

# SLIC-S / TSLIC-S

Subscriber Line Interface Circuit Standard Feature Set

SLIC-S (PEF 4264), Version 2.1

SLIC-S2 (PEF 4264-2), Version 2.1

TSLIC-S (PEF 4364), Version 2.1

Preliminary  
**Data Sheet**

Revision 2.0

Communication Solutions



Never stop thinking

**Edition 2006-10-10**

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## SLIC-S / TSLIC-S Subscriber Line Interface Circuit Standard Feature Set

Revision History: 2006-10-10, Revision 2.0

Previous Version: Revision 1.0

| Page                    | Subjects (major changes since last revision)                                                                       |
|-------------------------|--------------------------------------------------------------------------------------------------------------------|
| <a href="#">Page 38</a> | <a href="#">"Recommended PCB Foot Print Pattern for PG-DSO-36-15 Package"</a> on <a href="#">Page 38</a> modified. |
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## **1 General Description**

Infineon Technologies' high voltage ringing Subscriber Line Interface Circuit SLIC-S (PEF 4264) Version 2.1 (V2.1) is the latest out of the well-known and broadly used SLIC-S family. It has been designed not only to cover all previous SLIC-S applications, but also to extend the supply voltage range to 120 V to enable balanced sinusoidal ring signals up to 65 V<sub>rms</sub>.

As SLIC-S V2.1 is pin compatible with its previous versions, it can be operated with all codec devices of the DuSLIC® or VINETIC® chip sets. The highly flexible device offers 3.3 V and 5 V compatibility. Integrated supply switches allow the choice between two negative battery voltages for voice transmission, whereas in the ring mode an additional positive supply voltage is used.

To minimize the average system power dissipation, a power-down mode can be utilized; the transmission part is switched off completely and off-hook supervision is provided by activating a simple line current sensor with negligible power consumption.

SLIC-S V2.1 is available in a single (PEF 4264) channel version in either PG-DSO-20-24 or PG-VQFN-48-15 power packages, or in a dual channel version (PEF 4364), packaged in PG-DSO-36-15.

### **1.1 Version 2.1: Summary of Changes**

Compared with the previous version of SLIC-S (PEB 4264 V1.2), the new version V2.1 is characterized by the following changes:

- Increased supply voltage range VHR - VBATH of up to 120 V
- Sinusoidal ring voltage up to 65 V<sub>rms</sub>
- High impedance DC inputs
- Fully differential receive path - VCMS pin not required
- Fast current limitation for improved overvoltage behaviour
- Electrical Parameters ([Chapter 4.5](#)):
  - Supply currents
  - Open loop resistances RTG, RRB
  - Power down open loop line voltage
  - Off-hook output current on IT
  - IT output current reverse polarity (limitation with VDD = 3.3 V)
- Application circuit:
  - 100 nF / 50 V capacitor at CEXT
  - Per channel series diode in VBATL supply mandatory (no shared diodes)

**Subscriber Line Interface Circuit Standard Feature Set**  
**SLIC-S**  
**SLIC-S2**  
**TSLIC-S**

**PEF 4264**  
**PEF 4264-2**  
**PEF 4364**

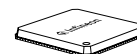
**Version 2.1**

**1.2 Features**

- High voltage SLIC with integrated ringing
- Compatible with both 3.3 and 5 V systems
- Available in single and dual-channel versions
- High-voltage line feed (long loop driving capability)
- Sensing of transversal and longitudinal line currents
- Two Battery voltages (–15 V ... –70 V)
- Positive ring supply voltage up to +70 V
- Total supply voltage up to 120 V
- Integrated balanced ringing up to 65 V<sub>rms</sub>
- High longitudinal balance performance with SLIC-S2 (PEF 4264-2)
- Power-saving active mode (ACTL) with reduced battery voltage
- Power Down mode with negligible power consumption
- Package options:
  - PG-DSO-20-24
  - PG-VQFN-48-15
  - PG-DSO-36-15 (dual channel)
- Reliable Smart Power Technology



PG-DSO-20-24



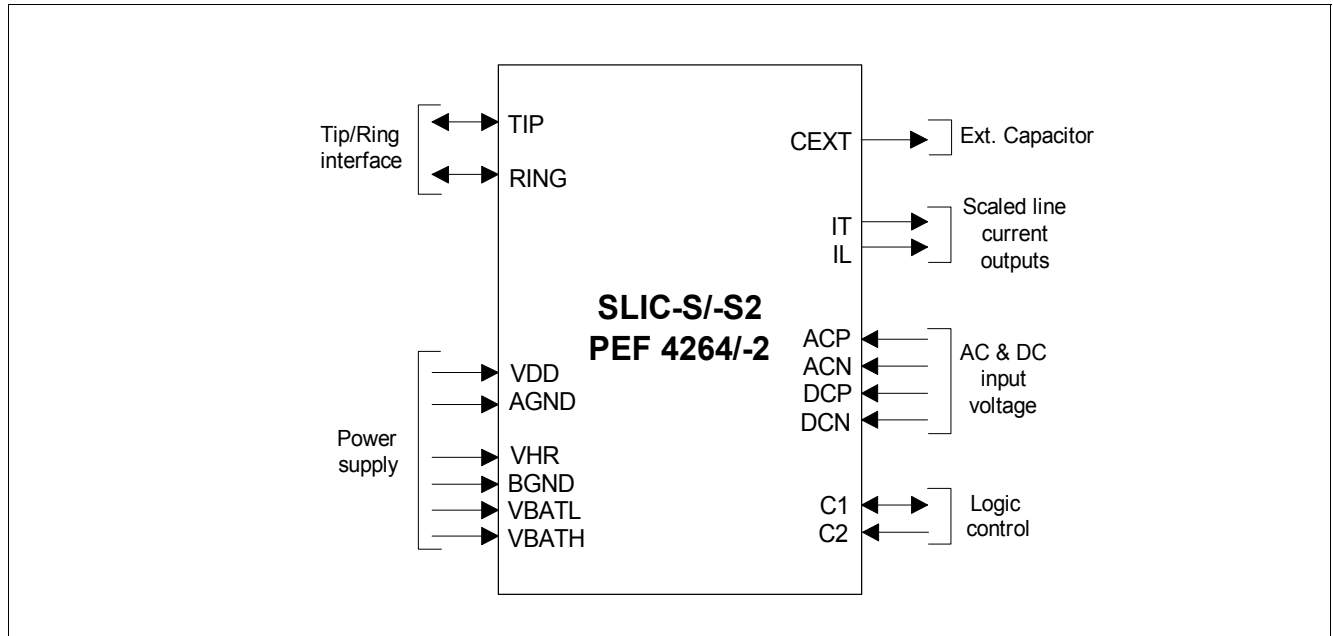
PG-VQFN-48-15



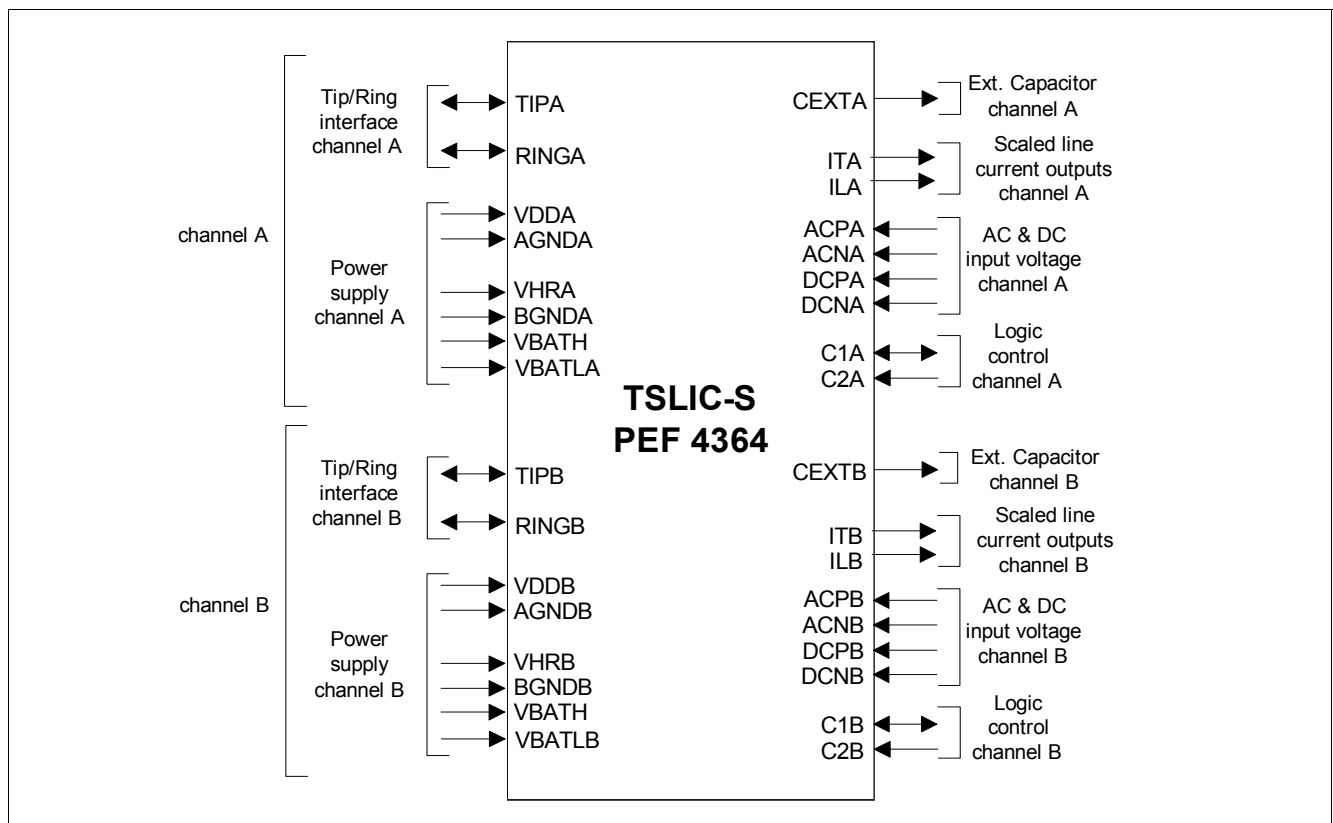
PG-DSO-36-15

| Product Name     | Product Type            | Package       |
|------------------|-------------------------|---------------|
| SLIC-S / SLIC-S2 | PEF 4264T / PEF 4264-2T | PG-DSO-20-24  |
| SLIC-S / SLIC-S2 | PEF 4264V / PEF 4264-2V | PG-VQFN-48-15 |
| TSLIC-S          | PEF 4364T               | PG-DSO-36-15  |

### 1.3 Logic Symbol



**Figure 1** Logic Symbol SLIC-S/-S2 (PEF 4264/-2)



**Figure 2** Logic Symbol TSLIC-S (PEF 4364)

## 1.4 Pin Configuration

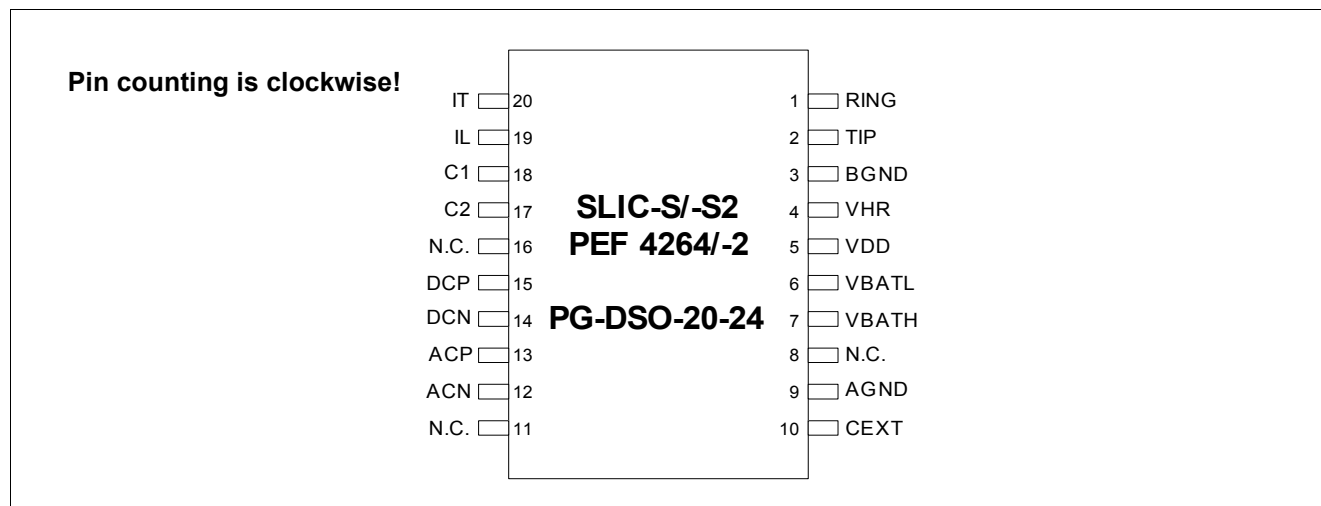


Figure 3 Pin Configuration PG-DSO-20-24 Package (top view)

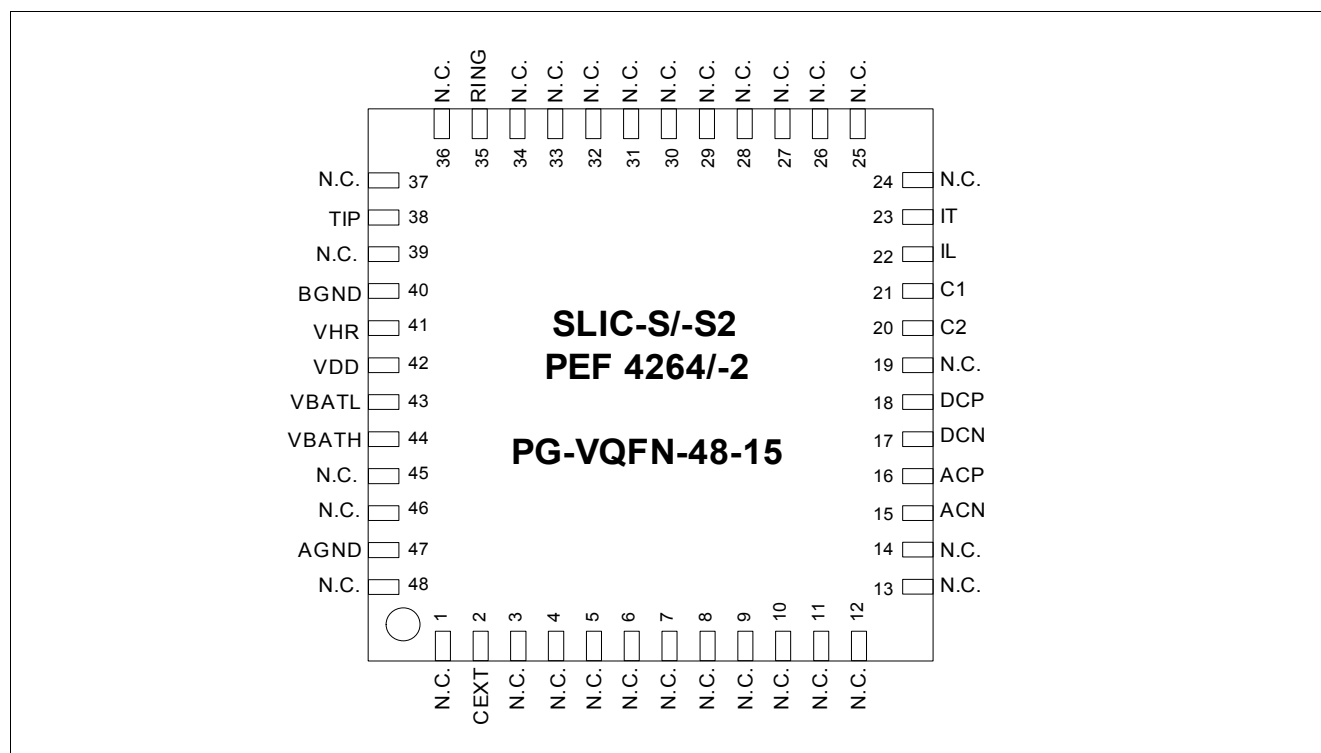


Figure 4 Pin Configuration PG-VQFN-48-15 Package (top view)

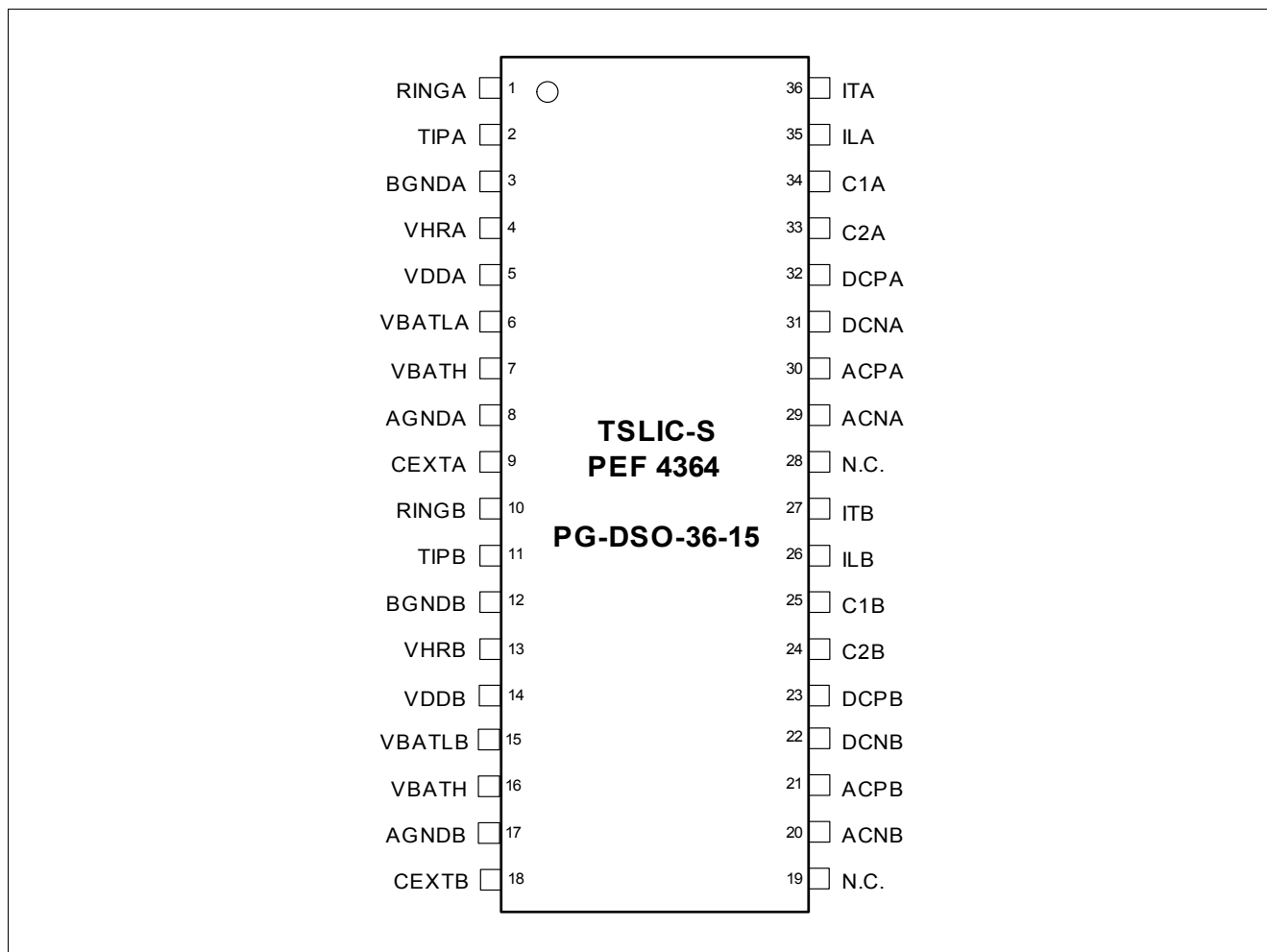


Figure 5 Pin Configuration PG-DSO-36-15 Package (dual channel) (top view)

## 1.5 Pin Definitions and Functions

**Table 1 Pin Definitions and Functions PG-DSO-20-24 and PG-VQFN-48-15**

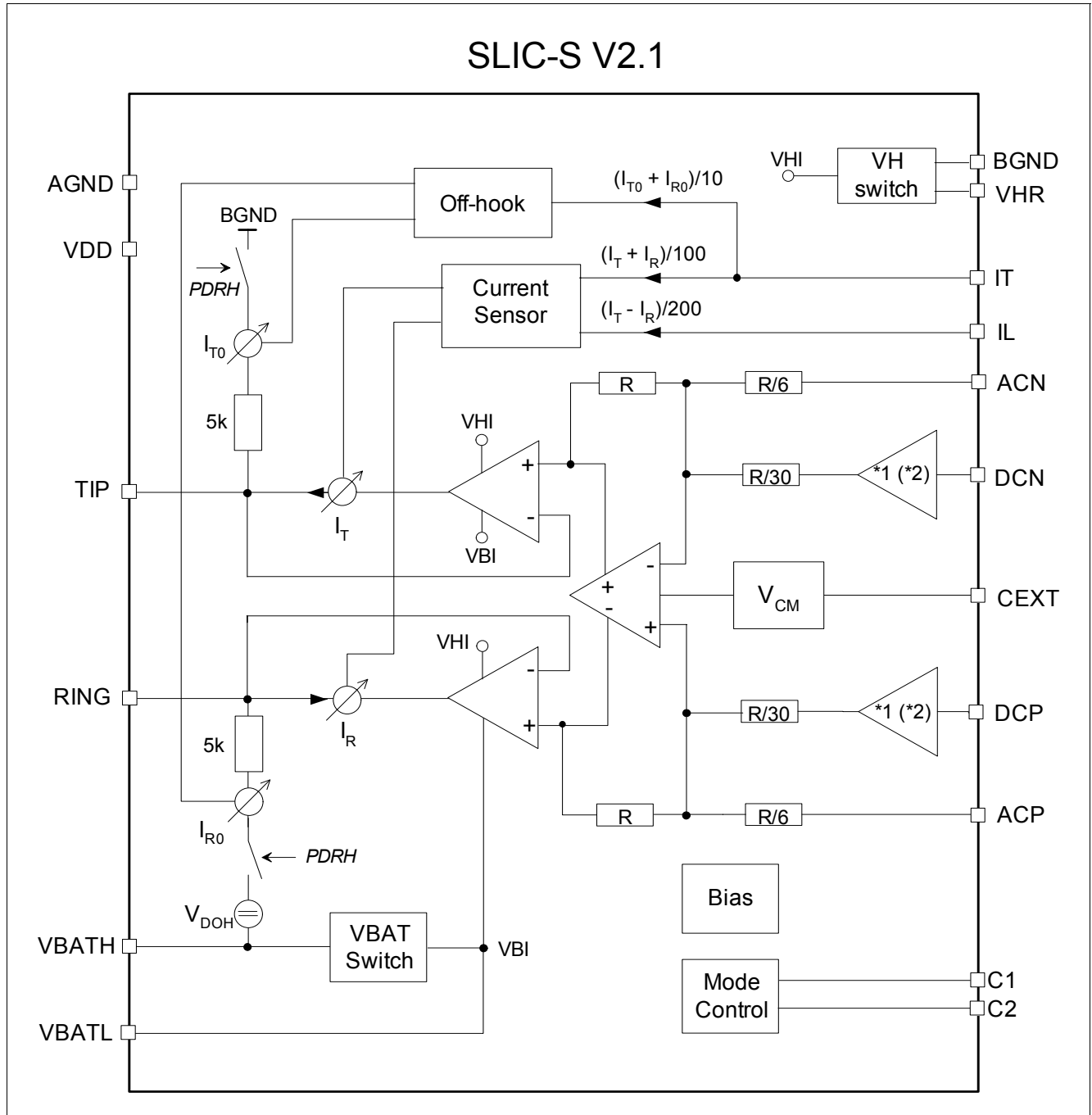
| Pin No.<br>PG-DSO-<br>20-24 | Pin No.<br>PG-VQFN-<br>48-15 | Name       | Pin<br>Type | Function                                                                                                                                                          |
|-----------------------------|------------------------------|------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                           | 35                           | RING       | I/O         | Subscriber loop connection RING                                                                                                                                   |
| 2                           | 38                           | TIP        | I/O         | Subscriber loop connection TIP                                                                                                                                    |
| 3                           | 40                           | BGND       | GND         | Battery ground: reference for TIP, RING, VBATH, VBATL and VHR                                                                                                     |
| 4                           | 41                           | VHR        | PWR         | Auxiliary positive battery supply voltage used in ringing mode<br>( $5\text{ V} \leq V_{\text{HR}} \leq 70\text{ V}$ )                                            |
| 5                           | 42                           | VDD        | PWR         | Positive supply voltage (+3.3 or +5 V), referred to AGND                                                                                                          |
| 6                           | 43                           | VBATL      | PWR         | Second negative battery supply voltage ( $-15\text{ V} \geq V_{\text{BATL}} \geq V_{\text{BATH}}$ )                                                               |
| 7                           | 44                           | VBATH      | PWR         | Most negative battery supply voltage; chip substrate potential<br>( $-20\text{ V} \geq V_{\text{BATH}} \geq -70\text{ V}$ )                                       |
| 9                           | 47                           | AGND       | GND         | Analog ground: reference for VDD and all signal and control pins except TIP and RING                                                                              |
| 10                          | 2                            | CEXT       | O           | Common mode line potential with high output resistance (160 kΩ); an external capacitance allows supply voltage filtering                                          |
| 12<br>13                    | 15<br>16                     | ACN<br>ACP | I           | ACP - ACN: differential two-wire AC input voltage; at TIP/RING amplified by -6                                                                                    |
| 14<br>15                    | 17<br>18                     | DCN<br>DCP | I           | DCP - DCN: differential DC or ring input voltage; at TIP/RING amplified by -30 (ACTL, ACTH) and -60 (ACTR mode), respectively                                     |
| 17                          | 20                           | C2         | I           | Ternary logic input, controlling the operation mode                                                                                                               |
| 18                          | 21                           | C1         | I/O         | Ternary logic input, controlling the operation mode in case of thermal overload (chip temperature exceeding 165 °C) this pin sinks a current of typically 150 μA. |
| 19                          | 22                           | IL         | O           | Current output: longitudinal line current scaled down by a factor of 100                                                                                          |
| 20                          | 23                           | IT         | O           | Current output: transversal line current scaled down by a factor of 50                                                                                            |
| 8, 11, 16                   | <sup>1)</sup>                | N.C.       |             | Not connected                                                                                                                                                     |

1) For the PG-VQFN-48-15 package the following pins are not connected:  
1,3,4,5,6,7,8,9,10,11,12,13,14,24,25,26,27,28,29,30,31,32,33,34,36,37,39,45,46,48

**Table 2 Pin Definitions and Functions PG-DSO-36-15**

| Pin No.          | Name                     | Pin Type | Function                                                                                                                                                                            |
|------------------|--------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1<br>10          | RINGA<br>RINGB           | I/O      | Subscriber loop connection RING (Channel A)<br>Subscriber loop connection RING (Channel B)                                                                                          |
| 2<br>11          | TIPA<br>TIPB             | I/O      | Subscriber loop connection TIP                                                                                                                                                      |
| 3<br>12          | BGNDA<br>BGNDDB          | GND      | Battery ground: reference for TIP, RING, VBATH, VBATL and VHR                                                                                                                       |
| 4<br>13          | VHRA<br>VHRB             | PWR      | Auxiliary positive battery supply voltage used in ringing mode<br>( $5\text{ V} \leq V_{\text{HR}} \leq 70\text{ V}$ )                                                              |
| 5<br>14          | VDDA<br>VDDDB            | PWR      | Positive supply voltage (+3.3 or +5 V), referred to AGND                                                                                                                            |
| 6<br>15          | VBATLA<br>VBATLB         | PWR      | Second negative battery supply voltage ( $-15\text{ V} \geq V_{\text{BATL}} \geq V_{\text{BATH}}$ )                                                                                 |
| 7, 16            | VBATH                    | PWR      | Most negative battery supply voltage; chip substrate potential<br>( $-20\text{ V} \geq V_{\text{BATH}} \geq -70\text{ V}$ )                                                         |
| 8<br>17          | AGNDA<br>AGNDB           | GND      | Analog ground: reference for VDD and all signal and control pins except TIP and RING                                                                                                |
| 9<br>18          | CEXTA<br>CEXTB           | O        | Common mode line potential with high output resistance (160 k $\Omega$ );<br>an external capacitance allows supply voltage filtering                                                |
| 29, 30<br>20, 21 | ACNA, ACPA<br>ACNB, ACPB | I        | ACP - ACN: differential two-wire AC input voltage; at TIP/RING<br>amplified by -6                                                                                                   |
| 31, 32<br>22, 23 | DCNA, DCPA<br>DCNB, DCPB | I        | DCP - DCN: differential DC or ring input voltage; at TIP/RING amplified<br>by -30 (ACTL, ACTH) and -60 (ACTR mode), respectively                                                    |
| 33<br>24         | C2A<br>C2B               | I        | Ternary logic input, controlling the operation mode                                                                                                                                 |
| 34<br>25         | C1A<br>C1B               | I/O      | Ternary logic input, controlling the operation mode<br>in case of thermal overload (chip temperature exceeding 165 °C) this<br>pin sinks a current of typically 150 $\mu\text{A}$ . |
| 35<br>26         | ILA<br>ILB               | O        | Current output: longitudinal line current scaled down by a factor of 100                                                                                                            |
| 36<br>27         | ITA<br>ITB               | O        | Current output: transversal line current scaled down by a factor of 50                                                                                                              |
| 19, 28           | N.C.                     |          | Not connected                                                                                                                                                                       |

## 1.6 Functional Block Diagram



**Figure 6 Block Diagram**

*Note: As in the dual channel version both channels "A" and "B" are identical, channel independent pin names (e.g. "TIP" instead of "TIPA / TIPB") are used throughout this document (with the exception of [Table 2](#))*

## 2 Functional Description

A functional block diagram is shown in [Figure 6](#).

SLIC-S V2.1 supports AC and DC control loops based on feeding a voltage  $V_{TR}$  to the line and sensing the transversal line current  $I_{Trans}$  and the longitudinal current  $I_{Long}$ .

In receive direction, DC and AC voltages are handled separately with different gains. Both are applied differentially via the codec interface pins DCP / DCN and ACP / ACN, respectively, defining the transversal line voltage  $V_{TR}$  through

$$\begin{aligned} V_{TR} &= V_{TIP} - V_{RING} = V_{ab} = \\ &= 30 * (V_{DCP} - V_{DCN}) + 6 * (V_{ACP} - V_{ACN}) \text{ for modes ACTH, ACTL} \\ &= 60 * (V_{DCP} - V_{DCN}) + 6 * (V_{ACP} - V_{ACN}) \text{ for mode ACTR} \end{aligned}$$

As the ring signal is processed in the DC path, the DC gain is doubled in the ring mode ACTR to enable the full output voltage swing.

The common mode line voltage is always equal to the mean supply voltage,  $V_{CM} = (V_{HI} + V_{BI}) / 2$ , leading to symmetrical line potentials with respect to the supplies. Depending on the operation mode,  $V_{HI}$  is switched either to  $V_{HR}$  or to BGND via the VH switch, whereas  $V_{BI}$  is connected either to  $V_{BATH}$  via the VBAT switch or to  $V_{BATL}$  via an external diode.

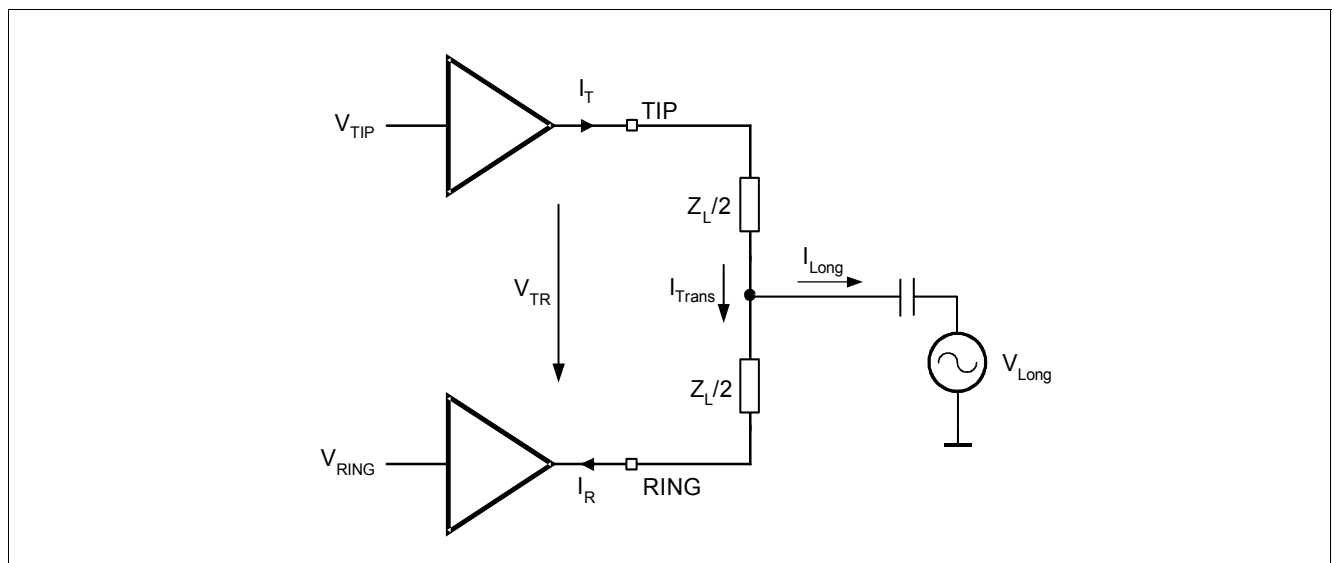
A reversed polarity of  $V_{TR}$  is easily obtained by changing the polarity of  $(V_{DCP} - V_{DCN})$ .

In transmit direction, the transversal and longitudinal line currents  $I_{Trans}$  and  $I_{Long}$  ([Figure 7](#)) are measured, and scaled images are provided at the IT and IL pins, respectively:

$$\begin{aligned} I_{IT} &= (I_T + I_R) / 100 = I_{Trans} / 50 & I_{IL} &= (I_T - I_R) / 200 = I_{Long} / 100 \\ I_{Trans} &= (I_T + I_R) / 2 & I_{Long} &= (I_T - I_R) / 2 \end{aligned}$$

For off-hook detection in PDRH mode, 5 kΩ resistors are connected from TIP to BGND and from RING to VBATH, respectively. The currents through these resistors,  $I_{T0}$  and  $I_{R0}$ , are sensed, scaled and provided at IT:

$$I_{IT0} = (I_{T0} + I_{R0}) / 10 = I_{TRANS0} / 5$$



**Figure 7 Transversal and Longitudinal Line Currents**

## 2.1 Operating Modes

SLIC-S V2.1 operates in the following modes controlled by ternary logic signals at C1 and C2:

**Table 3 SLIC-S Mode Table**

|    |                 | C2   |       |      |
|----|-----------------|------|-------|------|
|    |                 | L    | M     | H    |
| C1 | L <sup>1)</sup> | PDH  | PDRHL | PDRH |
|    | M               | ACTL | ACTH  | ACTR |
|    | H               | HIRT | HIT   | HIR  |

1) No 'Overtemp' signaling possible via pin C1, if C1 is low.

**Table 4 SLIC-S Modes and Supplies**

| Mode         | Mode Description               | Internal Supply Voltages $V_{BI}$ , $V_{HI}$ |
|--------------|--------------------------------|----------------------------------------------|
| <b>PDH</b>   | Power Down High Impedance      | VBATH, VH switch open                        |
| <b>PDRH</b>  | Power Down Resistive High      | VBATH, VH switch open                        |
| <b>PDRHL</b> | Power Down Resistive High Load | VBATH, VH switch open                        |
| <b>ACTL</b>  | Active Low                     | VBATL, BGND                                  |
| <b>ACTH</b>  | Active High                    | VBATH, BGND                                  |
| <b>ACTR</b>  | Active Ring                    | VBATH, VHR                                   |
| <b>HIRT</b>  | High Impedance on RING and TIP | VBATH, VHR                                   |
| <b>HIT</b>   | High Impedance on TIP          | VBATH, VHR                                   |
| <b>HIR</b>   | High Impedance on RING         | VBATH, VHR                                   |

### Power Down High Impedance (PDH)

PDH offers high impedance at TIP and RING; it can be used for testing purposes or when an error condition occurs. In PDH mode all functions are switched off. Off-hook detection is not available.

### Power Down Resistive High (PDRH)

Power consumption is reduced to a minimum by switching completely off all voice transmission functions. To allow off-hook detection, PDRH provides a connection of 5 k $\Omega$  each from TIP to BGND and RING to VBATH, respectively, while the output buffers show high impedance (see [Figure 6](#)). The current through these resistors is sensed, scaled by 1/5 and transferred to the IT pin for off-hook supervision.

### Power Down Resistive High Load (PDRHL)

PDRHL is used as a transition state from Power Down to Active modes (automatically initiated during a mode change). It causes fast preloading of CEXT in order to suppress line voltage transients.

### Active Low (ACTL), Active High (ACTH)

These are the regular transmission modes for voiceband. The line-driving section is operated between BGND and VBATL (ACTL) or VBATH (ACTH).

### Active Ring (ACTR)

Utilizing an additional positive battery voltage  $V_{HR}$ , this mode allows balanced ringing of up to 65 Vrms or feeding of very long telephone lines. In ACTR mode the DC voltage gain is doubled to 60.

**High Impedance (HIR, HIT, HIRT)**

In these modes each of the line outputs can be programmed to show high impedance. HIT switches off the TIP buffer, while HIR switches off the RING buffer. The current through the active buffer is still sensed. In the HIRT mode both buffers show high impedance. The current sensor remains active thus allowing sensor offset calibration (for test purposes).

**2.2 Current Limitation / Overtemperature Protection**

In any operating mode the total current delivered by the output drivers is limited to typically 85 mA.

If, however, the junction temperature exceeds 165 °C, the current limit is further reduced to keep the junction temperature constant.

Simultaneously, pin C1 sinks a signalling current  $I_{\text{therm}}$ .

### 3 Typical Application Circuit for DuSLIC® and VINETIC®

**Figure 8** to **Figure 9** show one channel of application circuits including SLIC-S / TSLIC-S V2.1 and SLICOFI®-2/-2S or VINETIC® codec (please refer to the latest DuSLIC® or VINETIC® Data Sheet).

In **Table 5** the recommended external components for a dual channel DuSLIC® or VINETIC® system and their typical values are listed.

**Table 5 External Components DuSLIC® / VINETIC® for 2 Channels**

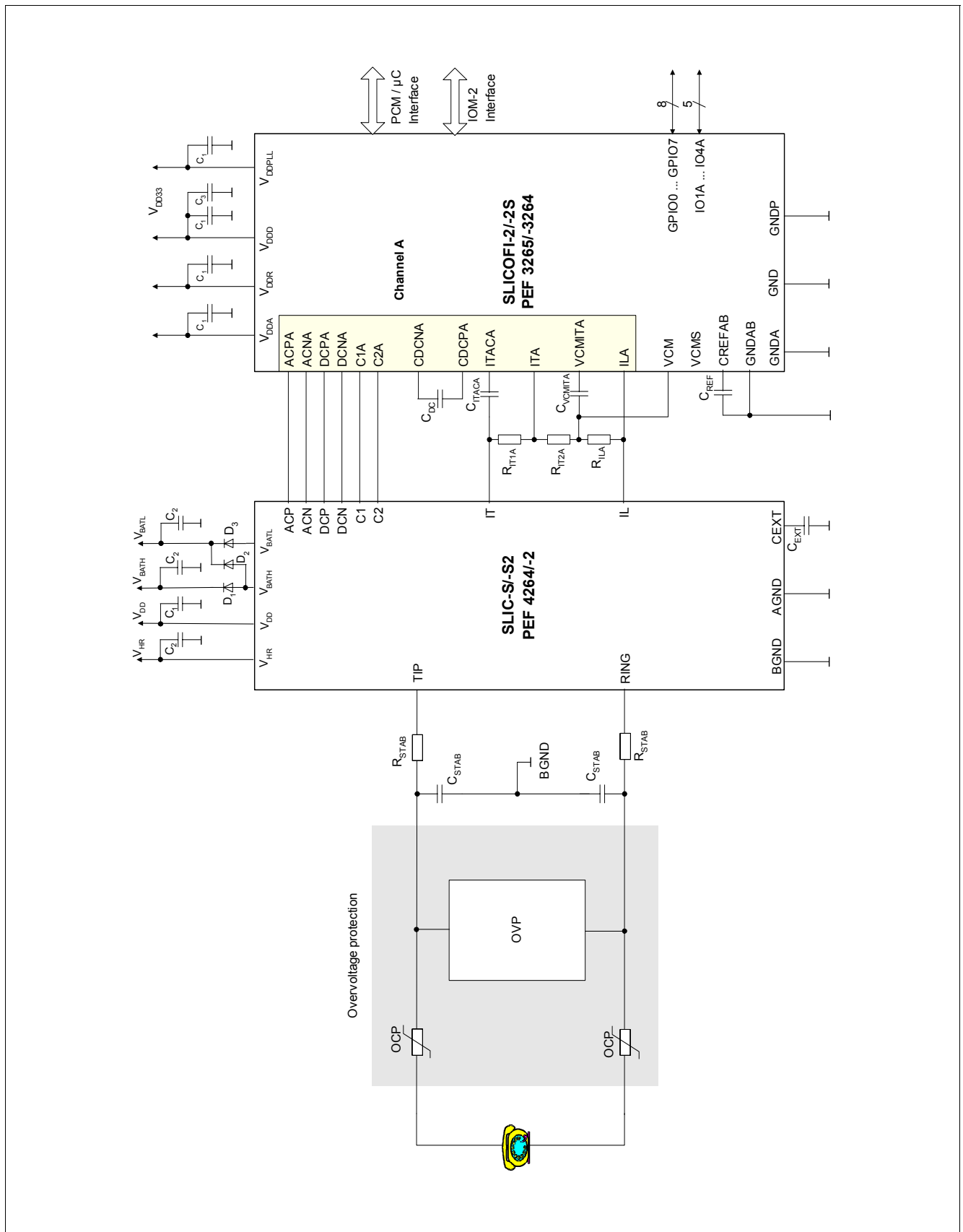
| No. | Symbol              | Value                                        | Unit       | Relat. Tol.       | Rating       | DuSLIC® Systems | VINETIC® Systems |
|-----|---------------------|----------------------------------------------|------------|-------------------|--------------|-----------------|------------------|
| 2   | $R_{IT1}$           | 470                                          | $\Omega$   | 1 %               | —            | x               | —                |
| 2   | $R_{IT1}$           | 510                                          | $\Omega$   | 1 %               | —            | —               | x                |
| 2   | $R_{IT2}$           | 680                                          | $\Omega$   | 1 %               | —            | x               | x                |
| 2   | $R_{IL}$            | 1.6                                          | k $\Omega$ | 1 %               | —            | x               | x                |
| 4   | $R_{STAB}$          | 30                                           | $\Omega$   | 1 % <sup>1)</sup> | —            | x               | x                |
| 4   | $C_{STAB}$          | 15                                           |            |                   | 100 V        | x               | x                |
| 2   | $C_{DC}$            | 120                                          | nF         | 10 %              | 10 V         | x               | —                |
| 2   | $C_{DC}$            | 220                                          | nF         | 10 %              | 10 V         | —               | x <sup>2)</sup>  |
| 2   | $C_{ITAC}$          | 680                                          | nF         | 10 %              | 10 V         | x               | —                |
| 2   | $C_{ITAC}$          | 1                                            | $\mu$ F    | 10 %              | 10 V         | —               | x                |
| 1   | $C_{PRE}$           | 18                                           | nF         | 5 %               | 10 V         | —               | x                |
| 2   | $C_{VCMIT}$         | 680                                          | nF         | 10 %              | 10 V         | x               | —                |
| 1   | $C_{REF}$           | 68                                           | nF         | 20 %              | 10 V         | x               | x                |
| 2   | $C_{EXT}$           | 100                                          | nF         | 20 %              | 50 V         | x               | x                |
| 6   | $C_1$               | 100                                          | nF         | 10 %              | 10 V         | x               | —                |
| 13  | $C_1$               | 100                                          | nF         | 10 %              | 10 V         | —               | x                |
| 6   | $C_2$               | 100                                          | nF         | 10 %              | 100 V        | x               | x                |
| 1   | $C_3$               | 4.7                                          | $\mu$ F    | 20 %              | 10 V, Tantal | x               | —                |
| 4   | $D_1, D_2$          | BAS 21                                       | —          | —                 | —            | x               | x                |
| 2   | $D_3$ <sup>3)</sup> | BAS 21                                       | —          | —                 | —            | x               | x                |
| 2   | OVP <sup>4)</sup>   | Overvoltage Protection (e.g. thyristor)      | —          | —                 | —            | x               | x                |
| 4   | OCP <sup>4)</sup>   | Overcurrent Protection (e.g. LFR, fuse, PTC) | —          | —                 | —            | x               | x                |

1) Matching tolerance depends on longitudinal balance requirements (for details see [2]).

2) With VINETIC®-2CPE this capacitance is substituted by 100 nF between DCN and DCP.

3) Due to the changed battery switch concept (see **Figure 6**), the VBATL series diode must not be shared between different channels; one diode per channel is mandatory (also for applications with TSLIC-S).

4) See [1]



**Figure 8      Application Circuit DuSLIC®**

Typical Application Circuit for DuSLIC® and VINETIC®

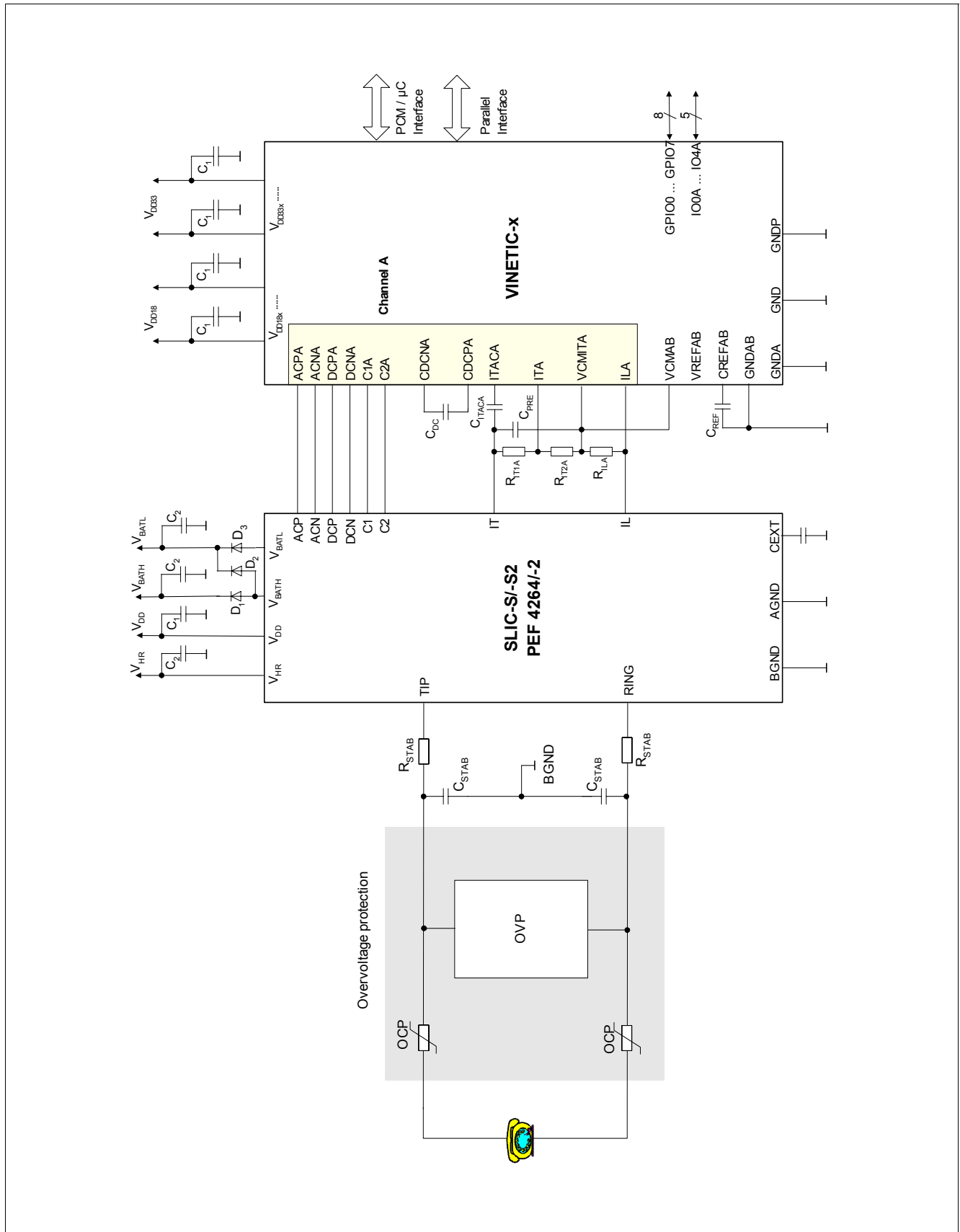


Figure 9 Application Circuit VINETIC®

## 4 Electrical Characteristics

### 4.1 Absolute Maximum Ratings

**Table 6 Absolute Maximum Ratings**

| Parameter                                | Symbol                                                       | Values |      |                | Unit | Note / Test Condition                     |
|------------------------------------------|--------------------------------------------------------------|--------|------|----------------|------|-------------------------------------------|
|                                          |                                                              | Min.   | Typ. | Max.           |      |                                           |
| Battery voltage low                      | $V_{BATL}$                                                   | -70    | –    | 0.4            | V    | Referred to BGND                          |
| Battery voltage high                     | $V_{BATH}$                                                   | -75    | –    | 0.4            | V    | Referred to BGND                          |
| Battery voltage difference               | $V_{BATL} - V_{BATH}$                                        | -0.4   | –    | –              | V    | –                                         |
| Auxiliary supply voltage                 | $V_{HR}$                                                     | -0.4   | –    | 75             | V    | Referred to BGND                          |
| Total battery supply voltage, continuous | $V_{HR} - V_{BATH}$                                          | -0.4   | –    | 125            | V    | –                                         |
| $V_{DD}$ supply voltage                  | $V_{DD}$                                                     | -0.4   | –    | 7              | V    | Referred to AGND                          |
| Ground voltage difference                | $V_{BGND} - V_{AGND}$                                        | -0.4   | –    | 0.4            | V    | –                                         |
| Input voltages                           | $V_{DCP}, V_{DCN}, V_{ACP}, V_{ACN}, V_{C1}, V_{C2}, V_{C3}$ | -0.4   | –    | $V_{DD} + 0.4$ | V    | Referred to AGND                          |
| Junction temperature                     | $T_j$                                                        | –      | –    | 150            | °C   | –                                         |
| ESD voltage, all pins                    | –                                                            | –      | –    | 1              | kV   | SDM (Socketed Device Model) <sup>1)</sup> |
|                                          | –                                                            | –      | –    | 1              | kV   | HBM (Human Body Model) <sup>1)</sup>      |

1) EOS/ESD Assn. Standard DS5.3-1993.

**Attention: Stresses exceeding the max. values listed above may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.**

### 4.2 Foreign Line Voltages

External voltages applied at the line outputs may cause large currents in the SLIC. The resulting on-chip power dissipation has to be limited to avoid thermal destruction, if the overtemperature protection cannot react sufficiently fast due to high local power density. The safe power dissipation values are strongly dependent on duration. They can be expressed in terms of voltage and current limits directly at the TIP and RING pins (see [Table 7](#) and [Table 8](#)).

**Table 7 Voltage Limits on Output Pins**

| Voltage Duration | Pins      | Min. Voltage [V] | Max. Voltage [V] |
|------------------|-----------|------------------|------------------|
| Continuous       | TIP, RING | $V_{BATH} - 0.4$ | $V_{HR} + 5$     |
| < 10 ms          | TIP, RING | $V_{BATH} - 5$   | $V_{HR} + 10$    |
| < 100 $\mu$ s    | TIP, RING | $V_{BATH} - 10$  | $V_{HR} + 20$    |
| < 1 $\mu$ s      | TIP, RING | $V_{BATH} - 15$  | $V_{HR} + 20$    |

**Table 8 Current Limits on Output Pins**

| Current Duration | Pins      | Min. current [A] | Max. current [A] |
|------------------|-----------|------------------|------------------|
| Continuous       | TIP, RING | – 0.1            | 0.1              |
| < 10 ms          | TIP, RING | – 0.5            | 0.5              |
| < 100 $\mu$ s    | TIP, RING | – 1.0            | 1.0              |
| < 1 $\mu$ s      | TIP, RING | – 1.5            | 1.5              |

The above limitations have to be regarded as typical. They are valid simultaneously. Together with external circuitry they determine protection requirements (see [1]).

### 4.3 Operating Range

**Table 9 Operating Range**

| Parameter                                        | Symbol                | Values   |      |                   | Unit | Note / Test Condition |
|--------------------------------------------------|-----------------------|----------|------|-------------------|------|-----------------------|
|                                                  |                       | Min.     | Typ. | Max.              |      |                       |
| Battery voltage L <sup>1)</sup>                  | $V_{BATL}$            | –65      | –    | –15               | V    | Referred to BGND      |
| Battery voltage H <sup>1)</sup>                  | $V_{BATH}$            | –70      | –    | –20               | V    | Referred to BGND      |
| Auxiliary supply voltage                         | $V_{HR}$              | $V_{DD}$ | –    | 70                | V    | Referred to BGND      |
| Total battery supply voltage                     | $V_{HR} - V_{BATH}$   | –        | –    | 120               | V    | –                     |
| $V_{DD}$ supply voltage                          | $V_{DD}$              | 3.15     | –    | 5.5               | V    | Referred to AGND      |
| Ground voltage difference                        | $V_{BGND} - V_{AGND}$ | –0.4     | –    | 0.4               | V    | –                     |
| Voltage at pins IT, IL                           | $V_{IT}, V_{IL}$      | –0.4     | –    | $V_{DD} - 0.6$    | V    | Referred to AGND      |
| Input range $V_{DCP}, V_{DCN}, V_{ACP}, V_{ACN}$ |                       | 0        | –    | 3.3               | V    | Referred to AGND      |
| Ambient temperature                              | $T_{amb}$             | –40      | –    | 85                | °C   | –                     |
| Junction temperature                             | $T_J$                 | –        | –    | 125 <sup>2)</sup> | °C   | –                     |

1) If the battery switch is not used, VBATL has to be connected with VBATH

2) Operation up to  $T_J = 150$  °C possible. However, a permanent junction temperature exceeding 125 °C could degrade device reliability.

### 4.4 Thermal Resistances

**Table 10 Thermal Resistances**

| Parameter           | Symbol       | Values |      |      | Unit | Note / Test Condition                                                                                                                           |
|---------------------|--------------|--------|------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
|                     |              | Min.   | Typ. | Max. |      |                                                                                                                                                 |
| Junction to case    | $R_{th, jC}$ | –      | 2    | –    | K/W  | All packages                                                                                                                                    |
| Junction to ambient | $R_{th, jA}$ | –      | 50   | –    | K/W  | PG-DSO-20-24 without heatsink                                                                                                                   |
|                     |              | –      | 20   | –    | K/W  | PG-DSO-20-24 with heatsink<br>PG-DSO-36-15, 4-layer JEDEC PCB with vias, die pad soldered to PCB (footprint see <a href="#">Chapter 6.3.1</a> ) |
|                     |              | –      | 25   | –    | K/W  | PG-VQFN-48-15, 4-layer JEDEC PCB with vias, die pad soldered to PCB (footprint see <a href="#">Chapter 6.2.1</a> )                              |

## 4.5 Electrical Parameters

Unless otherwise stated, minimum and maximum values are valid within the full operating range.

Testing is performed according to the specific test figures at  $V_{BATH} = -48\text{ V}$ ,  $V_{BATL} = -24\text{ V}$ ,  $V_{HR} = +32\text{ V}$  and  $V_{DD} = +3.3\text{ V}$ .

Functionality and performance is guaranteed for  $T_A = 0$  to  $70\text{ °C}$  by production testing. Extended temperature range operation at  $-40\text{ °C} < T_A < 85\text{ °C}$  is guaranteed by design, characterization and periodically sampling and testing production devices at the temperature extremes.

### 4.5.1 Supply Currents and Power Dissipation

**Table 11** Supply Currents, Power Dissipation ( $I_R = I_T = 0$ ;  $V_{TR} = 0$ ; one channel)

| Parameter                                            | Symbol     | Values |      |      | Unit | Note /<br>Test Condi<br>on | No. |
|------------------------------------------------------|------------|--------|------|------|------|----------------------------|-----|
|                                                      |            | Min.   | Typ. | Max. |      |                            |     |
| Power Down High Impedance, Power Down Resistive High |            |        |      |      |      |                            |     |
| $V_{DD}$ current                                     | $I_{DD}$   | –      | 250  | 350  | μA   | –                          | 1   |
| $V_{BATH}$ current                                   | $I_{BATH}$ | –      | 40   | 80   | μA   | –                          | 2   |
| $V_{BATL}$ current                                   | $I_{BATL}$ | –      | 0    | 10   | μA   | –                          | 3   |
| $V_{HR}$ current                                     | $I_{HR}$   | –      | 0    | 10   | μA   | –                          | 4   |
| Active Low                                           |            |        |      |      |      |                            |     |
| $V_{DD}$ current                                     | $I_{DD}$   | –      | 2.2  | 2.8  | mA   | –                          | 5   |
| $V_{BATH}$ current                                   | $I_{BATH}$ | –      | 40   | 80   | μA   | –                          | 6   |
| $V_{BATL}$ current <sup>1)</sup>                     | $I_{BATL}$ | –      | 3.3  | 4    | mA   | –                          | 7   |
| $V_{HR}$ current                                     | $I_{HR}$   | –      | 0    | 10   | μA   | –                          | 8   |
| Active High                                          |            |        |      |      |      |                            |     |
| $V_{DD}$ current                                     | $I_{DD}$   | –      | 2.6  | 3.2  | mA   | –                          | 9   |
| $V_{BATH}$ current <sup>2)</sup>                     | $I_{BATH}$ | –      | 3.8  | 4.5  | mA   | –                          | 10  |
| $V_{BATL}$ current                                   | $I_{BATL}$ | –      | 0    | 10   | μA   | –                          | 11  |
| $V_{HR}$ current                                     | $I_{HR}$   | –      | 0    | 10   | μA   | –                          | 12  |
| Active Ring                                          |            |        |      |      |      |                            |     |
| $V_{DD}$ current                                     | $I_{DD}$   | –      | 1.5  | 2    | mA   | –                          | 13  |
| $V_{BATH}$ current <sup>3)</sup>                     | $I_{BATH}$ | –      | 3.5  | 4.3  | mA   | –                          | 14  |
| $V_{BATL}$ current                                   | $I_{BATL}$ | –      | 0    | 10   | μA   | –                          | 15  |
| $V_{HR}$ current <sup>4)</sup>                       | $I_{HR}$   | –      | 1.8  | 2.3  | mA   | –                          | 16  |
| High Impedance on TIP or RING (HIR, HIT)             |            |        |      |      |      |                            |     |
| $V_{DD}$ current                                     | $I_{DD}$   | –      | 1.5  | 2    | mA   | –                          | 17  |
| $V_{BATH}$ current                                   | $I_{BATH}$ | –      | 2.9  | 3.6  | mA   | –                          | 18  |
| $V_{BATL}$ current                                   | $I_{BATL}$ | –      | 0    | 10   | μA   | –                          | 19  |
| $V_{HR}$ current                                     | $I_{HR}$   | –      | 1.3  | 1.7  | mA   | –                          | 20  |
| High Impedance on TIP and RING (HIRT)                |            |        |      |      |      |                            |     |
| $V_{DD}$ current                                     | $I_{DD}$   | –      | 1.4  | 1.8  | mA   | –                          | 21  |
| $V_{BATH}$ current                                   | $I_{BATH}$ | –      | 2.2  | 2.8  | mA   | –                          | 22  |

**Electrical Characteristics**
**Table 11 Supply Currents, Power Dissipation** ( $I_R = I_T = 0$ ;  $V_{TR} = 0$ ; one channel) (cont'd)

| Parameter          | Symbol     | Values |      |      | Unit | Note / Test Condition | No. |
|--------------------|------------|--------|------|------|------|-----------------------|-----|
|                    |            | Min.   | Typ. | Max. |      |                       |     |
| $V_{BATL}$ current | $I_{BATL}$ | —      | 0    | 10   | μA   | —                     | 23  |
| $V_{HR}$ current   | $I_{HR}$   | —      | 0.8  | 1.1  | mA   | —                     | 24  |

- 1) Current depending on supply voltage:  $I_{BATL}(V_{BATL}) = I_{BATL}(-24\text{ V}) + (-V_{BATL} - 24) / 40\text{ k}\Omega$
- 2) Current depending on supply voltage:  $I_{BATH}(V_{BATH}) = I_{BATH}(-48\text{ V}) + (-V_{BATH} - 48) / 40\text{ k}\Omega$
- 3) Current depending on line voltage:  $I_{BATH}(V_{TR}) = I_{BATH}(0) + |V_{TR}| / 40\text{ k}\Omega$
- 4) Current depending on line voltage:  $I_{HR}(V_{TR}) = I_{HR}(0) + |V_{TR}| / 60\text{ k}\Omega$

The total power dissipated in the SLIC consists of the quiescent power  $P_Q$  due to the supply currents and the output stage power  $P_O$  caused by any line current  $I_{Trans}$  (see [Table 12](#)).

$$P_{tot} = P_Q + P_O$$

$$\text{with } P_Q = V_{DD} * I_{DD} + |V_{BATH}| * I_{BATH} + |V_{BATL}| * I_{BATL} + V_{HR} * I_{HR}$$

**Table 12 Output Stage Power Dissipation**

| Operating Mode | Equation for $P_O$ Calculation                                                                                                                          | Comment                                                                            |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| ACTL           | $P_O = (1.05 *  V_{BATL}  - V_{TR}) * I_{Trans}$                                                                                                        | —                                                                                  |
| ACTH           | $P_O = (1.05 *  V_{BATH}  - V_{TR}) * I_{Trans}$                                                                                                        | —                                                                                  |
| ACTR           | $P_O = (1.02 * V_{HR} + 1.05 *  V_{BATH}  - V_{TR}) * I_{Trans}$<br>$P_O = [4 * (V_H +  V_{BATH} ) - \pi * V_P * \cos \varphi] * V_P / (2 * \pi * Z_L)$ | Ohmic load<br>complex load $Z = Z_L e^{j\varphi}$ ,<br>$V_P$ ... peak ring voltage |

For the dual channel version, the power values of each channel have to be added to yield the total power dissipation.

## 4.5.2 DC Characteristics

**Table 13 DC Characteristics ( $V_{ACP} = V_{ACN} = 1.5\text{ V}$ )**

| Parameter                                                                | Symbol                             | Values |      |       | Unit | Note / Test Condition                                                                                           | No. |
|--------------------------------------------------------------------------|------------------------------------|--------|------|-------|------|-----------------------------------------------------------------------------------------------------------------|-----|
|                                                                          |                                    | Min.   | Typ. | Max.  |      |                                                                                                                 |     |
| Line Termination TIP, RING                                               |                                    |        |      |       |      |                                                                                                                 |     |
| Differential DC line voltage                                             | $V_{TR, DC}$                       | -0.4   | 0    | 0.4   | V    | $V_{DCP} = V_{DCN} = 1.5\text{ V}$<br>Modes: ACTx                                                               | 25  |
|                                                                          |                                    | 23.5   | 24   | 24.5  | V    | $V_{DCP} - V_{DCN} = 0.8\text{ V}$<br>Mode: ACTH                                                                | 26  |
|                                                                          |                                    | -24.5  | -24  | -23.5 | V    | $V_{DCP} - V_{DCN} = -0.8\text{ V}$<br>Mode: ACTH                                                               | 27  |
| Common mode DC line voltage                                              | $V_{TIP, DC} = V_{RING, DC}$       | -13    | -12  | -11   | V    | Mode: ACTL                                                                                                      | 28  |
|                                                                          |                                    | -25    | -24  | -23   | V    | Mode: ACTH                                                                                                      | 29  |
|                                                                          |                                    | -10    | -9   | -8    | V    | Mode: ACTR                                                                                                      | 30  |
| DC line voltage drop (see <a href="#">Figure 10</a> )                    | $-V_{BATH} - V_{TR, max}$          | —      | 2.5  | 3     | V    | $I_{Trans, DC} = 20\text{ mA}$<br>$V_{DCP} - V_{DCN} = 2.5\text{ V}$<br>Temp = 25°C <sup>1)</sup><br>Mode: ACTH | 31  |
| Output current limit (see <a href="#">Figure 15</a> )                    | $ I_{R, max} ,  I_{T, max} $       | 70     | 85   | 100   | mA   | $V_T, V_R = 0$ (sinking)                                                                                        | 32  |
|                                                                          |                                    | 80     | 100  | 120   | mA   | $V_T, V_R = V_{BATx}$ (sourcing)<br>Temp = 25°C <sup>2)</sup>                                                   | 33  |
| Open loop resistance TIP to $V_{BGND}$ (see <a href="#">Figure 16</a> )  | $R_{TG}$                           | 4.2    | 5    | 5.8   | kΩ   | Temp = 25°C <sup>3)</sup><br>Mode: PDRH                                                                         | 34  |
| Open loop resistance RING to $V_{BATH}$ (see <a href="#">Figure 16</a> ) | $R_{RB}$                           | 4.2    | 5    | 5.8   | kΩ   | Temp = 25°C <sup>3)</sup><br>Mode: PDRH                                                                         | 35  |
| Power down open loop line voltage                                        | $V_{TR, PD} = -V_{BATH} - V_{DOH}$ | 42     | 44   | 47    | V    | Mode: PDRH                                                                                                      | 36  |
| Power down output leakage current                                        | $I_{Leak, R}$                      | -10    | —    | 10    | μA   | $V_{BATH} < V_{T/R} < 0$                                                                                        | 37  |
|                                                                          | $I_{Leak, T}$                      | -10    | —    | 10    | μA   | Mode: PDH                                                                                                       | 38  |
| High impedance output leakage current                                    | $I_{Leak, R}$                      | -10    | —    | 10    | μA   | $V_{BATH} < V_R < V_{HR}$<br>Mode: HIR, HIRT                                                                    | 39  |
|                                                                          | $I_{Leak, T}$                      | -10    | —    | 10    | μA   | $V_{BATH} < V_T < V_{HR}$<br>Mode: HIT, HIRT                                                                    | 40  |
| Inputs DCP, DCN, ACP, ACN, Output C <sub>EXT</sub>                       |                                    |        |      |       |      |                                                                                                                 |     |
| Input current DCP, DCN                                                   | $I_{DC}$                           | —      | 0.1  | —     | μA   | —                                                                                                               | 41  |
| Differential AC input resistance ACP, ACN                                | $R_{AC}$                           | —      | 20   | —     | kΩ   | —                                                                                                               | 42  |
| Output resistance on C <sub>EXT</sub>                                    | —                                  | —      | 100  | —     | kΩ   | —                                                                                                               | 43  |
| Current Outputs IT, IL                                                   |                                    |        |      |       |      |                                                                                                                 |     |
| IT output current                                                        | $I_{IT}$                           | -15    | 0    | 15    | μA   | $I_R = I_T = 0\text{ mA}$                                                                                       | 44  |

**Electrical Characteristics**
**Table 13 DC Characteristics ( $V_{ACP} = V_{ACN} = 1.5\text{ V}$ ) (cont'd)**

| Parameter                                                       | Symbol        | Values |      |                | Unit          | Note / Test Condition                                         | No. |
|-----------------------------------------------------------------|---------------|--------|------|----------------|---------------|---------------------------------------------------------------|-----|
|                                                                 |               | Min.   | Typ. | Max.           |               |                                                               |     |
| IT output current normal polarity                               | $I_{IT}$      | 380    | 400  | 420            | $\mu\text{A}$ | $I_R = I_T = 20\text{ mA}$                                    | 45  |
| IT output current reverse polarity <sup>4)</sup>                | $I_{IT}$      | −420   | −400 | −380           | $\mu\text{A}$ | $I_R = I_T = -20\text{ mA}$                                   | 46  |
| Transversal current ratio (see <b>Figure 18</b> ) <sup>5)</sup> | $I/G_{IT,DC}$ | 49.5   | 50   | 50.5           | –             | $I_R = I_T = 20\text{ mA}$ ,<br>$I_R = I_T = -20\text{ mA}$   | 47  |
| Off-hook output current on IT                                   | –             | 800    | 950  | 1100           | $\mu\text{A}$ | TIP/RING shorted,<br>Temp = 25 °C <sup>6)</sup><br>Mode: PDRH | 48  |
| IL output current (see <b>Figure 18</b> )                       | $I_{IL}$      | −20    | 0    | 20             | $\mu\text{A}$ | $I_R = I_T = 20\text{ mA}$                                    | 49  |
|                                                                 |               | 30     | 50   | 70             | $\mu\text{A}$ | $I_R = 15\text{ mA}$ , $I_T = 25\text{ mA}$                   | 50  |
|                                                                 |               | −160   | −125 | −90            | $\mu\text{A}$ | $I_R = 50\text{mA}$ , $I_T = 25\text{mA}$                     | 51  |
| <b>Control Inputs C1, C2</b>                                    |               |        |      |                |               |                                                               |     |
| H-input voltage                                                 | $V_{IH}$      | 2.7    | –    | $V_{DD} + 0.3$ | V             | –                                                             | 52  |
| M-input voltage                                                 | $V_{IM}$      | 1.2    | –    | 2.1            | V             | –                                                             | 53  |
| L-input voltage                                                 | $V_{IL}$      | −0.3   | –    | 0.6            | V             | –                                                             | 54  |
| Input pull down current                                         | $I_{in}$      | 0      | 2    | 10             | $\mu\text{A}$ | –                                                             | 55  |
| Thermal overload current C1                                     | $I_{therm}$   | 120    | 150  | 250            | $\mu\text{A}$ | $V_{C1} = 1.20\text{ V}$                                      | 56  |
| Thermal overload threshold temperature                          | $T_{jLIM}$    | –      | 165  | –              | °C            | Mode: ACTx, Hlx                                               | 57  |

- 1) The systematic temperature dependence is appr. + 7 mV / °C
- 2) The systematic temperature dependence is appr. -0.3 % / °C
- 3) The systematic temperature dependence is appr. +0.1 % / °C
- 4) With **VDD = 3.3 V**, the IT output current **in reverse polarity** is limited to typically 700  $\mu\text{A}$ ; thus, the DC current regulation loop operates correctly only up to the corresponding line current value of 35 mA. In all other cases, IT is linear within the full line current range
- 5) The offset ( $I_R = I_T = 0\text{ mA}$ ) has to be taken into account.
- 6) The systematic temperature dependence is appr. -0.1 % / °C

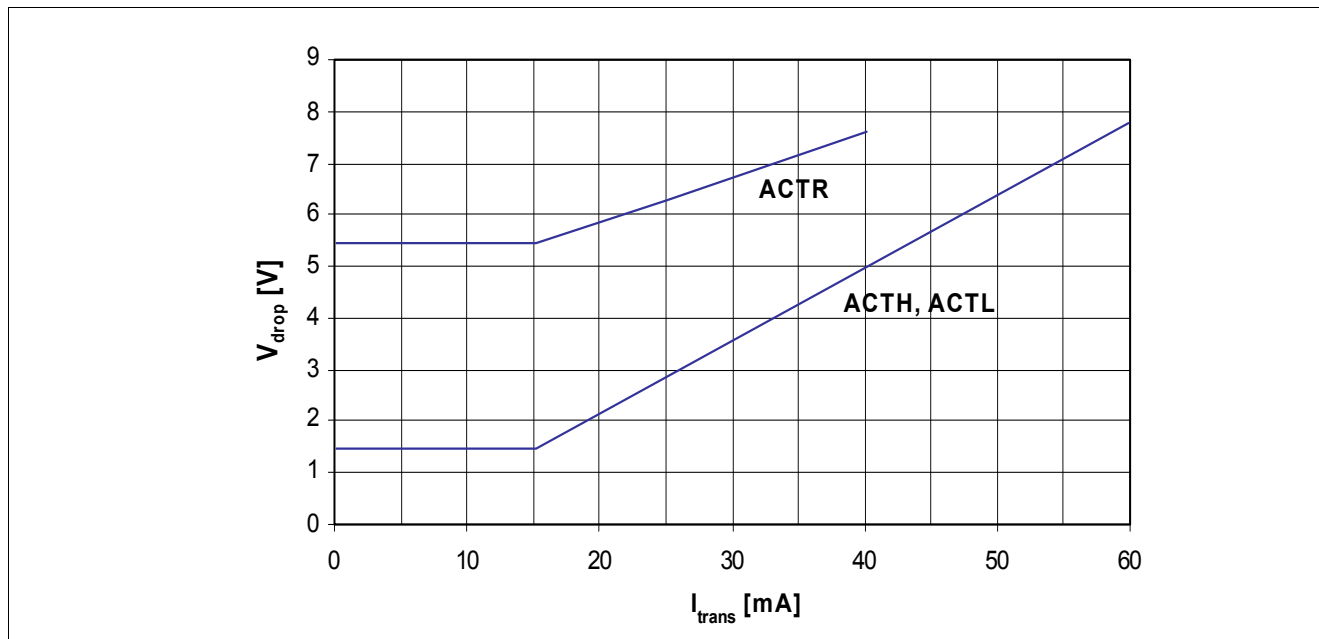


Figure 10 Typical Buffer Voltage Drop in Operating Modes ACTL, ACTH, ACTR

### 4.5.3 AC Characteristics

If not otherwise stated, AC characteristics are tested at a DC line current of 25 mA and –25 mA, respectively; they are valid in all active modes.

Table 14 AC Characteristics

| Parameter                                                                                                                                       | Symbol               | Values |      |       | Unit | Note / Test Condition                                                                                                               | No. |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------|------|-------|------|-------------------------------------------------------------------------------------------------------------------------------------|-----|
|                                                                                                                                                 |                      | Min.   | Typ. | Max.  |      |                                                                                                                                     |     |
| Line Termination TIP, RING                                                                                                                      |                      |        |      |       |      |                                                                                                                                     |     |
| Receive gain (see <a href="#">Figure 18</a> )                                                                                                   | $G_r$                | 5.925  | 6.0  | 6.075 | –    | $V_{ACP} - V_{ACN} = 640 \text{ mV}_{\text{rms}}$ ,<br>$f = 1015 \text{ Hz}$                                                        | 58  |
| Total harmonic distortion $V_{\text{TR}}$<br>(see <a href="#">Figure 18</a> )                                                                   | $THD$                | –      | 0.01 | 0.3   | %    | $V_{ACP} - V_{ACN} = 640 \text{ mV}_{\text{rms}}$ ,<br>$f = 1015 \text{ Hz}$                                                        | 59  |
| Teletax distortion                                                                                                                              | $THD_{TTX}$          | –      | 0.1  | 1     | %    | $V_{\text{TR,AC}} = 5 \text{ V}_{\text{rms}}$ , $f = 16 \text{ kHz}$ ,<br>$R_L = 200 \Omega$                                        | 60  |
|                                                                                                                                                 |                      | –      | 0.2  | 3     | %    | $V_{\text{TR,AC}} = 5 \text{ V}_{\text{rms}}$ , $f = 16 \text{ kHz}$ ,<br>$R_L = 200 \Omega$ , $I_{\text{Trans,DC}} = 0 \text{ mA}$ | 61  |
| Psophometric noise<br>(see <a href="#">Figure 18</a> )                                                                                          | $N_{\text{pVTR}}$    | –      | –82  | –76   | dBmp | –                                                                                                                                   | 62  |
| Longitudinal to transversal<br>rejection ratio $V_{\text{long}}/V_{\text{TR}}$<br>(see <a href="#">Figure 19</a> )                              | $LTRR$               | –      | 80   | –     | dB   | $V_{\text{long}} = 3 \text{ V}_{\text{rms}}$ ,<br>$300 \text{ Hz} < f < 3.4 \text{ kHz}$                                            | 63  |
| Longitudinal to transversal<br>rejection ratio $V_{\text{long}}/V_{\text{TR}}$ (loop)<br>PEF 4264, PEF 4364<br>(see <a href="#">Figure 19</a> ) | $LTRR_{\text{loop}}$ | 54     | 58   | –     | dB   | $V_{\text{long}} = 3 \text{ V}_{\text{rms}}$<br>$300 \text{ Hz} < f < 1 \text{ kHz}$                                                | 64  |
|                                                                                                                                                 |                      | 52     | 56   | –     | dB   | $f = 3.4 \text{ kHz}$                                                                                                               | 65  |

**Electrical Characteristics**
**Table 14 AC Characteristics (cont'd)**

| Parameter                                                                                                                                               | Symbol                 | Values |      |      | Unit | Note / Test Condition                                                                                                           | No. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------|------|------|------|---------------------------------------------------------------------------------------------------------------------------------|-----|
|                                                                                                                                                         |                        | Min.   | Typ. | Max. |      |                                                                                                                                 |     |
| Longitudinal to transversal rejection ratio $V_{\text{long}}/V_{\text{TR}}$ (loop)<br>PEF 4264-2 (see <a href="#">Figure 19</a> )                       | $LTRR-2_{\text{loop}}$ | 61     | 65   | –    | dB   | $V_{\text{long}} = 3 V_{\text{rms}}$<br>$300 \text{ Hz} < f < 1 \text{ kHz}$                                                    | 66  |
|                                                                                                                                                         |                        | 56     | 60   | –    | dB   | $f = 3.4 \text{ kHz}$                                                                                                           | 67  |
| Transversal to longitudinal rejection ratio $V_{\text{TR}}/V_{\text{long}}$ (see <a href="#">Figure 21</a> )                                            | $TLRR$                 | 48     | 60   | –    | dB   | $V_{\text{ACP}} - V_{\text{ACN}} = 1920 \text{ mV}_{\text{rms}}$ ,<br>$300 \text{ Hz} < f < 3.4 \text{ kHz}$                    | 68  |
| Power supply rejection ratio<br>(see <a href="#">Figure 11</a> , <a href="#">Figure 12</a> ,<br><a href="#">Figure 14</a> , <a href="#">Figure 14</a> ) | $PSRR$                 |        |      |      |      | $V_{\text{SupplyAC}} = 100 \text{ mV}_{\text{p}}$ ,<br>$300 \text{ Hz} < f < 3.4 \text{ kHz}$                                   |     |
| $V_{\text{BATL}}/V_{\text{TR}}$                                                                                                                         |                        | 40     | 60   | –    | dB   |                                                                                                                                 | 69  |
| $V_{\text{BATH}}/V_{\text{TR}}$                                                                                                                         |                        | 40     | 60   | –    | dB   |                                                                                                                                 | 70  |
| $V_{\text{HR}}/V_{\text{TR}}$                                                                                                                           |                        | 33     | 50   | –    | dB   |                                                                                                                                 | 71  |
| $V_{\text{DD}}/V_{\text{TR}}$                                                                                                                           |                        | 33     | 50   | –    | dB   |                                                                                                                                 | 72  |
| Interchannel crosstalk <sup>1)</sup>                                                                                                                    |                        |        | -80  |      | dB   | $300 \text{ Hz} < f < 3.4 \text{ kHz}$<br>both channels active                                                                  | 73  |
|                                                                                                                                                         |                        |        | -80  |      | dB   | One channel active,<br>one channel power down                                                                                   | 74  |
| Ringing amplitude TIP/RING                                                                                                                              | $V_{\text{RNG0}}$      | –      | 65   | –    | Vrms | $V_{\text{DCP}} - V_{\text{DCN}} = 0.15 \text{ V (DC)}$                                                                         | 75  |
| Ringing distortion (see <a href="#">Figure 22</a> )                                                                                                     | RD                     | –      | 0.1  | 2    | %    | + $1.42 V_{\text{rms}}$ (sine wave,<br>20 Hz)<br>$R_{\text{R}} = 450 \Omega$ , $C_{\text{R}} = 3.4 \mu\text{F}$ ,<br>Mode: ACTR | 76  |
| <b>Transversal Current <math>I_{\text{T}}^{2)}</math></b>                                                                                               |                        |        |      |      |      |                                                                                                                                 |     |
| Transversal current ratio<br>(see <a href="#">Figure 18</a> )                                                                                           | $I/G_{\text{it}}$      |        |      |      |      | $V_{\text{ACP}} - V_{\text{ACN}} = 640 \text{ mV}_{\text{rms}}$ ,<br>$f = 1015 \text{ Hz}$                                      |     |
|                                                                                                                                                         |                        | 49.5   | 50   | 50.5 |      | $I_{\text{Trans,DC}} = 25 \text{ mA}$                                                                                           | 77  |
|                                                                                                                                                         |                        | 49     | 50   | 51   |      | $I_{\text{Trans,DC}} = -25 \text{ mA}$                                                                                          | 78  |
| Total harmonic distortion $V_{\text{IT}}$                                                                                                               | $THD_{\text{IT}}$      | –      | 0.02 | 0.3  | %    | $V_{\text{ACP}} - V_{\text{ACN}} = 640 \text{ mV}_{\text{rms}}$ ,<br>$f = 1015 \text{ Hz}$                                      | 79  |
| Psophometric noise<br>(see <a href="#">Figure 18</a> )                                                                                                  | $N_{\text{pVIT}}$      | –      | -110 | -105 | dBmp | –                                                                                                                               | 80  |
| Longitudinal to transversal current output rejection ratio<br>$V_{\text{long}}/V_{\text{IT}}$ (see <a href="#">Figure 19</a> )                          | $LITRR$                | –      | 85   | –    | dB   | $V_{\text{long}} = 3 V_{\text{rms}}$ ,<br>$300 \text{ Hz} < f < 3.4 \text{ kHz}$                                                | 81  |
| Power supply rejection ratio                                                                                                                            | $PSRR$                 |        |      |      |      | $V_{\text{SupplyAC}} = 100 \text{ mV}_{\text{p}}$ ,<br>$300 \text{ Hz} < f < 3.4 \text{ kHz}$                                   |     |
| $V_{\text{BATL}}/V_{\text{IT}}$                                                                                                                         |                        | 50     | 70   | –    | dB   |                                                                                                                                 | 82  |
| $V_{\text{BATH}}/V_{\text{IT}}$                                                                                                                         |                        | 50     | 70   | –    | dB   |                                                                                                                                 | 83  |
| $V_{\text{HR}}/V_{\text{IT}}$                                                                                                                           |                        | 50     | 70   | –    | dB   |                                                                                                                                 | 84  |
| $V_{\text{DD}}/V_{\text{IT}}$                                                                                                                           |                        | 50     | 70   | –    | dB   |                                                                                                                                 | 85  |

1) Dual channel version PEF 4364 only

2) Unless otherwise specified, characteristics are valid for both DC line current directions (normal and reverse polarity)

#### 4.5.3.1 Frequency Dependence of PSRR

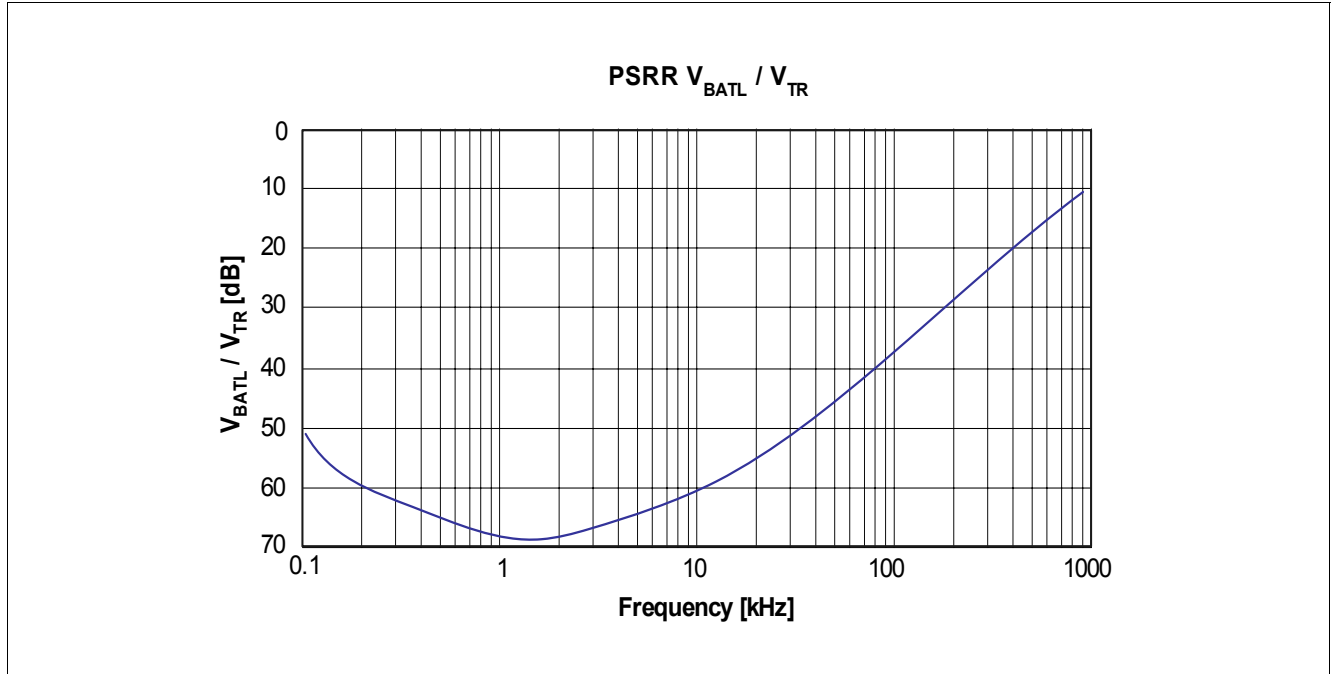


Figure 11 Typical Frequency Dependence of PSRR  $V_{BATL} / V_{TR}$

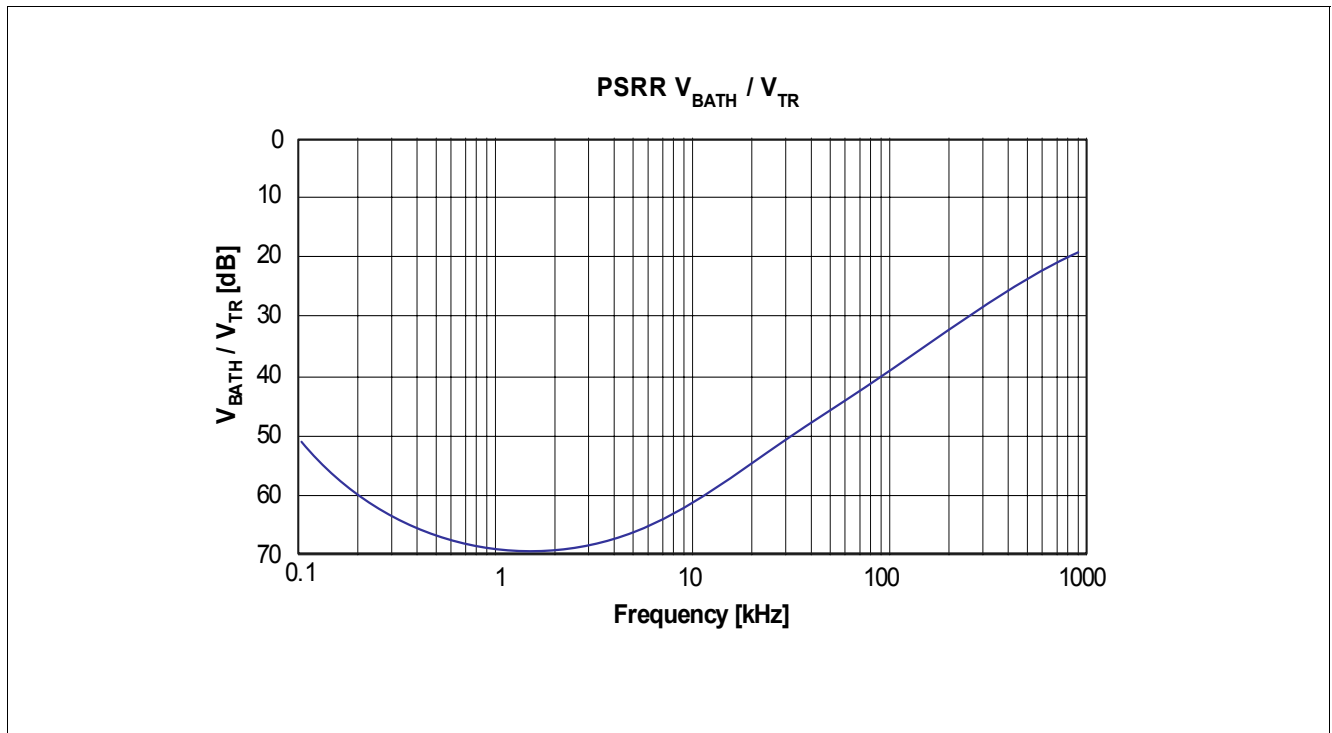


Figure 12 Typical Frequency Dependence of PSRR  $V_{BATH} / V_{TR}$

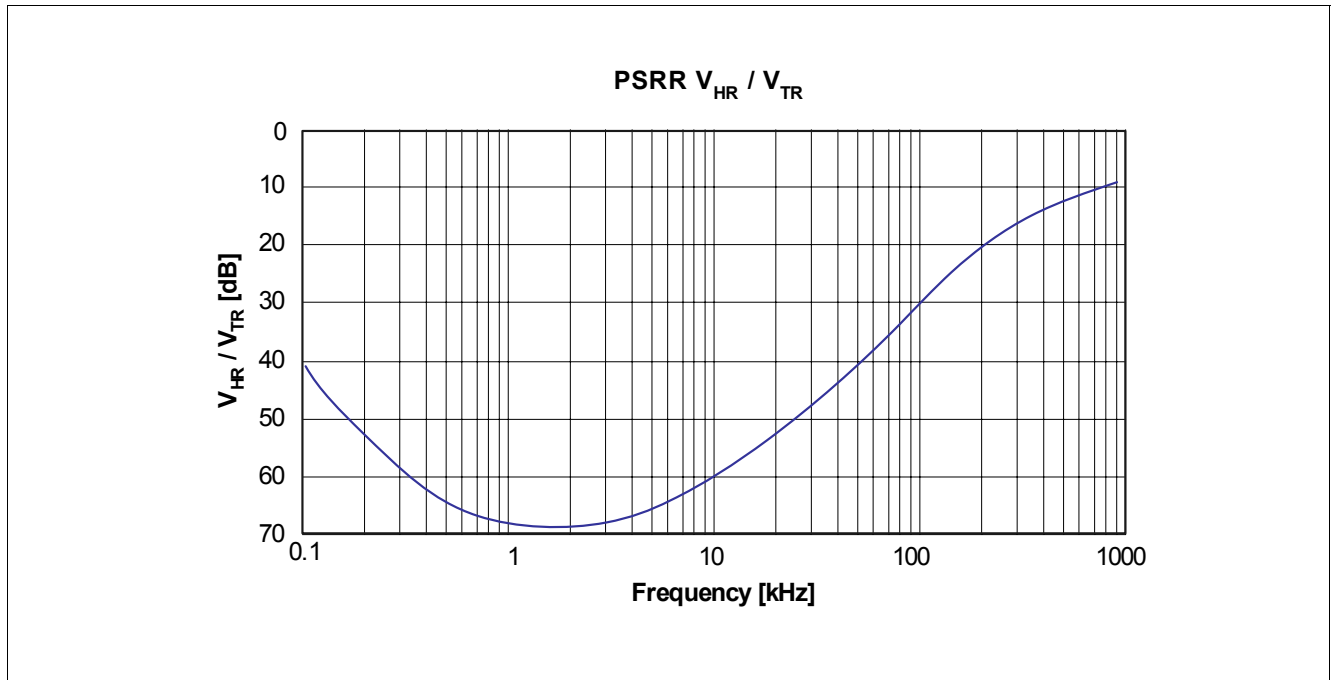


Figure 13 Typical Frequency Dependence of PSRR  $V_{HR}/V_{TR}$

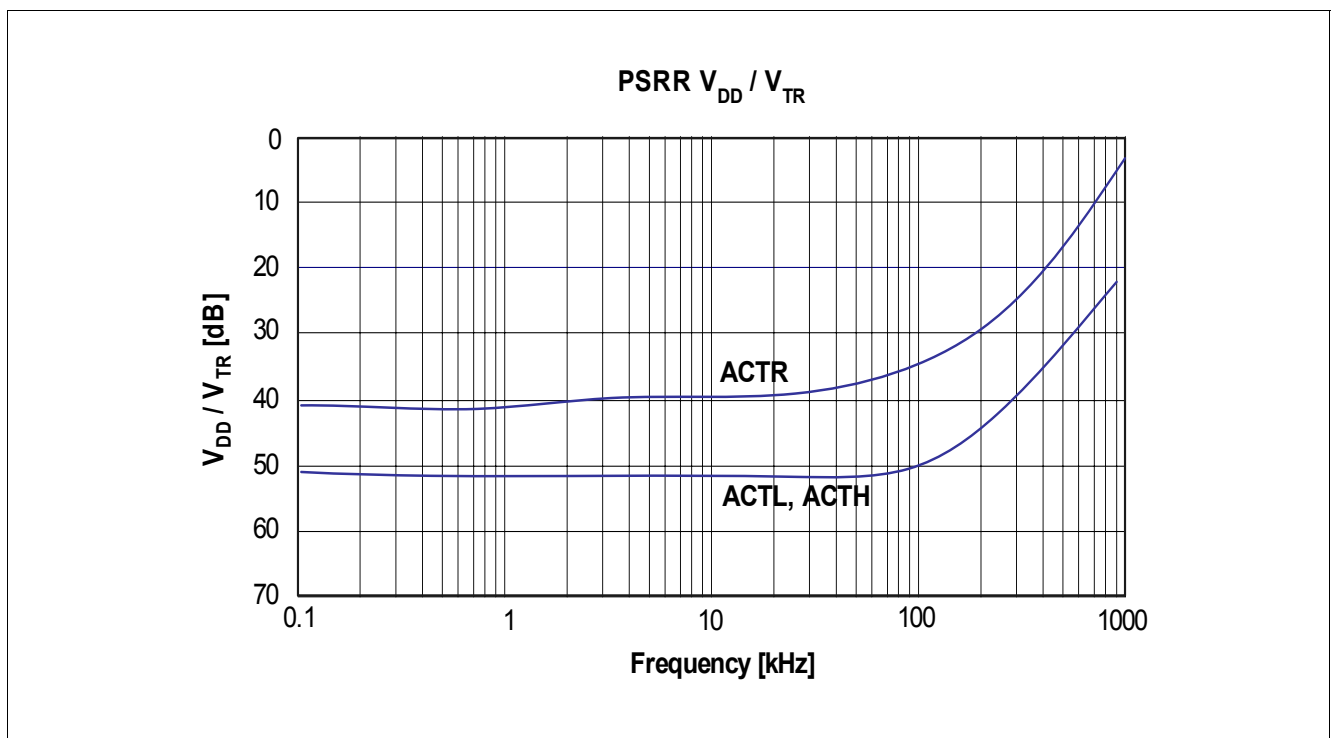
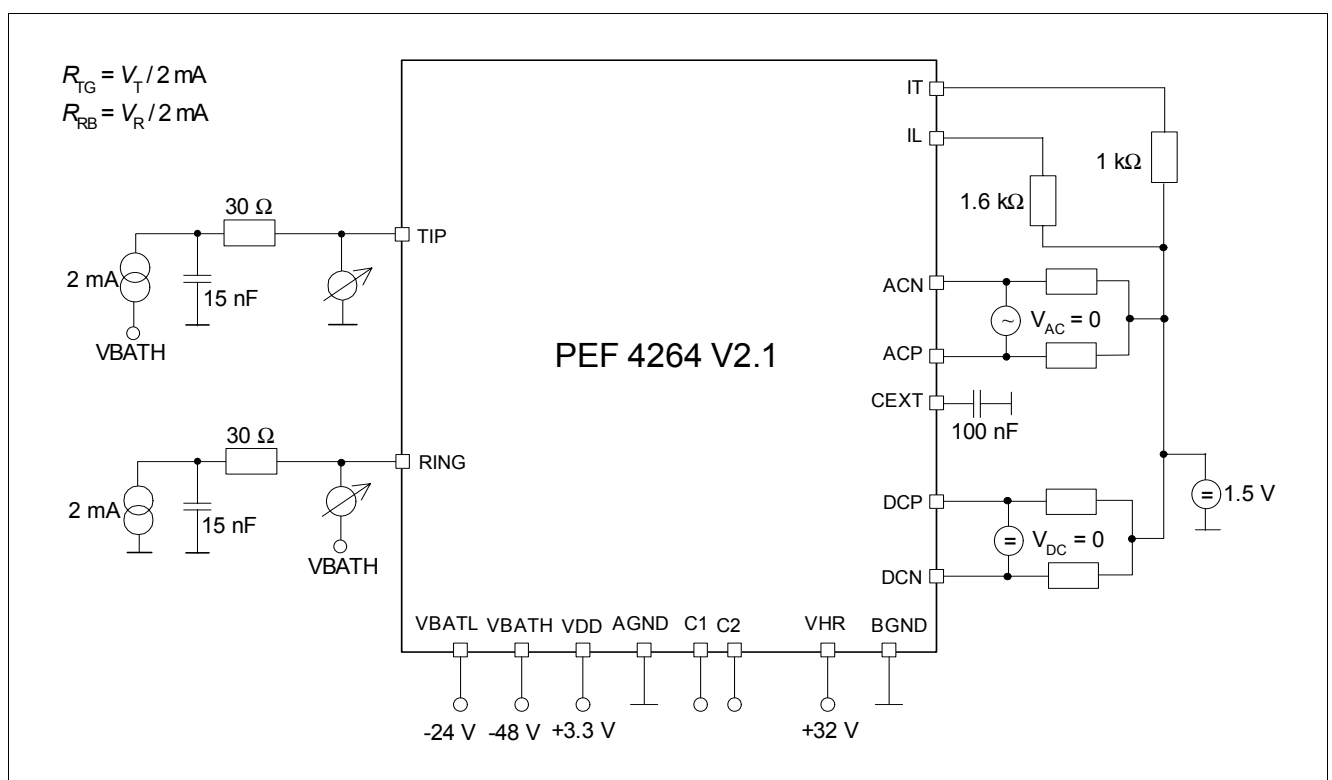
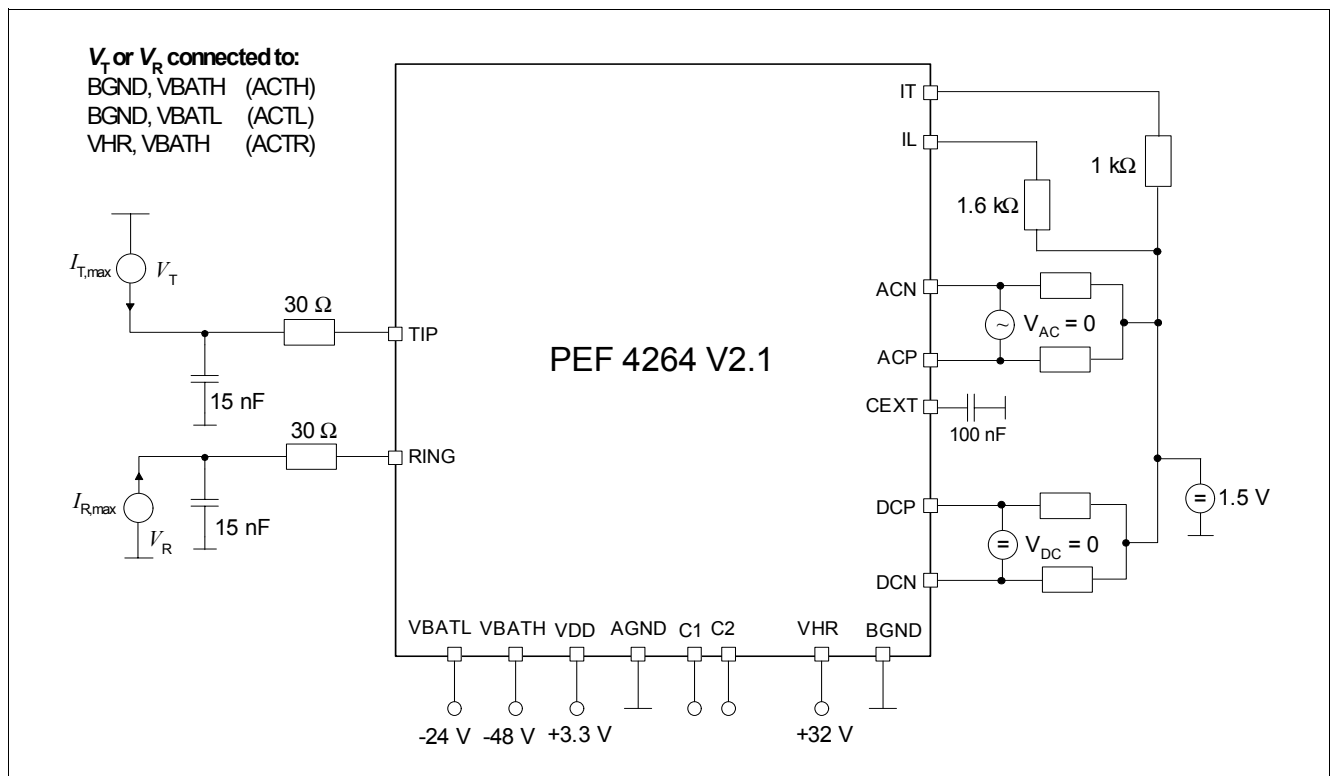


Figure 14 Typical Frequency Dependence of PSRR  $V_{DD}/V_{TR}$

## 5 Test Figures



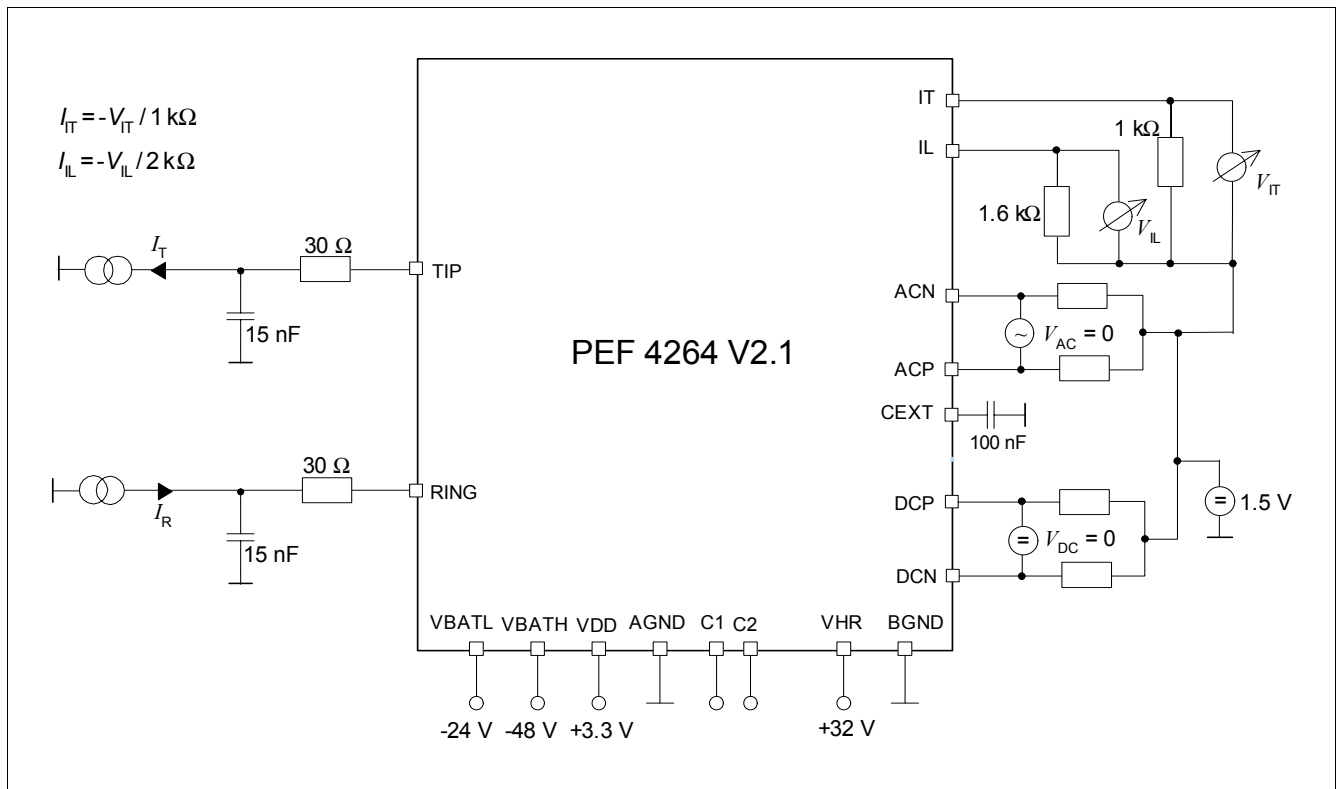


Figure 17 Current Outputs IT, IL

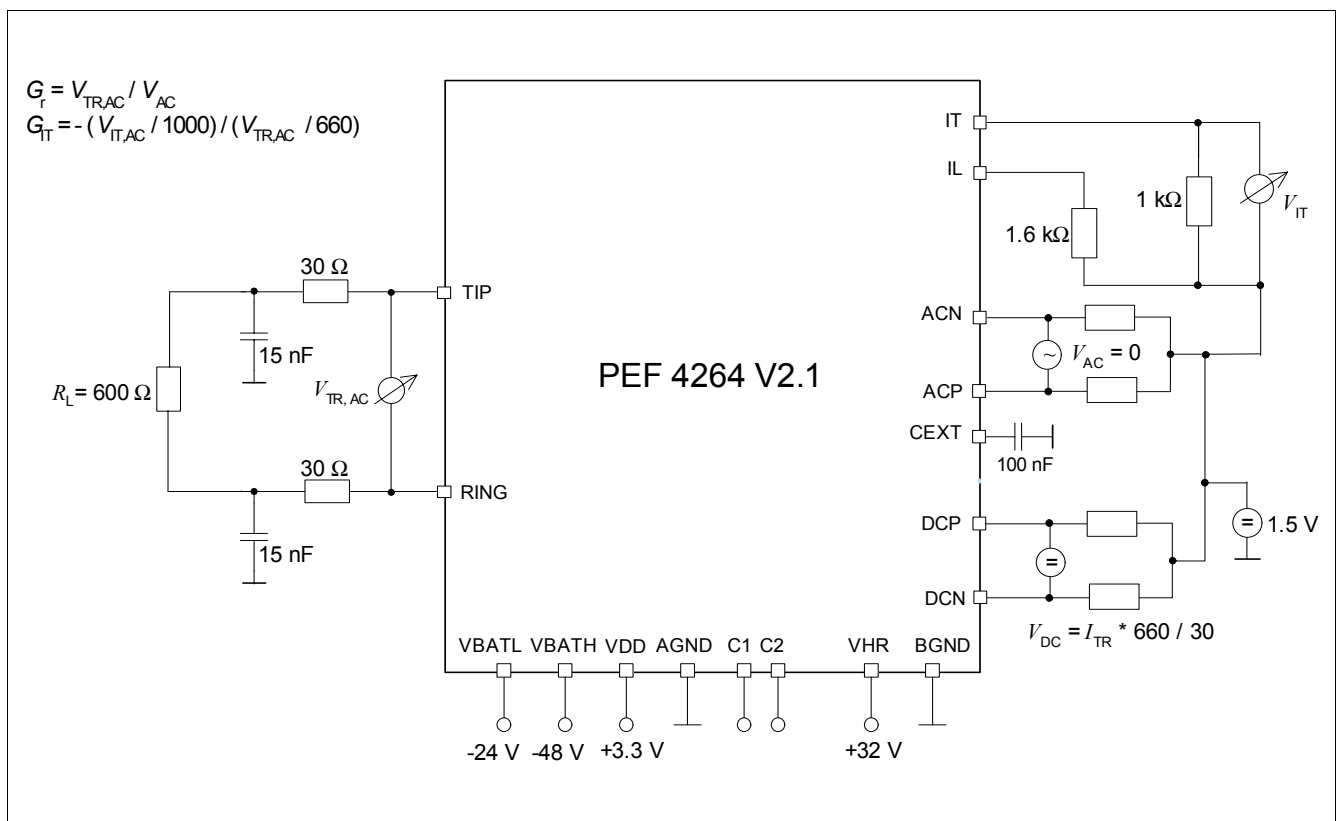


Figure 18 Transmission Characteristics

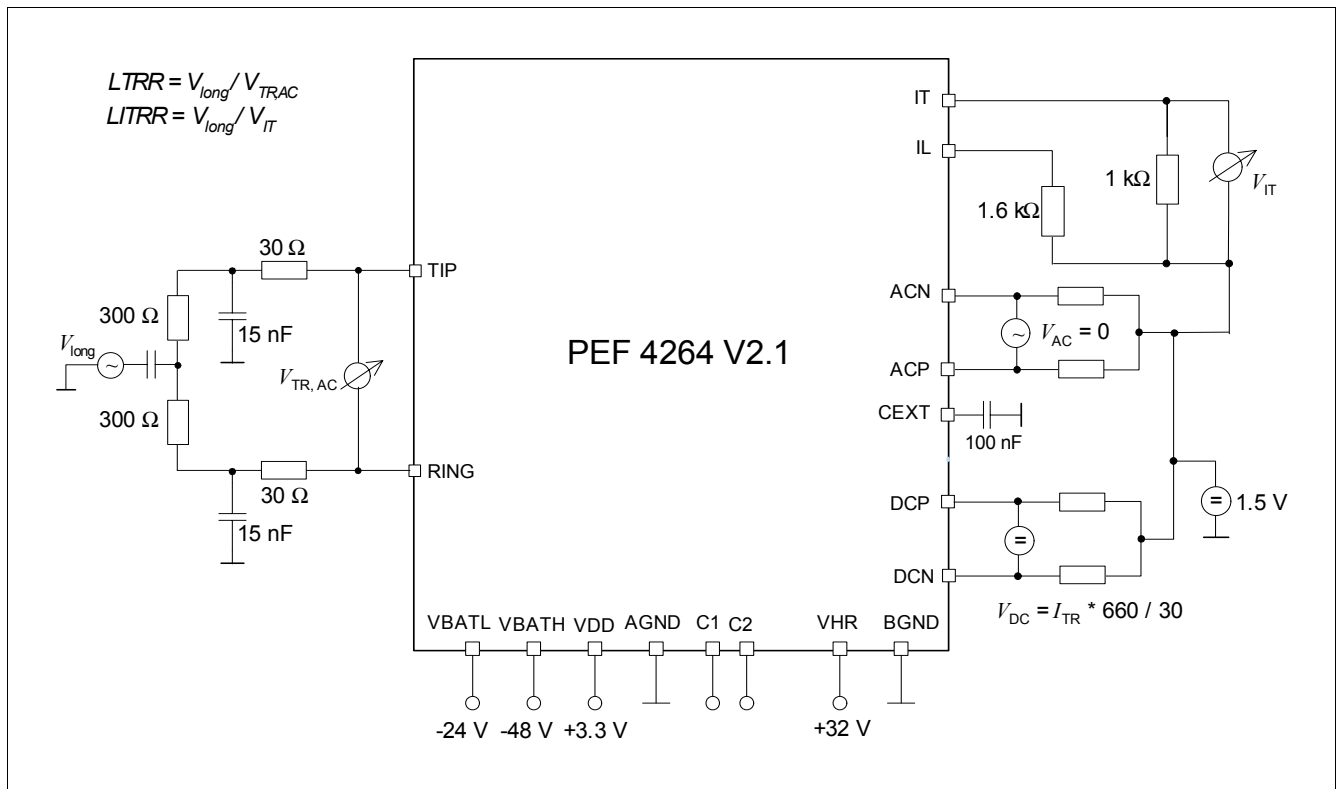


Figure 19 Longitudinal to Transversal Rejection

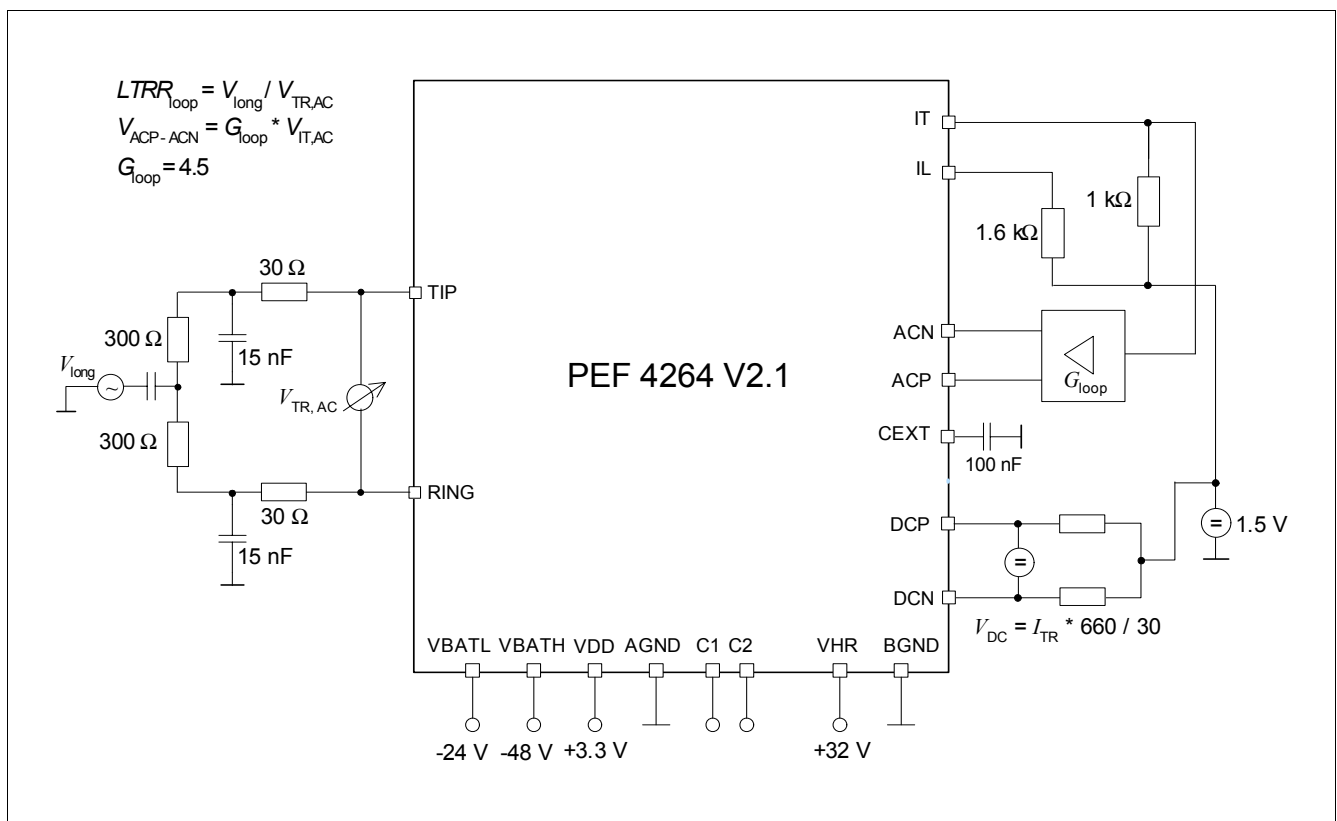


Figure 20 Longitudinal to Transversal Rejection Loop

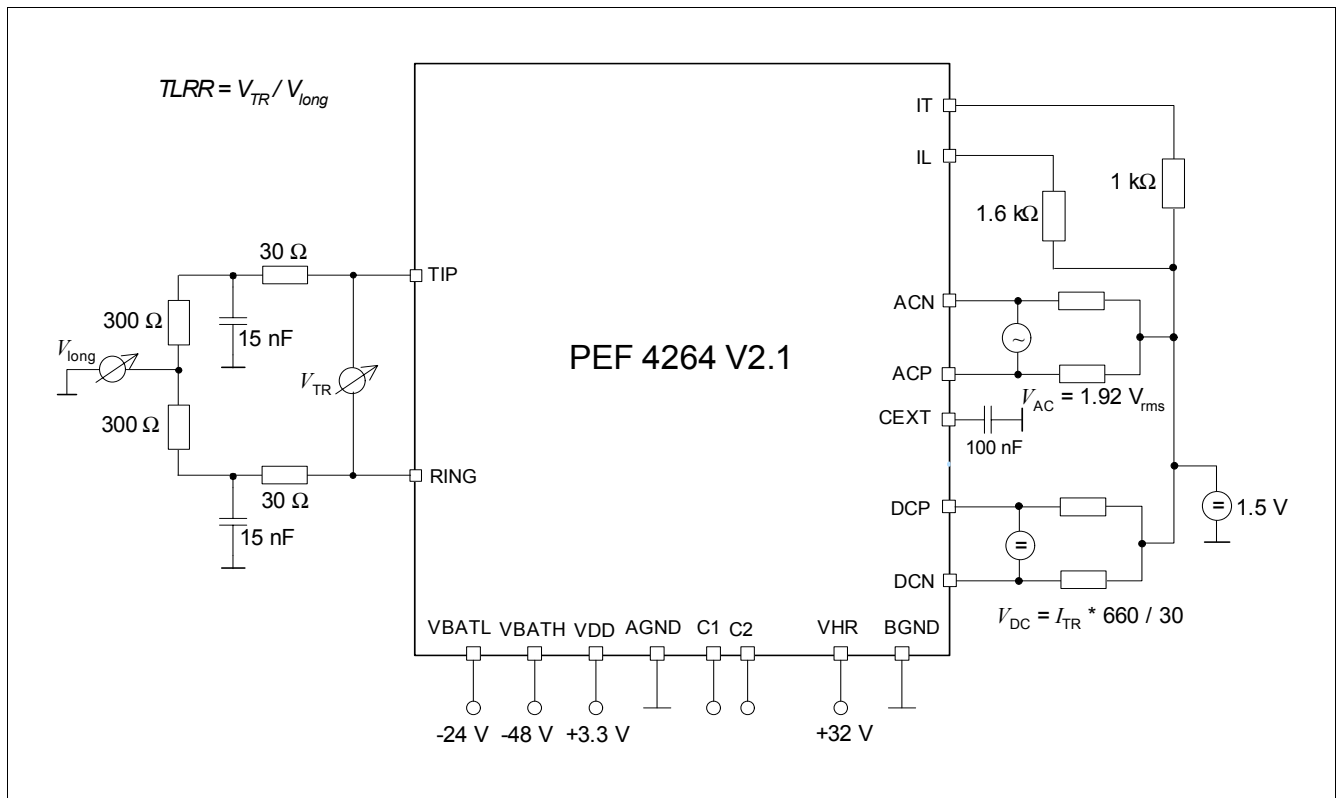


Figure 21 Transversal to Longitudinal Rejection

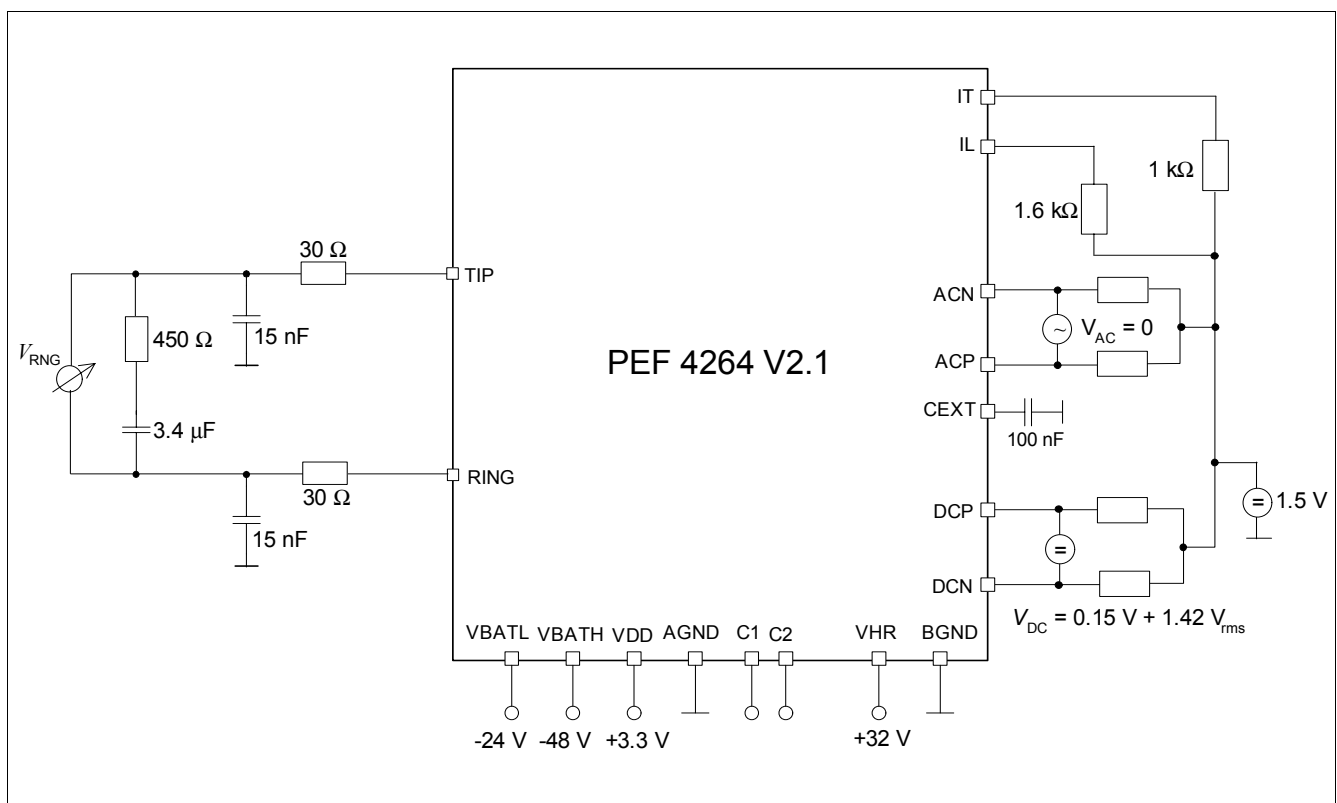
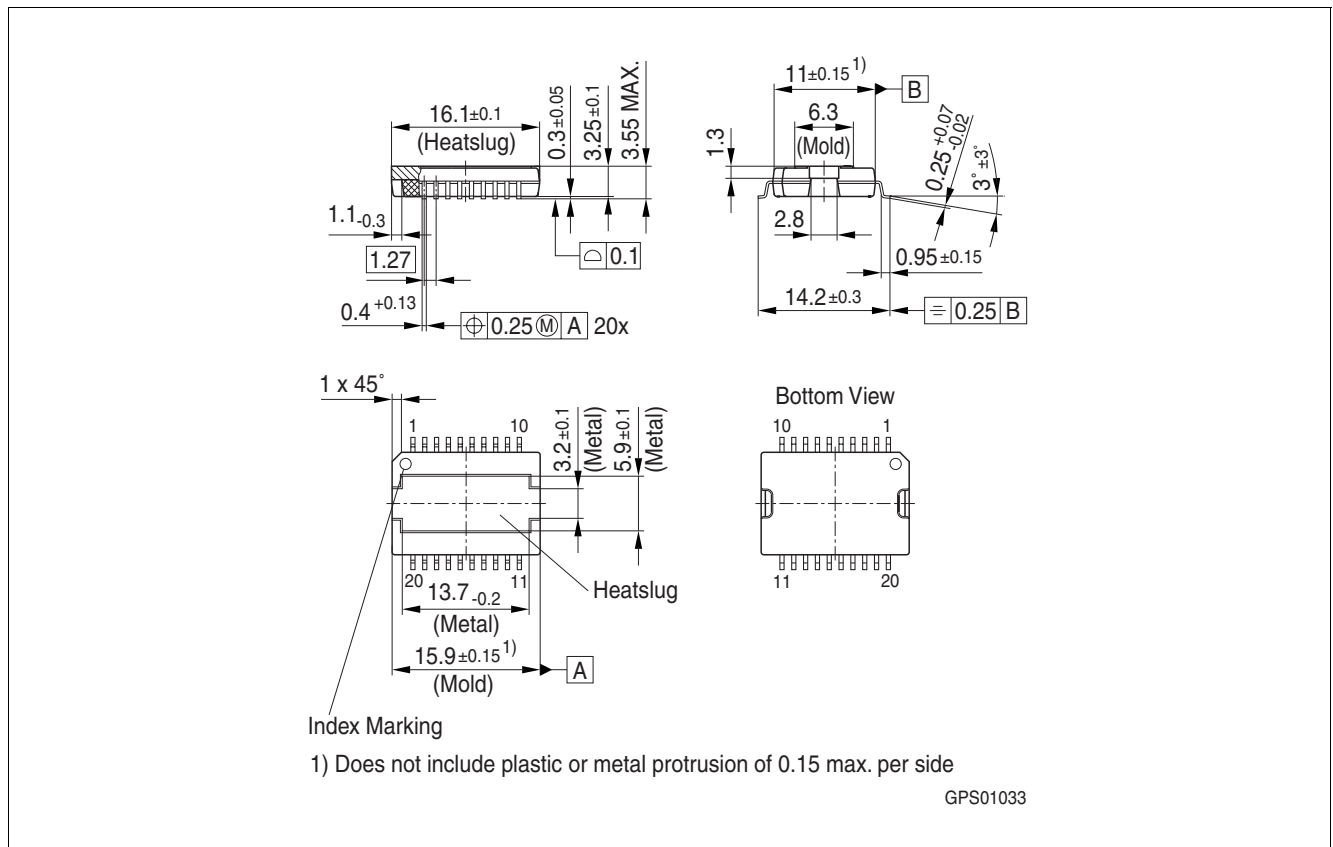


Figure 22 Ring Amplitude

## 6 Package Outlines

### 6.1 PG-DSO-20-24 Package



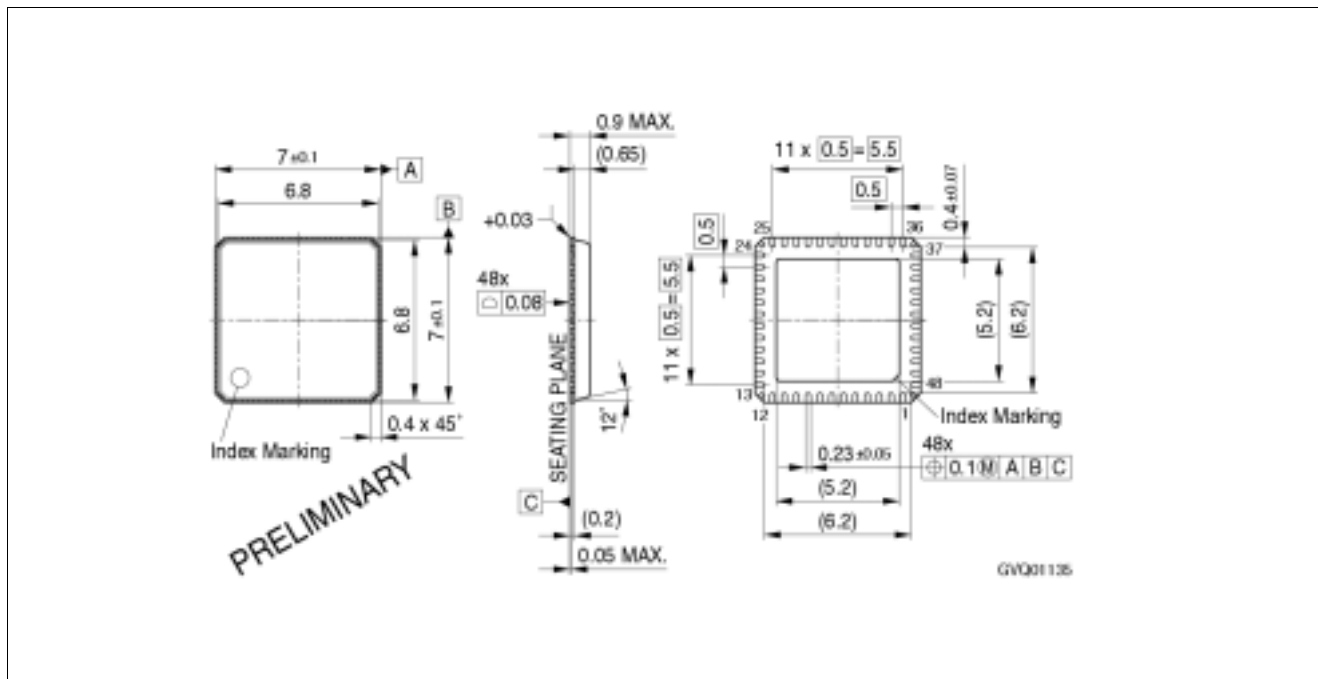
**Figure 23** Package Outline for PG-DSO-20-24 (Plastic Green Dual Small Outline)

#### Notes

1. Heatsink on top - pin counting clockwise (top view)
2. Dimensions in mm

**Attention:** The heatsink is connected to VBATH via the chip substrate. Due to the high voltage of up to 125 V between VHR and VBATH, touching of the heatsink or any attached conducting part can be hazardous.

## 6.2 PG-VQFN-48-15 Package



**Figure 24** Package Outline for PG-VQFN-48-15 (Plastic Green Very thin Profile Quad Flatpack No-lead)

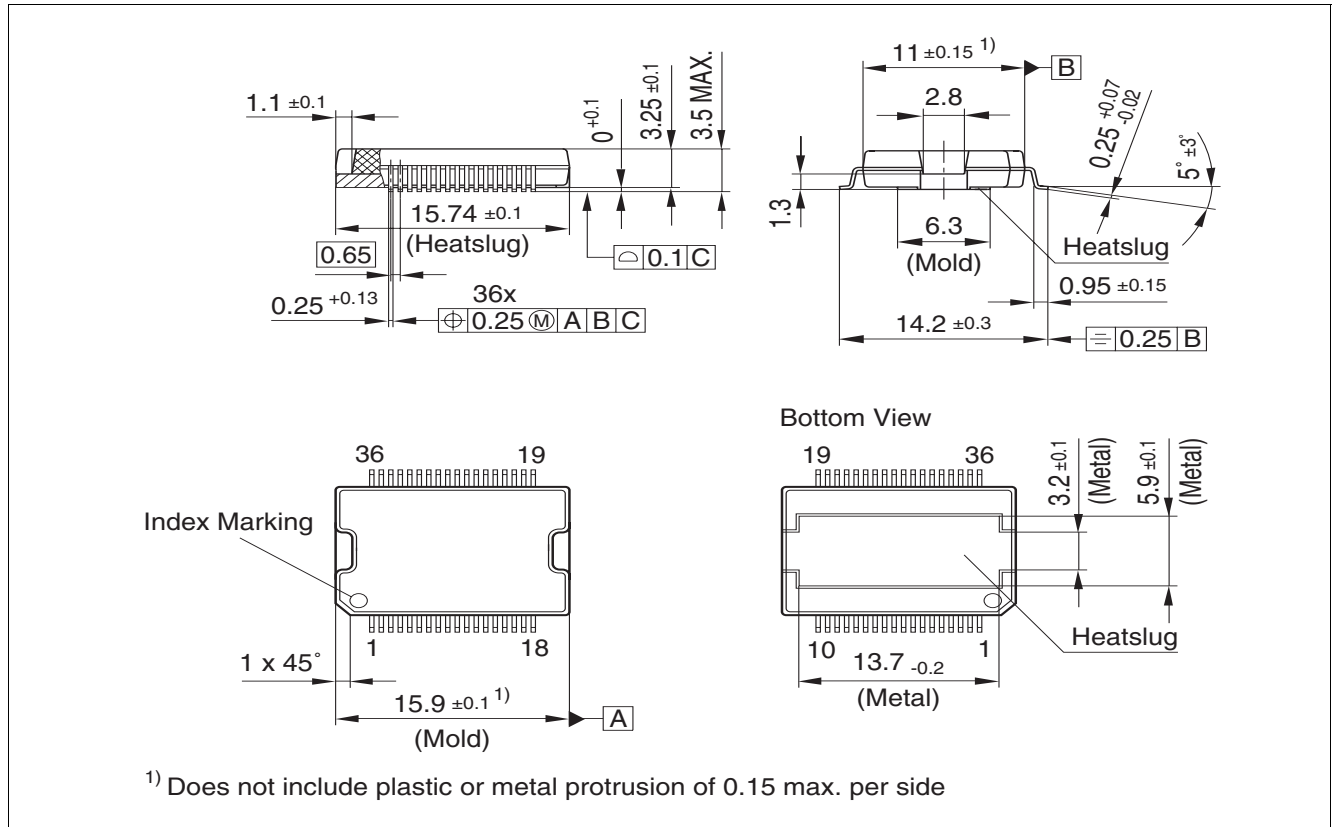
Note: Dimensions in mm

**Attention:** The exposed die pad and the die pad edges are connected to VBATH via the chip substrate. Due to the high voltage of up to 125 V between VHR and VBATH, touching of the die pad or any attached conducting part can be hazardous.

### 6.2.1 Recommended PCB Foot Print Pattern for PG-VQFN-48-15 Package

For detailed information on PCB related thermal and soldering issues of the PG-VQFN-48-15 package see [4], chapter 3 and 4.

### 6.3 PG-DSO-36-15 Package



**Figure 25** Package Outline for PG-DSO-36-15 (Plastic Green Dual Small Outline)

#### Notes

1. Heatslug down version - pin counting counterclockwise (top view)
2. Dimensions in mm

**Attention:** The heatslug is connected to VBATH via the chip substrate. Due to the high voltage of up to 125 V between VHR and VBATH, touching of the heatsink or any attached conducting part can be hazardous.

### 6.3.1 Recommended PCB Foot Print Pattern for PG-DSO-36-15 Package

The heatslug is soldered to the PCB according to [Figure 25](#). For improved thermal behaviour the utilization of another PCB metal layer as an additional cooling area is recommended. These copper areas should be both electrically separated from each other and floating, i. e. they must not be connected with any other metallic part on the PCB.

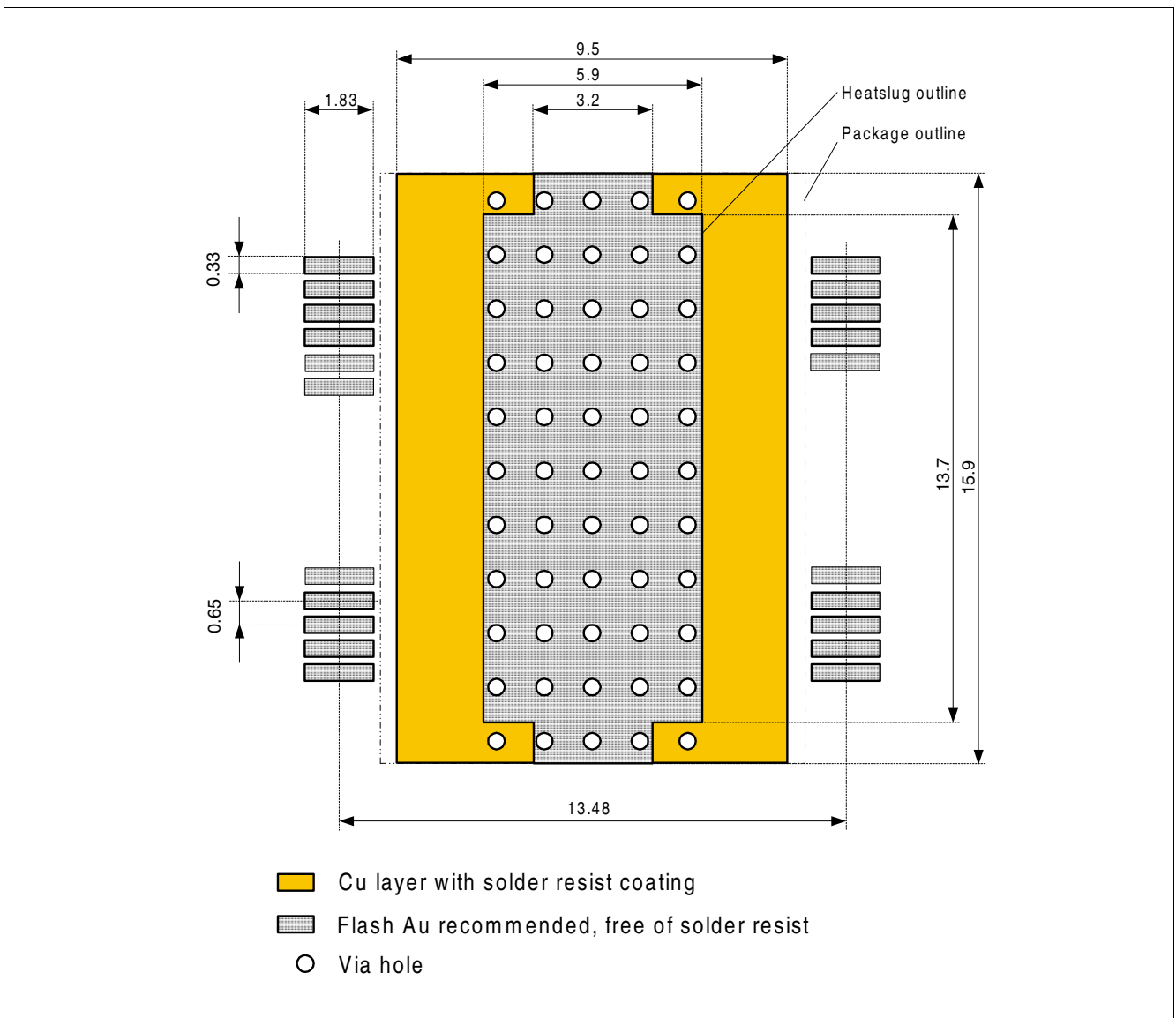


Figure 26 Footprint for PG-DSO-36-15

## **References**

- [1] SLIC-S/-S2 / TSLIC-S (PEF 4264/-2 / PEF 4364) Application Note "Protection for SLIC-S/-S2 against Overvoltages and Overcurrents according to ITU-T K. 20/K.21/K.45" Rev. 1.0, 2003-07-18
- [2] VINETIC® Version 1.4 Prel. Application Note External Components Rev. 2.0, 2005-09-06
- [3] VINETIC® Version 2.1/2.2 Preliminary Hardware Design Guide Rev. 2.0, 2005-05-19
- [4] Recommendations for Printed Circuit Board Assembly of Infineon P(G)-VQFN Packages, Application Support, DS3, 2006-03-03

[www.infineon.com](http://www.infineon.com)