.

Specifications

Test Methodologies

Call Generation with Abacus 5000

- Tones
- Speech and Video
- Path Confirmation
- Fax

Switching with Abacus 5000 (PCG3 and TCG3 only)

- Number dialed into a switching channel can comprise called and calling party numbers
- Number forwarded from Abacus 5000 can comprise called and calling party numbers
- Called and calling party numbers can be received and forwarded with prefix and suffix
- A single number can be allocated to any number of channels on Abacus 5000

Measuring Voice Quality with Abacus 5000

- PSQM, PSQM+
- PESQ
- PSQM to MOS correlation

Audio Monitor

- Listen to channels from controlling PC over Ethernet
- Listen to any two channels

Protocol Analyzers

- Trace and decode signaling and state machine
- Save traces to text files
- Open multiple trace windows (Two monitoring channels, each, for IP Telephony, Line, and Data links)
- Access analyzer from user interface

Speech and Video

- Send any WAV files
- Send video files

Scripts

- Attempts
- Completions

Fax

- T.30
- T.38

Payload Media

Voice CODECs

- G.711 μ -law and A-law encoding and decoding
- G.723.1, G.726, G.729A/B encoding and decoding

Video CODECs

- H.261, H.263 encoding

Protocols

IP Telephony

- SIP IETF RFC 2543, RFC 3261
- H.323 ITU-T H.323 Version 2.0 & 4.0
- RTP/RTCP RFC 1889, 1890 and 2833
- SDP RFC 2327 and 3108
- MGCP IETF RFC 2805, RFC 3435
- Megaco ITU-T H.248, IETF RFC 3525

TDM

- CAS, MF R1, MF R1.5, MF R2, and pulse dialing
- Primary Rate ISDN (US, ETSI, Lucent, Nortel Japan)
- GR-303 (IDT and RDT)
- V5.1 and V5.2
- SS7 (ANSI, ETSI, ITU-T, China, and Japan)

Analog

- Loop start
- Ground start

Interfaces

IP Telephony

- ICL and ICG3 subsystems for call generation, 10/100/1000Base-T (copper) Ethernet

TDM

- PCG3 subsystem for call generation and switching, T1 and E1
- TCG3 subsystem for call generation and switching, T3, E3, and G.747

Analog

- ECG3 subsystem for call generation

Physical

Chassis

- 3-slot rack-mountable chassis
- 4-slot portable chassis
- 13-slot rack-mountable chassis

System Controller

- System Controller front card fits into the slot 1 of the Abacus 5000 chassis
- Slot 1 is a reserved slot, which does not reduce the usable slots available for the Circuit Generator cards
- No rear card for SC

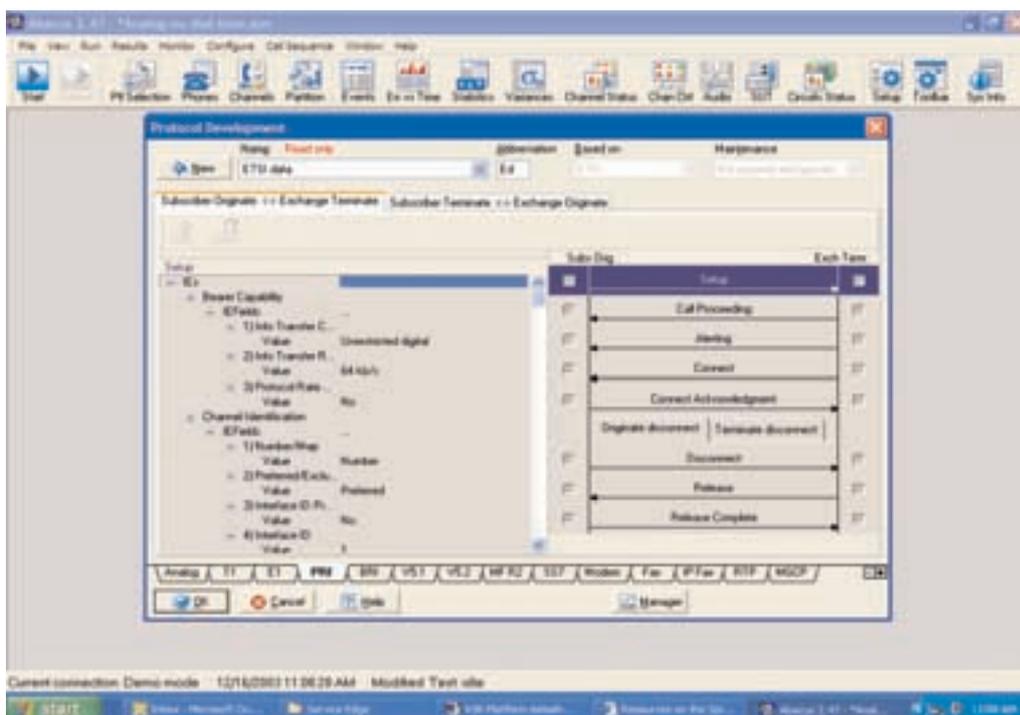
Circuit Generator

- One Circuit Generator (CG) front card fits into one Abacus 5000 slot
- Up to 3 CG cards can fit in the 3-slot rack-mountable chassis
- Up to 4 CG cards can fit in the 4-slot portable chassis
- Up to 13 CG cards can fit into the 13-slot rack-mountable chassis

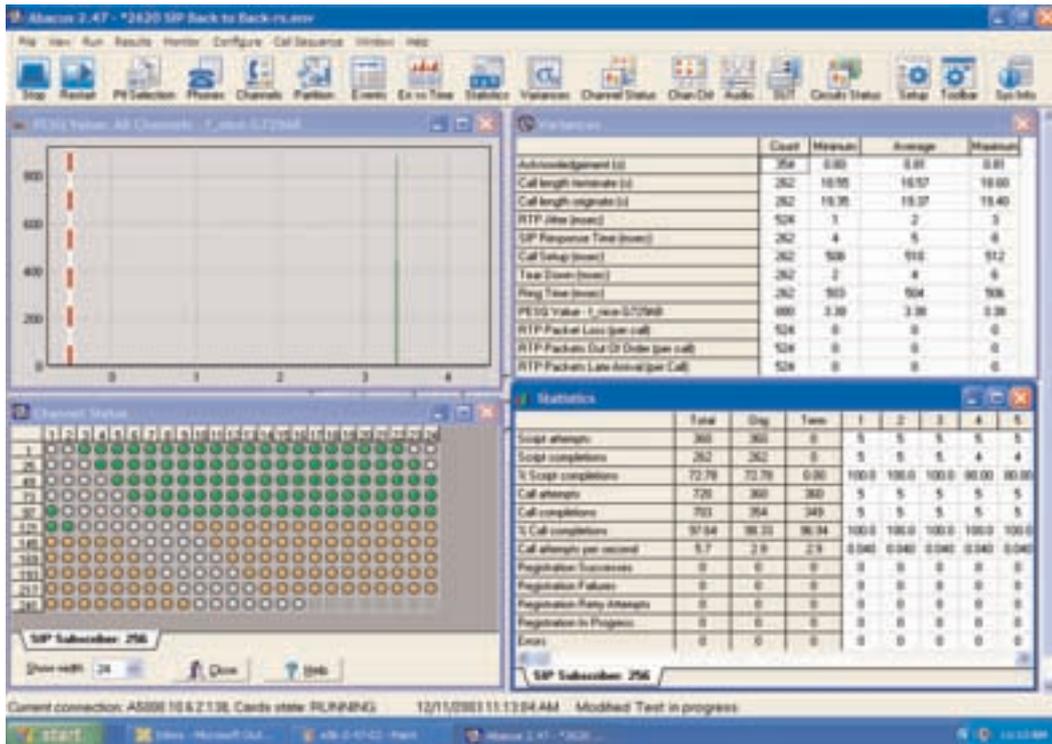
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Protocol Development Setup



Reported Results

Dimensions

- 3-slot chassis: 3.5" x 19" x 11.75" (89 mm x 482 mm x 298 mm)
- 4-slot chassis: 21.125" x 7.5" x 12.5" (536 mm x 190 mm x 317 mm)
- 13-slot chassis: 19.5" x 19" x 11.75" (495mm x 482mm x 298mm)

Environment

- Operating range: 0 °C to 40 °C
- CE marked

Electrical

Power Supply

- Nominal AC input: 100 to 240 Vac, 50 to 60 Hz

Power Draw

- 250 Watts maximum for the 3-slot rack-mountable chassis
- 500 Watts maximum for the 4-slot portable chassis
- 1000 Watts max. for 13-slot rack-mountable chassis

OS Architecture

- Windows® 2000 operating system
- Windows XP Professional operating system

Results Reported (Depending on CG)

Results

- Variances
- Errors
- Error summary
- Events
- System Events
- SS7 Events
- Statistics
- Measurement Per Channel
- Errors vs Time
- Errors vs Channels

Monitor

- Audio
- Line Protocol
- Data Link Monitor
- VoIP Signaling
- Channel Status
- Circuit Status
- QoS Monitor
- Fax Monitor

Variances

- Dial tone
- Tone
- Silence
- Energy
- Acknowledgement
- String
- Round trip delay
- Hit
- Clipping
- Call length terminate
- Call length originate

- User timer
- RTP Jitter
- SIP Response Time
- Call Setup
- Tear Down
- Ring Time
- Bit error rate
- MOS value
- PSQM value
- PESQ Value
- PESQ-LQ Value
- Packet PC Lost Rate (%)
- One Way Delay
- Jitter
- RTP Packet Loss (per call)
- RTP Packet Out of Order (per call)
- RTP Packets Late Arrival (per call)
- Fax Connection Speed
- Fax Throughput Speed
- Modem Connection Speed
- Modem Throughput Speed
- Fax Line Error Rate
- Modem Throughput Speed
- Modem Bit Error Rate
- Ping Roundtrip Delay
- Ping Packet Loss Rate
- FTP Download Throughput
- FTP Upload Throughput
- RRQ Response Time
- Received Fax Pages (per call)
- Sent T.38 Packets (per call)
- Received T.38 Packets (per call)
- T.38 Session Length
- T.38 Average Transmission Rate
- T.38 Average Reception Rate

Abacus 5000 - IP Telephony Call Generation and Calls per Second Measurements

Protocol	ICG3 Subsystem			4-slot portable chassis			
	Voice= RTP and Signaling	10/100/1000 Base-T Ethernet Ports	Call Generation		10/100/1000 Base-T Ethernet Ports	Call Generation	
			Endpoints	Calls per Sec		Endpoints	Calls per Sec
Signaling= Signaling without RTP							
SIP Voice (Single IP)	1	256	148.3892	4	1024	593.557	
SIP Signaling (Single IP)	1	1024	692.3055	4	4096	2769.222	
SIP Voice (Multiple IP)	1	256	99	4	1024	396.000	
SIP Signaling (Multiple IP)	1	1024	330	4	4096	1320.000	
H.323 Voice (Single IP)	1	256	146.0225	4	1024	584.090	
H.323 Signaling (Single IP)	1	1024	334.65175	4	4096	1338.607	
H.323 Voice (Multiple IP)	1	256	58.02525	4	1024	232.101	
H.323 Signaling (Multiple IP)	1	1024	252.7005	4	4096	1010.802	

Protocol	3-slot rack-mountable chassis			13-slot rack-mountable chassis			
	Voice= RTP and Signaling	10/100/1000 Base-T Ethernet Ports	Call Generation		10/100/1000 Base-T Ethernet Ports	Call Generation	
			Endpoints	Calls per Sec		Endpoints	Calls per Sec
Signaling= Signaling without RTP							
SIP Voice (Single IP)	3	768	445.168	13	3328	1929.060	
SIP Signaling (Single IP)	3	3072	2076.916	13	13312	8999.971	
SIP Voice (Multiple IP)	3	768	297.000	13	3328	1297.000	
SIP Signaling (Multiple IP)	3	3072	990.000	13	13312	4290.000	
H.323 Voice (Single IP)	3	768	438.067	13	3328	1898.291	
H.323 Signaling (Single IP)	3	3072	1003.955	13	13312	4350.472	
H.323 Voice (Multiple IP)	3	768	174.076	13	3328	754.329	
H.323 Signaling (Multiple IP)	3	3072	758.102	13	13312	3285.108	

Note: All call generation measurements performed using 1-tone path confirmation in back-to-back mode.



Abacus 5000
4-slot portable chassis

Abacus 5000 IP Telephony test systems verify integration of VoIP with the legacy networks, test scalability, performance and interoperability prior to VoIP deployment and rollout.

Errors

- No dial tone
- Continuous dial tone
- No ringback
- No answer
- No path confirm (first & subsequent)
- Unexpected busy
- Unexpected congestion
- No expected busy
- No tone
- No energy
- No silence
- No String (first digit & subsequent)
- Connect failed
- Unexpected disconnect
- Abnormal disconnect
- BERT exceeded
- Script holdoff
- No incoming call
- Caller ID timeout
- Received Caller ID is wrong
- Error while receiving Caller ID
- PSQM value exceeds threshold
- Too many bad PSQM frames
- No PSQM data
- PESQ value less than threshold
- Not enough PESQ resources
- No PESQ data
- No PRBS
- Negotiation failed
- Page transfer failed
- PPP connection failed
- SS7 COT failed
- Not enough modem resources
- No Codec resources
- Registration failed
- Domain name not resolved
- Dialed number not found
- First digit timeout
- Interdigit timeout
- Insufficient digits dialed
- No dialed number
- No MF R2 back digit (first digit & subsequent)
- Wrong MF R2 back digit
- No MF R2 silence
- No MF R1.5 back digit
- No MF R1.5 forward digit
- Wrong MF R1.5 back digit
- No MF R1.5 silence

Abacus 5000 - Analog/TDM BHCA Call Generation and Switching Measurements

Interface Protocol Type	14-circuit Subsystem					4-slot portable chassis				
	Circuits	Channels		BHCA		Circuits	Channels		BHCA	
		Call Gen	Switching	Call Gen	Switching		Call Gen	Switching	Call Gen	Switching
Analog Subscriber	14	14	N/A	4,766k	N/A	56	56	N/A	19,100k	N/A
T1 PR-ISDN	14	322	322	452.996k	427.654k	56	1288	1288	1811.984k	1710.616k
T1 CAS	14	336	336	269.222k	164.112k	56	1344	1344	1076.888k	656.448k
T1 GR-303	14	332	332	275.037k	166.115k	56	1328	1328	1100.148k	664.460k
T1 SS7	14	335	334	230.220k	221.036k	56	1340	1340	921.280k	884.144k
E1 PR-ISDN	14	420	420	589.307k	556.933k	56	1680	1680	2357.228k	2227.732k
E1 CAS	14	420	420	458.850k	296.967k	56	1680	1680	1835.400k	1187.868k
E1 SS7	14	433	432	233.441k	216.125k	56	1732	1732	933.764k	864.500k
E1 V5.1	14	420	420	372.501k	219.774k	56	1680	1680	1490.004k	879.096k
E1 V5.2	14	432	432	270.980k	173.793k	56	1728	1728	1083.920k	695.172k

Interface Protocol Type	3-slot rack-mountable chassis					13-slot rack-mountable chassis				
	Circuits	Channels		BHCA		Circuits	Channels		BHCA	
		Call Gen	Switching	Call Gen	Switching		Call Gen	Switching *Note 1	Call Gen	Switching *Note 1
Analog Subscriber	42	42	N/A	14,300k	N/A	182	182	N/A	62,000k	N/A
T1 PR-ISDN	42	966	966	1358.988k	1282.962k	182	4186	1610	5888.948k	2138.270k
T1 CAS	42	1008	1008	807.666k	492.336k	182	4368	1680	3499.886k	820.560k
T1 GR-303	42	996	996	825.111k	498.345k	182	4316	1660	3575.481k	830.575k
T1 SS7	42	1005	1004	690.960k	663.108k	182	4355	1674	2994.160k	1105.180k
E1 PR-ISDN	42	1260	1260	1767.921k	1670.799k	182	5460	2100	7660.991k	2785.665k
E1 CAS	42	1260	1260	1376.550k	890.901k	182	5460	2100	5965.050k	1484.835k
E1 SS7	42	1299	1298	700.323k	648.375k	182	5629	2164	3034.733k	1080.625k
E1 V5.1	42	1260	1260	1117.503k	659.322k	182	5460	2100	4842.513k	1098.870k
E1 V5.2	42	1296	1296	812.940k	521.379k	182	5616	2160	3522.740k	868.965k

*Note 1: Switching on 13-slot rack-mountable chassis can be performed on the first 5 slots only.

Note 2: All call generation measurements performed using 1-tone path confirmation in back-to-back mode.



Abacus 5000 3-slot rack-mountable chassis

Abacus 5000 IP Telephony test systems provide all essential PSTN, Analog and IP Telephony protocols, interfaces, media types and test methodologies in a single system, allowing for true converged testing while substantially reducing the total cost of ownership.

Errors Summary

Graphical display for:

- Channels
- Circuits
- Sets

Events

Errors received for all active channels:

- Elapsed time
- Real Time
- Event Type
- Comment
- Phone
- Cause

Statistics

- Script Attempts
- Script Completions
- % Script Completions
- Call Attempts
- Call Completions
- % Call Completions
- Call Attempts per second
- Registration Successes
- Registration Failures
- Registration Retry Attempts
- Registration in Progress
- Errors

Measurement Per Channel

- Tone Delay
- Dial Tone Delay
- Acknowledgement Delay
- String Delay
- Energy Delay
- Round Trip Delay
- Hit Count
- Clip Count
- Call Length Terminate
- Call Length Originate
- User Timer
- Bit Error Rate
- MOS
- PSQM
- PESQ
- PESQ-LQ
- One Way Delay
- Jitter
- VoIP Measurements (9 types)
- Fax/Modem Measurements (24 types)

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Ordering**Chassis**

- SPT-3040 - 3-slot rack-mountable chassis
- SPT-3150 - 13-slot rack-mountable chassis
- SPT-3050 - 4-slot portable chassis

IP Telephony - Circuit Generators

- ICG-3000 - ICL3 subsystem for call generation: 1 port Ethernet
- ICG-3001 - ICG3 subsystem for call generation: 1 port Ethernet, 1 daughtercard for increased functionality

Analog - Circuit Generator

- ECG-3000 - ECG3 subsystem for call generation: 14 circuits analog

TDM - Circuit Generators**4-Circuits**

- PCG-3000 - PCG3 subsystem for call generation: 4 circuits T1
- PCG-3001 - PCG3 subsystem for call generation: 4 circuits E1
- PCG-3002 - PCG3 subsystem with switching: 4 circuits T1
- PCG-3003 - PCG3 subsystem with switching: 4 circuits E1

14-Circuits

- PCG-3004 - PCG3 subsystem for call generation: 14 circuits T1
- PCG-3005 - PCG3 subsystem for call generation: 14 circuits E1
- PCG-3006 - PCG3 subsystem with switching: 14 circuits T1
- PCG-3007 - PCG3 subsystem with switching: 14 circuits E1

T3/E3/G.747 - Circuit Generators

- TCG-3000 - TCG3 subsystem for call generation: T3 exchange or subscriber
- TCG-3001 - TCG3 subsystem for switching: E3 exchange or subscriber
- TCG-3002 - TCG3 subsystem for call generation: T3 emulates exchange
- TCG-3003 - TCG3 subsystem for switching: E3 emulates exchange
- TCG-3004 - TCG3 subsystem for call generation: G.747 exchange or subscriber
- TCG-3005 - TCG3 subsystem for switching: G.747 emulates exchange

Firmware Options

- Firmware Options with different applications are available for each Circuit Generator

Spirent Service and Support

Abacus 5000 comes with comprehensive warranty, maintenance, and support packages with Spirent Communications' full commitment to helping you get the most from our innovative technology.

Spirent Communications offers ServiceEdge to support your business goals, increase employee productivity and job satisfaction.

ServiceEdge includes the following packages:

- ServiceEdge Care
- ServiceEdge Express
- ServiceEdge Tutor

For More Information

Access Abacus 5000 information at Spirent Communications' Web site www.spirentcom.com/voice to learn more about Spirent IP Telephony test systems and services, download product literature, white papers, and test methodologies. Contact your local sales representative for other details.