Features

- **Cost Optimized Single Channel FXS Solution**
  - Smaller, 36-pin 4x6 mm QFN package
  - Low cost, 2-Layer PCB Reference Designs

- **Software compatible with equivalent feature set to the Le9641/Le9651**

- **Pin-Selectable PCM/SPI or ZSI Interfaces**
  - Single port 4-wire ZSI control simplifies board routing
  - Compatible with numerous VoIP processors and SoC solutions

- **Le9643 95V Peak Battery Designs**
  - Up to 60-V_{RMS} with up to 3 REN load
  - Up to 50-V_{RMS} with up to 5 REN load

- **Le9653 150V Peak Battery Designs**
  - Up to 100-V_{RMS} with up to 5 REN load

- **Energy Efficient Switching Regulator Architectures**
  - Le9643
    - Buck-Boost fixed tracking
    - Inverting-Boost tracking
  - Le9653
    - High Voltage Flyback tracking
    - High Voltage Inverting-Boost tracking
  - 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

- **Complete Wideband or Narrowband BORSCHT functionality**

- **Worldwide Programmability**

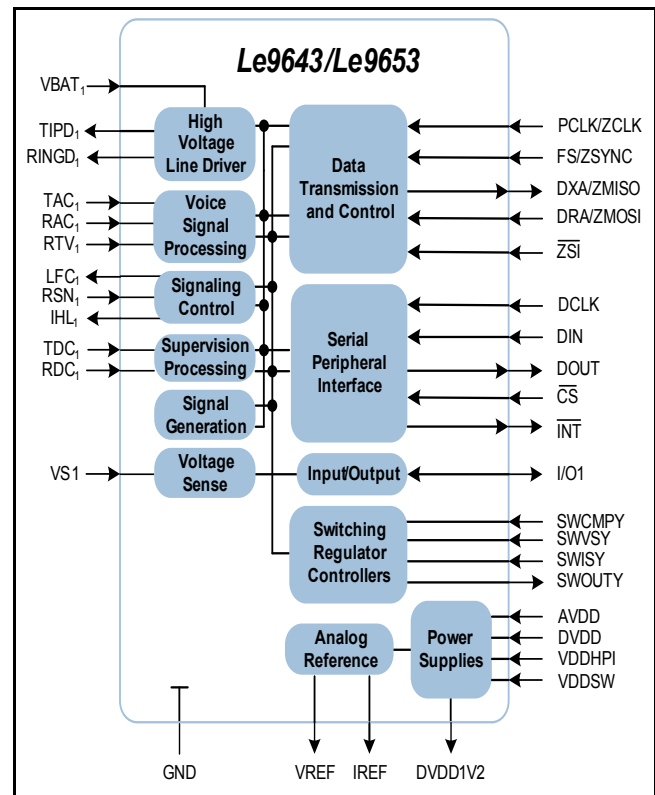Document ID# 157126   Version 3   May 2017

Applications

- **Fixed Wireless (LTE) Gateways**

- **DSL Residential Gateways and Integrated Access Devices (IADs)**

- **Cable Embedded Multimedia Terminal Adapters (eMTAs)**

- **PON Single Family Units (SFU)**

- **Fiber-to-the-premise (FTTX) solutions**

- **Analog Telephone Adapters (ATAs)**

Figure 1 - Le9643/Le9653 Block Diagram

1

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 Le9643/Le9653 miSLIC device implements a universal telephone line interface with pin-selectable PCM and SPI or ZSI serial digital interfaces. All AC, DC, and signaling parameters are fully programmable via the PCM and SPI or reduced pin-count ZSI interfaces.

The switching regulator controller generates the high voltage needed for efficiently powering and ringing analog telephones. The Le9643 supports two switching regulator architectures, both are capable of ringing 85-V_{PK}; a Buck-Boost fixed tracking switching regulator architecture which uses a fixed voltage for ringing signals, or an Inverting-Boost switcher circuit which tracks the ringing voltage during ringing. The Le9653 supports two switching regulator architectures, both are capable of ringing 140-V_{PK}; a High Voltage Flyback or a High Voltage Inverting-Boost switcher circuit both of which track the ringing voltage during ringing. 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 Le9643/Le9653 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 *Le9643/Le9653* device, *VP-API-II* and *Profiles*.
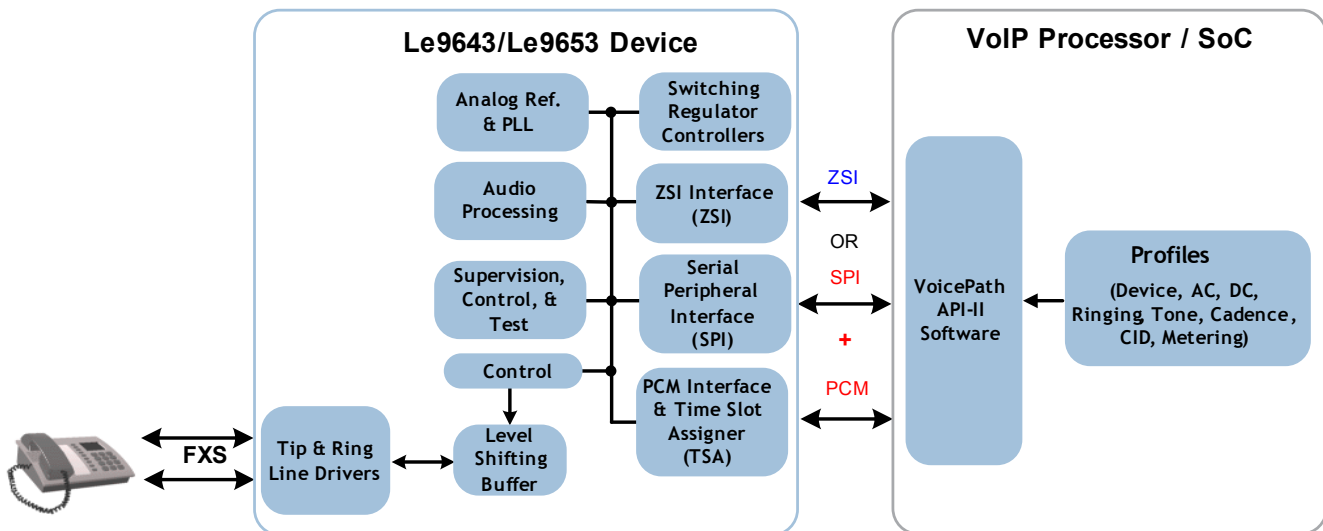
Figure 1 - Le9643/Le9653 Solution Diagram

Le9643/Le9653 Features

Feature	Le9643	Le9653
Package		
Package	4x6 mm, 36-pin QFN	4x6 mm, 36-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
VeriVoice Manufacturing Test Package	Yes	Yes
Interface		
ZSI Mode	Yes	Yes
PCM/SPI Mode	Yes	Yes
Power Supply		
Peak Battery Voltage	95V	150V
Fixed Buck Boost Power Supply Architecture	50V_{RMS} - 5 REN	N/A
Inverting Boost Power Supply Architecture	50V_{RMS} - 5 REN	100V_{RMS} - 5 REN
Flyback Power Supply Architecture	N/A	100V_{RMS} - 5 REN
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	30mA	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 - Fixed Buck Boost Power Supply Architecture	85V	N/A
Peak Ringing Voltage - Inverting Boost Power Supply Architecture	85V	140V
Peak Ringing Voltage - Flyback Power Supply Architecture	N/A	140V
Programmable Ringing waveform, frequency, DC Offset and amplitude	Yes	Yes
Programmable Ring 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 *VoicePath 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.
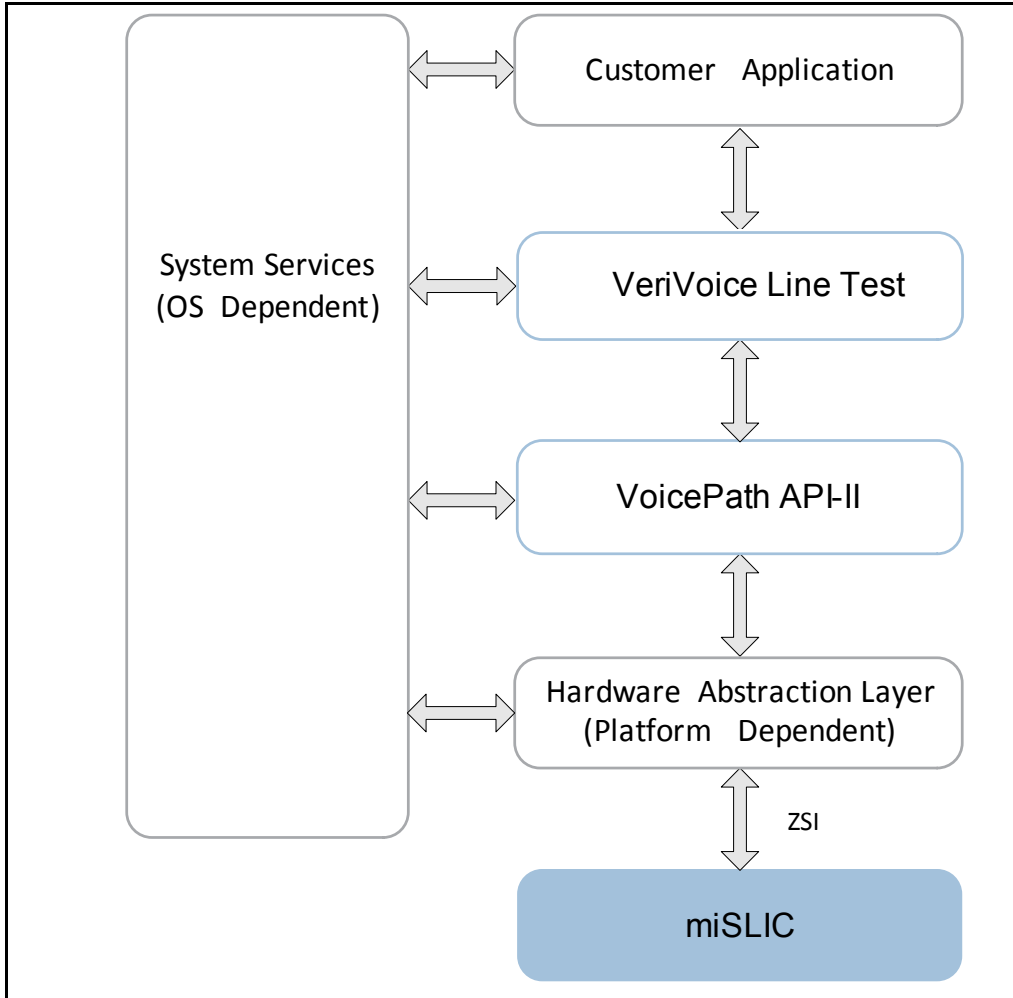
Figure 2 - VP-API-II Software Architecture

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 or multiplexed ZSI 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 Le9643 and Le9653 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 Le9643/53. The ZSI control interface is illustrated. Consult Microsemi for the most recent reference design.
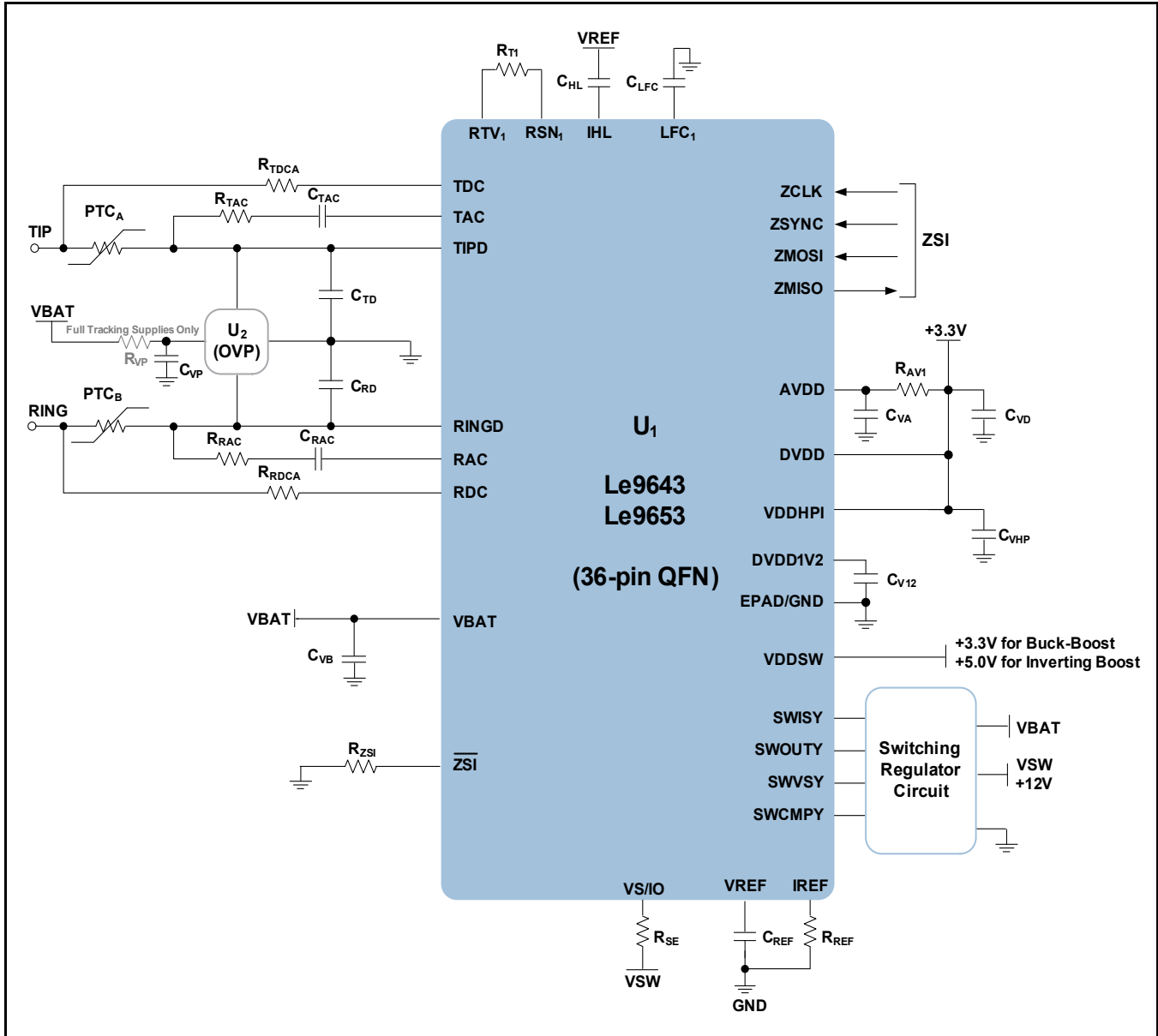

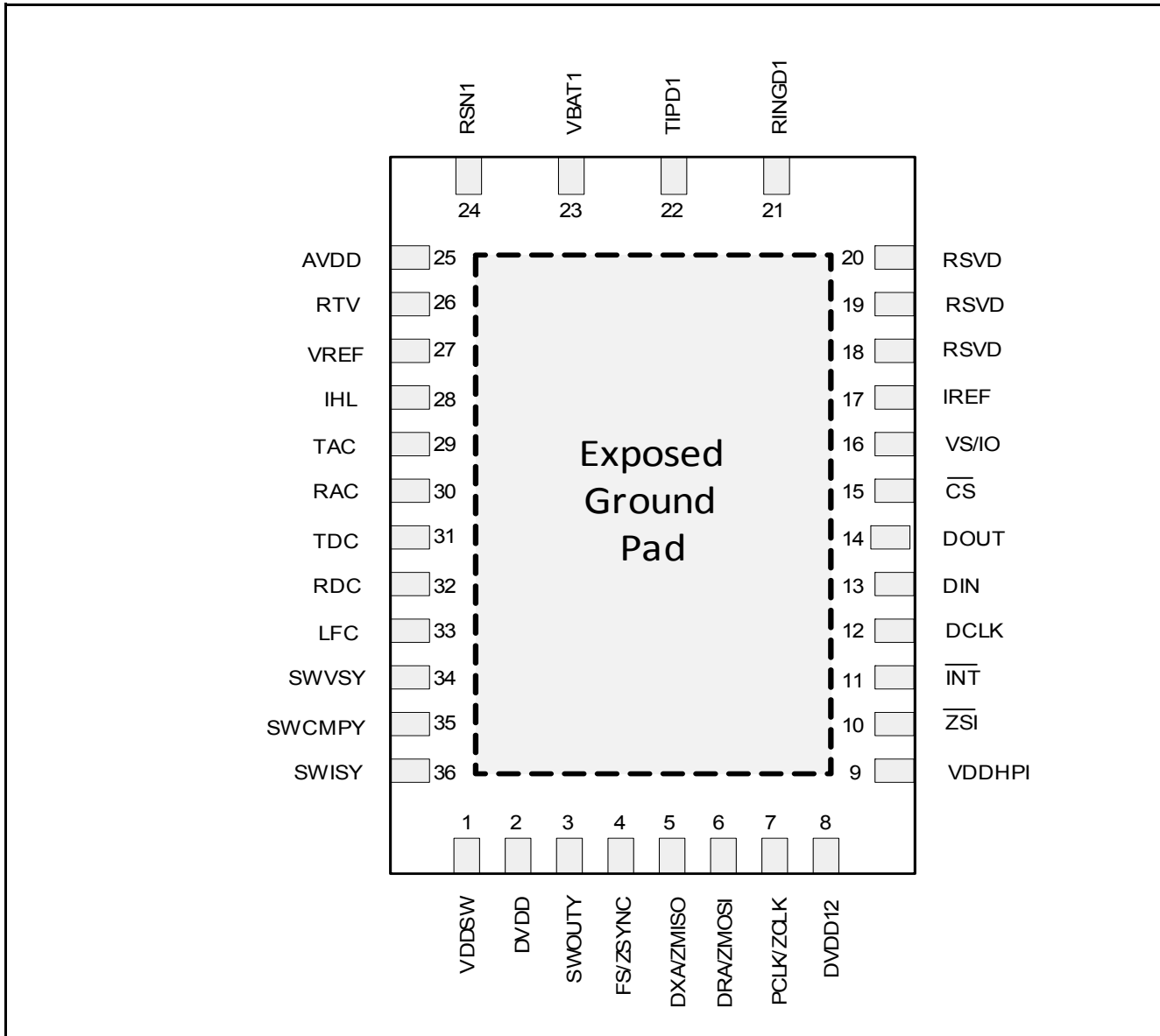**Figure 3 - Le9643/Le9653Line Interface Circuit**

Figure 4 - Le9643/Le9653 Device Pin Out (36-Pin QFN) – Top View

Collateral

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

Documentation

- Le9643 Data Sheet *Document Number 157127*
- Le9653 Data Sheet *Document Number 157152*
- 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*

IBIS Models

- Le9643 & Le9653 IBIS Models, available at **www.microsemi.com/voice-line-circuits.**

Development Hardware

Contact your sales representative for the latest Le9643 and Le9653 reference design hardware.

ZLR964321L SM2 Line Module

- *ZLR964321L Line Module -* one Le9643 operating in ZSI mode with a 1 FXS 12 V Buck-Boost battery supply

ZLR965324H SM2 Line Module

- *ZLR965324H Line Module -* one Le9643 and one Le9653 in PCM/SPI mode. The Le9643 is configured with a 1 FXS 12V Inverting-Boost battery supply and the Le9653 is configured with a 1 FXS 12V High Voltage Inverting-Boost battery.

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 MSCC Voice Line Circuits. A signed Software License Agreement (SLA) is required.

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. This software is available without an SLA.

ZL880SLVVP VeriVoice Professional Test Suite

- *VeriVoice™ Test Suite* provides GR909 Line Test Suite and additional inward tests

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.*