![Microsemi]

Le9622-Le9632
Subscriber Line Interface Circuit
miSLIC™ Series
Product Brief

Features

- **Cost Optimized Single Channel FXS Solution**
  - 53-pin 7x7mm 0.4mm Pitch QFN package
  - Low cost, 2-Layer PCB Reference Designs
  - Supports Multi-Channel Enterprise Applications

- **PCM/SPI Interfaces**
  - Programmable Interface Voltage to support 1.8V, 2.5V and 3.3V SoC Processors

- **Low Cost Energy Efficient Switching Regulator Architectures**
  - Le9622
    - *Patented* Shared Buck-Boost Automatic Battery Switch (BBABS) with $85V_{PK}$ open circuit ringing capability
    - Multi-Line Inverting-Boost Automatic Battery Switch (ABS) with $100V_{PK}$ open circuit ringing capability
  - Le9632
    - High Voltage Tracking Flyback with $140V_{PK}$ open circuit ringing capability
    - High Voltage Tracking Inverting-Boost with $125V_{PK}$ open circuit ringing capability
  - Consistent with Code of Conduct on Energy Consumption of Broadband Equipment

- **VoicePath SDK and VP-API-II Software available to implement FXS functions**

- **VeriVoice Professional Test Suite Software**
  - Comprehensive subscriber loop testing, per *Telcordia GR-909-CORE / TIA-1063*

- **VeriVoice Manufacturing Test Package (VVMT)**
  - Facilitates factory testing of assembled boards

- **Wideband or Narrowband Operation**

- **Worldwide Programmability**

Ordering Information

Device OPN	Device Type	Package	Packing
Le9622RQCT	120V SLIC	53-pin QFN (7x7)	Tape&Reel
Le9622RQC	120V SLIC	53-pin QFN (7x7)	Tray
Le9632RQCT	150V-Tracker	53-pin QFN (7x7)	Tape&Reel
Le9632RQC	150V-Tracker	53-pin QFN (7x7)	Tray

These Green packages meet RoHS 2 Directive 2011/65/EU of the European Council to minimize the environmental impact of electrical equipment.

Applications

- **Multi-Channel Enterprise and Small Office**
- **DSL Residential Gateways and Integrated Access Devices (IADs)**
- **Cable Embedded Multimedia Terminal Adapters (eMTAs)**
- **PON Single Family Units (SFU)**
- **Fiber to the Premise/Home/Building (FTTX)**
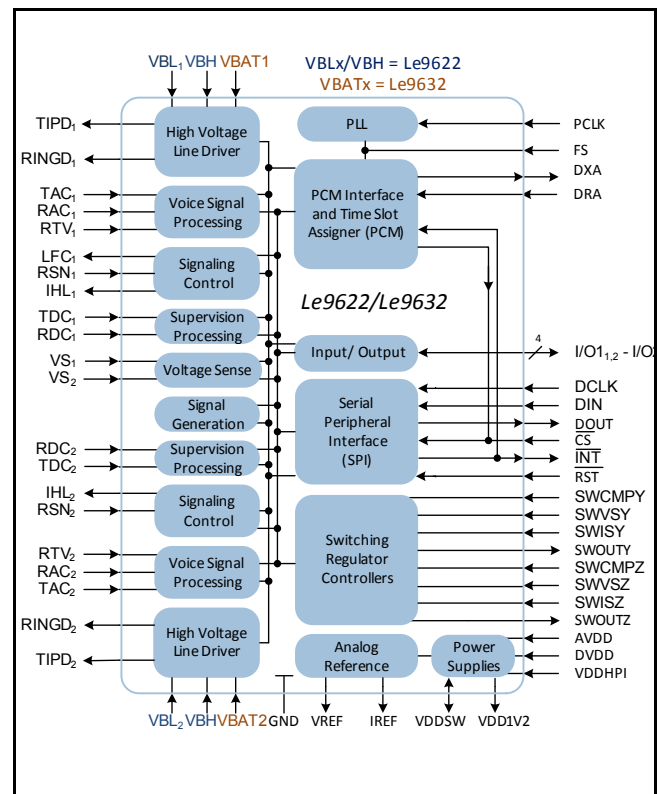- **Fixed Wireless (LTE Gateway)**

Figure 1 - Le9622/Le9632 Block Diagram

miSLIC™ Series Solution Overview

The sixth-generation *miSLIC* line interface solution consists of *a miSLIC* device, *VoicePath API-II (VP-API-II)* Software, and *Profiles* Data Structures. To support the *miSLIC* device, Microsemi offers comprehensive software and hardware collateral packages, including 2-layer printed circuit board reference designs.

The *VoicePath API-II (VP-API-II)* software initializes the FXS port coefficient data containing application or country-specific AC and DC parameters, ringing and other signaling characteristics, and configures the switching power supply. *VP-API-II* resides on the customer's VoIP processor or SoC and provides high-level control over the telephony functions. *VP-API-II* offers a seamless migration between products utilizing its common software architecture and interfaces with the Microsemi *VeriVoice Professional Test Suite Software*.

A *Microsoft® Windows®* GUI (Graphical User Interface) application, *VoicePath Profile Wizard (VP Profile Wizard)*, allows the user to select the operating parameters of the FXS channels and to automatically generate the sets of data structures, called *Profiles*, that are required by the *VP-API-II* for integration with the VoIP host software.

The Le9622/Le9632 miSLIC device implements a universal telephone line interface with a PCM and SPI interface. This interface is voltage programmable to support 1.8V, 2.5V and 3.3V SoC Processors. All AC, DC, and signaling parameters are fully programmable via the PCM and SPI interfaces

The switching regulator controller generates the high voltage needed for efficiently powering and ringing analog telephones. The Le9622 supports two switching regulator architectures. The lowest cost Shared Buck-Boost Automatic Battery Switch (BBABS) architecture uses a fixed voltage for ringing with up to $85V_{PK}$ open circuit capability. The Multi-Line Inverting-Boost Automatic Battery Switch (ABS) also uses a fixed voltage, with up to $100V_{PK}$ open circuit capability. The Le9632 also supports two switching regulator architectures. The High Voltage Flyback architecture tracks the ringing voltage during ringing, with up to $140\text{-}V_{PK}$ capability. The High Voltage Inverting-Boost switcher which also tracks the ringing voltage during ringing with up to $125\text{-}V_{PK}$ capability. The battery tracks the DC feed with both architectures. The switching regulators provide high efficiency in all operating states and corresponding low power consumption.

The Le9622/Le9632 utilizes the *VeriVoice Professional Test Suite Software* to resolve line circuit faults and to provide line diagnostics. The integrated digital access to line information such as AC and DC line voltages and Metallic or Longitudinal currents is crucial for remote applications where dedicated test hardware is not cost effective.

Additionally, the *VeriVoice Manufacturing Software (VVMT)* package provides test functions intended to facilitate factory testing, eliminating the need for expensive external test equipment.

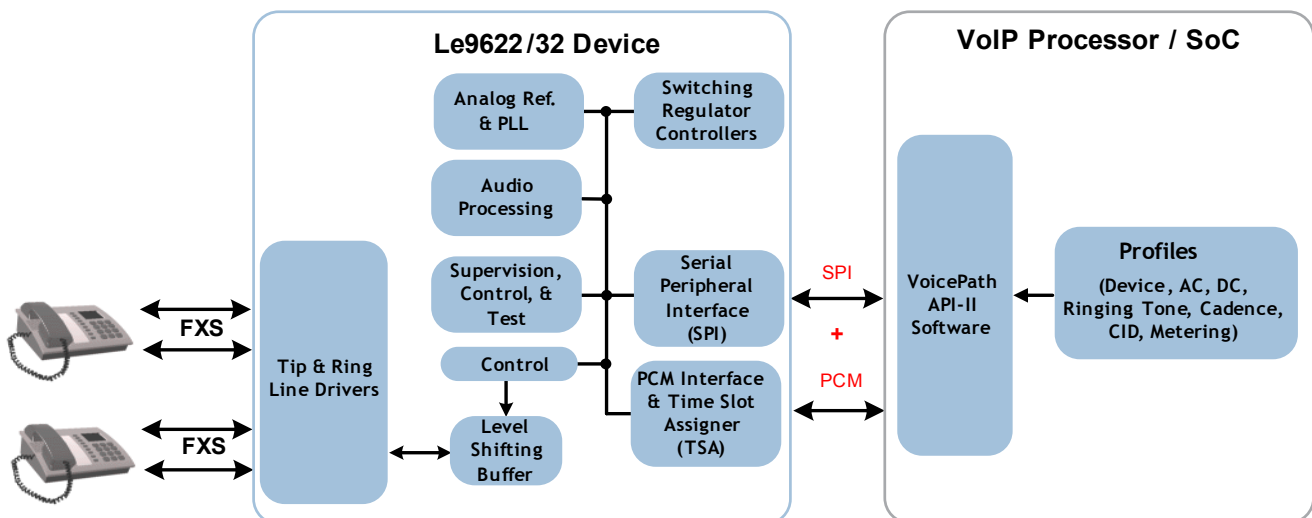Figure 1 shows a high-level solution diagram with a *Le9622/Le9632* device, *VP-API-II* and *Profiles*.

Figure 1 - Le9622/Le9632 Solution Diagram

Le9622/Le9632 Features

Feature	Le9622	Le9632
Package		
Package	7x7 mm, 53-pin QFN	7x7 mm, 53-pin QFN
Temperature Range	-40°C to +85°C	-40°C to +85°C
Compatible with 2-layer PCB designs	Yes	Yes
Software		
VoicePath SDK and *VP-API-II*	Yes	Yes
VeriVoice Professional Test Suite Software	Yes	Yes
V*eriVoice Manufacturing Test Package*	Yes	Yes
Interface		
PCM/SPI	Yes	Yes
Voltage Programmable Interface	Yes	Yes
Power Supply		
Patented Fixed Shared Buck-Boost Automatic Battery Switch (BBABS)	Yes	No
Fixed Multi-Line Inverting Boost Power Supply Architecture	Yes	No
Tracking Flyback Power Supply Architecture	No	Yes
Tracking Inverting Boost Power Supply Architecture	No	Yes
DC Feed		
Low Power Idle Mode	Yes	Yes
Power/service denial mode	Yes	Yes
On-hook transmission	Yes	Yes
Programmable DC Feed Characteristics	Yes	Yes
Programmable Maximum Loop Current	45mA	45mA
Supervision		
Programmable Loop Start Thresholds	Yes	Yes
Programmable Ground Start Threshold	Yes	Yes
Programmable on/off hook de-bounce times	Yes	Yes
Ringing		
Peak Ringing Voltage Shared Buck-Boost Automatic Battery Switch	$85V_{PK}$ open circuit	N/A
Peak Ringing Voltage Multi-Line Inverting Boost Power Supply Architecture	$100V_{PK}$ open circuit	N/A
Peak Ringing Voltage Flyback Power Supply Architecture	N/A	$140V_{PK}$ open circuit
Peak Ringing Voltage Inverting Boost Power Supply Architecture	N/A	$125V_{PK}$ open circuit
Programmable Ringing waveform, frequency, DC Offset, amplitude and cadence	Yes	Yes
Integrated ring trip filter and software, manual or automatic ring trip mode	Yes	Yes
Telephony		
Wideband -Narrowband Operation	Yes	Yes
A-law/µ-law and linear coding selection	Yes	Yes
Call progress tone generation	Yes	Yes
Howler tone generation	Yes	Yes
DTMF Generation	Yes	Yes
Two-wire AC impedance	Yes	Yes
Transhybrid balance impedance	Yes	Yes
Transmit and receive gains and equalization	Yes	Yes

VoicePath Application Programming Interface II (*VP-API-II*)

The Microsemi V*oicePath Application Programming Interface II* (*VP-API-II*) is a C source code module that provides a standard software interface for controlling, testing, and passing digitized voice through a set of subscriber lines using the Microsemi family of voice termination devices.
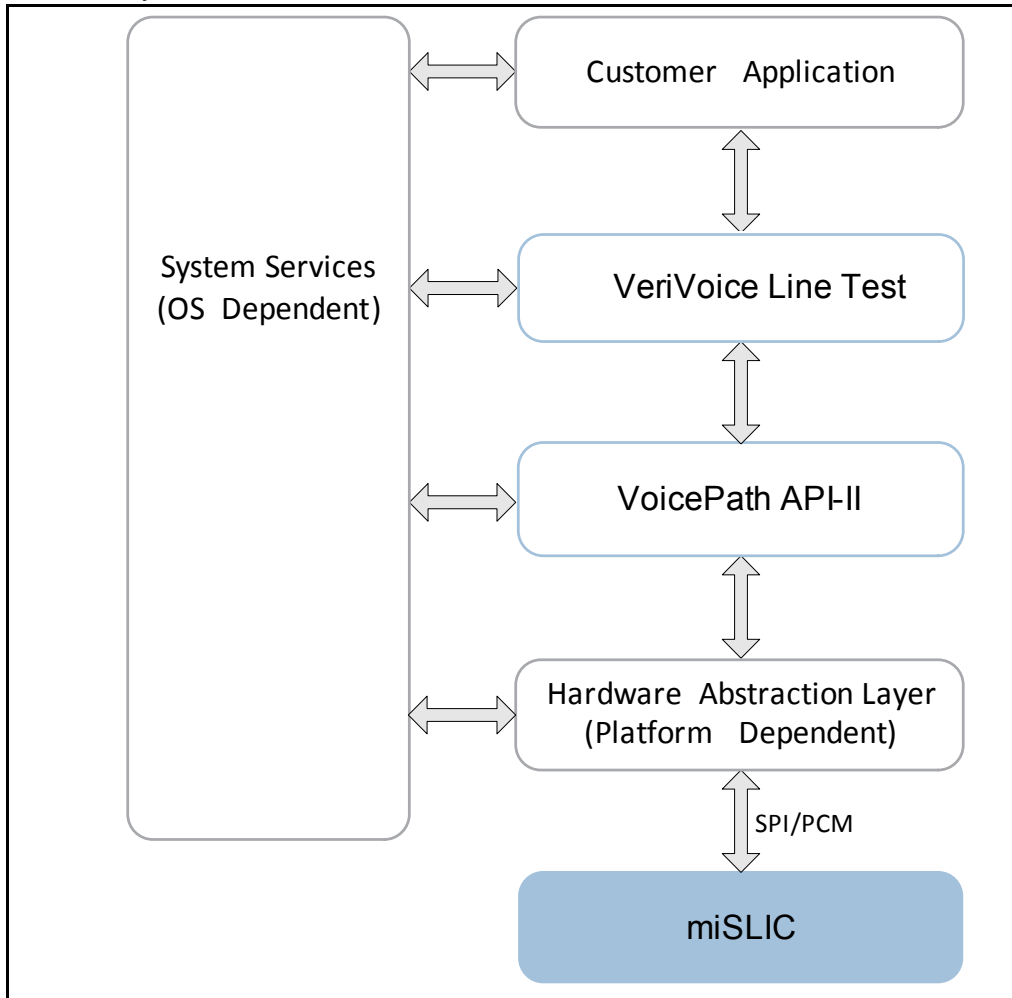

Figure 2 - VP-API-II Software Architecture

Customer Application

This block represents the user's line management module that performs tasks such as initializing the system, configuring lines, changing the line states in response to line events and other inputs, switching digitized voice traffic, etc. Microsemi provides example implementations of this layer as part of the *VoicePath SDK*.

VoicePath API-II

The *VoicePath API-II* is the core component of the Microsemi *VoicePath SDK*. This software module runs on the host microprocessor that controls one or more Microsemi voice telephony devices.

Hardware Abstraction Layer

The Hardware Abstraction Layer (HAL) provides access to Microsemi voice telephony devices through the SPI interface. The HAL software is platform-dependent and must be implemented by the *VP-API-II* user. Microsemi provides example HAL source code with the *VoicePath SDK*.

Test Packages

VeriVoice Professional Test Suite Software

VeriVoice Professional Test Suite Software is an advanced test suite that provides the ability for the user to perform the *Telcordia GR-909-CORE / TIA-1063* diagnostic testing for testing the physical subscriber loop. Additionally the *VeriVoice Professional Test Suite Software* provides for a series of inward looking tests so the operation of the FXS circuit and switching regulator can be verified.

The *VeriVoice Professional Test Suite features* the following tests:

- Line Voltage: Checks for hazardous and foreign AC and DC voltages.
- Receiver Off-Hook: Checks for longitudinal fault, off-hook resistive fault and receiver off-hook.
- Regular REN: Tests the impedance of the line and returns a fail if the Ringer Equivalence Number (REN) is too low or high.
- Electronic REN: Provides REN Tip to Ring, Tip to ground and Ring to ground based on capacitance
- Resistive Fault: Measures three-element resistance.
- GR-909-CORE / TIA-1063:   Performs all of the *GR-909-CORE* outward tests in the correct sequence.
- Capacitance: Measures three element capacitance
- Master Socket: Detects master socket terminations
- Cross Connect: Detects cross connected FXS
- Loop back: Enables receive-to-transmit signal loop-back using two different methods
- Read Loop Conditions: Measures DC voltages between Tip and Ring, Tip to ground, Ring to ground, and
-                                   VBAT to ground. Also measures metallic and longitudinal DC line currents in supported States.
- Read Battery Conditions: Reads the battery voltages connected to the line circuit.
- DC Voltage Self-Test: Verifies that the line circuit has the ability to drive the voltage ranges required for the normal operation of the line circuit.
- DC Feed Self-Test   Measures the voltage and current across a known internal test termination using the *DC Profile* that has been programmed.
- Ringing Self-Test   Verifies ring signal generation, drive capability, and ring trip.
- On/Off-Hook Self-Test   Creates on-hook and off-hook conditions on the line using the internal test termination and verifies that they are properly reported.
- Draw and Break Dial Tone   Verifies the capability of the line circuit to detect off-hook and on-hook as well as the voice path to/from the host
- Read Loop Conditions - Extended   Reads the loop conditions of the current state of the line without disturbing the T/R feed conditions. Measures AC and DC voltages Tip and Ring, Tip to ground and Ring to ground. Measures VBAT to ground. Also measures metallic and longitudinal AC and DC line currents in supported States.

Manufacturing Testing

The Le9622 and Le9632 are supported by the *VeriVoice Manufacturing Test Package (VVMT)*. T*he VeriVoice™ Manufacturing Test Package* is a stand-alone, self contained test package intended to facilitate factory testing of new products based on Microsemi miSLIC™ Series of Voice Solutions. The software is distributed as a portable, platform-independent C source code module. The software is architected as a rapid set of tests which provide thorough test cover and eliminates the need for expensive test equipment.

Line Interface Circuit

Figure 3 shows a typical line interface circuit for the Le9622. Consult Microsemi for the most recent reference design.
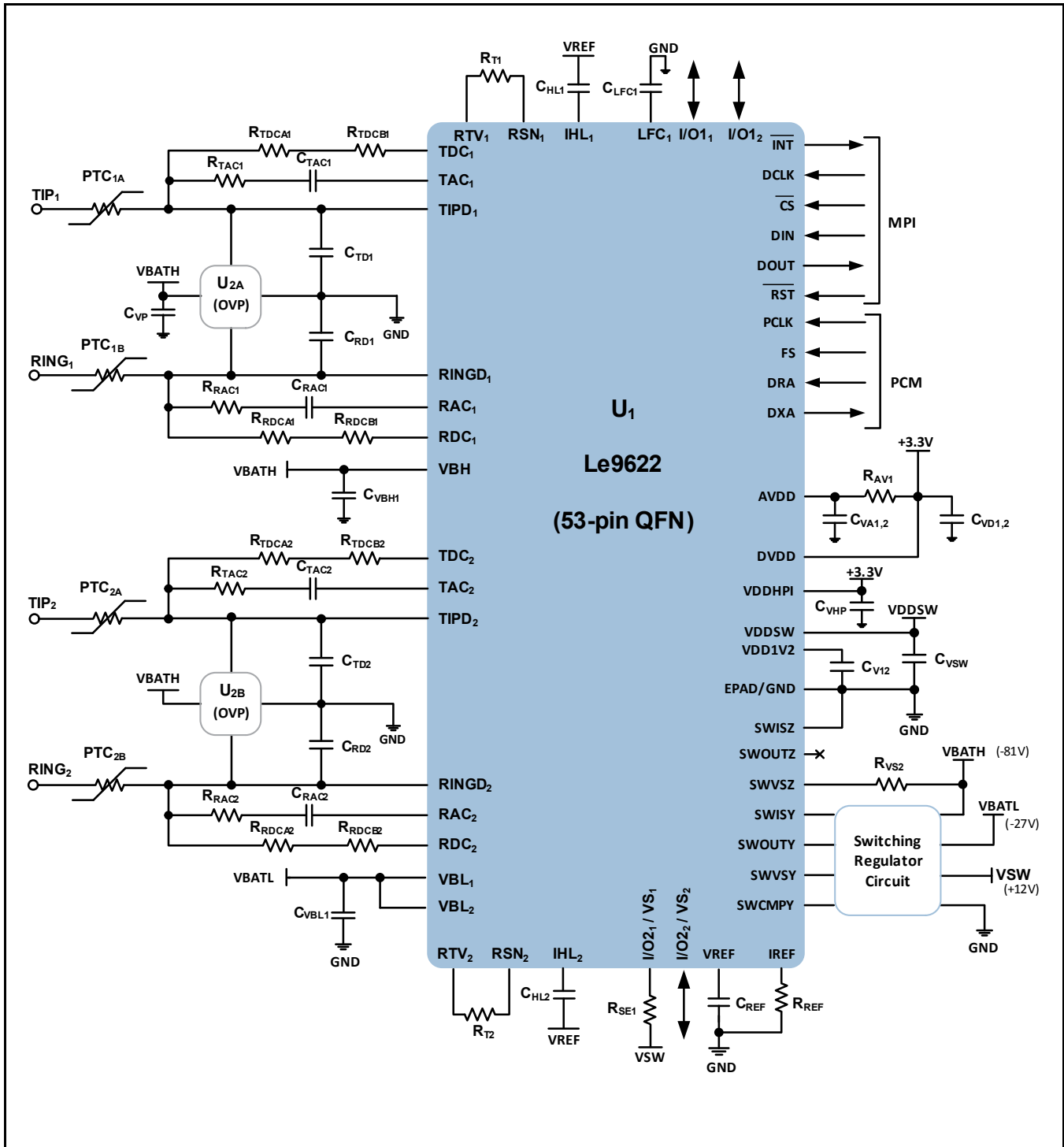

Figure 3 - Le9622/Line Interface Circuit

[Figure 4](#) shows a typical line interface circuit for the Le9632. Consult Microsemi for the most recent reference design.
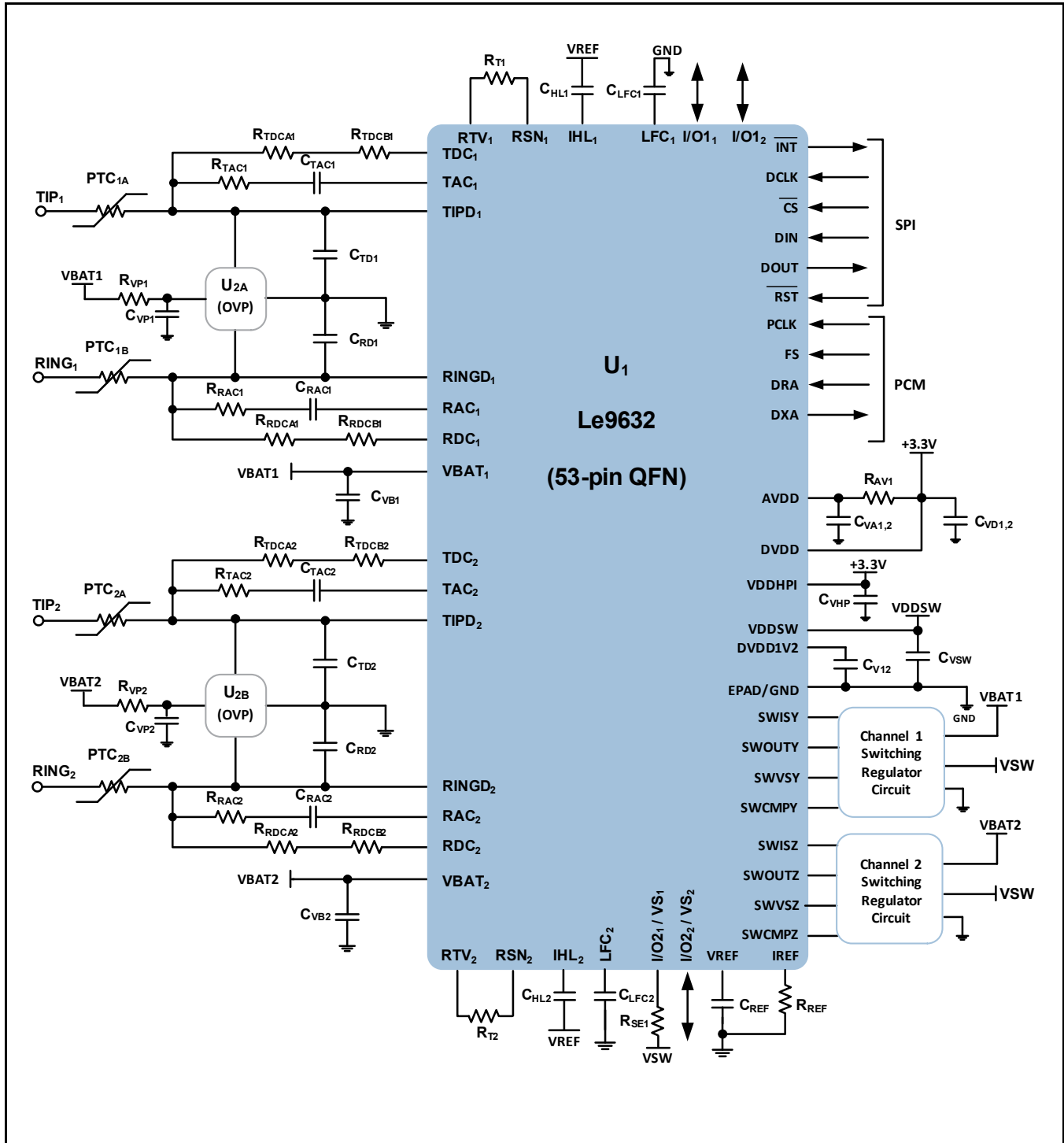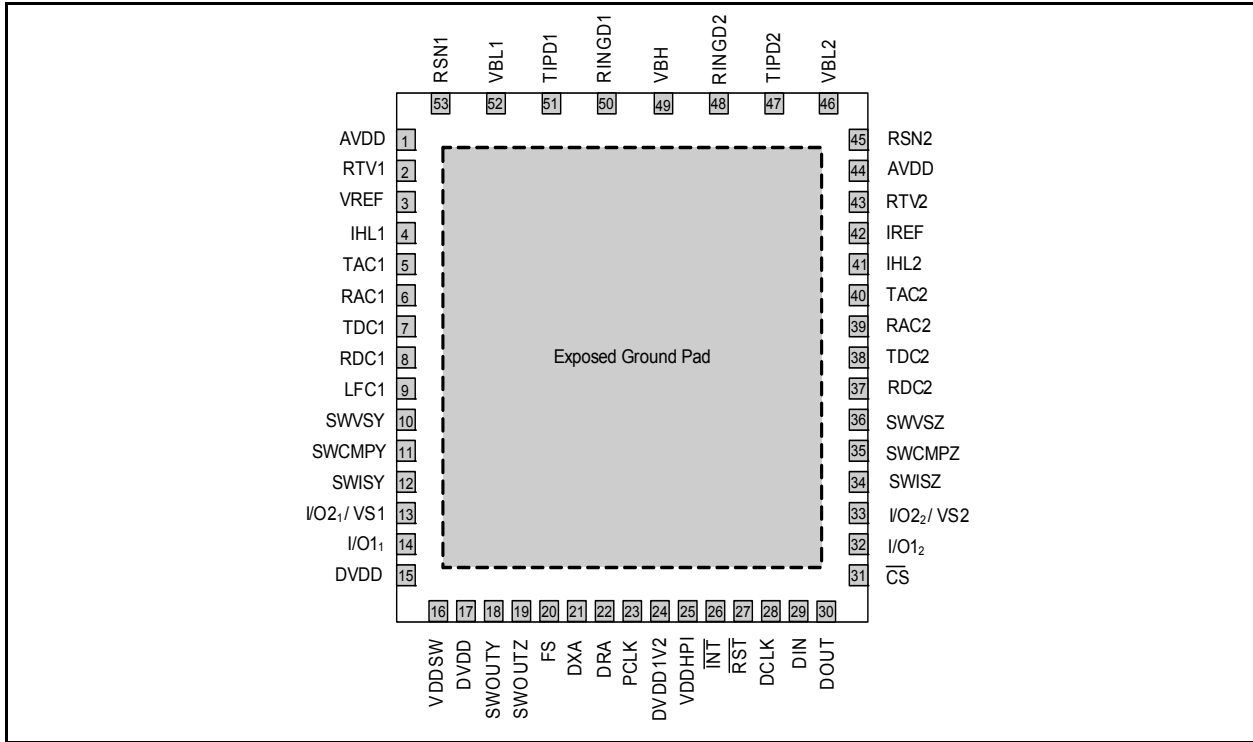

Figure 4 - Le9632/Line Interface Circuit
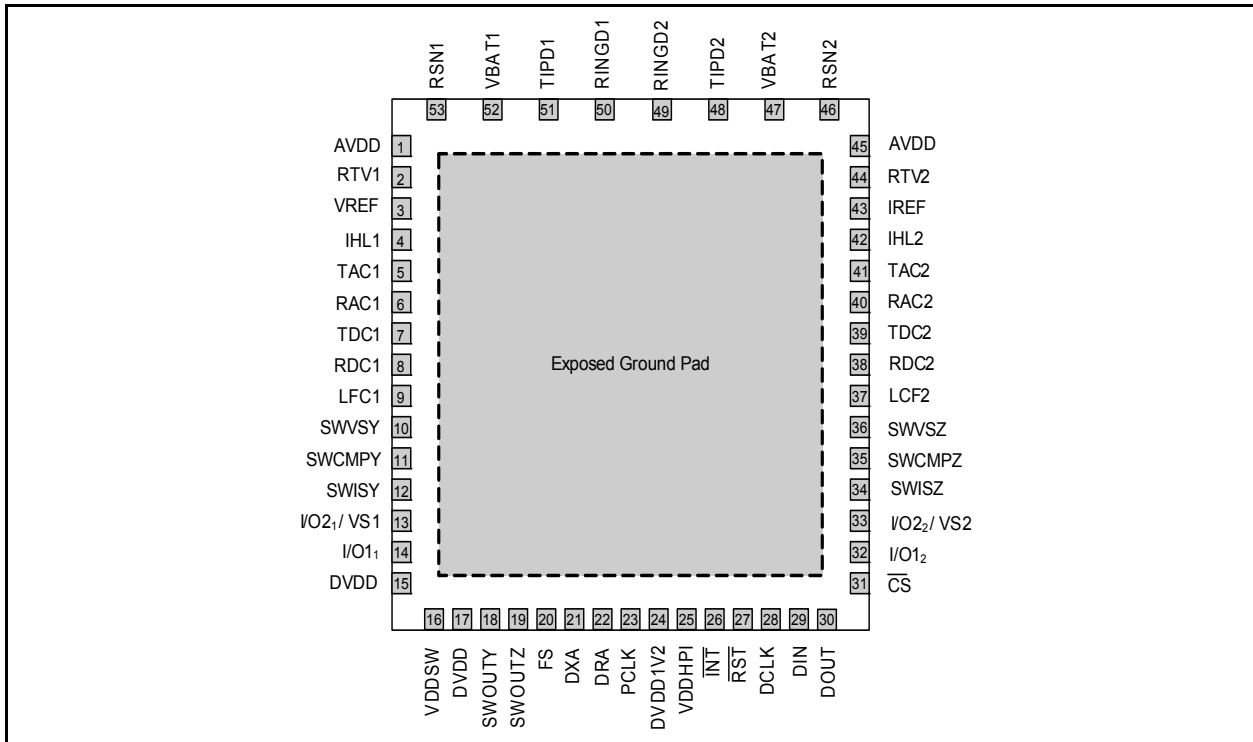
Figure 5 - Le9622 Device Pin Out (53-Pin QFN) – Top View

Figure 6 - Le9632 Device Pin Out (53-Pin QFN) - Top View

Related Collateral

The following documentation is available on the Microsemi website **www.microsemi.com/voice-line-circuits.**

Documentation

- **Le9622 Data Sheet** *Document Number* **157378**
- **Le9632Data Sheet** *Document Number* **157379**
- **Le9643 Data Sheet** *Document Number 157127*
- **Le9653 Data Sheet** *Document Number 157152*
- **Le9622/Le9632 Product Brief** *Document Number 157380*
- **Le9643/Le9653 Product Brief** *Document Number 157126*
- **VP-API-II Reference Guide** *Document Number 143271* (*included with software download*)
- **Line Test API (LT-API) User's Guide** *Document Number 081470* (*included with software download*)
- **VeriVoice Professional Data Sheet** *Document Number 1457775 (included with software download*)

Application Notes

- **EMI Radiated Immunity** *Document Number 146127*
- **Two Layer PCB Design** *Document Number 146669*
- **VP-API II Based DTMF Detection** *Document Number 154520*

Development Hardware

Contact your sales representative for the latest Le9622 reference design hardware.

- **ZLR962282H Line Module**
    - The *ZLR962282H Line Module* features four Le9622 *miSLIC™* Line Circuits operating in SPI/PCM mode with Microsemi's Multi-line Inverting Boost topology. The multi-line design uses two independent inverting boost DC/DC converters to create the VBATL and VBATH battery supplies. Each supply is optimized for its for best efficiency and cost. The design also uses off the shelf inductors instead of a custom transformer. The supplies are designed to operate from a nominal 12V +/-2V supply.

- **ZLR963222H Line Module**
    - The *ZLR963222H Line Module* features one Le9632 *miSLIC™* Line Circuits operating in SPI/PCM mode with Microsemi's 135V Full Tracking Inverting Boost topology. The design also uses off the shelf inductors instead of a custom transformer. The supplies are designed to operate from a nominal 12V +/-3V supply.

Downloads, Firmware and Drivers

- **Le9622 and Le9632 IBIS Model,** available at **www.microsemi.com/voice-line-circuits.**

Development Software

URLs for the following software is available on the Microsemi website **www.microsemi.com/voice-line-circuits.**

- **Le71SK0002 VoicePath API-II Software**

    - The *VP-API-II* is a set of C source used by the host application to interface to the *VE880*, *VE890*, *ZL880, and miSLIC Series* and other Microsemi voice product families.

- **Le71SDKAPIL API-II Lite**

    - The *VP-API-II Lite* is identical to *VP-API-II*, with reduced functionality. *VP-API-II Lite* does not support tone or ringing cadencing, Caller ID, or Metering signal generation.

- **Le71SDKTK Microsemi CMPG Toolkit**

    - The Microsemi CMPG Toolkit application is a scripting environment that allows for the development and distribution of Tcl related collateral for Microsemi CMPG hardware and software products. The Toolkit includes several custom Microsemi CMPG Tcl extension packages, i.e. *VP-Script* and *Mini-PBX*.

    - The *VP-Script* application is intended to provide a robust interactive GUI and scripting environment for each of Microsemi CMPG's currently manufactured Microprocessor Interface (MPI) devices as well as for the next generation Host Bus Interface (HBI) devices.

    - *Mini-PBX* provides an interactive GUI for the *Voice Path API-II* and the *LT-API* libraries, i.e. *VeriVoice* and *LineCare*.

- **Le71SDKPRO Profile Wizard**

    - The *VP Profile Wizard* is a *Microsoft Windows* GUI application that aids in the organization and creation of country *Profiles* used in the *VP-API-II* into a single project file.

- **Le71SDKZTAP ZTAP Support Package**

    - The *ZTAP* is the latest in Microsemi CMPG's hardware platforms designed to provide a demonstration and development vehicle for Microsemi CMPG's voice devices. In standalone mode, it operates as a basic call control environment that will automatically run Microsemi CMPG line modules. When used with Microsemi CMPG Toolkit, devices/lines can be monitored and programmed with user specified parameters. Voice quality measurements can be made in either E1 or T1 mode by connecting standard test equipment to the *ZTAP*.

- **ZL880SLVVP VeriVoice Professional Test Suite**

    - The *VeriVoice™ Professional Test Suite* provides customers with the most cost effective, reliable VoIP line testing tools available on the market. The *VeriVoice Test Suite Software* is used in conjunction with *VoicePath™ API-II and API-II Lite* software to provide line test and self-test for select devices from the miSLIC™ Series and ZL880 VoicePort™ Series. The *VeriVoice™ Professional Test Suite* software is available in C code, allowing for easy integration and customization by a developer.

- **ZLS880VVMT VeriVoice Manufacturing Test Package**

    - The *VeriVoice™ Manufacturing Test Package* is a stand-alone, self contained test package intended to facilitate factory testing of new products based on Microsemi CMPG's *miSLIC™ Series, ZL880 Series, VE880 Series, and VE890 chipsets*. The software is distributed as a portable, platform-independent C source code module. The software is architected as a rapid set of tests which provide thorough test cover. The software eliminates the need for expensive test equipment.

- **LE71SDKWIN WinSLAC™ Software (available in Software Delivery System)**

    - The *WinSLAC™* utility is a software program that aids in the design and development of telephony interfaces and related voice band applications.

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Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
email: sales.support@microsemi.com
www.microsemi.com

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