Data Sheet

AT&T Microelectronics

LB1276 High-Balance SLIC

Features

- No high-precision external resistors required for longitudinal balance of 58 dB
- Meter pulse compatible
- Thermal protection with logic output
- On-hook transmission
- Low-power scan mode
- Ground-start mode (external tip relay)
- User adjustable parameters:
  - — Loop current limit
  - — ac overhead voltage
  - — Termination impedance
  - — Loop closure threshold
- Forward disconnect
- Longitudinal current sense
- Differential current sense
- 24-pin package

Description

The LB1276 SLIC device is an electronic subscriber line interface circuit (SLIC) that supplies a controlled current to the TIP/RING pair. This SLIC is designed to meet LATA Switching Systems Generic Requirements (LSSGR) and EIA RS-464A requirements for central office, loop carrier, and PBX lines.

Functional Diagram

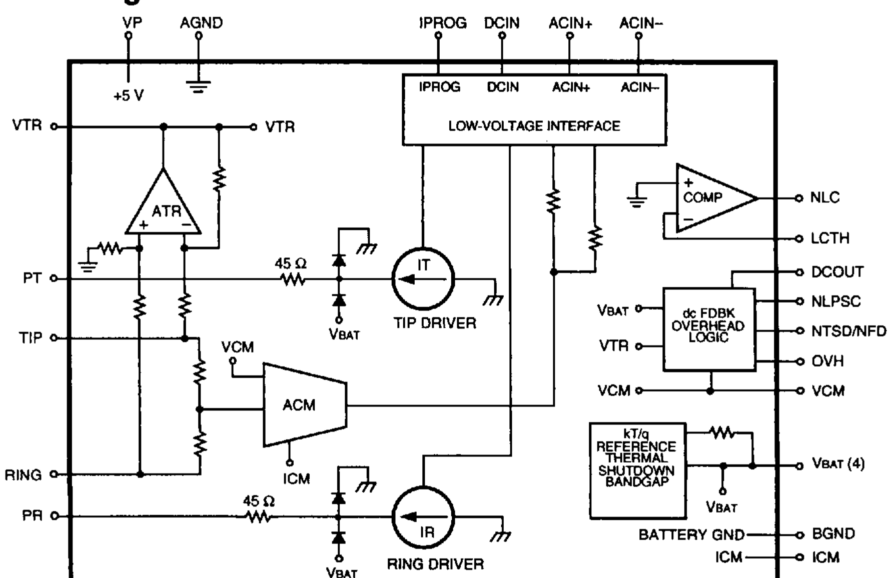


Figure 1. Functional Diagram

Pin Information

Table 1. Pin Description

DIP	PLCC	Symbol	Type	Name/Function
1	2	VP	—	**+5 V Supply.**
2	3	ACIN+	I	**ac Signal Input (Noninverting).** This high-impedance input controls the ac differential current on TIP and RING. Connect to VTR through a blocking capacitor to set the termination impedance. The receive ac signal from the codec is also summed at this node.
3	4	ACIN–	I	**ac Signal Input (Inverting).** This high-impedance input controls the ac differential current on TIP and RING.
4	6	OVH	I	**Overhead Voltage Adjustment.** Adjusts the open-circuit voltage on TIP and RING for maximum ac signal. This is set by a resistor to AGND. A single resistor can be used for several SLICs on the same card by busing the OVH pins together and dividing the resistor value by the number of devices connected.
5	9	DCOUT	O	**dc Output Voltage.** This voltage is a representation of the differential TIP/RING current. It is valid during low-power scan and powerup states. Connect a resistor between this pin and DCIN.
6	10	BGND*	—	**Talking Battery Ground.**
7, 8	11, 14	VBAT†	—	**Talking Battery Supply.** Negative high-voltage talking battery.
9	18	PT	O	**Protected TIP.** Output of TIP current amplifier. Connect a protection resistor between this lead and the TIP of the loop.
10	19	VCM‡	I/O	**Common-Mode Reference Voltage for TIP and RING.** Prevents noise on VBAT from appearing longitudinally on TIP and RING. This lead also sets the common-mode TIP/RING Voltage. Typical voltage is VBAT/2.
11	20	VTR	O	**TIP/RING Voltage.** Scaled version of the TIP/RING differential voltage. This output requires a dc blocking capacitor.
12	22	TIP	I	**TIP Sense Lead.** TIP of the loop.
13	24	RING	I	**RING Sense Lead.** RING of the loop.
14	26	AGND	—	**Analog Signal Ground.**
15	27	ICM	O	**Longitudinal Current Sense.** The output current is a scaled version of the instantaneous longitudinal current appearing on TIP and RING.
16	28	PR	O	**Protected RING.** Output of RING current amplifier. Connect a protection resistor between this lead and the RING of the loop.
17, 18	33, 34	VBAT†	—	**Talking Battery Supply.** Negative high-voltage talking battery.
19	36	NLC	O	**Not Loop Closure (Active-Low).** When low, this logic output indicates an off-hook condition. This output will be high on loss of VBAT.

* On the printed-circuit board, make the leads to BGND and VBAT as wide as possible for thermal and electrical reasons. Also, maximize the amount of printed-circuit board copper in the area of and specifically on the leads connected to this device for the lowest operating temperature.

† All VBAT leads must be connected.

‡ Leave disconnected if not required.

Pin Information (continued)

Table 1. Pin Description (continued)

DIP	PLCC	Symbol	Type	Name/Function
20	37	LCTH	I	**Loop Closure Threshold.** Use a resistor divider to DCOUT and a reference to set loop closure threshold.
21	39	NTSD/NFD	I/O	**Not Thermal Shutdown/Not Forward Disconnect.** When low, this logic input/output pin indicates that the SLIC is in thermal shutdown. When forced low, this pin puts the SLIC in the forward disconnect state. (See Table 2.)
22	41	NLPSC	I	**Not Low-Power Scan (Active-Low).** This active-low input, puts the line feed in low-power scan mode. (See Table 2.)
23	43	IPROG	I	**Constant Current Limit.** A resistor to AGND sets the dc loop current limit of the line feed. A single resistor can be used for several SLICs on the same card by busing the IPROG pins together and dividing the resistor value by the number of devices so connected. Bypass this bus with a 0.1 µF capacitor to AGND.
24	44	DCIN	I	**dc Input Voltage.** The voltage on this pin controls the dc differential current on TIP/RING. Connect to DCOUT through a resistor, and connect a capacitor to AGND. Shunting this capacitor with a resistor increases the dc feed resistance.

Absolute Maximum Ratings (At 25 °C)

Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those indicated in the operational sections of the data sheet. Exposure to Absolute Maximum Ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
+5 V Power Supply	V_P	—	7.0	V
Battery (Talking) Supply	V_{BAT}	–85	—	V
Logic Input Voltage	—	–0.5	7.0	V
Analog Input Voltage	—	–7.0	7.0	V
Operating Temperature Range	T_A	–40	125	°C
Storage Temperature Range	T_{stg}	–40	125	°C
Relative Humidity Range	—	5	95	%
Ground Potential Difference (BGND to AGND)	—	V_{BAT}	V_{BAT} + 90	V

Notes:

The TIP and RING leads (pins 12 & 13) of the LB1276 IC meet Level 1 and Level 2 power cross requirements as specified in the LSSGR (TR-TSY-000064).

The LB1276 IC can be damaged unless all ground connections are applied before, and removed after, all other connections. Furthermore, when powering the device, the user must guarantee that no external potential creates a voltage on any pin of the device that exceeds the device ratings. Some of the known examples of conditions that cause such potentials during powerup include the following: 1) an inductor connected to TIP and RING can force an overvoltage on V_{BAT} through the protection devices if the V_{BAT} connection chatters; and 2) inductance in the V_{BAT} lead could resonate with the V_{BAT} filter capacitor to cause a destructive overvoltage.

Pin Information (continued)

Definition of States

- Powerup — Normal talk state.
- Low-Power Scan
  - — Common-mode feedback is disconnected.
  - — TIP and RING amplifiers operate as current sources with current limit set by IPROG.
  - — TIP amplifier current source is saturated to BGND.
  - — RING amplifier current source is saturated to V_{BAT}.
  - — DCOUT represents the differential TIP/RING current.
  - — The LB1276 Battery Feed does not automatically power up when loop current is detected.
- ac Powerup — dc Feed Shutdown State
  - — This state provides a quiet disconnect. It is the normal talk state except that both the TIP and RING voltages are set to $V_{BAT}/2$, which denies dc current to the loop. The RC filter in the dc feedback path provides the time constant of the disconnect.
- Disconnect State
  - — The TIP and RING amplifiers are turned off, and the SLIC goes to a high-impedance state.

Table 2. Input-State Coding

NTSD/NFD	NLPSC	State
1	1	Powerup
1	0	Low-power scan
0	1	ac powerup — dc feed shutdown
0	0	Disconnect state

Electrical Characteristics

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information purposes only and are not part of the testing requirements.

Minimum and maximum values apply across the entire temperature range (–40 °C to +85 °C) and the entire battery range (–24 V to –70 V powerup; –40 V to –60 V scan and disconnect) unless otherwise specified. Typical is defined as 25 °C, V_P = +5.0 V, V_{BAT} = –48.0 V, and I_{LOOP} = 40 mA. Positive current is defined as flowing into the device.

Table 3. General Characteristics

Parameter	Min	Typ	Max	Units
Temperature Range:				
Meets All Requirements	–40	—	85	°C
Humidity Range:				
Operational	5	—	95	%RH
TIP/RING Lightning Surge Voltage:				
10 x 1000 µs	—	—	±1500	V
2 x 10 µs	—	—	±2500	V
Supply Voltages:				
V_P	4.75	—	5.25	V
V_{BAT}	–70	—	–24	V
Supply Currents (powerup & no loop current):				
I_P (5 V)	—	5	6.5	mA
I_{BAT} (–48 V)	—	–4.0	–6.5	mA
I_{BAT} (–70 V)	—	–4.3	–7.0	mA
Supply Currents (powerup & I_{LOOP} ≥ 10 mA):*				
I_P (5 V)	—	5.2	6.5	mA
I_{BAT} (–48 V)	—	I_{LOOP} + 3.9	I_{LOOP} + 4.4	mA
I_{BAT} (–70 V)	—	I_{LOOP} + 4.2	I_{LOOP} + 4.7	mA
Supply Currents (scan mode & no loop current):				
I_P (5 V)	—	3.5	4.0	mA
I_{BAT} (–48 V)	—	–2.3	–3.1	mA
Maximum Power Dissipation (–48 V)	—	150	170	mW
Maximum Supply Currents (fault condition):				
I_P (5 V)	—	—	25	mA
I_{BAT} (–48 V)	—	—	–200	mA
Power Supply Rejection† (500 Hz—3 kHz):				
V_P	(See Figures 4 and 5.)			dB
V_{BAT}	(See Figures 6 and 7.)			dB

* Device quiescent battery current decreases as loop current increases.

† Power supply rejection is specified for metallic signal only. Common-mode power supply rejection depends on the filter capacitor attached to VCM pin.

Electrical Characteristics (continued)

Table 3. General Characteristics (continued)

Parameter	Min	Typ	Max	Units
Thermal Protection:				
Thermal Resistance (still air)	—	47	—	°C/W
Thermal Resistance (300 ft/min)	—	36	—	°C/W
T_{jc} Shutdown	—	170	—	°C
TIP or RING Drive Current: (loop + longitudinal + signal currents)	65	90	—	mA
TIP or RING Longitudinal Current	30	35	40	mA(Peak)
Longitudinal Balance (IEEE Std 455-1976):				
50 Hz—1 kHz	58	69	—	dB
3 kHz	53	64	—	dB
Longitudinal Impedance (TIP or RING to BGND)	130	145	160	Ω
Metallic to Longitudinal Balance: 200 Hz—4000 Hz	46	—	—	dB
RFI Rejection (500 kHz to 100 MHz): 0.5 V rms, 50 Ω source, 30% AM Mod 1 kHz:				
500 kHz—10 MHz	—	–75	–65	dBV
10 MHz—100 MHz	—	–55	–45	dBV
Overhead Voltage (V_{OH}*)				
Value	—	*	—	V
Accuracy				
(–40 V ≤ V_{BAT} ≤ –56 V)	—	±4	±7.5	%
(–24 V ≤ V_{BAT} ≤ –70 V)	—	±5	±9	%
Amplifier Saturation Voltage				
TIP @ I_{LOOP} = 40 mA	—	–1.4	–1.5	V
RING @ I_{LOOP} = 40 mA	—	V_{BAT} + 2.2	V_{BAT} + 2.35	V
TIP to RING @ I_{LOOP} = 40 mA (Includes margin for common-mode variation)	—	3.8	4.2	V

* V_{OH} = –0.33 + 0.50 x RDC (kΩ) + 0.557 x R_{OVH} (kΩ).

Electrical Characteristics (continued)

Table 4. Analog Signal Pins (Except TIP and RING)

Parameter	Min	Typ	Max	Units
ICM — Longitudinal Current Sense:				
Current Gain [ICM/(I_{TIP} + I_{RING})]	1.26	1.4	1.56	µA/mA
Initial Offset (I_{TIP} + I_{RING} = 0)	–7	0	7	µA
Compliance Range	V_{BAT} + 10	—	3.4	V
DCIN:				
Input Impedance	10	50	—	MΩ
Input Bias Current	20	90	250	nA
ACIN+ and ACIN–:				
Input Impedance	3	20	—	MΩ
Input Bias Current	0	–175	–900	nA
LCTH:				
Input Bias Current	0	–135	–600	nA
Input Offset Voltage	0	±5	±10	mV
DCOUT:*				
Output Voltage Swing (R_L = 10 kΩ):				
Maximum	V_{BAT}/2	—	V_P	V(Peak)
Minimum	–10.0	—	3.7	V(Peak)
Output Load Resistance	10	—	—	kΩ
Output Load Capacitance	—	—	50	pF
VTR:				
Output Voltage Swing (R_L = 2 kΩ):				
Maximum	V_{BAT}/2	—	V_P	V(Peak)
Minimum	–10	—	3.5	V(Peak)
Output Load Resistance	2	—		kΩ
Output Load Capacitance	—	—	50	pF

* Output voltage is monotonic with overdrive voltages of up to ±300 V from TIP to RING. The voltage at DCOUT is undefined on loss of V_P or V_{BAT}.

Electrical Characteristics (continued)

Table 5. dc Feed Characteristics

Parameter	Min	Typ	Max	Units
dc Feed Resistance:*				
Nominal (no programming resistor)	300	315	340	Ω
Programmability Range (40 mA loop current limit)	315	—	700	Ω
Programmability Accuracy	—	—	±5	%
Maximum dc Loop Current Limit:†				
R_{PROG} Range	5.6	—	25	kΩ
Powerup:				
I_{LOOP}	—	1.8 x R_{PROG}	—	mA
Accuracy	—	—	±2.5	mA
Scan:				
I_{TIP}	1.8 x R_{PROG} – 8	1.8 x R_{PROG} – 5	1.8 x R_{PROG} – 2	mA
I_{RING}	1.8 x R_{PROG} – 3.5	1.8 x R_{PROG} + 6.5	1.8 x R_{PROG} – 9.5	mA
I_{TIP} (limit) – I_{RING} (limit)	9.5	11.5	13.5	mA
Loop Resistance Range:‡ (+3 dBm overload into 900 Ω)				
No On-hook Transmission (R_{OVH} = 0)				
20 mA at V_{BAT} = 48 V	1680	1750	—	Ω
On-hook Transmission (external R_{OVH})				
20 mA at V_{BAT} = 42.5 V	1415	1475	—	Ω
20 mA at V_{BAT} = 48 V	1690	1750	—	Ω
Differential TIP/RING Current Sense (DCOUT):§				
Gain TIP/RING to DCOUT:				
All States	0.1326	0.1333	0.1340	mho
Offset Loop Current = 0 mA:				
Powerup	–40	20	80	mV
Scan	–150	–50	50	mV
Offset Loop Current = 1 mA:				
Scan	5	60	125	mV
Accuracy Loop Current = 10 mA:				
Powerup	370	440	520	mV
Scan**	345	420	495	mV

* Programmed by placing a voltage divider between DCOUT and DCIN.
† Use R_{PROG} in kΩ.
‡ Total external resistance not including the dc feed resistance of the device.
§ The voltage at DCOUT is undefined on loss of V_P or V_{BAT}.
** Assumes 100 Ω protection resistors.

Electrical Characteristics (continued)

Table 5. dc Feed Characteristics (continued)

Parameter	Min	Typ	Max	Units
dc Receive Gain				
(DCIN to TIP/RING):				
Powerup	0.0225	0.024	0.025	mho
Scan	—	—	1	μmho
TIP/RING Voltages (loop open)††				
Scan:				
TIP Voltage	–1.0	–0.6	–0.1	V
RING Voltage	V_{BAT} + 1.0	V_{BAT} + 1.4	V_{BAT} + 2.0	V
TIP to RING	$\lvert V_{BAT} + 3.0\rvert$	$\lvert V_{BAT} + 2.0\rvert$	$\lvert V_{BAT} + 1.1\rvert$	V
Powerup @ 25 °C:				
TIP Voltage	$0.7 - V_{OH}/2$	$0.5 - V_{OH}/2$	$0.3 - V_{OH}/2$	V
RING Voltage	$V_{BAT} + 0.3 + \frac{V_{OH}}{2}$	$V_{BAT} + 0.5 + \frac{V_{OH}}{2}$	$V_{BAT} + 0.7 + \frac{V_{OH}}{2}$	V
Common-mode Voltage $\frac{(V_T + V_R)}{2}$	$V_{BAT}/2$ 0.2	$V_{BAT}/2 + 0.5$	$V_{BAT}/2 + 0.8$	V
Powerup (forward disconnect): $\frac{(V_T + V_R)}{2}$	$V_{BAT}/2$ 0.6	$V_{BAT}/2$	$V_{BAT}/2 + 0.6$	V
Differential TIP to RING Voltage	–0.7	0	0.7	V

†† When calculating TIP and RING voltages, include the accuracy of V_{OH}.

Table 6. ac Feed Characteristics

Transmit direction is TIP/RING to 4-wire. Receive direction is 4-wire to TIP/RING.

Parameter	Min	Typ	Max	Units
ac Termination Impedance*	180	—	1800	Ω
Maximum Signal Current				
LB1276AF, LB1276AP	10	—	—	mA
LB1276CF, LB1276CP	36	—	—	mA
Total Harmonic Distortion (200 Hz—4 kHz)	—	0.1	0.3	%
Intermodulation Distortion (IEEE Std 743-1984):				
Second-order Products	50	—	—	dB
Third-order Products	56	—	—	dB
Powerdown Isolation (scan state):				
Transmit	–3	0	3	dB
Receive	40	50	—	dB
Gain (1 kHz):				
Transmit (TIP/RING to VTR)	0.1326	0.1333	0.1340	mho
Receive (ACIN+ to TIP/RING)	0.0476	0.0500	0.0509	mho
Receive (ACIN– to TIP/RING)	–0.0476	–0.0500	–0.0509	mho

* Set by external components. Any complex impedance $R_1 + R_2 \parallel C$ can be synthesized. $R_1 \geq 180\ \Omega$.

Electrical Characteristics (continued)

Table 6. ac Feed Characteristics (continued)

Transmit direction is TIP/RING to 4-wire. Receive direction is 4-wire to TIP/RING.

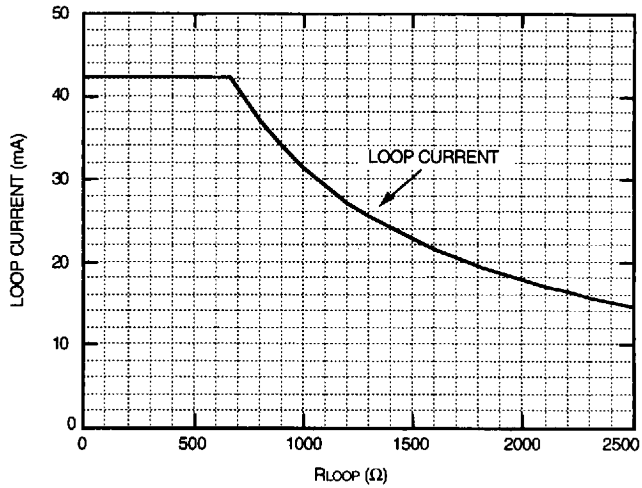
Parameter	Min	Typ	Max	Units
Gain vs. Frequency (600 Ω termination) (transmit & receive reference 1 kHz):				
200 Hz—300 Hz	–0.5	0	0.05	dB
300 Hz—3 kHz	–0.2	0	0.05	dB
3 kHz—266 kHz	—	—	0.05	dB
Gain vs. Level (transmit & receive reference 0 dBV): –50 dB to +3 dB	–0.02	0	0.02	dB
Return Loss:†				
200 Hz—500 Hz	20	28	—	dB
500 Hz—3400 Hz	26	35	—	dB
TIP/RING Idle-channel Noise (600 Ω or 900 Ω termination):				
Psophometric	—	–84	–78	dBmp
C-message	—	6	12	dBrnC
3 kHz Flat	—	12	20	dBrn
Transmit Idle-channel Noise:				
Psophometric	—	–84	–78	dBmp
C-message	—	6	12	dBrnC
3 kHz Flat	—	12	20	dBrn
Transhybrid Loss:†				
200 Hz—300 Hz	20	23	—	dB
300 Hz—500 Hz	20	27	—	dB
500 Hz—2500 Hz	24	30	—	dB
2500 Hz—3400 Hz	20	30	—	dB

† Return loss and transhybrid loss performance assumes 1% tolerance external components. Transhybrid loss at high frequencies (2000 Hz, 3400 Hz) can be improved substantially (min. 36 dB) by adding a capacitor in the hybrid.

Table 7. Logic Inputs and Outputs (NLC, NTSD/NFD, & NLPSC)

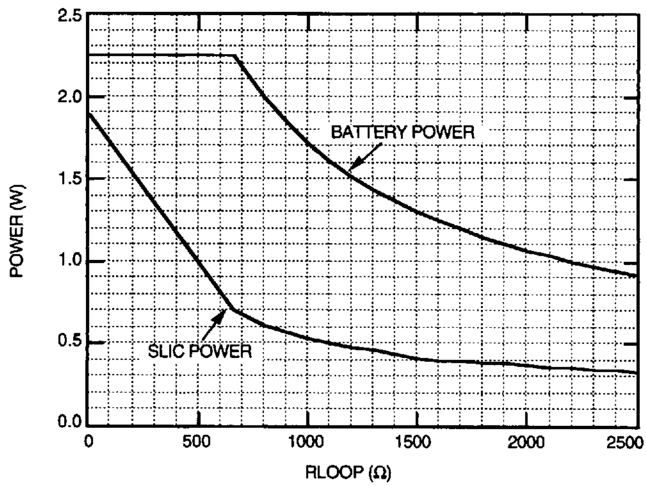
Parameter	Symbol	Min	Typ	Max	Units
Input Voltages					
Low-level (permissible range)	V_{IL}	–0.5	0.4	0.7	V
High-level (permissible range)	V_{IH}	2.0	2.4	V_P	V
Input Currents					
Low-level (V_P = 5.25 V, V_I = 0.4 V)	I_{IL}	–150	—	20	µA
High-level (V_P = 5.25 V, V_I = 2.7 V)	I_{IH}	–70	—	20	µA
Output Voltages (open collector with internal pull-up resistor)					
Low-level (V_P = 4.75 V, I_{OL} = 360 µA)	V_{OL}	0.0	0.2	0.4	V
High-level (V_P = 4.75 V, I_{OL} = 20 µA)	V_{OH}	2.4	—	V_P	V
Output Saturation Current (current necessary to force a low output high)					
NLC ($1 \le V_{NLC} \le V_P$)	I_{SAT}	2.5	7	30	mA
NTSD/NFD ($1 \le V_{NTSD/NFD} \le V_P$)	I_{SAT}	1.5	3	5	mA

Typical Characteristics



Note: VBAT = –48 V, Overhead Voltage (VOH) = 6.5 V, Program Current = 42.5 mA, Protection Resistors = 100 Ω, dc Feed Resistance = 315 Ω

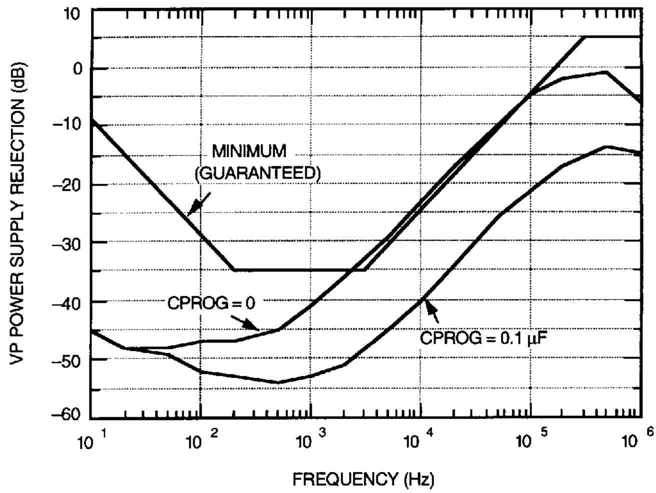
Figure 2. Typical Loop Current vs. Loop Resistance



Note: VBAT = –48 V, Overhead Voltage (VOH) = 6.5 V, Program Current = 42.5 mA, Protection Resistors = 100 Ω, dc Feed Resistance = 315 Ω

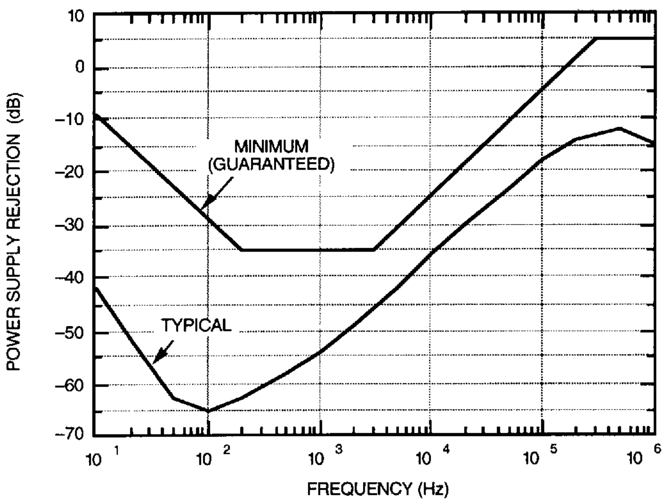
Figure 3. Typical Power Dissipation vs. Loop Resistance

Typical Characteristics (continued)



Note: 600 Ω Termination, Insertion Gain 0 dB, Applied to both Tip & Ring and 4 W XMT Port, Measured with 100 mV on VP

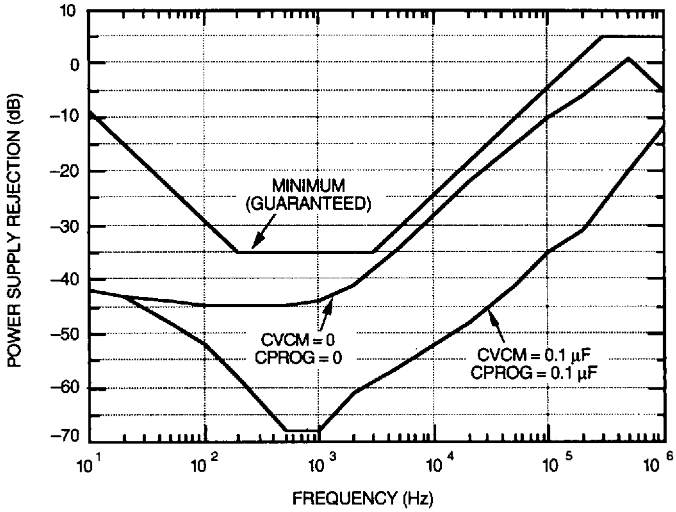
Figure 4. VP Power Supply Rejection vs. Frequency (Tip and Ring Current Limit at 40 mA)



Note: 600 Ω Termination, Insertion Gain 0 dB, Applied to both Tip & Ring and 4 W XMT Port, Measured with 100 mV on VP, CPROG has no effect

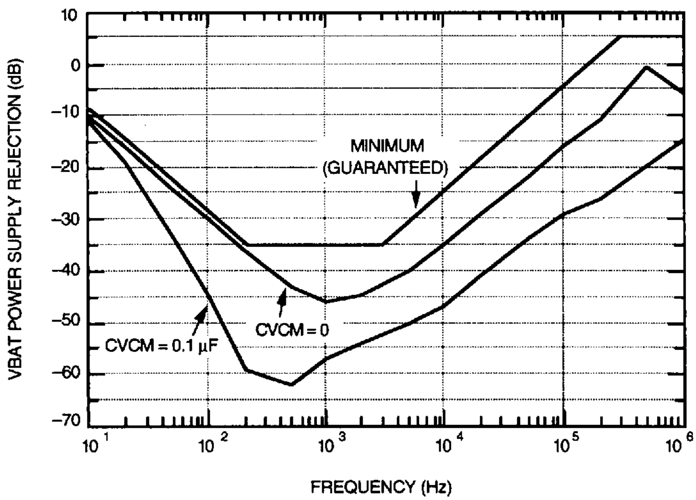
Figure 5. VP Power Supply Rejection vs. Frequency (Tip and Ring Open or Resistive Feed)

Typical Characteristics (continued)



Note: 600 Ω Termination, Insertion Gain 0 dB, Applied to both Tip & Ring and 4 W XMT Port, Measured with 100 mV on VBAT

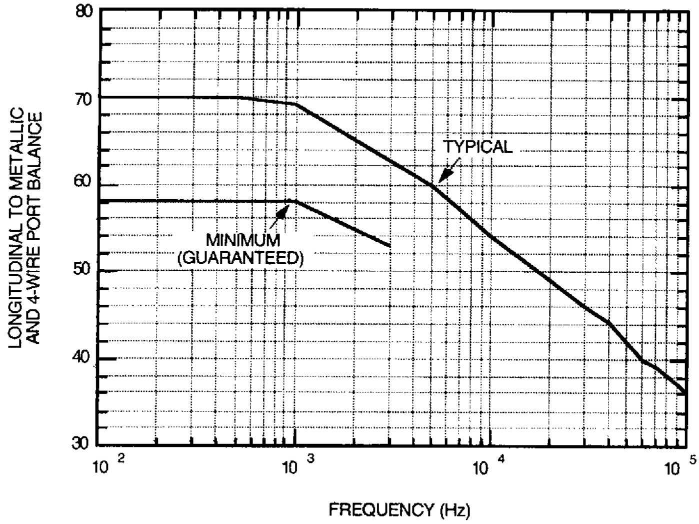
Figure 6. VBAT Power Supply Rejection vs. Frequency (TIP and RING Current Limit at 40 mA)



Note: 600 Ω Termination, Insertion Gain 0 dB, Applied to both Tip & Ring and 4 W XMT Port, Measured with 100 mV on VBAT, CPROG has no effect

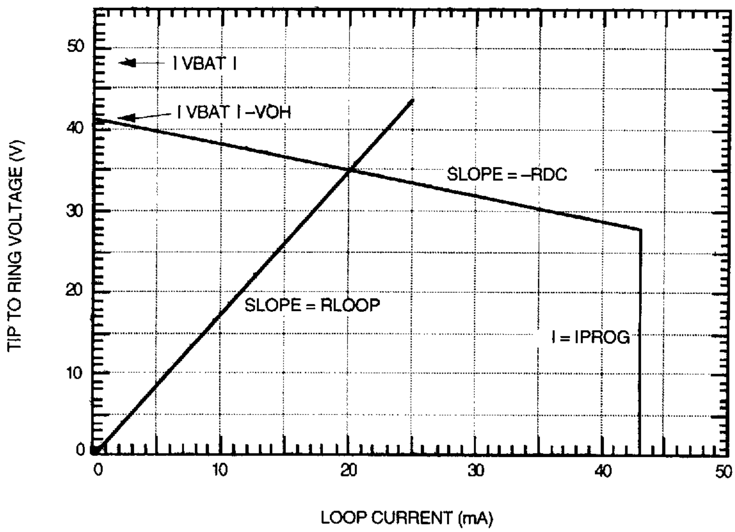
Figure 7. VBAT Power Supply Rejection vs. Frequency (TIP and RING Open or Resistive Feed)

Typical Characteristics (continued)



Note: IEEE STD 455-1976, 600 Ω ac termination, Insertion Gain 0 dB

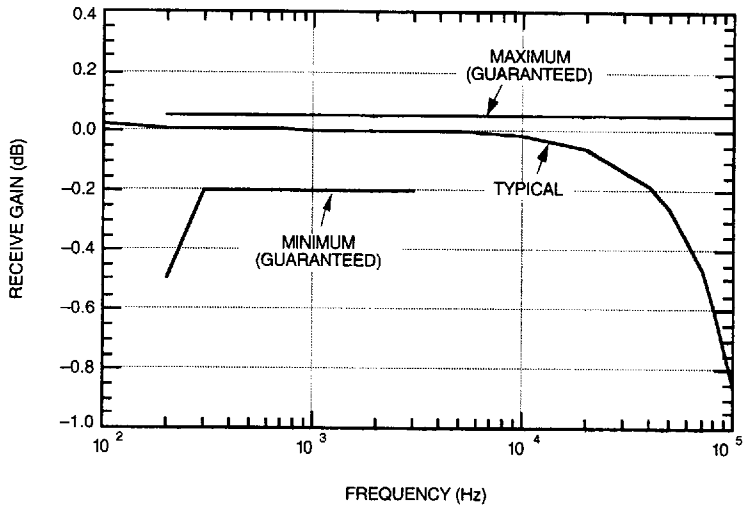
Figure 8. Longitudinal to Metallic and 4-Wire Port Balance vs. Frequency



Note: IPROG = 43 mA, RDC = 315 Ω, VBAT = –48 V, VOH = 6.5 V, RLOOP = 1750 Ω

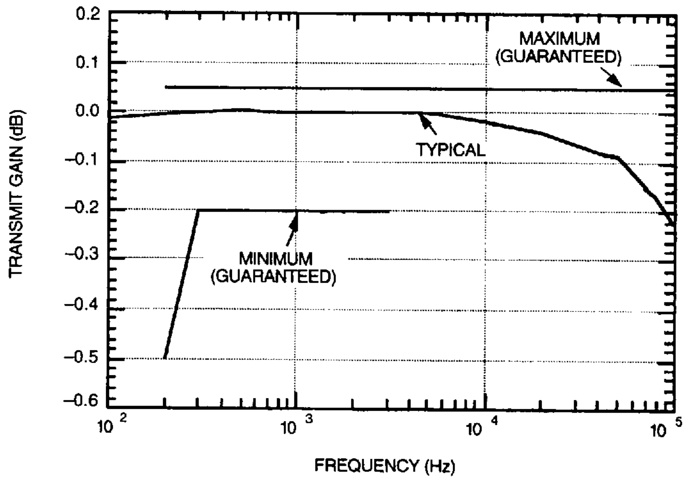
Figure 9. Loop Current vs. TIP-to-RING Voltage

Typical Characteristics (continued)



Note: 600 Ω Termination, Assume Ideal RCV Amplifier, Low Frequency Gain Increase Due to 2.2 μF Blocking Capacitor (CT)

Figure 10. Receive Gain vs. Frequency



Note: 600 Ω Termination, Assume Ideal XMT Amplifier, Low Frequency Gain Roll Off Due to 2.2 μF Blocking Capacitor (CT)

Figure 11. Transmit Gain vs. Frequency

Typical Characteristics (continued)

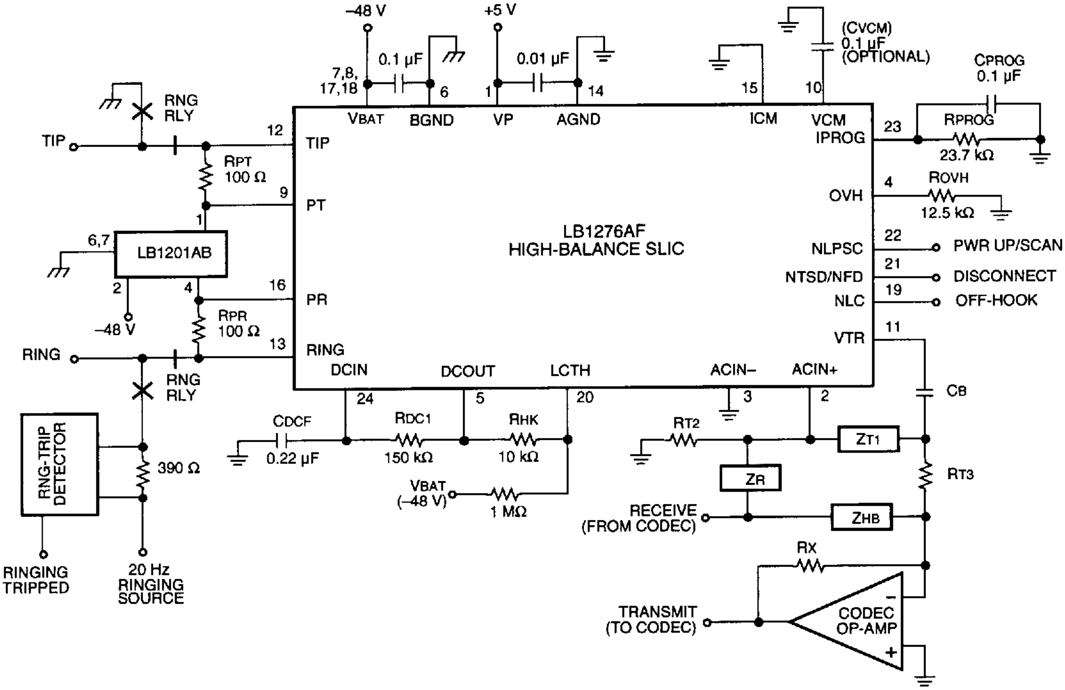
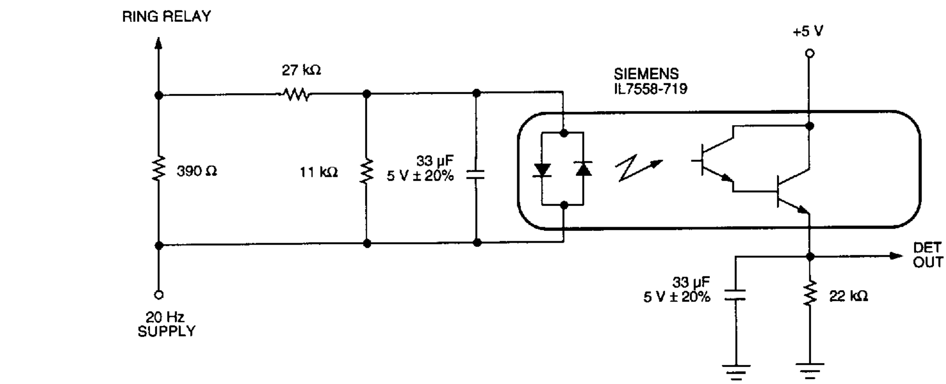


Figure 12. Typical 600 Ω Loop-Start Application



Notes:
Temperature: –40 °C to +85 °C
20 Hz Supply: 53 Vrms to 106 Vrms, 17 Hz, 10 Hz, 33 Hz
Superimposed on 42.5 Vdc to 52.5 Vdc
Pretrip Immunity: 6.8 µF ll 15 kΩ
Trip Resistance: ≤1800 Ω
Trip Time: ≤250 ms
Det Out: ≥2.1 V Ring Trip
≤0.5 V Ringing Not Tripped

Figure 13. Ring Trip Detector Schematic