VoiceEdge

Le79234-SW

VoiceEdge™ Control Processor Software Package
Next Generation Carrier Chipset (NGCC)

Data Sheet

Applications

- Call Control Package
  - Call Control Functions
- Basic Test Package
  - Call Control Functions
  - GR909 Equivalent Line Testing
- Advanced Test Package
  - Call Control Functions
  - GR844 Equivalent Line Testing
- Advanced Test Plus Package
  - Call Control Functions
  - GR844 equivalent Line testing
  - Increased Accuracies
  - Additional Tests

Benefits

- Most cost-effective, highly-integrated, highly-featured line interface solution for plug 'n play analog line cards in self contained architectures and worldwide applications.
- Detailed 32 Channel RoHS compliant reference schematics available.
- Complete, all encompassing line testing solution for applications requiring comprehensive, multi-line analog line card functionality.
- Downloadable Digital Voice Control Processor for expanding line card test, control and signal processing capabilities.
- The NGVCP reduces the processing duties of the Host Processor. Tasks such as the line testing and cadencing are performed by the NGVCP, leaving the host more processor cycles for more complex applications or allowing the host to be a lower performance processor.
- Simplified programming interface as well as a sample quick start application to reduce development cycle and speed time to market.
- Self-diagnostics simplify production & system testing for lower cost of ownership.
- Fully validated test routines with published accuracies.

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Ordering Information

Software Packages	Description
Le79234SLNT	Call Control
Le79234SLBT	Basic Test
Le79234SLAT	Advanced Test
Le79234SLATP	Advanced Test Plus

Description

Zarlink's Next Generation Voice Control Processor (NGVCP) software package is a complete software solution that simplifies control of Zarlink's Voice Termination Devices (VTDs) to provide a simplified programming interface.

The NGVCP software package provides a set of functions additional to the feature set of the underlying VTDs. It significantly reduces the product development cycle and time-to-market. This document describes the software package for the NGVCP and the Next Generation Carrier Chipset (NGCC) devices. In combination with the NGCC devices, the NGVCP allows for a cost-effective, highly integrated and fully programmable line testing solution for applications requiring complete line card functionality.

Four different software packages are available:

1. Call Control (NT) package, implements all supported call control features.
2. Basic Test (BT) package, includes all the features of the NT package plus GR909 equivalent line test capabilities.
3. Advanced Test (AT) package, includes all the features of the BT package plus GR844 equivalent line test capabilities.
4. Advanced Test Plus (ATP) package, includes all the features of the AT package plus additional diagnostic tests and a line calibration feature for increased accuracies.

Each software package has an associated hardware configuration. Detailed reference designs are available for each configuration.

Related Literature

- 129907 VoicePath™ API II Reference Guide - VCP/VCP2-BT/AT/ATP
- 129908 VoicePath™ API II Reference Guide - VCP/VCP2-NT
- 130145 VoicePath™ API-II Test Library User's Guide
- 081567 Le79124 NGVCP Data Sheet
- 133514 Le79234 NGVCP Data Sheet
- 081193 Le79238 Octal NGSLAC Data Sheet
- 081555 Le79271 NGSLIC Data Sheet
- 126583 NGCC Hardware Design Guide

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1.0 Zarlink‘s VoicePath™ Software Package

1.1 Key Features

Zarlink’s VoicePath™ software application implements common features and functions to reduce complexity. Note that some features depend on support from the underlying hardware.

Key features of the VoicePath™ application include:

- Provides an abstract, uniform software interface for any combination of Zarlink voice products.
- Provides various design tools to help in the creation and organization of design-specific parameters.
- Supports any combination of FXS lines configured for either loop-start signaling or ground-start signaling.
- Includes pulse-digit or flash decoder and a ringing or tone cadence engine.
- Proven on embedded operating systems such as Linux and VxWorks, and also compatible with non-OS environments; fits into common driver and static/dynamic library models.
- Can be used with single or multi-threaded applications.
- Supports various interrupt modes and both big-endian and little-endian host processors.
- Implemented in C code that is efficient, portable, and ANSI C compliant.
- Provides Self Test and Advanced line testing capabilities, including the support for GR-844 and GR-909 equivalent line testing.
- Provides control for enhanced accuracy utilizing external calibration circuit in combination with NGVCP Advanced line measurement functions.
- Available in four different packages (Call Control, Basic Test, Advanced Test and Advanced Test Plus) to fit the customer needs.
- Sample Quick Start Guide and Quick Start Application software provided with source code to facilitate startup and troubleshooting.
- NGVCP-Host (HBI/SPI) Hardware Verification Application source code and MPI Verification Application NGVCP loadable binary image provided to verify the interfaces between the NGVCP and the SLAC.
- Includes comprehensive documentation, an excellent starting point to help the developer quickly become familiar with the architecture.

The software package includes the following items.

1.2 VoicePath™ API-II

Zarlink’s VoicePath™ Application Programmer Interface (VP API-II) is a C source code module that provides a standard software interface for implementing call control and line testing functions for a set of subscriber lines using Zarlink VTDs. The VP-API-II abstracts and simplifies the details of controlling the Zarlink VTDs and allows software developers to focus on the application instead of the underlying hardware.

The API functions can be summarized into the following five groups:

- **Initialization functions:** These functions initialize various aspects of the NGVCP or perform the configuration required before a particular NGVCP feature may be used. Example of initialization features include:
    - Boot-load the firmware image into the NGVCP and start the DSP core inside the NGVCP.
    - Configure all lines with specified design parameters.
    - Calibrate all analog circuits of termination devices.

- **Query Functions:** The query functions provide several methods for servicing the NGVCP device's interrupts and checking the status of the lines. These functions allow the user to read option settings or line conditions, and to retrieve event contents or test results. Examples of query functions include:
  - On/Off hook, read loop conditions for a specific line.
  - Global device status for up to 32 lines.
  - Read various VoicePath™ API device set options and test results.
- **Control Functions:** These functions control the current line state and set options that may change during run-time. Examples of control functions include:
  - Set a line to a desired state.
  - Places a cadenced DTMF call progress tone on the line.
  - Start metering on a particular line.
  - Set various VoicePath™ API device specific option.
- **Test Functions:** The test functions provide a toolbox of line tests and diagnostic utilities. Example of test functions include:
  - Perform Self Test on a particular line or the entire system.
  - Test primitives to support GR844 or GR909 line test on any given channel. Note the measured values need to be converted from integer 16 bit 2's complement into standard units.
- **Helper Functions:** The helper functions provide an interface for sending raw commands to a SLAC device controlled by the NGVCP over the MPI.

1.3 VoicePath™ Test Library

The VoicePath™ Test Library (VP-TL) is a collection of functions and data types that further utilize the line testing capabilities of Zarlink's VP API-II. These algorithms are executed on the host processor interfaced to Zarlink's NGVCP device combined with the NGCC devices though the VoicePath™ API-II.

The VP-TL offers the following key features:

- Provides optimal default values for test input parameters that do not typically change at runtime, such as integration times, settling times, etc.
- Performs a complete high-level test by running several VP-API-II test primitives in sequence.
- Converts fixed-point results returned by the VP-API-II test primitives into standard units that the application can readily use.
- Includes line Self-Testing to check for possible problems before putting a line into service.
- Includes line calibration for improving the testing accuracy by identifying correction factors that will be applied against measurement results.
- Allows line topology to be specified on a per line basis.
- Includes three versions of the Test Library, with increasing feature sets depending on the test package selected.

1.4 NGVCP Firmware

NGVCP firmware implements specific functions such as the line test primitives, advanced tone processing and cadencing. The software package controls the NGVCP device. The NGVCP device's registers and commands are shielded behind the VP-API-II which is the communication layer between the NGVCP device and the customer's host processor. The NGVCP firmware is currently available in four variations, depending on the test package selected:

- NT - Includes all supported call control features.
- BT - Includes all supported call control features plus the GR909 equivalent line testing.
- AT - Includes all the features of the BT package plus the GR844 equivalent line testing.
- ATP - Includes all the features of the AT package, additional line diagnostic tests, and a line calibration routine for increased accuracies.

1.5 Design Toolset

Zarlink products can be configured to meet standards worldwide, including custom requirements. To address such varying system-level specifications, Zarlink provides tools like WinSLAC™ and Profile Wizard to help engineers generate design data. The design data provided by these tools is organized into profiles to meet specific system requirements. The data for each profile is created with the Profile Wizard application. Profiles can be generated for the following design parameters:

- **System Profile** - The System Profile is a data array that contains set and forget parameters for the event mask, clocks, etc., and for other global configuration options.
- **AC Profile** - The AC Profile is a transmission characteristic profile. The AC profile holds the SLAC device's gain block and filter block commands and data. Each AC Profile is designed to address the specific AC transmission requirements for a given design. In general, AC Profiles are used to address the varying requirements of different market segments.
- **DC Profile** - The DC Profile holds the SLAC device's DC feed and Loop Supervision command and data. Each DC profile is designed to address the specific DC feed and Loop Supervision requirements of a given design. Examples of different DC feed profiles include a Constant Current Profile and a Resistive Feed Profile.
- **Ringing Profile** - The Ringing Profile contains the necessary commands and data to set up the ringing generator of a SLAC device. Different Profiles can be used to vary the ringing characteristics of a line. Options available in the Ringing Profile include: ringing waveform, frequency, amplitude, DC offset, ring trip detector mode and a selection of internal or external ringing.
- **Metering Profile** - The Metering Configuration Profile contains the necessary commands and data to set up the Pulse Meter Signal Generator of the SLAC device. The parameters configured include voltage limits.
- **Tone Profile** - The Tone Profile defines the various call progress tones that might be used in a system. The tones include dial tone, busy, ring-back, and reorder. The Tone Profiles are used to address the market variations that exist around the world.
- **Cadence Profile** - The Cadence Profile defines the various cadences that might be used in a system. The cadences may be used for call progress tones, ringing, and metering. The Cadence Profiles are used to address market variations.
- **Caller ID** - Defines the various Caller Line Identity (CLI) types that might be used in a system. The Caller ID Profiles are used to address the market variations that exist around the world

The NGVCP contains internal tables for each of the profile types. This allows a fixed number (as defined in the Profile Table section of the *VoicePath™ API-II Reference Guide*) of each profile type to be stored in the NGVCP. When the host application requires the services of a particular profile for a function, it can simply refer to the profile by its index in the NGVCP device's profile table. Alternatively, the host application can maintain some (or all) of the needed profiles in the host, and pass them to the NGVCP for any function call that requires them.

Once the profiles have been created, they can be compiled into the user's application and the VoicePath™ API. Then, the application can either load the profiles into the NGVCP, keep the profiles on the host and download them on demand, or perform a combination of the two methods.

The VoicePath™ Profile Wizard and WinSLAC are Microsoft® Windows® based applications that are part of the NGCC Design Kit and are used to create the various profiles needed to fulfill the specific market requirements.

1.6 System Architecture

Figure 1 illustrates a typical system block diagram incorporating the software block diagram and a detailed block diagram of the underlying hardware combining the NGVCP and the NGCC line termination architecture. The VoicePath™ software requires the System Services Layer and Hardware Abstraction Layer to operate correctly. The following sections describe each of the blocks.

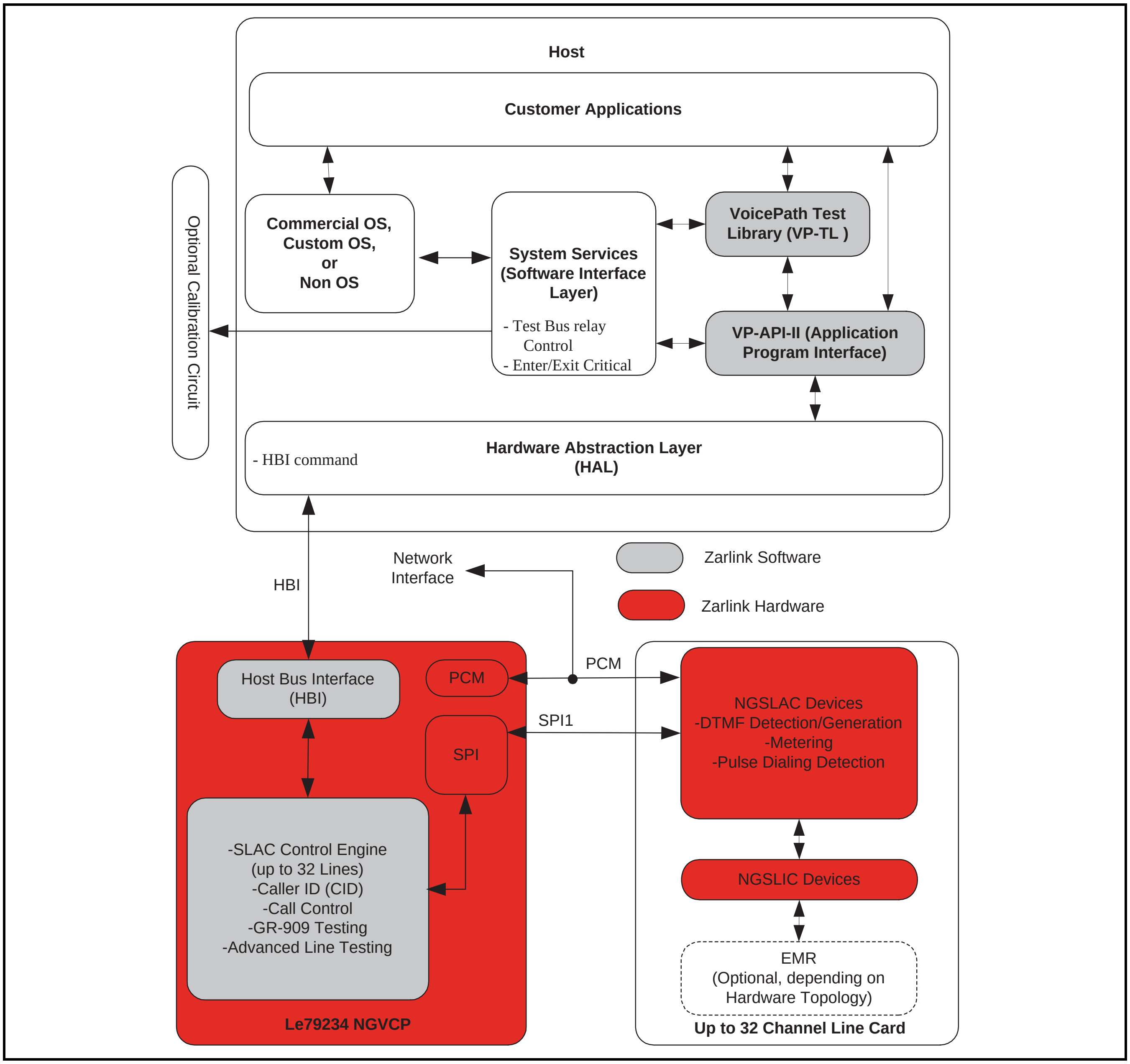

Figure 1 - NGCC System Architecture with Le79234 NGVCP

1.7 Software Architecture

1.7.1 Customer Applications

This block represents the user's *line management* module that performs tasks such as initializing the system, configuring lines, changing line states in response to line events and other inputs, switching digitized voice traffic, line testing etc. These functions may be distributed across a complex system. Zarlink provides example applications as part of the NGVCP software package.

1.7.2 Operating System

This block represents whatever operating system (if any) the user is running on the host processor. The VP-API-II does not directly utilize any operating system resources (e.g. queues, semaphores, etc.). The application developer may use operating system features such as tasks or shared memory with the VP-API-II. Chapter 3 in the *API Reference Guide* covers using the VP-API-II in a multitasking environment in details.

1.7.3 System Services Layer

The System Services Layer abstracts platform-specific functions such as test relay control and other customer's specific functions. This layer derives the functions required by the VP-API-II from the facilities provided by the underlying hardware or operating system. This module is also platform-dependent and must be implemented by the VP-API-II user. Zarlink provides example System Services Layer source code.

The System Service Layer should contain different procedures to control the various states of the calibration circuit when such circuit is present. These procedures will be called by the Test Library whenever a specific calibration load is required.

1.7.4 VoicePath™ Test Library

The VoicePath™ Test Library (VP-TL) algorithms are executed on the host processor though the VoicePath™ API-II.

1.7.5 VoicePath™ API-II

The VP-API-II is the core component of the VoicePath™ Software Development Kit. This software module runs on the host processor that controls Zarlink VTDs. This code is supplied by Zarlink and should not be modified by the application developer.

1.7.6 Hardware Abstraction Layer

The Hardware Abstraction Layer (HAL) provides access to Zarlink devices through the Host Bus Interface (HBI). The HAL software is platform-dependent and must be implemented by the VP-API-II user. Zarlink provides example HAL source code with the NGVCP Software Package.

1.7.7 Host Bus Interface

The Host Bus Interface (HBI) provides a means for the host to communicate with the NGVCP. The HBI includes the Application, Transport, and Physical Layers of the NGVCP device's host interface.

The physical layer defines the electrical characteristics of the interface (pins, timings, etc.) between the host and the NGVCP. The NGVCP supports two different physical layers: a General Purpose Parallel Interface (GPI) and a Serial Peripheral Interface (SPI).

This layered architecture allows the host programmer to program the NGVCP independent of the chosen physical layer.

1.8 Hardware Architecture

The hardware consists of the Le79234 NGVCP, the Le79238 NGSLAC and the Le79271 NGSLIC Voice Termination Devices.

The NGVCP is a digital signal processor platform that performs all of the management required for controlling multiple SLAC devices, as well as all the sequencing necessary for advanced line test functionality. To the host processor, the NGVCP looks like a single 32-line voice controller. The host communicates directly with the NGVCP device(s) through the HBI and does not communicate directly with any of the individual SLAC devices controlled by the NGVCP. The host can choose to poll the NGVCP or service it by waiting for an interrupt to indicate that servicing is needed. Multiple NGVCP devices can be connected to the same host.

The NGVCP communicates with the SLAC device(s) through a SPI port. The Le79234 NGVCP has 8 General Purpose I/O pins of which 4 are used as chip selects and 4 are used as interrupts.

The API line mapping to the SPI bus is fixed as shown in Table 1. There are 32 channels for the Le79234 device, these are numbered from 0 to 31 (boardLineID). At system initialization, a software line object needs to be created for each individual line and contains all parameters associated with that line (VpMakeLineObject). A line context pointer to this line object is also created. After the system initialization is completed, all VP-API-II functions use the line context pointer as a channel identifier such that the host application code needs not be concerned with the NGVCP channel ID.

				Chip Select			Interrupt		
APIchannelID	**boardLineID (LineCtx)**	**SPI Port #**	**SLAC_ID**		**GPIO**	**GPIO TQFP Pin #**		**GPIO**	**GPIO TQFP Pin #**
0 to 7	0 to 7	1	0	CS0	16	36	INT0	0	76
8 to 15	8 to 15		1	CS1	17	7	INT1	1	77
16 to 23	16 to 23		2	CS2	18	8	INT2	2	78
24 to 31	24 to 31		3	CS3	19	12	INT3	3	79

Table 1 - NGVCP GPIO Chip Select and Interrupt Assignments

1.9 Hardware Topologies

Zarlink specifies standard topologies that defines the hardware test architecture. This architecture defines the termination type for the VoicePath™ Test Library software. The VoicePath™ software for NGCC currently supports two general hardware topologies. Table 2 lists the hardware topologies and the supported termination types.

Hardware Topologies	Software Termination Types	Device	Description
Configuration C	VP_TERM_FXS_GENERIC	NGVCP	Generic FXS termination
Configuration D	VP_TERM_FXS_TI	NGVCP	FXS termination with Test-In relay

Table 2 - VoicePath™ Test Library Supported Termination Types

1.9.1 Configuration C Topology (VP_TERM_FXS_GENERIC)

Configuration C topology has the following features:

- POTS service.
- Foreign voltages in excess of the SLIC power rail voltages can be measured when the PTC's are activated or if the fault current doesn't exceed the SLIC current drive capability.
- The test load resistor is used for self-testing.
  - No disconnect relay. There is no mean to disconnect the line from the loop during inward looking test, therefore Self Test can only be performed in the factory. The published Self Test accuracies are given for production testing only, when no loop is connected to the equipment port. If Self Tests are performed in the field, the host application needs to take into account any loop impedance present.

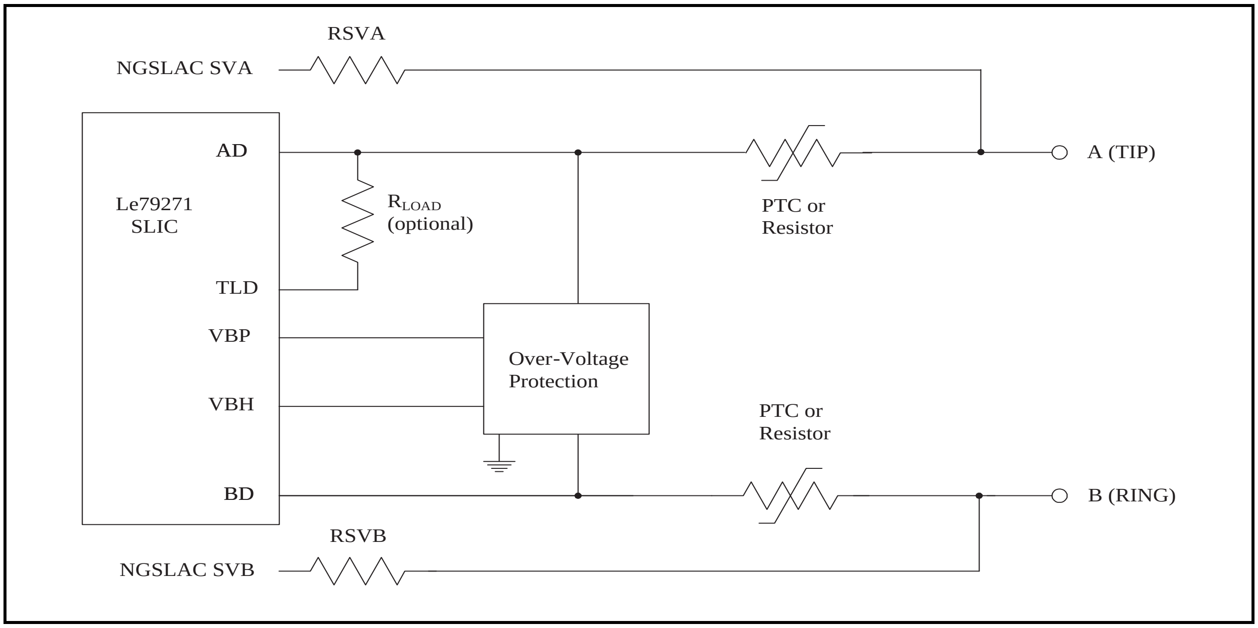

Figure 2 - Configuration C Topology

Configuration C supports the relay states listed in Table 3. See the *API-II Reference Guide* for details. Connectivity for the various relay states is listed in Table 4.

Software State (VpRelayState)	Description
VP_RELAY_NORMAL	Test load switch off
VP_RELAY_TALK	Test load switch off
VP_RELAY_BRIDGED_TEST	Test load switch on

Table 3 - Software States for Configuration C

Software State	AD/BD	SVA/SVB	Rload	TIP/RING
VP_RELAY_NORMAL	●	●		●
VP_RELAY_TALK	●	●		●
VP_RELAY_BRIDGED_TEST	●	●	●	●

Table 4 - Configuration C Bus Connections

1.9.2 Configuration D Topology (VP_TERM_FXS_TI)

Configuration D topology has the following features:

- POTS service with a relay to connect to a calibration circuit for In-Service Calibration and Self Testing.
- Foreign voltages in excess of the SLIC power rail voltages can be measured when the PTC's are activated or if the fault current doesn't exceed the SLIC current drive capability.
- The relay is used to disconnect the loop during self-testing.
- Calibration can be performed using a shared circuit connected to the Calibration Bus.
- Self-test is performed using the calibration circuit or a per-channel test load resistor.

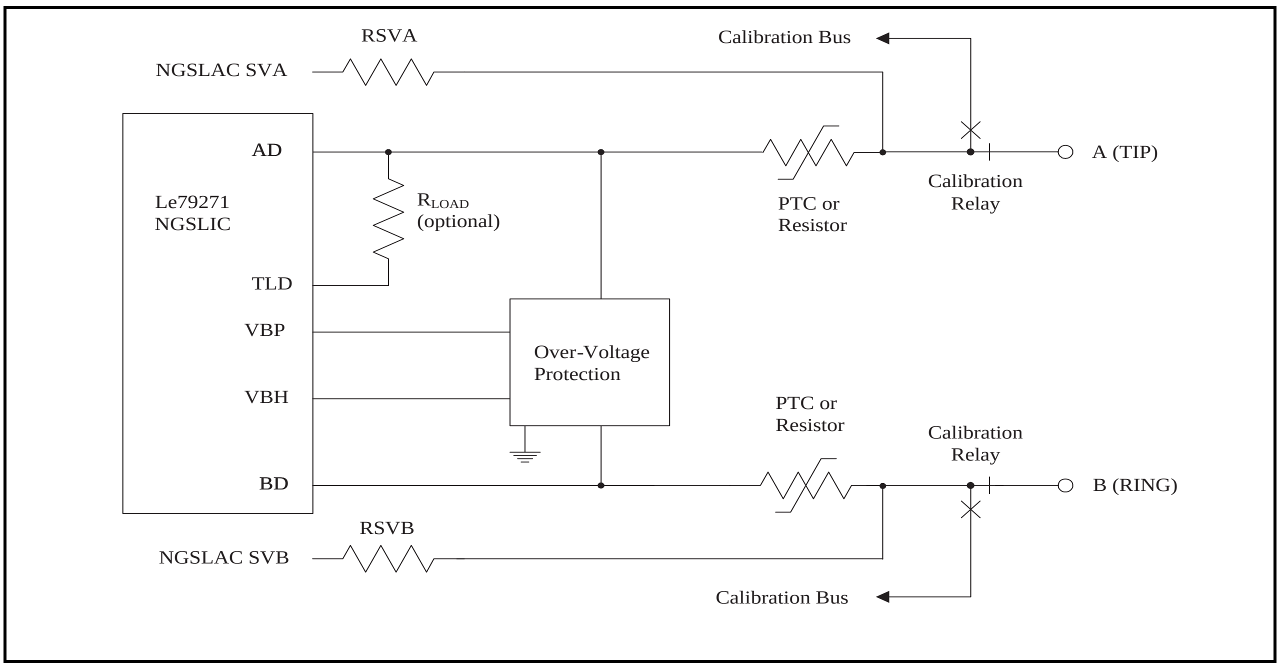

Figure 3 - Configuration D Topology

Configuration D supports the relay states listed in Table 5. See the *API-II Reference Guide* for details.

Connectivity for the various relay states is listed in Table 6.

Software State (VpRelayState)	Description
VP_RELAY_NORMAL	Test load switch off
VP_RELAY_TALK	Test load switch off
VP_RELAY_TEST	Test load switch off, Calibration relay activated
VP_RELAY_DISCONNECT	Test load switch off, Calibration relay activated
VP_RELAY_BRIDGED_TEST	Test load switch on
VP_RELAY_SPLIT_TEST	Test load switch on, Calibration relay activated

Table 5 - Software States for Configuration D

Software State	AD/BD	SVA/SVB	R_{load}	Calibration Bus	TIP/RING
VP_RELAY_NORMAL	●—	—●—	——	——	—●
VP_RELAY_TALK	●—	—●—	——	——	—●
VP_RELAY_TEST	●—	—●—	——	—●	
VP_RELAY_DISCONNECT	●—	—●—	——	—●	
VP_RELAY_BRIDGED_TEST	●—	—●—	—●—	——	—●
VP_RELAY_SPLIT_TEST	●—	—●—	—●—	—●	

Table 6 - Configuration D Bus Connections

1.10 Calibration

The VoicePath™ Test Library delivered with the NGVCP ATP configuration includes a calibration function that can be used to improve the testing accuracy. Performing the line testing on an external calibration circuit (see Figure 4) identifies the correction factors that will be applied against subsequent results.

Two classes of calibration can be performed, Factory Calibration and In-Service Calibration.

Factory Calibration would be performed at the time the line card is manufactured, prior to the line card being shipped. Correction factors would be stored on the respective line card board. Using Factory Calibration requires the user to store the calibration factors in non-volatile memory and re-apply theses factors as needed.

In-Service Calibration can be performed after the line card is deployed. To achieve this, a test relay is required.

Configuration C does not include a relay and can only be calibrated at the Factory by applying the calibration circuit directly to the line A and B leads.

Configuration D has a relay that can provide Calibration Bus access to perform In-Service Calibration. Of course the Factory Calibration can also be performed with Configuration D.

2.0 Line Testing

2.1 Time Slot Requirements

Line test works in linear mode so a minimum of two adjacent time slots per channel are required. The 15-kHz noise test requires 8 adjacent time slots. For line test the NGVCP keeps an image of the time slot assignments, so there is no need to do a reassignment. The NGVCP does not however keep track of adjacent time slot usage, so the host must ensure that the adjacent time slot is not assigned. As an example, if there is a voice channel assigned to time slot 5, when you request a test to that same channel, the NGVCP will know the channel is on time slot 5, but the NGVCP will not check to see if time slot 6 is available - the NGVCP assumes this time slot is available.

Another way to manage time slot control is to put the voice time slots adjacent to each other and reserve a block of 20 time slots for testing. The block of 20 time slots will accommodate the following valid combinations:

- Four regular transmission tests: 8 time slots.
- One 15-kHz test plus three regular transmission tests: 14 time slots.
- Two 15-kHz test plus two regular transmission tests: 20 time slots.

Common time slot management options:

- Put all channels contiguous, one after each other, and allocate 20 time slots for line testing. Always re-allocate the channel time slot before executing any test requiring PCM access. Or,
- Skip every second channel, leaving an empty time slot between each time slot in use, and allocate 16 time slots to line testing. Only re-allocate the channel time slot before executing a 15-kHz noise test. Regular transmission tests do not require a time slot re-allocation.

Of course the host must keep a record of the testing time slots already in use and grab an empty one when starting a new test.

The number of channels controlled by the NGVCP (up to 32), the PCM clock frequency (maximum 8.192 MHz), usage assumptions, and the choice of line test time slot management will dictate the number of PCM highways that are required. The NGVCP supports one or two PCM highways.

2.2 Device Level Test Restrictions

Line test restrictions at the device level are:

- Up to 4 lines in line testing simultaneously running per NGVCP.
- Of the 4 lines in line testing simultaneously running per NGVCP, there is a limit of two simultaneous 15-kHz noise tests per NGVCP.
- Up to 2 lines in line testing simultaneously running per SLAC.
- Of the 2 lines in line testing simultaneously running per SLAC, only one of these tests may be the 15-kHz noise test.

2.3 Line Test Packages

Table 7 provides a complete list of the supported line test algorithms and their library names. The table also shows which configuration topology the algorithms can be used with and in which software package they're available.

Many of these tests will be used for GR-844 testing. A subset of these will be used for GR-909 testing. These tests are detailed in Table 8.

Algorithm Names	Description	VP-Test Library Names	Config.		NGVCP Packages			
			C	D	NT	BT	AT	ATP
Calibration	To measure correction factors that can be used to improve measurement and DC feed accuracy. **Factory Calibration.**	VPTL_TID_CALIBRATE	•					•
	To measure correction factors that can be used to improve measurement and DC feed accuracy. **Factory or In-Service Calibration.**			•				•
Apply Calibration	To transfer the calibration factors into the SLAC in order to improve the testing and DC feed accuracy.	VPTL_TID_APPLY_CALIBRATION	•	•				•
Foreign DC Voltage Test	To measure the DC foreign voltage present in the loop while the line card is in a high impedance state. A low-pass filter is used to filter out any AC voltage present on the line.	VPTL_TID_OPEN_DC_VOLTAGE	•	•		•	•	•
Foreign AC Voltage Test	To measure the AC foreign voltage present in the loop. A high pass filter is used to filter out any DC voltage present on the line.	VPTL_TID_OPEN_AC_VOLTAGE	•	•		•	•	•
DC Loop Resistance Test	To measure low loop impedance values generally less than 4K Ohms using either Forward/Reverse Battery or Offset Compensation algorithms.	VPTL_TID_DC_LOOP_RES	•	•		•	•	•
Three-Element Insulation Resistance Test	To measure the resistances connected between Tip and Ground, Ring and Ground, and Tip to Ring. The test can also measure the foreign DC voltage and current. The test can measure foreign voltage sources in excess of the SLIC power supply rails.	VPTL_TID_3ELE_RES	•	•		•	•	•
Four-Element Insulation Resistance Test	To measure the resistances connected between Tip and Ground, Ring and Ground, Tip to Ring, and Ring to Tip using dual polarities for the metallic test signal.	VPTL_TID_4ELE_RES	•	•			•	•
Five-Element Insulation Resistance Test	To measure the resistances connected between Tip and Ground, Ring and Ground, and Tip to Ring as well as resistances between Tip and Battery and Ring and battery.	VPTL_TID_5ELE_RES	•	•				•

Table 7 - NGVCP-NGCC Supported Line Test Packages

Algorithm Names	Description	VP-Test Library Names	Config.		NGVCP Packages			
			C	D	NT	BT	AT	ATP
Six-Element Insulation Resistance Test	Similar to Five-Element Resistance with the addition of Tip to Ring and Ring to Tip resistance differentiation in order to detect a non-linear element such as a diode.	VPTL_TID_6ELE_RES	•	•				•
Master Socket Test	To detect the presence of an M-Socket used in Hong Kong and a passive test termination (PPA - Passiver Prüfabschluss) used in the German telephony network. An M-Socket termination diagram is presented in Figure 5. A PPA termination diagram is presented in Figure 6.	VPTL_TID_MSOCKET	•	•				•
CO Splitter Signature Detection	To measure the POTS splitter filter located at the CO end of the loop. Two zener options are provided, VPTL_ZENER_24V and VPTL_ZENER_36V. CO splitter signature types are presented in Figure 9.	VPTL_TID_CO_SPLITTER	•	•				•
CPE Splitter and IAD Signature Detection	To detect CPE splitter and Integrated Access Device signature types. Zener and mode input parameters allow for discrimination of the various networks. Signature network diagrams are presented in Figure 7 and Figure 8.	VPTL_TID_CPE_SPLITTER_IAD	•	•				•
ISDN Terminal Detection Test	To detect if an ISDN terminal is connected at the customer end of the loop. Targeted at detecting a German NTBA (Network Termination Basisanschluss).	VPTL_TID_ISDN_TERMINAL	•	•				•
Three-Element Capacitance Test	To measure the capacitances connected between Tip and Ground, Ring and Ground, and Tip to Ring. This test also measures foreign AC voltage. The test can measure foreign voltage sources in excess of the SLIC power supply rails.	VPTL_TID_3ELE_CAP	•	•			•	•
Generic Three-Element Capacitance Test	To measure the capacitance connected between Tip and ground, Ring and ground, and Tip and Ring with control over the test stimulus voltages and frequency. This can be used to implement a low capacitance phone detection algorithm.	VPTL_TID_GEN_3ELE_CAP	•	•			•	•
Receiver Off-Hook Test	To verify the difference between a receiver taken off hook or a line short.	VPTL_TID_ROH	•	•		•	•	•
Distance to Open Test	To diagnose a line to locate a cable cut. Return the distance in meters between the central office and the cable cut.	VPTL_TID_DISTANCE_TO_OPEN	•	•			•	•
Foreign AC Currents Test	To measure the AC current flowing in each lead when the line is set to a specific common mode voltage.	VPTL_TID_FOREIGN_AC_CURRENT	•	•			•	•

Table 7 - NGVCP-NGCC Supported Line Test Packages (continued)

Algorithm Names	Description	VP-Test Library Names	Config.		NGVCP Packages			
			C	D	NT	BT	AT	ATP
Ringer Equivalency Number Test	To measure REN characteristics of regular or electronic phones.	VPTL_TID_REN	•	•		•	•	•
Ringer Equivalency Number with Phase	To measure REN characteristics of a phone attached to the line taking into account loop conditions.	VPTL_TID_REN_PHASE	•	•		•	•	•
DTMF and Pulse Digit Measurement Test	To detect and measure a DTMF digit, pulse digit, or hook-switch flash.	VPTL_TID_DTMF_PULSE_MSRMNT	•	•			•	•
Noise Measurement Test	To measure the sum of the line circuit noise and the subscriber loop noise using one of the many weighting filters – Flat, 3-kHz, 15-kHz, 3.4-kHz, CMSG, D-Filter, Psophometric.	VPTL_TID_NOISE	•	•		•	•	•
Signal to Noise Ratio Test	To measure the signal to noise ratio due to circuit noise and quantization distortion while applying a 1010 Hz test tone to the loop.	VPTL_TID_SNR_QNTZ_DIST	•	•				•
Arbitrary Single Tone Measurement Test	To measure the frequency and level of an arbitrary single tone that may be present on the loop.	VPTL_TID_ARB_TONE	•	•				•
Tone Generation Test	To generate specific tones to a specific line. (Generate up to 4 tones)	VPTL_TID_TONE_GEN	•	•			•	•
Unbalanced Tone Generation	To generate a tracing tone on a single wire.	VPTL_TID_UNBAL_TONE	•	•		•	•	•
Trans-Hybrid Loss Test	To measure the Trans Hybrid Loss of the line circuit under test.	VPTL_TID_TRANS_HYBRID_LOSS	•	•		•	•	•
Draw and Break Dial Tone Test	Apply an off-hook load and detect the presence of dial tone on the loop. Return the characteristics of the tones (amplitudes and frequencies).	VPTL_TID_DRAW_BREAK_DIALTONE	*	•			•	•
Inward Current Test	When used as a test head, to verify the ac/dc current generated by another line.	VPTL_TID_INWRD_CUR		•				•
DC Feed Self-Test	To verify the capability of the SLIC to drive currents into a load and to measure the voltage developed across it.	VPTL_TID_DC_FEED_SELF_TEST	*	•		•	•	•
On/Off Hook Self-Test	To verify the capability of the line card circuitry to detect on-hook and off-hook events.	VPTL_TID_ON_OFF_HOOK_SELF_TES T	*	•		•	•	•
Ringing Self-Test	To verify the capability of the line card circuitry to generate a ringing voltage at the desired amplitude and to perform ring trip upon an off-hook event.	VPTL_TID_RINGING_SELF_TEST	*	•		•	•	•
Ringing Monitor Test	To measure the ringing voltage while applying normal ringing on a terminating call.	VPTL_TID_RINGING_MONITOR_TEST	•	•		•	•	•

Table 7 - NGVCP-NGCC Supported Line Test Packages (continued)

Algorithm Names	Description	VP-Test Library Names	Config.		NGVCP Packages			
			C	D	NT	BT	AT	ATP
Metering Self-Test	To verify the capability of the line card circuitry to generate a metering pulse.	VPTL_TID_METERING_SELF_TEST	*	•			•	•
Transmission Self-Test	To verify the capability of the line card circuitry to pass Voice Frequency signals in the D/A and in the A/D directions.	VPTL_TID_TRANSMISSION_SELF_TES T	*	•		•	•	•
Dialing Self-Test	To verify the capability of the line card circuitry to detect pulse dialing and DTMF dialing.	VPTL_TID_DIALING_SELF_TEST	*	•			•	•
Line Circuit Currents and Voltages	Measure AC or DC current or voltage while providing service.	VPTL_TID_MONITOR_IV	•	•		•	•	•
AC Transmission Test	To verify the channel transmission characteristics.	VPTL_TID_AC_TRANS	*	•				•
Howler Test	British, Australian and North American Howler Tone generation.	VPTL_TID_HOWLER_TEST	•	•			•	•
Fuse Test	To verify the integrity of the fuses on the Tip and Ring leads.	VPTL_TID_FUSE_TEST	•	•				•
Read Loop and Battery Conditions	Read the loop conditions and, high, low and positive battery voltages.	VPTL_TID_LOOP_BAT_COND_TEST	•	•		•	•	•
GR909-All Test	To execute the complete list of GR-909 tests in less than 2 seconds.	VPTL_TID_GR909_ALL	•	•		•	•	•
Combined Multi-Test	To execute a series of voltage, resistance, and capacitance tests.	VPTL_TID_MULTI_TEST	•	•			•	•
Susceptance Test	Measures the complex admittance of the Tip to ground, Ring to ground, and Tip to Ring branches using a sinewave with phase control and reports the conductance and admittance of each branch.	VPTL_TID_SUSCEPTANCE_TEST	•	•				•

* Configuration C has no disconnect relay. If there is no other mean to disconnect the line from the loop during inward looking test, Self Tests can only be performed in the factory. The published Self Test accuracies are given for production testing only when no loop is connected to the equipment port. If the Self Tests are performed in the field, the host application needs to interpret the data accordingly, taking into account any loop impedance present.

Table 7 - NGVCP-NGCC Supported Line Test Packages (continued)

GR-909 test names	Description	Test library function
Outward loop testing		
Hazardous potential test AC	To measure the foreign AC Voltage present in the loop. A high pass filter is used to filter out any DC voltage present on the line.	VPTL_TID_OPEN_AC_VOLTAGE
Foreign voltage test AC		
Hazardous potential test DC	To measure the foreign DC Voltage present in the loop while the card is in a high impedance state	VPTL_TID_OPEN_DC_VOLTAGE
Foreign voltage test DC		
Resistive fault test	To measure any resistive fault present between Tip and Ground, Ring and Ground, Tip and Ring.	VPTL_TID_3ELE_RES
Receiver off-hook test	To verify the difference between a receiver taken off-hook and a line short.	VPTL_TID_ROH
Ringer test	To measure the ringer equivalence number of a phone	VPTL_TID_REN
GR-909 tests	Performs all outward loop tests	VPTL_TID_GR909_ALL
Inward equipment testing		
DC feed test[1]	See DC Feed and On-OFF Hook Self Test definitions in Table 7	VPTL_TID_DC_FEED_SELF_TEST and VPTL_TID_ON_OFF_HOOK_SELF_TEST
Ringing test[1]	To verify the capability of the line card circuitry to generate a ringing voltage at the desired amplitude and to perform ring trip upon an off-hook event	VPTL_TID_RINGING_SELF_TEST
Two-wire channel loss[1, 2]	To measure the Trans Hybrid Loss of the line circuit under test	VPTL_TID_TRANSMISSION_SELF_TEST or VPTL_TID_TRANS_HYBRID_LOSS
Echo return loss[1]		
Idle channel noise	To measure the sum of the line circuit noise and the subscriber loop noise using a C-Message filter	VPTL_TID_NOISE

Table 8 - GR-909 Tests and their corresponding Test Library Names

Notes:

1. *Requires the test load resistor as the termination.*
2. *Using open-circuit as the reflect termination.*

2.4 Measurement Range and Accuracy

Table 9 presents measurement ranges and accuracies for the Configuration C topology. Table 10 presents measurement ranges and accuracies for the Configuration D topology. Accuracies are listed for each calibration option and are specified for the recommended sense resistor tolerance. Accuracies apply to the recommended application circuits and parts lists that are defined in the *NGCC Hardware Design Guide, Document ID 126583*. Refer to the notes following the tables for additional information.

			CONFIGURATION C				CONFIGURATION C			
			No Calibration				Factory Calibration			
			RSVA/RSVB 0.5%, 100 ppm				RSVA/RSVB 0.5%, 100 ppm			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_OPEN_DC_VOLTAGE	Tip or ring voltage	Notes 1, 3, 8, 10, 12, 13	-1000	-400	V	±2.0% & ±2.1 V	-1000	-400	V	±1.95% & ±0.6 V
			-400	400		±1.85% & ±0.7 V	-400	400		±1.75% & ±0.2 V
			400	1000		±2.0% & ±2.1 V	400	1000		±1.95% & ±0.6 V
		AC induction rejection	0	280	Vrms	> 40 dB	0	280	Vrms	> 40 dB
VPTL_TID_OPEN_AC_VOLTAGE	Tip or ring voltage	Notes 1, 3, 8, 10, 12, 14	0	280	Vrms	±1.85% & ±0.05 V	0	280	Vrms	±1.75% & ±0.05 V
			280	700		±2.0% & ±0.2 V	280	700		±1.95% & ±0.2 V
		Frequency Range	50	200	Hz		50	200	Hz	
		Foreign DC rejection	-400	400	V	> 40 dB	-400	400	V	> 40 dB
	Differential voltage	Notes 1, 3, 8, 10, 12, 14	0	280	Vrms	±1.85% & ±0.05 V	0	280	Vrms	±1.75% & ±0.05 V
			280	700		±2.0% & ±0.2 V	280	700		±1.95% & ±0.2 V
		Frequency Range	50	200	Hz		50	200	Hz	
		Common-mode Rejection	0	280	Vrms	< 2%	0	280	Vrms	< 2%
		Foreign DC rejection	-400	400	V	> 40 dB	-400	400	V	> 40 dB

Table 9 - Configuration C Measurement Range and Accuracy

			CONFIGURATION C No Calibration RSVA/RSVB 0.5%, 100 ppm				CONFIGURATION C Factory Calibration RSVA/RSVB 0.5%, 100 ppm			
Test Library Function	Specific Test	Parameter	From	To	Unit	Accuracy	From	To	Unit	Accuracy
VPTL_TID_MONITOR_IV	DC current	Notes 3, 8, 13, 14, 15	0	80	mA	±2.5% & ±0.7 mA	0	80	mA	±1.9% & ±0.2 mA
VPTL_TID_DC_LOOP_RES	Test with offset compensation	Notes 2, 3, 8	0	4	kΩ	±6% & ±10 Ω	0	4	kΩ	±4.5% & ±10 Ω
		Note 4	5	80	mA	±2 mA offset	5	80	mA	±0.75 mA offset
VPTL_TID_REN	Mechanical ringer test	Notes 3, 8	1	10	kΩ	±5% & ±10 Ω	1	10	kΩ	±4.5% & ±10 Ω
			10	100	kΩ	±6%	10	100	kΩ	±5%
		Signal Frequency Range	10	80	Hz		10	80	Hz	
	Electronic ringer test	With 500 Ω to 7500 Ω Series Resistor and > 100 kΩ Parallel Resistor	0	4	µF	±6% & ±50 nF	0	4	µF	±5% & ±50 nF

Table 9 - Configuration C Measurement Range and Accuracy (continued)

			CONFIGURATION C No Calibration RSVA/RSVB 0.5%, 100 ppm				CONFIGURATION C Factory Calibration RSVA/RSVB 0.5%, 100 ppm			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_3ELE_RES, VPTL_TID_4ELE_RES	Resistance to GND	Notes 3, 5, 8	1	1000	Ω	±3.25% & ±7.5 Ω	1	1000	Ω	±2.5% & ±7.5 Ω
			1	10	kΩ	±3.0% & ±5 Ω	1	10	kΩ	±2.25% & ±5 Ω
			10	30		±3.75%	10	30		±2.5%
			30	100		-4.75%, +2.75%	30	100		±2.5%
			100	150		-5.75%, +2.75%	100	150		±2.5%
			150	360		-10%, +4%	150	360		±3.0%
			360	1000		-23%, +10%	360	1000		±4.5%
			1	5	MΩ	-65%, +70%	1	5	MΩ	-15%, +20%
			5	10		-80%, +450%	5	10		-25%, +50%
							10	20		-40%, +170%
	Resistance A to B	Notes 3, 5, 8	1	1000	Ω	±3.25% & ±7.5 Ω	1	1000	Ω	±2.5% & ±7.5 Ω
			1	10	kΩ	±3.0% & ±5 Ω	1	10	kΩ	±2.25% & ±5 Ω
			10	30		±3.75%	10	30		±2.5%
			30	100		±3.75%	30	100		±2.5%
			100	150		±3.75%	100	150		±2.5%
			150	360		±4.25%	150	360		±3.0%
			360	1000		±6%	360	1000		±4.5%
			1	5	MΩ	-20%, +40%	1	5	MΩ	-15%, +20%
			5	10		-40%, +50%	5	10		-25%, +40%
							10	20		-40%, +80%

Table 9 - Configuration C Measurement Range and Accuracy (continued)

Test Library Function	Specific Test	Parameter	CONFIGURATION C No Calibration RSVA/RSVB 0.5%, 100 ppm				CONFIGURATION C Factory Calibration RSVA/RSVB 0.5%, 100 ppm			
			From	To	Unit	Accuracy	From	To	Unit	Accuracy
VPTL_TID_3ELE_RES	Foreign DC currents	IAE + IBE (Notes 3, 8, 9)	0	60	mA	±5% & ±1.2 mA	0	60	mA	±4% & ±0.5 mA
		AC current rejection	0	40	mArms	> 40 dB	0	40	mArms	> 40 dB
VPTL_TID_3ELE_CAP	Capacitance to GND	Notes 3, 5, 8	0	100	nF	±3.0% & ±0.55 nF	0	100	nF	±2.25% & ±0.25 nF
			100	1000	nF	±3.0% & ±0.75 nF	100	1000	nF	±2.25% & ±0.65 nF
			1	10	μF	±3.0%	1	10	μF	±2.25%
			10	100	μF	±3.5%	10	100	μF	±2.5%
	Capacitance A to B	Notes 3, 5, 8	0	100	nF	±3.0% & ±0.55 nF	0	100	nF	±2.25% & ±0.25 nF
			100	1000	nF	±3.0% & ±0.75 nF	100	1000	nF	±2.25% & ±0.65 nF
			1	10	μF	±3.0%	1	10	μF	±2.25%
			10	100	μF	±3.5%	10	100	μF	±2.5%
		Signal Frequency Range	10	80	Hz		10	80	Hz	
VPTL_TID_FOREIGN_ AC_CURRENT		IAE + IBE (Notes 8, 9, 15)	0.1	40	mArms	±5%	0.1	40	mArms	±4%
		Frequency Range	50	200	Hz		50	200	Hz	
		DC current rejection	-60	60	mA	> 40 dB	-60	60	mA	> 40 dB

Table 9 - Configuration C Measurement Range and Accuracy (continued)

			CONFIGURATION C				CONFIGURATION C			
			No Calibration				Factory Calibration			
			RSVA/RSVB 0.5%, 100 ppm				RSVA/RSVB 0.5%, 100 ppm			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_DTMF_PULSE_ MSRMNT	Dial pulse test	Dial Speed	8	12	pps	±1.0%	8	12	pps	±1.0%
		Break Interval	40	80	%	±1.0%	40	80	%	±1.0%
		Dial Speed	18	22	pps	±2.0%	18	22	pps	±2.0%
		Break Interval	40	80	%	±2.0%	40	80	%	±2.0%
	DTMF test	DTMF Level (Notes 6, 8)	-20	0	dBm	±1.0 dB	-20	0	dBm	±1.0 dB
		DTMF Level (Notes 6, 8)	-25	-20	dBm	±1.5 dB	-25	-20	dBm	±1.5 dB
		DTMF Frequency (Notes 6, 8)	600	2000	Hz	±2 Hz	600	2000	Hz	±2 Hz
VPTL_TID_NOISE		Notes 7, 8, 20	-40	0	dBm	±1 dB	-40	0	dBm	±1 dB
			-50	-40	dBm	±2 dB	-50	-40	dBm	±2 dB
			-60	-50	dBm	±3 dB	-60	-50	dBm	±3 dB
VPTL_TID_SNR_QNTZ_DIST		Notes 7, 8, 21	-40	0	dBm	±1 dB	-40	0	dBm	±1 dB
			-50	-40	dBm	±2 dB	-50	-40	dBm	±2 dB
			-60	-50	dBm	±3 dB	-60	-50	dBm	±3 dB
VPTL_TID_ARB_TONE		Notes 6, 8, 22	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB
			300	3400	Hz	±2 Hz	300	3400	Hz	±2 Hz
VPTL_TID_AC_TRANS		Notes 6, 8, 21	-40	0	dBm	±1.0 dB	-40	0	dBm	±1.0 dB
			300	3400	Hz	±2 Hz	300	3400	Hz	±2 Hz
VPTL_TID_TONE_GEN		Note 23	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB
			300	3400	Hz	±0.25%	300	3400	Hz	±0.25%
VPTL_TID_UNBAL_TONE	Notes 19, 24	AC peak output	0	150	V	Note 16	0	150	V	Note 17
		Frequency output	0	1200	Hz	±2 Hz	0	1200	Hz	±2 Hz
		DC level output	-150	150	V	±1.6% ±0.5 V	-150	150	V	±1.3% ±0.2 V

Table 9 - Configuration C Measurement Range and Accuracy (continued)

Test Library Function	Specific Test	Parameter	CONFIGURATION C No Calibration RSVA/RSVB 0.5%, 100 ppm				CONFIGURATION C Factory Calibration RSVA/RSVB 0.5%, 100 ppm			
			From	To	Unit	Accuracy	From	To	Unit	Accuracy
VPTL_TID_DRAW_BREAK_ DIALTONE	Self Test	Notes 6, 8, 22	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB
			300	800	Hz	±2 Hz	300	800	Hz	±2 Hz
	Inward test	Notes 6, 8	-20	0	dBm	±1.0 dB	-20	0	dBm	±1.0 dB
			300	800	Hz	±2 Hz	300	800	Hz	±2 Hz
VPTL_TID_TRANS_HYBRID_ LOSS		Notes 7, 8, 21	-40	0	dBm	±1.0 dB	-40	0	dBm	±1.0 dB
			300	3400	Hz	±0.25%	300	3400	Hz	±0.25%

Table 9 - Configuration C Measurement Range and Accuracy (continued)

Test Library Function	Specific Test	Parameter	CONFIGURATION D No Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D Factory Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D In-Service Calibration RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
			From	To	Unit	Accuracy	From	To	Unit	Accuracy	From	To	Unit	Accuracy
VPTL_TID_OPEN_ DC_VOLTAGE	Tip or ring voltage	Notes 1, 3, 8, 10, 12, 13	-1000	-400	V	±2.0% & ±0.2 V	-1000	-400	V	±1.95% & ±0.2 V	-1000	-400	V	±1.3% & ±0.2 V
			-400	400		±1.85% & ±0.05 V	-400	400		±1.75% & ±0.05 V	-400	400		±1.1% & ±0.05 V
			400	1000		±2.0% & ±0.2 V	400	1000		±1.95% & ±0.2 V	400	1000		±1.3% & ±0.2 V
		AC induction rejection	0	280	Vrms	> 40 dB	0	280	Vrms	> 40 dB	0	280	Vrms	> 40 dB

Table 10 - Configuration D Measurement Range and Accuracy

			CONFIGURATION D				CONFIGURATION D				CONFIGURATION D			
			No Calibration				Factory Calibration				In-Service Calibration			
			RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_OPEN_ AC_VOLTAGE	Tip or ring voltage	Notes 1, 3, 8, 10, 12, 14	0	280	Vrms	±1.85% & ±0.05 V	0	280	Vrms	±1.75% & ±0.05 V	0	280	Vrms	±1.1% & ±0.05 V
			280	700		±2.0% & ±0.2 V	280	700		±1.95% & ±0.2 V	280	700		±1.3% & ±0.2 V
		Frequency Range	50	200	Hz		50	200	Hz		50	200	Hz	
		Foreign DC rejection	-400	400	V	> 40 dB	-400	400	V	> 40 dB	-400	400	V	> 40 dB
	Differential voltage	Notes 1, 3, 8, 10, 12, 14	0	280	Vrms	±1.85% & ±0.05 V	0	280	Vrms	±1.75% & ±0.05 V	0	280	Vrms	±1.1% & ±0.05 V
			280	700		±2.0% & ±0.2 V	280	700		±1.95% & ±0.2 V	280	700		±1.3% & ±0.2 V
		Frequency Range	50	200	Hz		50	200	Hz		50	200	Hz	
		Common-mode Rejection	0	280	Vrms	< 2%	0	280	Vrms	< 2%	0	280	Vrms	< 2%
		Foreign DC rejection	-400	400	V	> 40 dB	-400	400	V	> 40 dB	-400	400	V	> 40 dB
VPTL_TID_ MONITOR_IV	DC current	Notes 3, 8, 13, 14, 15	0	80	mA	±2.5% & ±0.02 mA	0	80	mA	±1.9% & ±0.02 mA	0	80	mA	±1.2% & ±0.02 mA
VPTL_TID_DC_ LOOP_RES	Test with offset compensa-tion	Notes 2, 3, 8	0	4	kΩ	±6% & ±10 Ω	0	4	kΩ	±4.5% & ±10 Ω	0	4	kΩ	±3.5% & ±10 Ω
		Note 4	5	80	mA	±2 mA offset	5	80	mA	±0.75 mA offset	5	80	mA	±0.5 mA offset

Table 10 - Configuration D Measurement Range and Accuracy (continued)

			CONFIGURATION D				CONFIGURATION D				CONFIGURATION D			
			No Calibration				Factory Calibration				In-Service Calibration			
			RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_REN	Mechanical ringer test	Notes 3, 8	1	10	kΩ	±5% & ±10 Ω	1	10	kΩ	±4.5% & ±10 Ω	1	10	kΩ	±3.5% & ±10 Ω
			10	100	kΩ	±6%	10	100	kΩ	±5%	10	100	kΩ	±4%
		Signal Frequency Range	10	80	Hz		10	80	Hz		10	80	Hz	
	Electronic ringer test	With 500 Ω to 7500 Ω series resistor and > 100 kΩ parallel resistor	0	4	µF	±6% & ±50 nF	0	4	µF	±5% & ±50 nF	0	4	µF	±4% & ±50 nF

Table 10 - Configuration D Measurement Range and Accuracy (continued)

			CONFIGURATION D No Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D Factory Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D In-Service Calibration RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_ 3ELE_RES, VPTL_TID_ 4ELE_RES	Resistance to GND	Notes 3, 5, 8	1	1000	Ω	±3.25% & ±7.5 Ω	1	1000	Ω	±2.5% & ±7.5 Ω	1	1000	Ω	±2% & ±7.5 Ω
			1	10	kΩ	±3.0% & ±5 Ω	1	10	kΩ	±2.25% & ±5 Ω	1	10	kΩ	±1.75% & ±5 Ω
			10	30		±3.25%	10	30		±2.5%	10	30		±2.25%
			30	100		±3.25%	30	100		±2.5%	30	100		±2.25%
			100	150		±3.0%	100	150		±2.25%	100	150		±1.75%
			150	360		±3.0%	150	360		±2.5%	150	360		±2.0%
			360	1000		±4.0%	360	1000		±3.5%	360	1000		±3.25%
			1	5	MΩ	-12%, +15%	1	5	MΩ	-12%, +15%	1	5	MΩ	-12%, +15%
			5	10		-20%, +35%	5	10		-20%, +35%	5	10		-20%, +35%
			10	20		-33%, +100%	10	20		-33%, +100%	10	20		-33%, +100%
	Resistance A to B	Notes 3, 5, 8	1	1000	Ω	±3.25% & ±7.5 Ω	1	1000	Ω	±2.5% & ±7.5 Ω	1	1000	Ω	±2% & ±7.5 Ω
			1	10	kΩ	±3.0% & ±5 Ω	1	10	kΩ	±2.25% & ±5 Ω	1	10	kΩ	±1.75% & ±5 Ω
			10	30		±3.25%	10	30		±2.5%	10	30		±2.25%
			30	100		±3.25%	30	100		±2.5%	30	100		±2.25%
			100	150		±3.0%	100	150		±2.25%	100	150		±1.75%
			150	360		±3.0%	150	360		±2.5%	150	360		±2.0%
			360	1000		±4.0%	360	1000		±3.5%	360	1000		±3.25%
			1	5	MΩ	-12%, +15%	1	5	MΩ	-12%, +15%	1	5	MΩ	-12%, +15%
			5	10		-20%, +35%	5	10		-20%, +35%	5	10		-20%, +35%
			10	20		-33%, +100%	10	20		-33%, +100%	10	20		-33%, +100%

Table 10 - Configuration D Measurement Range and Accuracy (continued)

			CONFIGURATION D No Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D Factory Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D In-Service Calibration RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_ 3ELE_RES, VPTL_TID_ 4ELE_RES	Resistance to GND	Notes 3, 5, 8	1	1000	Ω	±3.25% & ±7.5 Ω	1	1000	Ω	±2.5% & ±7.5 Ω	1	1000	Ω	±2% & ±7.5 Ω
			1	10	kΩ	±3.0% & ±5 Ω	1	10	kΩ	±2.25% & ±5 Ω	1	10	kΩ	±1.75% & ±5 Ω
			10	30		±3.25%	10	30		±2.5%	10	30		±2.25%
			30	100		±3.25%	30	100		±2.5%	30	100		±2.25%
			100	150		±3.0%	100	150		±2.25%	100	150		±1.75%
			150	360		±3.0%	150	360		±2.5%	150	360		±2.0%
VPTL_TID_ 3ELE_RES	Foreign DC currents	IAE + IBE (Notes 3, 8, 9)	0	60	mA	±5% & ±1.2 mA	0	60	mA	±4% & ±0.5 mA	0	60	mA	±3% & ±0.25 mA
		AC current rejection	0	40	mA rms	> 40 dB	0	40	mA rms	> 40 dB	0	40	mA rms	> 40 dB
VPTL_TID_ 3ELE_CAP	Capacitance to GND	Notes 3, 5, 8	0	100	nF	±3.0% & ±0.1 nF	0	100	nF	±2.25% & ±0.1 nF	0	100	nF	±1.75% & ±0.1 nF
			100	1000	nF	±3.0% & ±0.9 nF	100	1000	nF	±2.25% & ±0.9 nF	100	1000	nF	±1.75% & ±0.9 nF
			1	10	μF	±3.0%	1	10	μF	±2.25%	1	10	μF	±1.75%
			10	100	μF	±3.25%	10	100	μF	±2.5%	10	100	μF	±2.0%
	Capacitance A to B	Notes 3, 5, 8	0	100	nF	±3.0% & ±0.1 nF	0	100	nF	±2.25% & ±0.1 nF	0	100	nF	±1.75% & ±0.1 nF
			100	1000	nF	±3.0% & ±1.1 nF	100	1000	nF	±2.25% & ±1.1 nF	100	1000	nF	±1.75% & ±1.1 nF
			1	10	μF	±3.0%	1	10	μF	±2.25%	1	10	μF	±1.75%
			10	100	μF	±3.25%	10	100	μF	±2.5%	10	100	μF	±2.0%
		Signal Freq. Range	10	80	Hz		10	80	Hz		10	80	Hz	

Table 10 - Configuration D Measurement Range and Accuracy (continued)

			CONFIGURATION D				CONFIGURATION D				CONFIGURATION D			
			No Calibration				Factory Calibration				In-Service Calibration			
			RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_ FOREIGN_ AC_CURRENT		IAE + IBE (Notes 8, 9,15)	0.1	40	mA rms	±5%	0.1	40	mA rms	±4%	0.1	40	mA rms	±3%
		Freq. Range	50	200	Hz		50	200	Hz		50	200	Hz	
		DC current rejection	-60	60	mA	> 40 dB	-60	60	mA	> 40 dB	-60	60	mA	> 40 dB
VPTL_TID_ DTMF_PULSE_ MSRMNT	Dial pulse test	Dial Speed	8	12	pps	±1.0%	8	12	pps	±1.0%	8	12	pps	±1.0%
		Break Interval	40	80	%	±1.0%	40	80	%	±1.0%	40	80	%	±1.0%
		Dial Speed	18	22	pps	±2.0%	18	22	pps	±2.0%	18	22	pps	±2.0%
		Break Interval	40	80	%	±2.0%	40	80	%	±2.0%	40	80	%	±2.0%
	DTMF test	DTMF Level (Notes 6, 8)	-20	0	dBm	±1.0 dB	-20	0	dBm	±1.0 dB	-20	0	dBm	±1.0 dB
		DTMF Level (Notes 6, 8)	-25	-20	dBm	±1.5 dB	-25	-20	dBm	±1.5 dB	-25	-20	dBm	±1.5 dB
VPTL_TID_NOISE		Notes 7, 8, 20	-40	0	dBm	±1 dB	-40	0	dBm	±1 dB	-40	0	dBm	±1 dB
			-50	-40	dBm	±2 dB	-50	-40	dBm	±2 dB	-50	-40	dBm	±2 dB
			-60	-50	dBm	±3 dB	-60	-50	dBm	±3 dB	-60	-50	dBm	±3 dB
VPTL_TID_ SNR_QNTZ_DIST		Notes 7, 8, 21	-40	0	dBm	±1 dB	-40	0	dBm	±1 dB	-40	0	dBm	±1 dB
			-50	-40	dBm	±2 dB	-50	-40	dBm	±2 dB	-50	-40	dBm	±2 dB
			-60	-50	dBm	±3 dB	-60	-50	dBm	±3 dB	-60	-50	dBm	±3 dB

Table 10 - Configuration D Measurement Range and Accuracy (continued)

			CONFIGURATION D No Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D Factory Calibration RSVA/RSVB 0.5%, 100 ppm No Calibration Bus				CONFIGURATION D In-Service Calibration RSVA/RSVB 0.5%, 100 ppm Calibration Bus			
Test Library Function	**Specific Test**	**Parameter**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**	**From**	**To**	**Unit**	**Accuracy**
VPTL_TID_ ARB_TONE		Notes 6, 8, 22	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB
			300	3400	Hz	±2 Hz	300	3400	Hz	±2 Hz	300	3400	Hz	±2 Hz
VPTL_TID_ AC_TRANS		Notes 6, 8, 21	-40	0	dBm	±1.0 dB	-40	0	dBm	±1.0 dB	-40	0	dBm	±1.0 dB
			300	3400	Hz	±2 Hz	300	3400	Hz	±2 Hz	300	3400	Hz	±2 Hz
VPTL_TID_ TONE_GEN		Note 23	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB
			300	3400	Hz	±0.25%	300	3400	Hz	±0.25%	300	3400	Hz	±0.25%
VPTL_TID_ UNBAL_TONE	Notes 19, 24	AC peak output	0	150	V	Note 16	0	150	V	Note 17	0	150	V	Note 18
		Frequency output	0	1200	Hz	±2 Hz	0	1200	Hz	±2 Hz	0	1200	Hz	±2 Hz
		DC level output	-150	150	V	±1.6% ±0.5 V	-150	150	V	±1.3% ±0.2 V	-150	150	V	±1.25% ±0.05 V
VPTL_TID_ DRAW_BREAK_ DIALTONE	Self Test	Notes 6, 8, 22	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB	-40	0	dBm	±0.5 dB
			300	800	Hz	±2 Hz	300	800	Hz	±2 Hz	300	800	Hz	±2 Hz
	Inward test	Notes 6, 8	-20	0	dBm	±1.0 dB	-20	0	dBm	±1.0 dB	-20	0	dBm	±1.0 dB
			300	800	Hz	±2 Hz	300	800	Hz	±2 Hz	300	800	Hz	±2 Hz
VPTL_TID_TRANS_ HYBRID_LOSS		Notes 7, 8, 21	-40	0	dBm	±1.0 dB	-40	0	dBm	±1.0 dB	-40	0	dBm	±1.0 dB
			300	3400	Hz	±0.25%	300	3400	Hz	±0.25%	300	3400	Hz	±0.25%

Table 10 - Configuration D Measurement Range and Accuracy (continued)

Notes:

1. *The total voltage range is ±1000 V for the sum of AC and DC signals and may be further limited by the protection devices.*
2. *Using the two-step method with offset cancellation*
3. *Absolute and relative tolerances are cumulative.*
4. *The achievable current will be limited by the driver output voltage as a function of the load under test.*
5. *Accuracies only apply to a real resistor or to a real capacitor of the exact value of the test load. Resistance and Capacitance measurement accuracies are given for a single element present. The presence of an impedance in any of the other two branches may cause >50 times this impedance to appear in the branch under test and will degrade the observed accuracy. This is also true for the branches that are open. Since when performing the 3 element measurement the test will measure all 3 branches, whether the branches are open or not.*
6. *Accuracies are given for FFT sizes of 1024 or more.*
7. *Accuracies are given for filter integration time of 100 ms or more.*
8. *Accuracies are given for testing in the absence of interference from a foreign AC or DC voltage.*
9. *The total current range is ±60 mA for the sum of the AC and DC signals.*
10. *The specified tolerance for RSVA and RSVB is 0.5% with a temperature coefficient of resistance of 100 ppm. Stated performance is only validated and guaranteed for the 0.5%, 100 ppm resistor. If a looser tolerance resistor is used, DC voltage and AC voltage measurement accuracies need to be relaxed. For instance, if a resistor with a 1% tolerance and a 200 ppm temperature coefficient of resistance is used, then widen the accuracies as follows. For No Calibration tests, widen the listed VPTL_TID_OPEN_DC_VOLTAGE and VPTL_TID_OPEN_AC_VOLTAGE accuracies by 0.2%. For Factory Calibration and In-Service Calibration tests, widen the listed VPTL_TID_OPEN_DC_VOLTAGE and VPTL_TID_OPEN_AC_VOLTAGE accuracies by 0.25%. If non-standard configurations are used, customer must do due diligence with regards to validation.*
11. *Additional notes with regards to stated accuracies. Accuracies are set at 95% of the estimated distribution including all BOM component tolerances as documented in the NGCC Hardware Design Guide, Doc ID 126583. Calibration circuit has tolerances and temperature coefficients as specified in the Calibration Circuit Parts List. Temperature at Factory Calibration time is 20°C ±10°C. The temperature changes by no more than 20°C between executing the SLAC internal calibration function, executing In-Service Calibration (if applicable), applying the Factory or In-Service calibration factors (if applicable), and running the test.*
12. *Accuracy of VPTL_TID_INWRD_CUR is set by this test.*
13. *Accuracy of DC voltage level when using VPTL_TID_MONITOR_IV is set by VPTL_TID_OPEN_DC_VOLTAGE.*
14. *Accuracy of AC voltage level when using VPTL_TID_MONITOR_IV is set by VPTL_TID_OPEN_AC_VOLTAGE.*
15. *Accuracy of AC current level when using VPTL_TID_MONITOR_IV is set by VPTL_TID_FOREIGN_AC_CURRENT.*

16. *AC amplitude accuracy:*

$$+1.6\% + \left(\sqrt{\frac{1+\left(\frac{freq}{3617}\right)^2}{1+\left(\frac{freq}{5024}\right)^2}} - 1\right) * 100\% \qquad -1.6\% + \left(\sqrt{\frac{1+\left(\frac{freq}{3617}\right)^2}{1+\left(\frac{freq}{2740}\right)^2}} - 1\right) * 100\%$$

17. *AC amplitude accuracy:.*

$$+1.3\% + \left(\sqrt{\frac{1+\left(\frac{freq}{3617}\right)^2}{1+\left(\frac{freq}{5024}\right)^2}} - 1\right) * 100\% \qquad -1.3\% + \left(\sqrt{\frac{1+\left(\frac{freq}{3617}\right)^2}{1+\left(\frac{freq}{2740}\right)^2}} - 1\right) * 100\%$$

18. *AC amplitude accuracy:*

$$+1.25\% + \left(\sqrt{\frac{1+\left(\frac{freq}{3617}\right)^2}{1+\left(\frac{freq}{5024}\right)^2}} - 1\right) * 100\% \qquad -1.25\% + \left(\sqrt{\frac{1+\left(\frac{freq}{3617}\right)^2}{1+\left(\frac{freq}{2740}\right)^2}} - 1\right) * 100\%$$

19. *Level is limited by the selection of power supply rails.*
20. *Accuracy figures are given for a measurement of wideband noise applied to the Tip and Ring port and measured with any of the optional noise filters. The accuracy figure relates the rms noise result produced by the line test with the rms noise result produced by a reference instrument using the same filter selection and the same input impedance.*
21. *The accuracy figures provide the tolerances to be applied to the sum of the nominal transmit path and receive path frequency response computed by WinSLAC for the AC profile and the load impedance used during the test.*
22. *The accuracy figures provide the tolerances to be applied to the nominal transmit path frequency response computed by WinSLAC for the AC profile and the signal source impedance used during the test.*
23. *The accuracy figures provide the tolerances to be applied to the nominal receive path frequency response computed by WinSLAC for the AC profile and the load impedance used during the test.*
24. *The maximum peak-to-peak signal amplitude is reduced as the frequency increases because the maximum rate of change must be limited to 250 V/ms on the Tip and Ring port when using 220 nF C_{DCA} and C_{DCB} capacitors. This is equivalent to a 11.7 Vpeak sinewave at 3400 Hz.*

2.5 Calibration Circuit

The calibration circuit used for In-Service Calibration is shown in Figure 4. The circuit provides a precision reference voltage and precision reference loads. The Test-In Bus leads are wired to the Calibration Bus leads of Configuration D shown in Figure 3. The relays are controlled by the host controller.

The bill of materials for the calibration circuit is listed in Table 11.

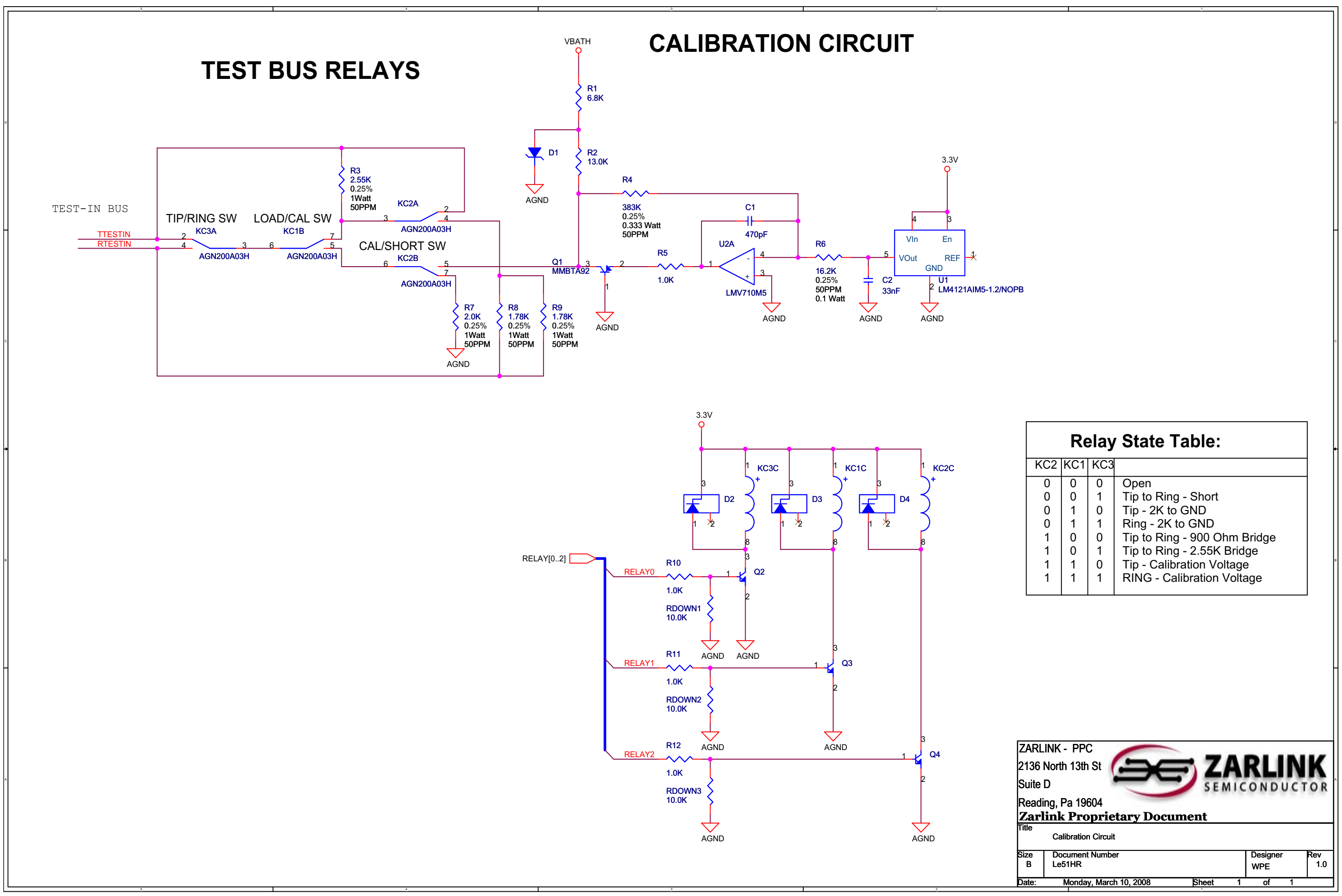

Figure 4 - Calibration Circuit

Item	Type	Part Number	Manufacturer	Value	Required Tolerance	Rating	T.C.R.
U1	Voltage Reference	LM4121AIM5-1.2	National Semiconductor		±0.2%		50 ppm
U2A	Op Amp	LMV710M5	National Semiconductor			Max offset ±3 mV	
Q1	Transistor	MMBTA92	Diodes Inc.	500 mA		300 V	
Q2, Q3, Q4	NPN Transistor	MMBT3904T	Diodes Inc.	200 mA		40 V	
R1	Resistor	ERJ-1TYJ682U	Panasonic	6.8 kΩ	±5%	1 W	
R2	Resistor	ERJ-6ENF1302V	Panasonic	13 kΩ	±1%	1/10 W	
R3	Resistor	PTN2512H2551BS	Vishay	2.55 kΩ	±0.25%	1 W	50 ppm
R4	Resistor	TNPW1206383KBHTYEA	Vishay	383 kΩ	±0.25%	1/3 W	50 ppm
R5, R10, R11, R12	Resistor	ERJ-2RKF1001X	Panasonic	1.0 kΩ	±10%	1/16 W	
R6	Resistor	TNPW060316K2BHENEA	Vishay	16.2 kΩ	±0.25%		50 ppm
R7	Resistor	PTN2512H2001BS	Vishay	2.0 kΩ	±0.25%	1 W	50 ppm
R8, R9	Resistor	PTN2512H1781BS	Vishay	1.78 kΩ	±0.25%	1 W	50 ppm
C1	Capacitor	C0402C471K5RACTU	Kemet	470 pF	±10%	50 V	
C2	Capacitor	C0402C103K4RACTU	Kemet	33 nF	±10%	50 V	
D1	Zener Diode	1SMA5941	Taiwan Semiconductor	47 V		1.5 W	
D2, D3, D4	Diode	BAS116T	Diodes Inc.			85 V	
KC1C, KC2C, KC3C	DPDT Relay	AGN200A03	Aromat			3 V	

Table 11 - Calibration Circuit Parts List

Note:

Listed part numbers may have a tighter tolerance then required.

2.6 Test Timing Analysis

Timing analysis has been performed in order to provide an estimate of the execution time for each test included in the Line test library. Table 12 presents the supported line tests and their estimated execution time in milliseconds.

Test Measurement	Test Execution Time in mS	
	Configuration C	Configuration D
VPTL_TID_OPEN_DC_VOLTAGE - Without auto disconnect - Active drive - In disconnect for long - No Active drive	TBD	
VPTL_TID_OPEN_AC_VOLTAGE	TBD	
VPTL_TID_FOREIGN_AC_CURRENT	TBD	
VPTL_TID_MONITOR_IV	TBD	
VPTL_TID_DC_LOOP_RES	TBD	
VPTL_TID_DC_LOOP_RES_OFF_COMP	TBD	
VPTL_TID_ROH - With Receiver off-hook - With short across TR - With open circuit	TBD	
VPTL_TID_REN - Regular phone - Electronic (high cap = 2010 ms)	TBD	
VPTL_TID_3ELE_RES (HIGH)	TBD	
VPTL_TID_3ELE_RES (LOW)	TBD	
VPTL_TID_4ELE_RES	TBD	
VPTL_TID_5ELE_RES (HIGH)	TBD	
VPTL_TID_5ELE_RES (LOW)	TBD	
VPTL_TID_MSOCKET	TBD	
VPTL_TID_3ELE_CAP (AC present or not) - Low cap 10 nF (repeat in high gain) - Mid cap 4 μF - High cap 12 μF and induction	TBD	
VPTL_TID_DISTANCE_TO_OPEN	TBD	
VPTL_TID_FUSE_TEST - Ringer present (phone on-hook) - Open circuit (no phone present)	TBD	
VPTL_TID_NOISE - FILTER_15KHZ - Others	TBD	
VPTL_TID_TRANS_HYBRID_LOSS	TBD	
VPTL_TID_SNR_QNTZ_DIST	TBD	
VPTL_TID_RD_LOOP_BAT_COND_TEST	TBD	
VPTL_TID_DC_FEED_SELF_TEST	TBD	

Table 12 - Test Timing Analysis

Test Measurement	Test Execution Time in mS	
	Configuration C	Configuration D
VPTL_TID_ON_OFF_HOOK_SELF_TEST	TBD	
VPTL_TID_RINGING_SELF_TEST	TBD	
VPTL_TID_TRANSMISSION_SELF_TEST	TBD	
VPTL_TID_METERING_SELF_TEST	TBD	
VPTL_TID_AC_TRANS -if integration time = 8000	TBD	
VPTL_TID_ARB_TONE - if detected - if timed out	TBD	
VPTL_TID_DIALING_SELF_TEST	TBD	
VPTL_TID_DTMF_PULSE_MSRMNT - Pulse mode (digit 1 = 800; 0 = 1570) - DTMF mode (detected =400+) - both	TBD	
VPTL_TID_DRAW_BREAK_DIALTONE	TBD	
VPTL_TID_GR909_ALL - All tests executed - Foreign voltage present	TBD	
VPTL_TID_TONE_GEN - Duration	TBD	
VPTL_TID_HOWLER_TEST	TBD	

Table 12 - Test Timing Analysis (continued)

Note:

** Delay is the dial tone application delay. This delay is dependent upon the host platform.*

2.7 Termination and Signature Network Diagrams

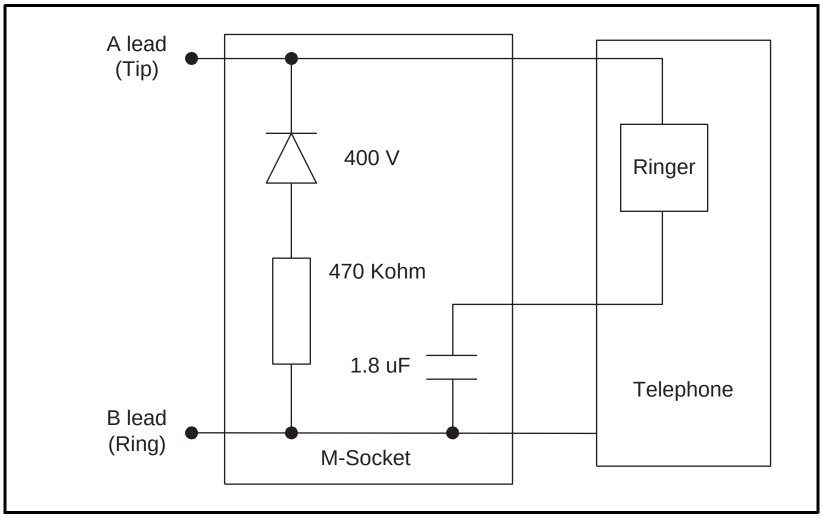

Figure 5 - M-Socket Termination

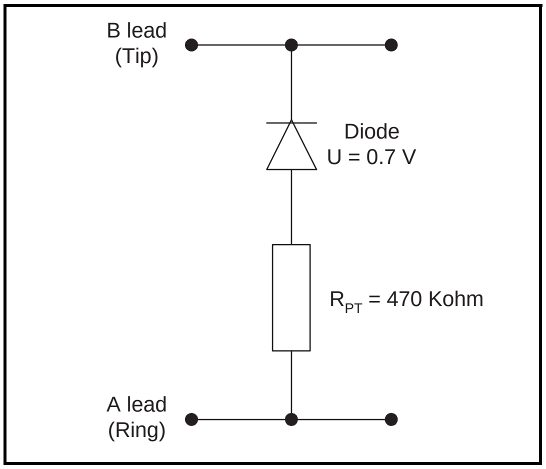

Figure 6 - PPA Termination

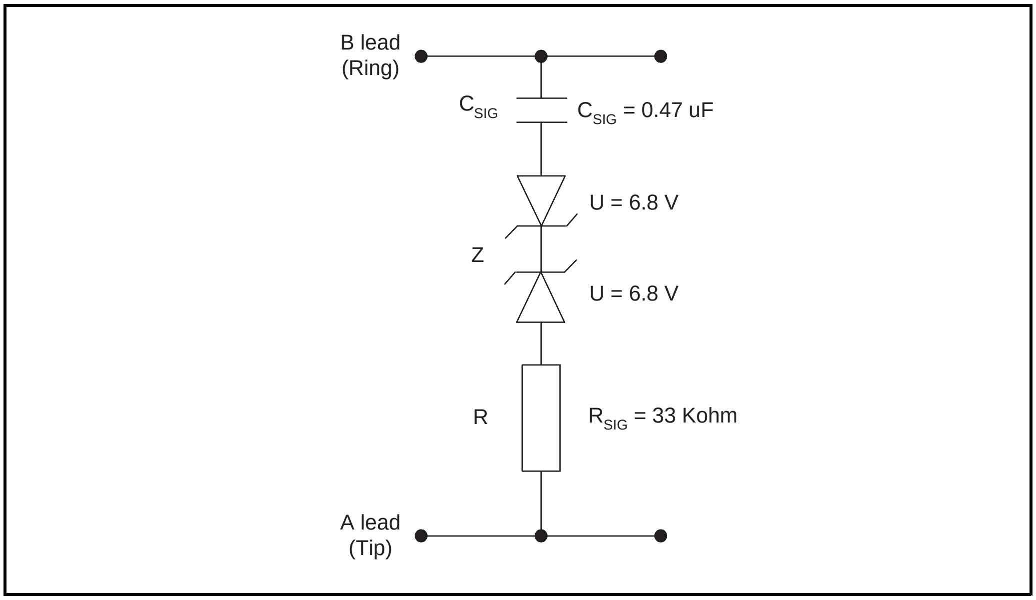

Figure 7 - IAD Signature Network

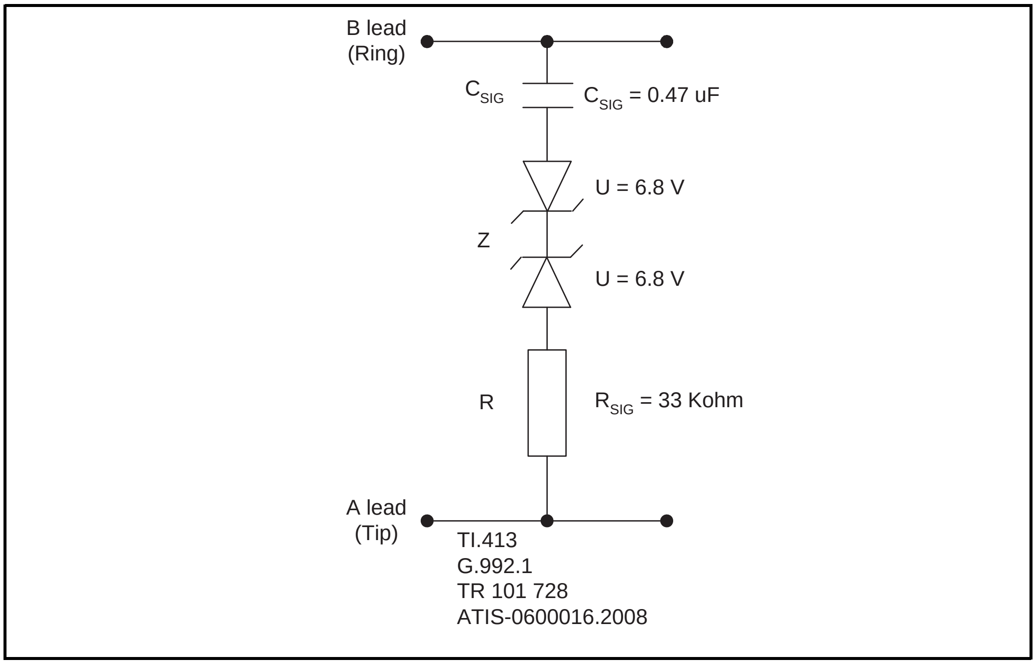

Figure 8 - CPE Splitter Signature Network

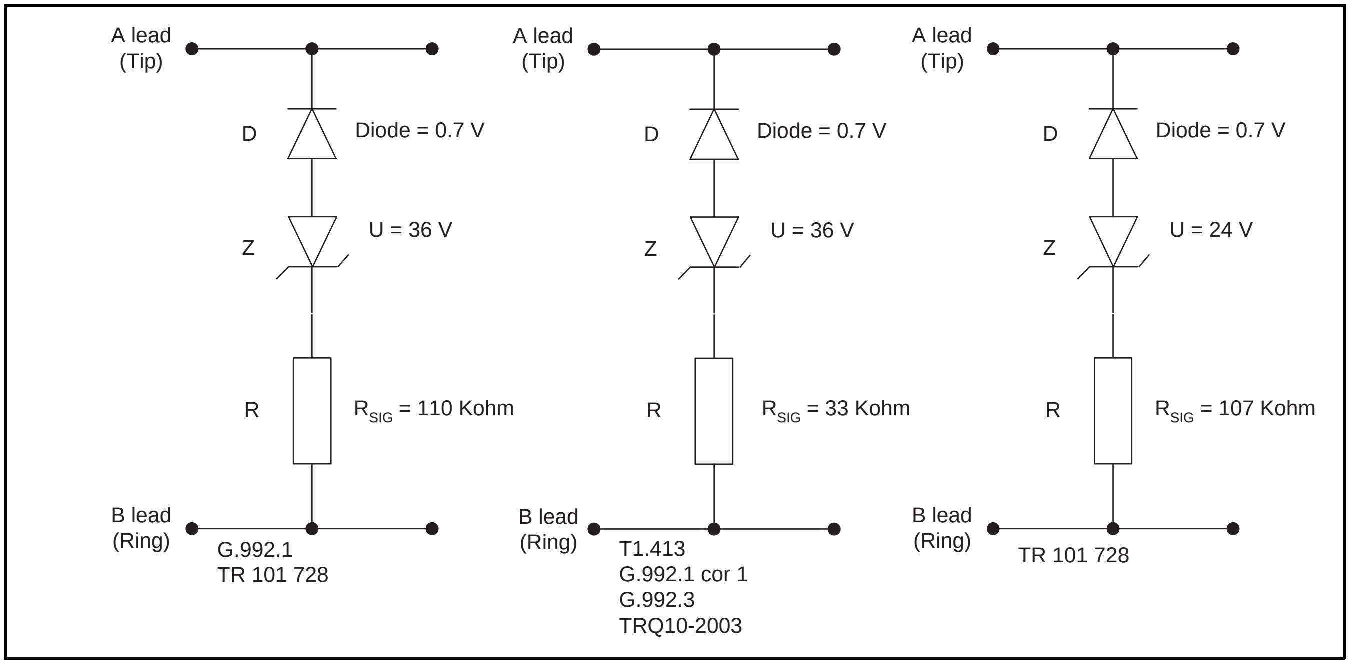

Figure 9 - CO Splitter Signature Networks

3.0 Memory Requirements

For optimum results, Zarlink recommends the following host platform minimum memory requirements shown in the table below.

Note: *Memory requirements are subject to change with every software release.*

Parameters	Per VCP Device (Bytes)
API Code size	77000
Memory in application space per device*	788
Memory in application space per line*	50
PROFILES in application space (one each)	
Device	40
AC	120
DC	41
Ringing	31
Tone	29
Caller ID type 1 (simple)	40
Standard On/Off Ringing Cadence	18
Standard On/Off tone cadence	14
Metering	10
Testing	
Line Testing - Advanced test plus library code size	132000
Data size for calibration coefficients per line	70
Data size for test topology per line	48
Data size for test input per line	36
Data size for test result per line	52
Data size test temp buffer per line	748
Data size for text content per line	48

Table 13 - Approximate Memory Requirements per VCP Device

Note*:*

** These are necessary and required by the API-II even though they are in the application's data space.*

Note*:*

The memory size was measured using the Zarlink development platform. Values may vary depending on the compiler used. The compiler used has the following size for the ansi C standard data types:

float = 4 bytes

int = 4 bytes

char = 1 byte

bool = 1 byte

And the API defined variable types:

int16; uint16 = 2 bytes

int32; uint32 = 4 bytes

int8; uint8, uchar = 1 byte

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