

Am79212/Am79C202

Advanced Subscriber Line Interface Circuit (ASLIC™) Device
Advanced Subscriber Line Audio-Processing
Circuit (ASLAC™) Device

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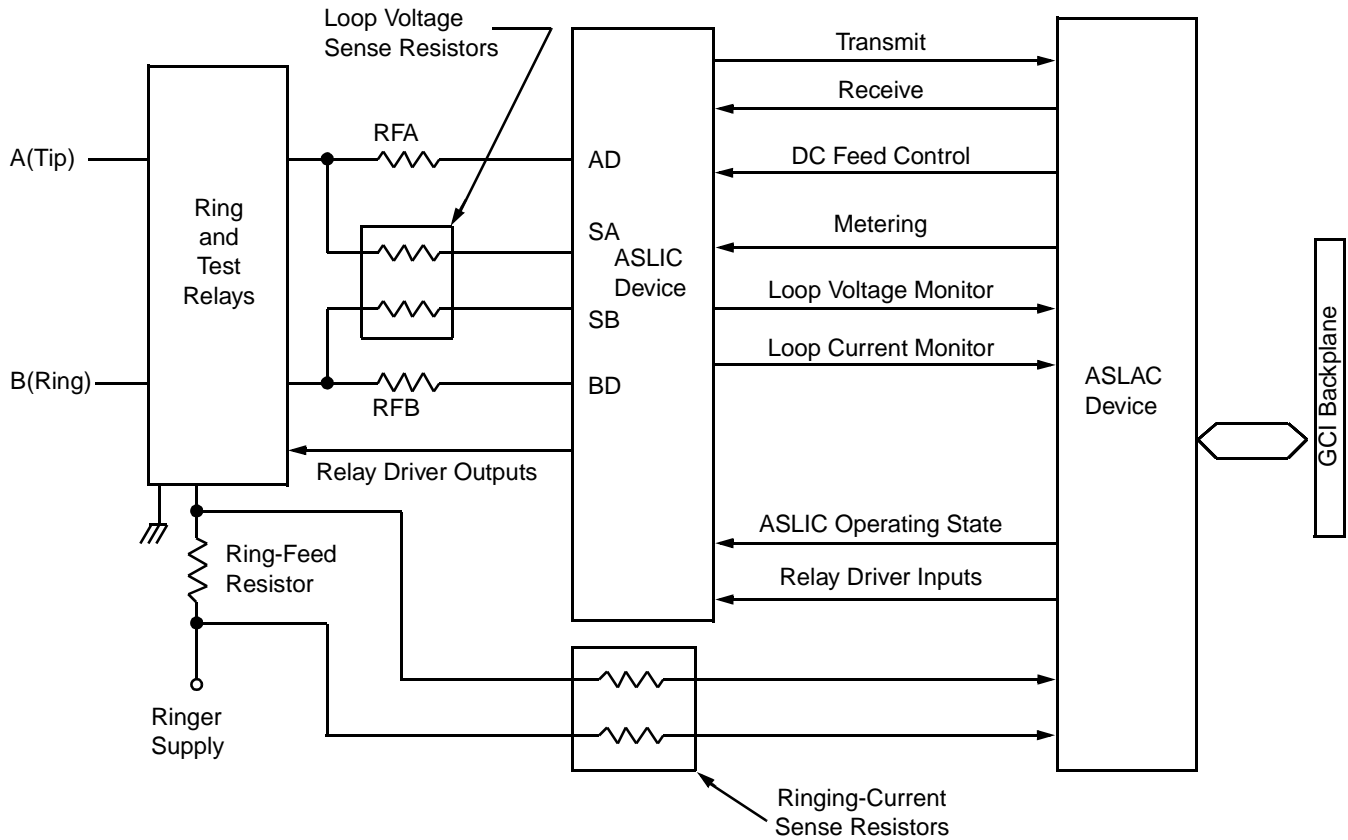
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The Am79212/Am79C202 Advanced Subscriber Line Interface chipset implements a universal telephone line interface function. This enables the design of a single, low-cost, high-performance, fully-software-programmable line interface card for multiple country applications world wide. All AC, DC, and Signaling parameters are fully programmable via the General

Control Interface (GCI). Additionally, the ASLIC device and ASLAC device have integrated self test and line test capabilities to resolve faults to the line or line circuit. The integrated test capability is crucial for remote applications where dedicated test hardware is not cost effective. Use of the accompanying Technical Reference, document PID 21324A is recommended.

LINECARD BLOCK DIAGRAM



DISTINCTIVE CHARACTERISTICS

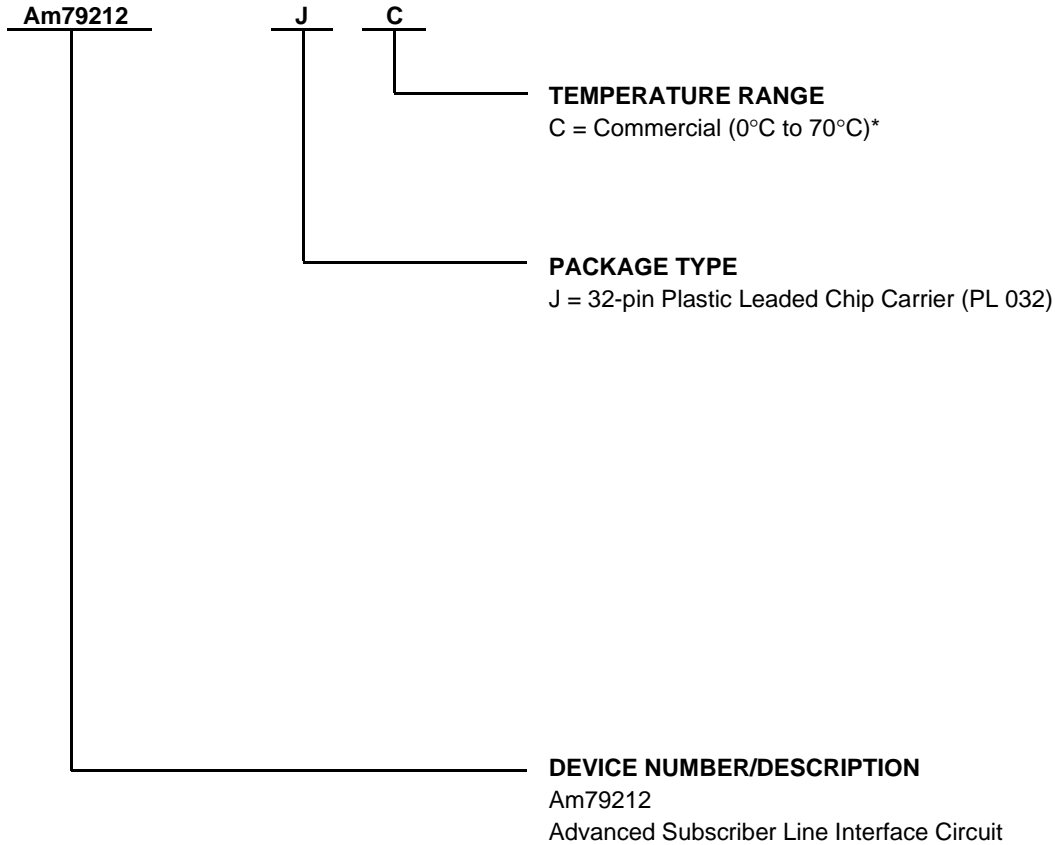
- Performs all of the functions of a CODEC-Filter
- Single channel architecture
- Performs Battery-Feed, Ring-trip, Signaling, Coding, Hybrid, and Test (BORSCHT) functions
- Single hardware design meets multiple country requirements through software programming
- GCI Interface
 - Control and PCM on one bus
 - Data rate up to 4.096 MHz
- Monitor of two-wire interface voltage and current for subscriber line diagnostics
- Low idle power per line
- On-hook transmission
- Only Battery and +5 V supplies needed
- Exceeds LSSGR and CCITT central office requirements
- Off-hook and ground-key detectors with programmable thresholds
- Programmable line feed characteristics independent of battery voltage
- Built-in voice path test modes
- Analog and digital hybrid balance capability
- Adaptive hybrid balance capability
- Linear power feed with power management and thermal shutdown features
- Abrupt and smooth polarity reversal
- Power cross detection in ringing and non-ringing states
- Software programmable
 - DC loop feed characteristics and current limit
 - Loop supervision detection thresholds
 - Off-hook detect debounce interval
 - Two-wire AC impedence
 - Transhybrid balance
 - Transmit and receive gains
 - Equalization
 - Digital I/O pins
 - A-law/ μ -law selection
- Compatible with inexpensive protection networks. Accommodates low-tolerance fuse resistors while maintaining longitudinal balance to Bellcore specifications.
- Power/Service Denial state
- Small physical size
- Integrated ring-trip function
- Four relay drivers with built-in energy absorption zener diodes
- Synchronized ring relay operation: zero volts AC on, zero current off
- Software-enabled normal or automatic Ring-Trip state
- On-chip 12/16 kHz metering generation with on- and off-meter pulse shaping
- Supports loop-start and ground-start signaling.
- 0°C to 70°C commercial operation guaranteed by production testing
- -40°C to +85°C temperature range operation available

ORDERING INFORMATION

ASLIC Device

AMD standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of the elements below.

Must order Am79C202 with the device below.



| Valid Combinations | |
|--------------------|----|
| Am79212 | JC |

Valid Combinations
 Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

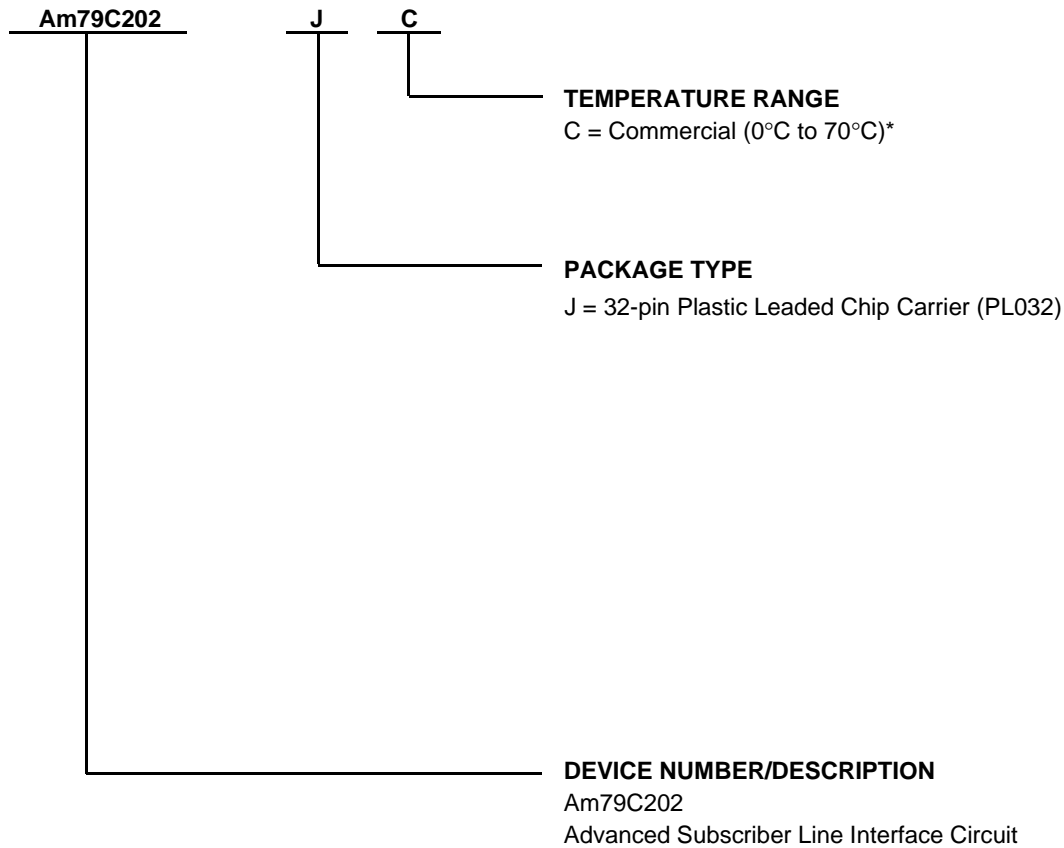
Note:

* Functionality of the device from 0°C to +70°C is guaranteed by production testing. Performance from -40°C to +85°C is guaranteed by characterization and periodic sampling of production units.

ASLAC Device

AMD standard products are available in several packages and operating ranges. The order number (Valid Combination) is formed by a combination of the elements below.

Must order Am79212 with the part below.



| Valid Combinations | |
|--------------------|----|
| Am79C202 | JC |

Valid Combinations

Valid Combinations list configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations and to check on newly released combinations.

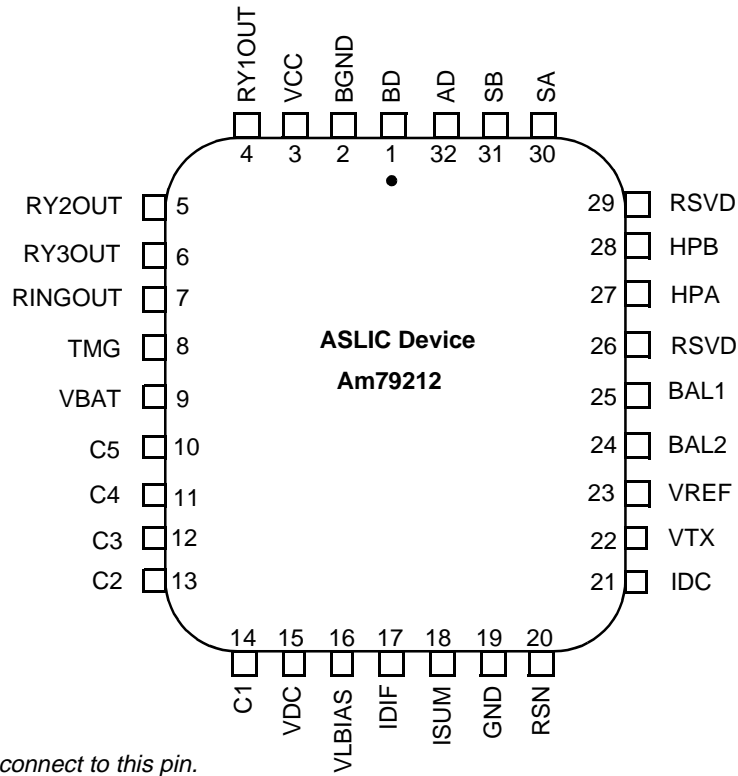
Note:

* Functionality of the device from 0°C to +70°C is guaranteed by production testing. Performance from -40°C to +85°C is guaranteed by characterization and periodic sampling of production units.

CONNECTION DIAGRAMS

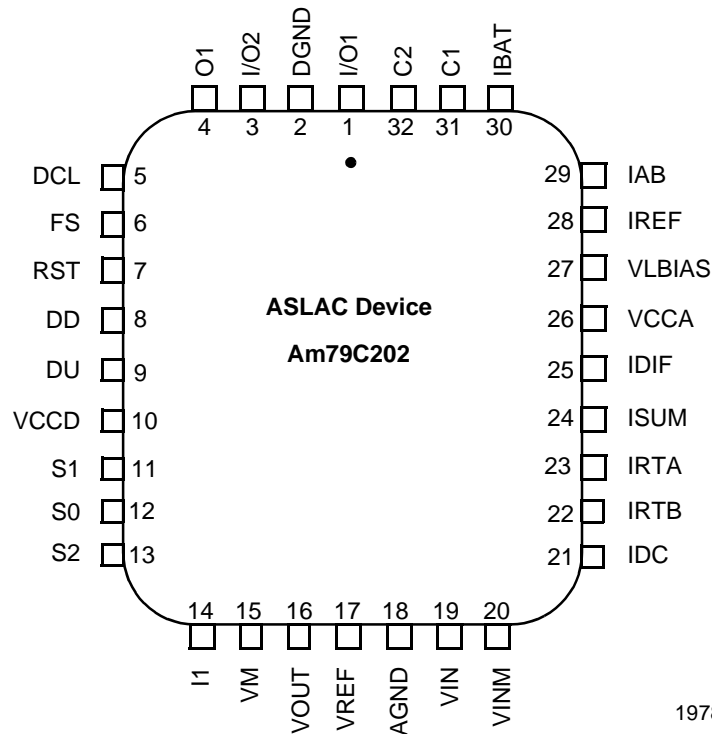
Top View

32-Pin PLCC



19780A-004

32-Pin PLCC



19780A-003

PIN DESCRIPTIONS

ASLIC Device

AD, BD

A and B Line Drivers (Output)

These pins provide the currents to the A and B leads of the subscriber loop.

BAL1, BAL2

Pre-balance (Input)

These pins receive voltages that are added to the VTX output signal. They can be used to cancel out the metering echo in the transmit path.

BGND

Battery Ground

This pin connects to the ground return for Central Office or talk battery.

C2–C1

ASLIC Device Control (Input)

These ternary logic input pins control the operating state of the ASLIC device.

C5–C3

Test Relay Control (Input)

These are control inputs for the test relay drivers in the ASLIC device. A logic Low turns on the relay driver and activates the relay. C3 controls RY1OUT, C4 controls RY2OUT, and C5 controls RY3OUT.

GND

Ground

Analog and digital ground return for VCC.

HPA, HPB

High-Pass Filter Capacitor Connections

These pins connect to CHP, the external high-pass filter capacitor that isolates the DC control loop from the voice transmission path.

IDC

DC Loop Control Current (Input)

The DC loop current control line from the ASLAC device is connected to this pin. An internal resistance is provided between the IDC pin and RSN. An external noise filter capacitor should be connected between this pin and VREF.

IDIF

A – B Leg Current (Output)

The current at this pin is proportional to the difference of the currents flowing out of the AD pin and into the BD pin of the ASLIC device.

ISUM

A + B Leg Current (Output)

The current at this pin is proportional to the absolute value of the sum of the currents flowing out of the AD pin and into the BD pin of the ASLIC device.

RINGOUT, RY1OUT, RY2OUT, RY3OUT

Relay Drivers (Output)

These are open collector, high-current relay driver outputs with emitters internally connected to BGND. To absorb the inductive pulse from the relay coils, an internal Zener diode is connected between the collector of each driver and BGND.

RSN

Receive Summing Node (Input)

The metallic current (both AC and DC) between AD and BD is equal to the ASLIC device current gain, K1, times the current into this pin. Networks that program receive gain and two-wire impedance connect to this node. This input is nominally at VREF potential.

RSVD

Reserved (Input)

This is used during AMD testing. In the application, this pin must be floating.

SA, SB

A and B Lead Voltage Sense (Input)

These pins sense the voltages on the line side of the fuse resistors at the A and B leads. External sense resistors, RSA and RSB, are required to protect these pins from lightning or power cross conditions.

TMG

Thermal Management

A resistor connected from this pin to VBAT reduces the on-chip power dissipation by absorbing excess power from the ASLIC device for short loop conditions.

VBAT

Battery Voltage (Power)

This pin supplies battery voltage to the line drivers.

VCC

Power Supply (Power)

This pin is the positive supply for low-voltage analog and digital circuits in the ASLIC device.

VDC**DC Loop Voltage (Output)**

The voltage on this output is referenced to VREF and is proportional to the negative absolute value of the DC subscriber loop voltage between A and B. This voltage is a fraction (β) of the voltage between HPA and HPB. This pin connects to the IAB pin on the ASLAC device through the external resistor RAB. A voltage that is significantly more positive than VREF on the VDC pin indicates that the ASLIC device is in thermal shutdown.

VLBIAS**Longitudinal Offset Voltage (Input)**

The input to this pin is the offset reference voltage for the ASLIC device longitudinal control loop.

VREF**Analog Reference (Input)**

This voltage is provided by the ASLAC device and is used by the ASLIC device for internal reference purposes. All analog input and output signals interfacing to the ASLAC device are referenced to this pin. Nominally set to 2.1 V.

VTX**Four-Wire Transmit Signal (Output)**

The voltage between this pin and VREF is a scaled version of the AC component of the voltage sensed between the SA and SB pins. One end of the two-wire input impedance programming network connects to VTX. The voltage at VTX swings positive and negative about VREF.

ASLAC Device

AGND

Analog (Quiet) Ground

VREF is referenced to this ground.

C2–C1

ASLIC Device Control (Output)

These ternary logic output pins are dedicated to controlling the operating state of the ASLIC device. The levels of these outputs are logic High, logic Low, and High impedance.

DCL

GCI Clock (Input)

This input controls the clocking of the GCI data and is also used as the master clock for the CODEC and DSP. 2.048 MHz or 4.096 MHz clock frequencies can be used. In either case, the GCI bit rate is always 2.048 MHz.

DD

Downstream GCI Data (Input)

Downstream data is received serially on the DD port every 125 μ s at the DCL rate.

DGND

Digital Ground

This is digital ground return.

DU

Upstream GCI Data (Output)

Upstream data is sent serially on the DU pin every 125 μ s at the DCL rate. DU is high impedance between bursts. This pin is an open drain output.

FS

Frame Sync (Input)

The Frame Sync signal is an 8 kHz pulse that identifies the beginning of a GCI frame. The ASLAC device references the timing of back-plane data transfer to this input. The back-plane data bit rate must be synchronized to DCL.

I1

Control Port (Input)

This input port is TTL compatible and can be used to monitor an external TTL compatible device. The logic state of this pin appears in the I1 bit (bit 2) of the upstream C/I channel.

IAB

Loop Voltage Sense (Input)

The IAB pin is a current summing node referenced to VREF. An external resistor (RAB) is connected between this pin and the VDC pin of the ASLIC device. In normal operation, current flows out of this pin. When the ASLIC device is in thermal shutdown, current will be forced into this pin.

IBAT

Battery Voltage Sense (Input)

The IBAT pin is a current summing node referenced to AGND and receives a current that is proportional to the system battery voltage. A sense resistor/capacitor network is connected between the VBAT pin of the ASLIC device and the IBAT pin.

IDC

DC Loop Control Current (Output)

The IDC output supplies a current to the ASLIC device for proportional control of the DC loop current flowing through the subscriber loop.

IDIF

Longitudinal Sense (Input)

IDIF is a current input pin and is fed by the IDIF pin of the ASLIC device. The current in this pin is used by the ASLAC device for supervisory and diagnostic functions. The IDIF pin has an internal input resistance so an external longitudinal noise-filter capacitor can be connected.

I/O1, I/O2

Control Ports (Input/Output)

These control lines are TTL compatible and each can be programmed as an input or an output. When programmed as inputs, they can monitor external, TTL-compatible logic circuits. In the output mode, these pins are controlled by the I/O1 and I/O2 bits in the downstream C/I channel. In the output or input modes, the logic state of these pins appears in the I/O1 and I/O2 bits of the upstream C/I channel. When programmed as outputs, they can control an external logic device or they can be connected to pin C3, C4, or C5 of the ASLIC device to control test relay drivers RY1OUT, RY2OUT, and RY3OUT.

IREF**Current Reference (Input)**

An external resistor (RREF) connected between this pin and analog ground generates an accurate on-chip reference current. This current is used by the ASLAC device in its DC Feed and loop-supervision circuits.

IRTA, IRTB**Ring-Trip Sense (Inputs)**

These pins are current summing nodes referenced to VREF. They provide terminations for external resistors RSR1 and RSR2 that sense the voltages on both sides of the ringing-feed resistor connected to the ring bus. To determine the ringing current in the loop, the ASLAC device finds the difference between the currents in these pins.

ISUM**Metallic Sense (Input)**

ISUM is a current input pin and is fed by the ISUM pin of the ASLAC device. The current in this pin is used by the ASLAC device for supervisory and diagnostic functions.

O1**Control Port (Output)**

This output port is TTL compatible and is controlled by the O1 bit (bit 2) in the downstream C/I channel. It can control an external logic device or it can be connected to pin C3, C4, or C5 of the ASLAC device to control relays.

RST**Reset (Input)**

A logic 1 on this pin resets the ASLAC device to initial default conditions. A signal less than 100 ns in duration should not cause a reset. To ensure proper reset, the minimum length of a reset pulse is 50 μ s.

S0, S1, S2**GCI Channel Identification Straps (Input)**

When the input pins are individually strapped to VCC or DGND, the ASLAC device can be coded to communicate with one of the eight GCI channels within a frame.

VCCA**Analog Power Supply**

VCCA is internally connected to substrate near the analog I/O section.

VCCD**Digital Power Supply**

VCCD is internally connected to substrate near the digital section.

VIN**Analog Input (Input)**

The analog output (VTX) from the ASLAC device is applied to the ASLAC device transmit path input, VIN. The signal is sampled, processed, encoded, and placed on the upstream GCI port.

VINM**Inversion of Analog Input (Output)**

An inverted version of the analog input voltage on VIN appears on this pin.

VLBIAS**Longitudinal Reference (Output)**

VLBIAS is programmed by VOFF and supplies the longitudinal reference voltage for the longitudinal control loop to the ASLAC device.

VM**12 kHz or 16 kHz Metering Signal (Output)**

For 12 kHz or 16 kHz teletax, an internally generated and shaped 12 kHz or 16 kHz sine wave metering pulse is output from this pin.

VOUT**Analog Output (Output)**

The voice data from the downstream GCI port, B1 channel, is digitally processed and converted to an analog signal that is sent out of the VOUT pin to the ASLAC device.

VREF**Analog Reference (Output)**

This pin provides a voltage reference to be used as the analog zero-level reference on the ASLAC device.

ASLIC/ASLAC DEVICES FUNCTIONAL DESCRIPTION

The ASLIC/ASLAC devices chipset integrates all functions of the subscriber line. The chipset comprises an ASLIC device and an ASLAC device. The set provides two basic functions: 1) the ASLIC device, a high-voltage, bipolar device that drives the subscriber line, maintains longitudinal balance, and senses line conditions, and 2) the ASLAC device, a low-voltage, CMOS device that combines CODEC, DC Feed control, and line supervision. A complete schematic of a linecard using the ASLIC/ASLAC devices chipset is shown in Figure 7.

The ASLIC device uses reliable, bipolar technology to provide the power necessary to drive a wide variety of subscriber lines. It can be programmed by the ASLAC device to operate in eight different states that control Power Consumption and Signaling modes. This enables full control over the subscriber loop. The ASLIC device is customized to be used exclusively with the ASLAC device providing a two-chip universal line interface. The ASLIC device requires only a +5 V power supply and a negative battery supply for its operation.

The ASLIC device implements a linear loop current feeding method with the enhancement of thermal management to limit the amount of power dissipated on the ASLIC device by dissipating excess power in an external resistor.

The ASLAC device is a high-performance, CMOS CODEC/filter device with additional digital filters and circuits that allow software control of transmission, DC Feed, and supervision.

Advanced CMOS technology makes the ASLAC device an economical device that has both the functionality and the low power consumption required by linecard designers to maximize linecard density at minimum cost.

When used with an ASLIC device, the ASLAC device provides a complete software-configurable solution to linecard functions as well as complete programmable control over subscriber line DC Feed characteristics. In addition, the ASLIC/ASLAC devices chipset provides system-level solutions for the loop supervisory functions and metering. In total, the ASLIC/ASLAC devices chipset provides a programmable solution that can satisfy worldwide linecard requirements by software configuration.

All software-programmed coefficients and DC Feed parameters are easily calculated with the AmSLAC3[®] software. This software is provided free of charge and runs on an IBM-compatible PC. It allows the designer to enter a description of system requirements, then the software returns the necessary coefficients and the predicted system response.

The ASLAC device uses the General Control Interface (GCI) protocol to interface with the back plane highway.

The ASLIC device interface unit inside the ASLAC device processes information regarding line voltages, loop currents, and battery voltage levels. These inputs allow the ASLAC device to place several key ASLIC device performance parameters under programmable supervision.

The main functions that can be observed and/or controlled through the ASLAC device control interface are:

- DC Feed characteristics
- Ground-key detection
- Off-hook detection
- Metering signal
- Longitudinal operating point
- Subscriber line voltage and currents
- Ring trip
- Abrupt and smooth battery polarity reversal

To accomplish these functions, the ASLAC device collects the following information from the ASLIC device and the Central Office system:

- The sum and difference of the currents in each loop leg, ISUM, and IDIF
- Currents proportional to:
 - The voltage across the loop (IAB)
 - The battery voltage (IBAT)
 - The ringing current in the loop (IRTA - IRTB)

The outputs supplied by the ASLAC device are then:

- A current proportional to the desired DC loop current (IDC)
- A voltage proportional to the desired longitudinal offset voltage (VLBIAS)
- A 12/16 kHz metering signal (appears on VM for 12/16 kHz teletax)

The ASLAC device performs the CODEC and filter functions associated with the four-wire section of the subscriber line circuitry in a digital switch. These functions involve converting an analog voice signal into digital PCM samples and converting digital PCM samples back into an analog signal. During conversion, digital filters are used to band-limit the voice signals.

The user-programmable filters set the receive and transmit gain, perform the transhybrid balancing function, permit adjustment of the two-wire termination impedance, and provide frequency attenuation

adjustment (equalization) of the receive and transmit paths. Adaptive transhybrid balancing is also included.

The PCM data can be either 8-bit companded A-law or μ -law code. Voice and control data are read or written to the digital interface in channels that are pin strap compatible.

Besides the CODEC functions, the ASLAC device provides all the sensing, feedback, and clocking necessary to completely control ASLIC device functions with programmable parameters. System-level parameters under programmable control include active and disable loop-current limits, feed resistance, and apparent battery-feed voltage. The longitudinal operating point is programmable to optimize the ASLIC device signal swing capability.

The ASLAC device provides signals at 12 or 16 kHz for metering functions. The frequency and level of these signals are programmable.

The ASLAC device provides extensive loop supervision capability, including off-hook, ring-trip, and ground-key detection. Detection thresholds for these functions are programmable. A programmable debounce timer is available that eliminates false detection due to contact bounce. For subscriber line diagnostics, AC and DC line conditions can be monitored using special test modes. Results are sent upstream over the control interface.

ELECTRICAL REQUIREMENTS

Power Dissipation

Loop resistance = 0 to ∞ (not including fuse resistors), 2 x 50 Ω fuse resistors, $V_{BAT} = -48$ V, $V_{CC} = +5$ V. For power dissipation measurements, DC Feed conditions are programmed as follows:

VAPP (Apparent voltage) = 50.2 V

ILA (Active state current limit) = 42.3 mA

ILD (Disable state current limit) = 21.2 mA

RFD (Feed resistance) = 807 Ω

VAS (Anti-sat activate voltage) = 8.2 V

N2 (Anti-sat feed resistance factor) = 2

VOFF (Longitudinal offset voltage) = 6 V

RTMG (Thermal management resistor) = 1200 Ω

RREF (Referenced current setting resistor) = 7.87 k Ω

Table 1. Power Dissipation

| Description | Test Conditions | Min | Typ | Max | Unit |
|--|---|-----|-----|------|------|
| ASLIC device power dissipation Normal polarity | On-hook Disconnect | | 30 | 70 | mW |
| | On-hook Standby | | 50 | 105 | |
| | On-hook Disable | | 120 | 215 | |
| | On-hook Active | | 330 | 450 | |
| | Off-hook Active $R_L = 294 \Omega$ | | 850 | 1200 | |
| | Off-hook Disable $R_L = 600 \Omega$ | | 800 | 950 | |
| ASLAC device power dissipation MCLK, PCLK = 2.048 MHz | ASLAC device Activated | | 85 | 110 | mW |
| | ASLAC device Inactive, C/I Standby state command issued | | 22 | 25 | |

Thermal Resistance

The junction-to-air thermal resistance of the ASLIC device in a 32-pin, PLCC package will be less than 45°C/W.

The junction-to-air thermal resistance of the ASLAC device in a 32-pin, PLCC package will be less than 45°C/W.

ABSOLUTE MAXIMUM ELECTRICAL AND THERMAL RATINGS

ASLIC Device

| | |
|---|--|
| Storage temperature | $-55^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ |
| Ambient temperature, under Bias..... | $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ |
| Ambient relative humidity (noncondensing) | 5 to 100% |
| V_{CC} with respect to AGND/DGND | $-0.4\text{ V to }+7\text{ V}$ |
| V_{BAT} with respect to BGND | $+0.4\text{ V to }-75\text{ V}$ |
| V_{CC} with respect to V_{BAT} | +80 V |
| BGND with respect to AGND/DGND | $-0.5\text{ V to }+0.5\text{ V}$ |
| Voltage on relay outputs | +7 V |
| AD or BD to BGND: | |
| Continuous..... | $-75\text{ V to }+1.0\text{ V}$ |
| 10 ms (f = 0.1 Hz) | $-75\text{ V to }+5\text{ V}$ |
| 1 μs (f = 0.1 Hz) | $-90\text{ V to }+10\text{ V}$ |
| 250 ns (f = 0.1 Hz) | $-120\text{ V to }+15\text{ V}$ |
| Current into SA or SB: 10 μs rise to I_{peak} ; 1000 μs fall to 0.5 I_{peak} ; 2000 μs fall to $I = 0$ | $I_{peak} = \pm 5\text{ mA}$ |
| Current into SA or SB: 2 μs rise to I_{peak} ; 10 μs fall to 0.5 I_{peak} ; 20 μs fall to $I = 0$ | $I_{peak} = \pm 12.5\text{ mA}$ |
| Current through AD or BD..... | $\pm 150\text{ mA}$ |
| C5–C1 to DGND or AGND..... | $-0.4\text{ V to }V_{CC} + 0.4\text{ V}$ |
| Maximum power dissipation, $T_A = 70^{\circ}\text{C}$ | 1.67 W |

Note: Thermal limiting circuitry on chip will shut down the circuit at a junction temperature of about 160°C . The device should never be exposed to this temperature. Operation above 145°C junction temperature may degrade device reliability. See the SLIC Packaging Considerations for more information.

ASLAC Device

| | |
|---|--|
| Storage temperature..... | $-60^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ |
| Ambient temperature, under Bias | $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ |
| Ambient relative humidity (noncondensing)..... | 5 to 100% |
| V_{CCA} , V_{CCD} with respect to DGND..... | $-0.4\text{ V to }+6\text{ V}$ |
| V_{CCA} with respect to V_{CCD} | $\pm 0.4\text{ V}$ |
| V_{IN} with respect to DGND | $-0.4\text{ V to }V_{CCA} + 0.4\text{ V}$ |
| AGND | DGND $\pm 0.4\text{ V}$ |
| Latch up immunity (any pin) | $\pm 100\text{ mA}$ |
| Any other pin with respect to DGND | $-0.4\text{ V to }V_{CC} + 0.4\text{ V}$ |

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.

OPERATING RANGES

Environmental

| | |
|---------------------------------|--|
| Ambient temperature | $0^{\circ}\text{C to }+70^{\circ}\text{C}$ Commercial* |
| Ambient relative humidity | 15% to 85% |

ASLIC Device

| | |
|--|------------------------------------|
| V_{CC} | $+5\text{ V} \pm 5\%$ |
| V_{BAT} | $-18\text{ V to }-70\text{ V}$ |
| BGND with respect to GND | $-100\text{ mV to }+100\text{ mV}$ |
| Load resistance on V_{TX} to ground..... | 10 k Ω min |

ASLAC Device

| | |
|--------------------------------------|-------------------------|
| Supplies V_{CCA} , V_{CCD} | $+5.0\text{ V} \pm 5\%$ |
| DGND | 0 V |
| AGND | DGND $\pm 50\text{ mV}$ |

Operating ranges define those limits over which the functionality of the device is guaranteed by production testing.

* Functionality of the device from 0°C to $+70^{\circ}\text{C}$ is guaranteed by production testing. Performance from -40°C to $+85^{\circ}\text{C}$ is guaranteed by characterization and periodic sampling of production units.

PERFORMANCE CHARACTERISTICS (See Note 1)

(See note 1) $T_A = 0^\circ\text{C}$ to 70°C unless otherwise noted.

Table 2. ASLIC Device DC Specifications

| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|---|---|-----------------|-----------------|-----------------|---------------|------|
| 1 | 2-wire loop voltage | Standby state, $R_L = 1 \text{ Meg } \Omega$ | $V_{BAT} - 1.8$ | $V_{BAT} - 1.1$ | $V_{BAT} - 0.5$ | V | 4 |
| | | Active state, $R_{L_{AD-BD}} = 600 \Omega$ $IRSN = 140 \mu\text{A}$ | 19.51 | 21.1 | 22.68 | | |
| | | Disable state, $R_{L_{AD-BD}} = 600 \Omega$ $IRSN = 80 \mu\text{A}$ | 11.34 | 12.19 | 13.04 | | |
| 2 | Feed resistance per leg at pins AD and BD | Standby state | 130 | 250 | 375 | Ω | |
| 3 | ISUM current | Standby state, $R_L = 1930 \Omega$ | 44.6 | 56 | | μA | |
| | IDIF current | Standby state A to V_{BAT} B to ground | 35.4 43.4 | | | | |
| 4 | Ternary input voltage boundaries for C2–C1 pins. Mid-level input source must be high impedance or 3-state | | | | | V | |
| | Low boundary | | | | 0.8 | | |
| | High boundary | | $V_{CC} - 1$ | | | | |
| | Logic inputs C2–C1 Input High current | | | –80 | 200 | μA | |
| | Input Low current | | | 90 | 200 | | |
| | 3-state voltage | $I_{C1} = I_{C2} = 1 \mu\text{A}$ | 0.8 | | | 3.5 | |
| 5 | Logic inputs C5–C3 Input High voltage | | 2.0 | | | V | |
| | Input Low voltage | | | | 0.8 | | |
| | Input High current | | –200 | | 40 | μA | |
| | Input Low current | | –400 | | 40 | | |
| 6 | V_{TX} output offset | BAL1 pin open | –50 | | +50 | mV | |
| 7 | V_{REF} input voltage | $I_{REF} = \pm 1 \text{ mA}$ | 2.0 | 2.1 | 2.2 | V | |
| 8 | β , Ratio of V_{DC} to loop voltage: $\beta = \frac{ V_{DC} - V_{REF}}{ V_{SA} - V_{SB} }$ | $T_j < 145^\circ\text{C}$, V_{DC} is referenced to V_{REF} , 35.7 k Ω resistor connected from V_{DC} to V_{REF} . $V_{SA} - V_{SB} = 40 \text{ V}$. | 0.0253 | 0.0242 | 0.0232 | V/V | |
| 9 | Thermal shutdown threshold voltage output on VDC | $I_{VDC} = 20 \mu\text{A}$ | 4.2 | $V_{CC} - 0.4$ | | V | 4 |
| 10 | Gain from VLBIAS pin to AD or BD pin | | 5.58 | 6.0 | 6.42 | V/V | |
| 11 | Input resistance to AGND, VLBIAS pin | VLBIAS = 3 V | 20 | 33.3 | | k Ω | |
| 12 | ISUM/ILOOP | ILOOP = 10 mA | 1/333 | 1/300 | 1/273 | | |
| 13 | IDIF/ILONG | ILONG = 10 mA | 1/667 | 1/600 | 1/546 | | |

Table 2. ASLIC Device DC Specifications (continued)

| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|--------------------------------|-----------------------------|------|-----|------|------|------|
| 14 | Input current, SA and SB pins | | | 1 | 3 | μA | 4 |
| 15 | Input current HPA and HPB pins | | | 0.1 | 3 | | |
| 16 | IDC input impedance | | 1.26 | 1.8 | 3 | | |
| 17 | K1 | Incremental DC Current Gain | | 254 | | A/A | 13 |
| 18 | Metallic offset current | | | 0 | -0.4 | mA | |

ASLIC Device Relay Driver Schematic

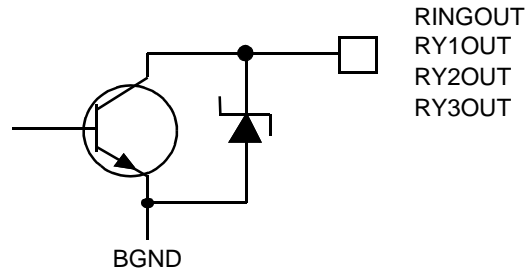


Table 3. ASLIC Device Relay Driver Specifications

| Item | Condition | | Min | Typ | Max | Unit | Note |
|---------------------------------|----------------------|-------------|-----|-------|------|------|------|
| On voltage | 25 mA per relay sink | 1 relay on | | 0.225 | +0.3 | V | |
| | | 4 relays on | | 0.4 | 0.5 | | 4 |
| | 40 mA per relay sink | 1 relay on | | 0.45 | 0.7 | | |
| | | 4 relays on | | 0.8 | +1.0 | | 4 |
| Off leakage, each relay driver. | $V_{OH} = +6 V$ | | 0 | | 100 | μA | |

Table 4. ASLIC Device Transmission Specifications

| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|-------------------------------|---|------------------|--------|------------------|------|------|
| 1 | R_{SN} input impedance | $f = 300 \text{ Hz to } 3400 \text{ Hz}$ | | 1 | | Ω | 4 |
| 2 | V_{TX} output impedance | | | 3 | | | |
| 3 | Gain, BAL1 to V_{TX} | | 1.4 | 1.5 | 1.6 | V/V | |
| 4 | Gain, BAL2 to V_{TX} | | 2.8 | 3.0 | 3.2 | | |
| 5 | BAL1 input impedance | | 3.17 | 5 | 7.5 | kΩ | |
| 6 | BAL2 input impedance | | 2.09 | 3.3 | 4.95 | | |
| 7 | Input impedance A or B to GND | | | 70 | 135 | Ω | |
| 8 | 2- to 4-wire gain | $T_A = 0^\circ\text{C to } 70^\circ\text{C}, -10 \text{ dBm}, 1 \text{ kHz}$ $T_A = -40^\circ\text{C to } 0^\circ\text{C}/70^\circ\text{C to } 85^\circ\text{C}$ | -12.19 -12.24 | -12.04 | -11.89 -11.84 | dB | |

Table 4. ASLIC Device Transmission Specifications (continued)

| No. | Item | Condition | Min | Typ | Max | Unit | Note | |
|------------------|---|--|----------------|-----|----------------|------|------|---|
| 9 | 2- to 4-wire gain variation with frequency | 300 to 3400 Hz relative to 1 kHz $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | -0.1 -0.15 | | +0.1 +0.15 | dB | | |
| 10 | 2- to 4-wire gain tracking | +3 dBm to -55 dBm Reference: -10 dBm $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | -0.1 -0.15 | | +0.1 +0.15 | | | |
| 11 | 4- to 2-wire gain | -10 dBm, 1 kHz $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | -0.15 -0.20 | 0 | +0.15 +0.20 | | | |
| 12 | 4- to 2-wire gain variation with frequency | 300 to 3400 Hz relative to 1 kHz $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | -0.1 -0.15 | | +0.1 +0.15 | | | |
| 13 | 4- to 2-wire gain tracking | +3 dBm to -55 dBm Reference: -10 dBm $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | -0.1 -0.15 | | +0.1 +0.15 | | | |
| 14 | Total Harmonic Distortion 2-wire | 300 Hz to 3400 Hz 0 dBm +4 dBm | | | -50 -40 | | | |
| | 4-wire | -12 dBm -8 dBm | | | -50 -40 | | | |
| | 2-wire metering overload level | VLBIAS = 2.4 V, ILOOP = 30 mA, $V_{BAT} = -60$ V, DC Load = 200 Ω , Load at 16 kHz = 10 k Ω | | 42 | | | Vp-p | 4 |
| 15 | Idle channel noise C-message | Active and Disable states 2-wire $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | | +7 | +11 +15 | | dBmC | 4 |
| | weighted | 4-wire | | -5 | | | | 4 |
| | Psophometric | 2-wire $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | | -83 | -79 -75 | | dBmp | |
| | weighted | 4-wire | | -95 | | | | 4 |
| 16 | Longitudinal balance (IEEE method) Normal Polarity | L - T 200 to 1000 Hz $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | 58 53 | 63 | | | dB | |
| | | 1000 to 3400 Hz $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | 53 48 | 58 | | | | |
| | | T - L 200 to 3400 Hz | 40 | | | | | |
| | L - T, IL = 0 50 to 3400 Hz | | 63 | | 4 | | | |
| Reverse Polarity | L - T 200 to 1000 Hz $T_A = -40^\circ\text{C}$ to $0^\circ\text{C}/70^\circ\text{C}$ to 85°C | 50 48 | | | | | | |
| 17 | PSRR (V_{BAT}) | 50 to 3400 Hz | 25 | 45 | | dB | 3, 5 | |
| | | 3.4 kHz to 50 kHz | 25 | 40 | | | 4 | |
| | | ASLIC device in Anti-Sat state (Loop open) $f = 50$ Hz, CB = 100 nF $f = 200$ to 3400 Hz, CB = 100 nF | 2 12 | | | | 4, 8 | |
| 18 | PSRR (V_{CC}) | 50 to 3400 Hz | 25 | 45 | | dB | 3, 5 | |
| | | 3.4 kHz to 50 kHz | 25 | 35 | | | 2, 4 | |

Table 4. ASLIC Device Transmission Specifications (continued)

| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|--------------------------------------|--|-----|-----|-----|-------|------|
| 19 | Low frequency induction (REA method) | Active state, VLONG = 30 V rms, $I_L = 20$ mA, $f = 60$ Hz | | | +23 | dBrnC | 4 |
| 20 | Longitudinal AC current per wire | $f = 15$ to 60 Hz | 20 | | | mArms | |

Table 5. ASLAC Device DC Specifications

| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|--|---------------------------|-----------------|-----|----------------|---------|------|
| 1 | Input Low voltage DD, FS, DCL, RST, I1, I/O1, I/O2 | | -0.4 | | 0.8 | V | |
| | S0, S1, S2 | | -0.4 | | 0.6 | | |
| 2 | Input High voltage DD, FS, DCL, RST, I1, I/O1, I/O2 | | 2.0 | | $V_{CC} + 0.5$ | | |
| | S0, S1, S2 | | $V_{CC} - 0.5$ | | $V_{CC} + 0.4$ | | |
| 3 | Input leakage current DD, FS, DCL, RST, I1, I/O1, I/O2, S0, S1, S2 | | -10 | | +10 | μ A | |
| 4 | Input hysteresis DD, FS, DCL, RST | | | 0.5 | | V | 4 |
| 5 | Ternary output voltages C2-C1 | | | | | V | |
| | High voltage | $I_{OUT} = \pm 200 \mu$ A | $V_{CC} - 0.85$ | | | | |
| | Low voltage | $I_{OUT} = \pm 200 \mu$ A | | | 0.65 | | |
| | Output current | Mid level | -1 | | +1 | μ A | |
| 6 | Output Low voltage on digital outputs I/O1, I/O2, 01, DU | $I_{OL} = 10$ mA | | | 1.0 | V | |
| | | $I_{OL} = 2$ mA | | | 0.4 | | |
| 7 | Output High voltage I/O1, I/O2, 01 | $I_{OH} = 400 \mu$ A | $V_{CC} - 0.4$ | | | | |

Table 5. ASLAC Device DC Specifications (continued)

| No. | Item | Condition | Min | Typ | Max | Unit | Note | | | | | |
|--------------|--|--|-----------|---------|-------|------------|--------|---|--------|-----------|--------|---------|
| 8 | DC Feed | ILA = 47.6 mA, RFD = 403 Ω , N2 = 2, VAS = 10.3 V, IBAT = 69.9 μ A Active state, Normal polarity, IAB = 0, VAPP = 50.2 V | 172.7 | 188.5 | 204.9 | μ A | 17 | | | | | |
| | IDC | | | | | | 17 | | | | | |
| | $\frac{\Delta IAB}{\Delta IDC}$ | | | | | | | In resistive-feed region | 0.0624 | 0.0694 | 0.0764 | A/A |
| | IAB | | | | | | | IBAT = 69.9 μ A Adjust IAB until IDC = 0 | 27.93 | 29.93 | 31.93 | μ A |
| | Measured VAPP | | | | | | | Programmed VAPP = 50.2 V | | ± 2.2 | | V |
| Measured VAS | Programmed VAS = 10.3 V | | ± 1.6 | | | | | | | | | |
| 9 | IDC error among programmed ILA, ILD | Any ILA or ILD programmed value > 20 mA (IDC > 78.7 μ A) | | ± 5 | | % | 4, 17 | | | | | |
| | | Any ILA or ILD programmed value \leq 20 mA (IDC \leq 78.7 μ A) | | ± 4 | | μ A | 17 | | | | | |
| 10 | Offset voltage allowed on V_{IN} | | -50 | | +50 | mV | 10 | | | | | |
| 11 | V_{OUT} offset voltage | AISN off | -40 | | +40 | mV | 10, 17 | | | | | |
| | | AISN on | -80 | | +80 | | | | | | | |
| 12 | Output voltage, V_{REF} | Load current = 0 to 1 mA Source or sink | 2.0 | 2.1 | 2.2 | V | 17 | | | | | |
| 13 | Capacitance load on V_{REF} or V_{OUT} | | | | 200 | pF | 4 | | | | | |
| 14 | Output current V_{OUT} | Source or sink | -1 | | +1 | mA | | | | | | |
| 15 | Input resistance IDIF pin to V_{REF} | | 8.84 | 13.6 | 18.36 | k Ω | 6 | | | | | |
| 16 | VLBIAS operating voltage | Source current < 250 μ A or sink current < 25 μ A | +1 | | +2.4 | V | 17 | | | | | |
| 17 | Percent error of VLBIAS voltage | For VLBIAS equation, see Longitudinal Control Loop section | -5 | | +5 | % | | | | | | |
| 18 | Capacitance load on VLBIAS | | | | 120 | pF | 6 | | | | | |
| 19 | Capacitance load on IRTA or IRTB | | | | 400 | | | | | | | |

Table 6. ASLAC Device Transmission and Signaling Specifications

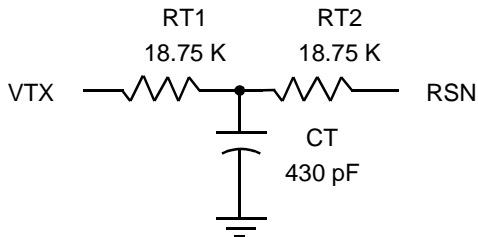
| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|---|---|---------------|-------|---------------|---------------|-------|
| 1 | Insertion loss A-D D-A A-D + D-A | Input: 1014 Hz, -10 dBm0 RG = AR = AX = GR = GX = 0 dB, AISN, R, X, B, and Z filters disabled | | | | dB | 7 |
| | | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$ | -0.25 | 0 | +0.25 | | |
| | | $T_A = -40^\circ\text{C to } 0^\circ\text{C}/70^\circ\text{C to } 85^\circ\text{C}$ | -0.30 | | +0.30 | | |
| | | $T_A = 0^\circ\text{C to } 70^\circ\text{C}$ | -0.25 | 0 | +0.25 | | |
| | | $T_A = -40^\circ\text{C to } 0^\circ\text{C}/70^\circ\text{C to } 85^\circ\text{C}$ | -0.30 | | +0.30 | | |
| | | $T_A = 70^\circ\text{C}$ | -0.20 | 0 | +0.20 | | |
| | $T_A = 0^\circ\text{C to } 70^\circ\text{C}; V_{CC} = 4.75 - 5.25\text{ V}$ | -0.25 | 0 | +0.25 | | | |
| | $T_A = -40^\circ\text{C to } 0^\circ\text{C}/70^\circ\text{C to } 85^\circ\text{C}$ | -0.34 | | +0.34 | | | |
| 2 | Level set error (Error between setting and actual value) | A-D AX + GX | -0.1 | | +0.1 | dB | |
| | | D-A AR + GR | -0.1 | | +0.1 | | |
| 3 | DD to DU gain in Full Digital Loopback mode | DD Input: 1014 Hz, -10 dBm0 RG = AR = AX = GR = GX = 0 dB, AISN, R, X, B, and Z filters disabled $T_A = 0^\circ\text{C to } 70^\circ\text{C}$ $T_A = -40^\circ\text{C to } 0^\circ\text{C}/70^\circ\text{C to } 85^\circ\text{C}$ | -0.2 -0.25 | +0.1 | +0.4 +0.50 | | |
| 4 | Idle channel noise, psophometric weighted (A-law) | AX = 0 dB AR = 0 dB | | | | dBm0p | 12 |
| | | A-D (PCM output) | | | -68 | | |
| | | D-A (V_{OUT}) | | | -78 | | |
| 5 | Idle channel noise, C-message weighted (μ -law) | AX = 0 dB AR = 0 dB | | | | dBmC0 | |
| | | A-D (PCM output), GX = +8 dB | | | +16 | | |
| | | D-A (2 wire), GR = -8 dB | | | +12 | | |
| 6 | Coder offset decision value, Xn | A-D, Input signal = 0 V, A-law | -5 | | +5 | Bits | 6 |
| 7 | GX step size | $0 \leq GX < 10\text{ dB}$ $10 \leq GX \leq 12\text{ dB}$ | | | 0.1 0.3 | dB | 4 |
| 8 | GR step size | $-12 \leq GR \leq 0\text{ dB}$ | | | 0.1 | | |
| 9 | PSRR (V_{CC}) image frequency | Input: 4800 to 7800 Hz 200 mV p-p Measure 8000 Hz input frequency | | | | dB | 4 |
| | | A-D | 37 | | | | |
| | | D-A | 37 | | | | |
| 10 | Group delay PCLK $\geq 1.53\text{ MHz}$ PCLK $\leq 1.03\text{ MHz}$ | 1014 Hz; -10 dBm0 B, X, R, and Z filters programmed with null coefficients | | | 590 655 | μs | 4, 14 |

Table 6. ASLAC Device Transmission and Signaling Specifications (continued)

| No. | Item | Condition | Min | Typ | Max | Unit | Note |
|-----|--|---|--------------------|-----|--------------------|---------------|--------------|
| 11 | Switchhook thresholds | All TSH settings | -0.45 or -10 | | +0.45 or +10 | mA % | 9, 15, 18 |
| | Switchhook hysteresis | | | -10 | | % | 4 |
| 12 | Ground-key thresholds | All TGK settings | -0.90 or -10 | | +0.90 or +10 | mA % | 9, 15, 18 |
| | Ground-key hysteresis | | | -10 | | % | 4 |
| 13 | Voltage that sets thermal shutdown bit | Voltage on ASLAC device V_{DC} with $R_{AB} = 35.7 \text{ k}\Omega$ | +4.19 | | | V | 4 |
| 14 | IDIF fault current thresholds | Tip-to-battery fault current (mA) | | | | | |
| | FT, pkFT | 19.3, 50.6 | -10 | | +10 | | 9, 15, 18 |
| | FT, pkFT hysteresis | | | -10 | | | 4 |
| 15 | AISN gain accuracy | $G_{AISN} = \pm 0.0625$ | -16 | | +16 | % | |
| | | $G_{AISN} = \pm 0.125$ | -8 | | +8 | | |
| | | $G_{AISN} = \pm 0.1875$ | -6 | | +6 | | |
| | | $G_{AISN} = \leq -0.25$ or $G_{AISN} \geq +0.25$ | -4 | | +4 | | |
| 16 | Metering voltage (MTRA) accuracy | Measured at ASLAC device VM pin | -7 | | +7 | | |
| 17 | Metering voltage noise | Wide-band signal to noise | 40 | | | dB | |
| 18 | Ring-trip accuracy | 0°C to 70°C | -5 | | +5 | % | 4, 16, 19 |
| 19 | Ring-trip hysteresis | V_{ZX} | | 4 | | V | — |
| | | I_{ZX} | | 5 | | μA | 4, 16 |
| 20 | Power-cross accuracy | During transmission | -10 | | +10 | % | 19 |
| | | During ringing | -10 | | +10 | | 4, 16, 19 |

Notes:

- Unless otherwise specified, test conditions are:
 $V_{CC} = 5 \text{ V}$, $R_{TMG} = 1200 \Omega$, $BAT = -51 \text{ V}$, $R_{AB} = 35.7 \text{ K}$, $R_{BAT1} = R_{BAT2} = 365 \text{ k}\Omega$, $R_{REF} = 7.87 \text{ k}\Omega$, $R_{RX} = 75 \text{ k}\Omega$, $R_L = 600 \Omega$,
 $R_{SA} = R_{SB} = 200 \text{ k}\Omega$, $C_{HP} = 220 \text{ nF}$, $C_{DC1} = 1.0 \mu\text{F}$, 50Ω fuse resistors, $R_{SR1} = R_{SR2} = 750 \text{ k}\Omega$, $C_{AD} = C_{BD} = 22 \text{ nF}$,
 $C_B = 100 \text{ nF}$ and the following network is connected between V_{TX} and R_{SN} :



Ambient temperature = 70°C

Active state, normal polarity for transmission performance

0 dBm = 1 mW @ 600 Ω (0.775 V rms)

Programmed DC Feed conditions:

VAPP (Apparent battery voltage) = 50.2 V

ILA (Active state loop-current limit) = 47.6 mA

ILD (Disable state loop-current limit) = 21.2 mA

RFD (DC Feed resistance) = 403 Ω

VAS (Anti-sat activate voltage) = 10.3 V

N2 (Anti-sat feed resistance factor) = 2

VOFF (Longitudinal Offset Voltage) = 8.4 V

RG = GX = GR = AX = AR = 0 dB

R, X, B, and Z filter disabled

AISN = 0

TSH < ILD

TSH = Programmed switchhook-detect threshold current.

ILD = Programmed disable limit current.

DC Feed conditions are normally set by the ASLAC device. When the ASLIC device is tested by itself, its operating conditions must be simulated as if it were connected to an ideal ASLAC device. When the ASLAC device is tested by itself, its operating conditions must simulate as if it were connected to an ideal ASLIC device.

2. These tests are performed with the following load impedances:

Frequency < 12 kHz – Longitudinal impedance = 500 Ω; metallic impedance = 300 Ω

Frequency > 12 kHz – Longitudinal impedance = 90 Ω; metallic impedance = 135 Ω

3. This parameter is tested at 1 kHz in production. Performance at other frequencies is guaranteed by characterization.

4. Not tested or partially tested in production. This parameter is guaranteed by characterization or correlation to other tests.

5. When the ASLIC device is in the anti-sat operating region, this parameter will be degraded. The exact degradation will depend on system design.

6. Guaranteed by design.

7. Overall 1.014 kHz insertion loss error of the ASLIC/ASLAC devices kit is guaranteed to be ≤ 0.34 dB.

8. The VBAT PSRR specifications are valid only when the ASLIC device is used with the ASLAC device which generates the anti-sat reference. Because the anti-sat reference depends upon the battery voltage sensed by the IBAT pin of the ASLAC device, the PSRR of the kit will depend upon the amount of battery filtering provided by CB.

9. Must meet at least one of these specifications.

10. These voltages are referred to VREF.

11. These limits refer to the two-wire output of an ideal ASLIC device but reflect only the capabilities of the ASLAC device.

12. When relative levels (dBm0) are used, the specification holds for any setting of (AX + GX) gain from 0 to 12 dB or (AR + GR + RG) from 0 to -12 dB.

13. This parameter tested by inclusion in another test.

14. The Group Delay specification is defined as the sum of the minimum values of the group delays for the transmit and the receive paths when the transmit and receive time slots are identical and the B, X, R, Z filters are disabled with null coefficients. For PCLK frequencies between 1.03 MHz and 1.53 MHz, the group delay may vary from one cycle to the next. See Figure 2, Group Delay Distortion also.

15. These limits reflect only the capabilities of the ASLAC device.

16. RSR1 = RSR2 = 750 kΩ, 0% tol. RGFD1 = 510 Ω.

17. DC Feed performance derates by 5% when operating from -40°C to 0°C and 70°C to 85°C.

18. Threshold values derate by 5% when operating from -40°C to 0°C and 70°C to 85°C.

19. Power cross and ring trip values derate by 5% when operating from -40°C to 0°C and 70°C to 85°C.

The transmit path is defined as the section between the analog input to the ASLAC device (VIN) and the GCI voice output of the ASLAC device A-law/ μ -law speech compressor (see the Voice Transmission Path figure in the Technical Reference). The receive path is defined as the section between the GCI voice input to the ASLAC device speech expander and the analog output of the ASLAC device (VOUT). All limits defined in this section are tested with $B = 0$, $Z = 0$, and $X = R = RG = 1$.

When RG is enabled, a nominal gain of -6.02 dB is added to the digital section of the receive path.

When AR is enabled, a nominal gain of -6.02 dB is added to the analog section of the receive path.

When AX is enabled, a nominal gain of $+6.02$ dB is added to the analog section of the transmit path.

When the gains in the transmit path are set to $AX = 0$ dB and $GX = 0$ dB, a 1014 Hz sine wave with a nominal voltage of 0.596 V rms for μ -law and 0.6 V rms for A-law at the ASLAC device analog input will correspond to a level of 0 dBm0 at the GCI voice output. Under these conditions, the overload level of the transmit path is 1.25 V peak referenced to VREF.

When the gains in the receive path are set to $AR = GR = 0$ dB, a 1014 Hz sine wave with a level of 0 dBm0 at the GCI voice input will correspond to a nominal voltage of 0.596 V rms for μ -law and 0.6 V rms for A-law at the analog output of the ASLAC device. Under these conditions, the maximum receive output level is 1.25 V peak referenced to VREF.

When relative levels (dBm0) are used in any of the following transmission characteristics, the specification holds for any setting of $(AX + GX)$ gain from 0 dB to 12 dB or $(AR + GR + RG)$ from 0 to -12 dB.

These transmission characteristics are valid for 0°C to 70°C and for $VCC = +5\text{ V} \pm 0.25\text{ V}$.

Attenuation Distortion

The attenuation of the signal in either path is nominally independent of the frequency. The deviations from nominal attenuation will stay within the limits shown in Figure 1. The reference frequency is 1014 Hz and the signal level is -10 dBm0. Minimum transmit attenuation at 60 Hz is 24 dB.

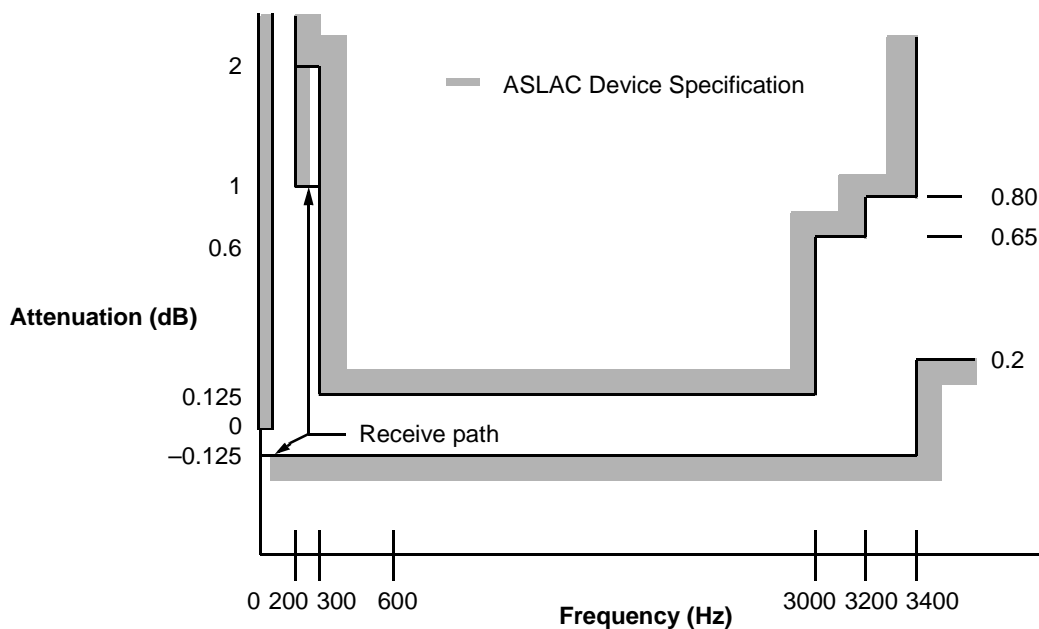


Figure 1. Transmit and Receive Path Attenuation vs. Frequency

Group Delay Distortion

For either transmission path, the group delay distortion is within the limits shown in Figure 2. The minimum value of the group delay is taken as the reference. The signal level should be -10 dBm0.

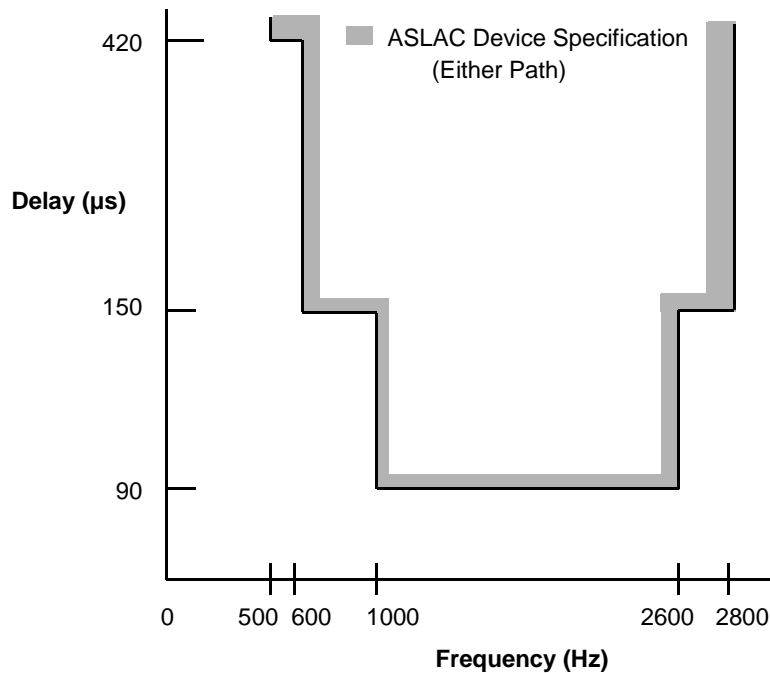


Figure 2. Group Delay Distortion

Single Frequency Distortion

The output signal level, at any single frequency in the range of 300 Hz to 3400 Hz, other than that due to an applied 0 dBm0 sine wave signal with frequency f_0 in the same frequency range, is less than -46 dBm0. With f_0 swept between 0 to 300 Hz and 3400 Hz to 12 kHz, any generated output signals other than f_0 are less than -28 dBm0. This specification is valid for either transmission path.

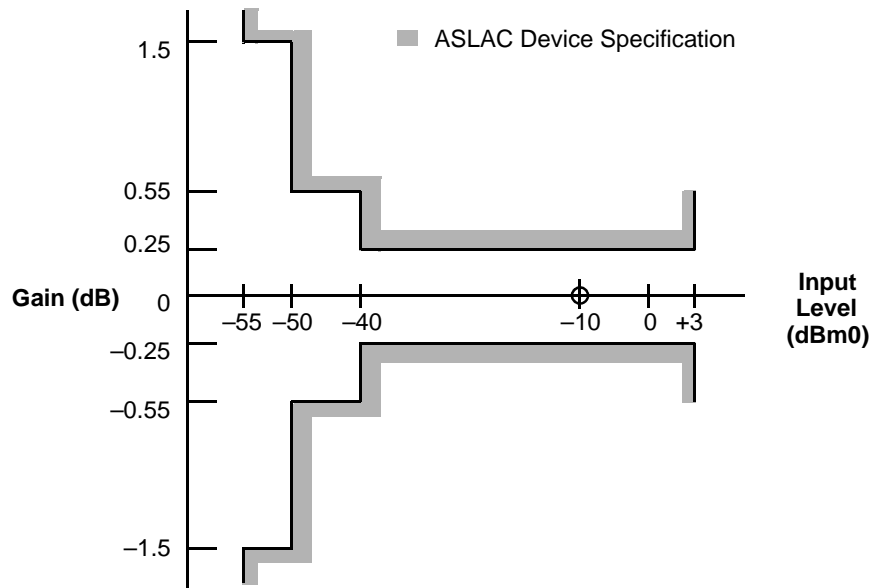
Intermodulation Distortion

Two sine wave signals of different frequencies f_1 and f_2 (not harmonically related) in the range 300 Hz to 3400 Hz and of equal levels in the range -4 dBm0 to -21 dBm0 will not produce $2 \cdot (f_1 - f_2)$ products having a level greater than -42 dB relative to the level of the two input signals.

A sine wave signal in the frequency band 300 Hz to 3400 Hz with input level -9 dBm0 and a 50 Hz signal with input level -23 dBm0 will not produce intermodulation products exceeding a level of -56 dBm0. These specifications are valid for either transmission path.

Gain Linearity

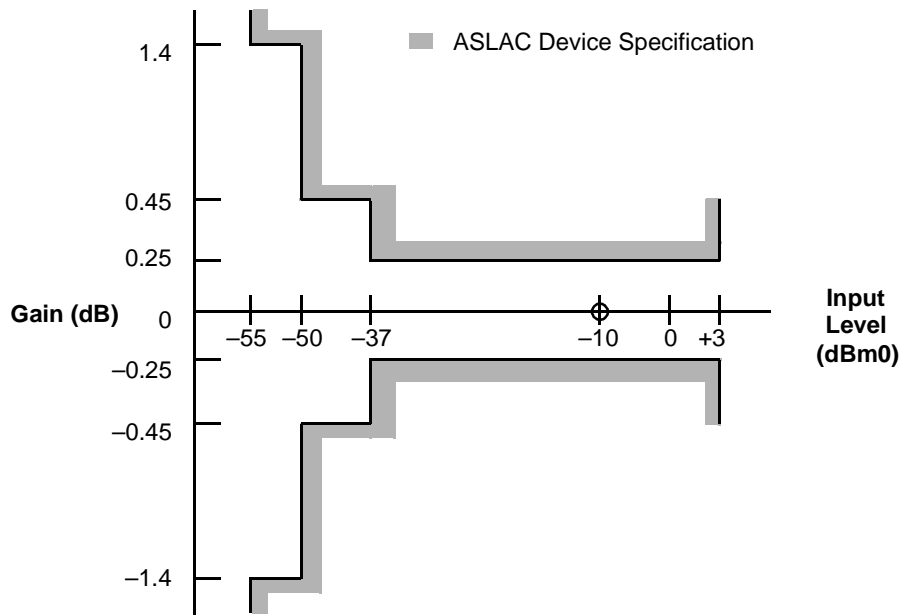
The gain deviation relative to the gain at -10 dBm0 is within the limits shown in Figure 3 (A-law) and Figure 4 (μ -law) for either transmission path when the input is a sine wave signal of 1014 Hz.



Note:

Relax specification by 0.05 dB at -40°C .

Figure 3. A-law Gain Linearity with Tone Input (Both Paths)



Note:

Relax specification by 0.05 dB at -40°C .

Figure 4. μ -law Gain Linearity with Tone Input (Both Paths)

Total Distortion Including Quantizing Distortion

The signal-to-total distortion ratio will exceed the limits shown in Figure 5 for either path when the input signal is a sine wave signal of frequency 1014 Hz.

Improved distortion at lower levels in LSSGR applications can be obtained by proper selection of the GX and GR ranges.

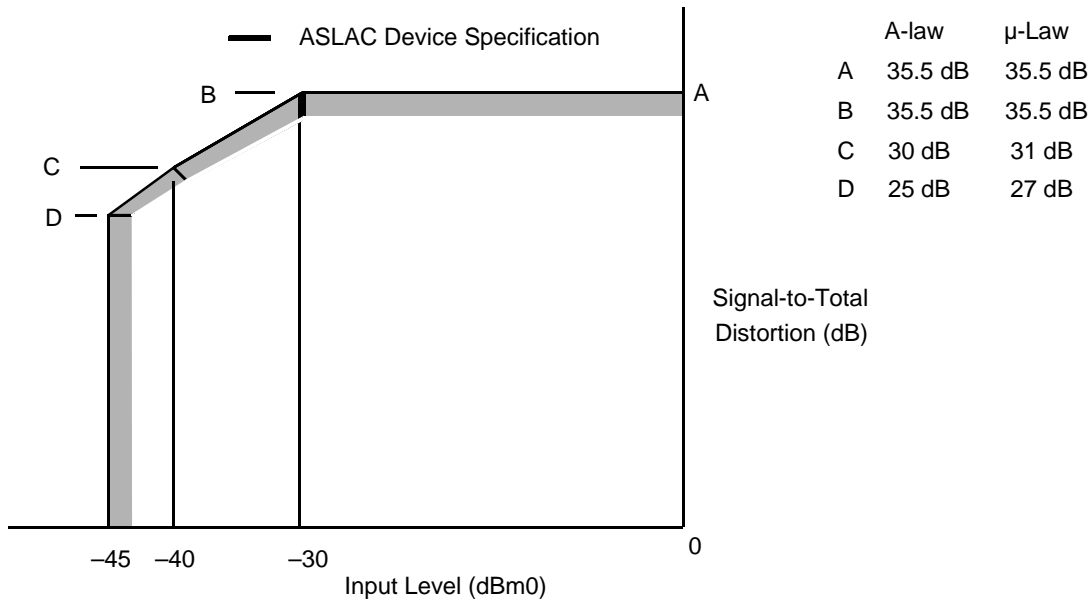


Figure 5. Total Distortion with Tone Input (Both Paths)

Overload Compression

Figure 6 shows the acceptable region of operation for input signal levels above the reference input power (0 dBm0). The conditions for this figure are: (1) 1 dB < transmit path ≤ +12 dB; (2) -12 dB ≤ receive path < -1 dB; (3) Digital voice output connected to digital voice input; and (4) measurement analog-to-analog.

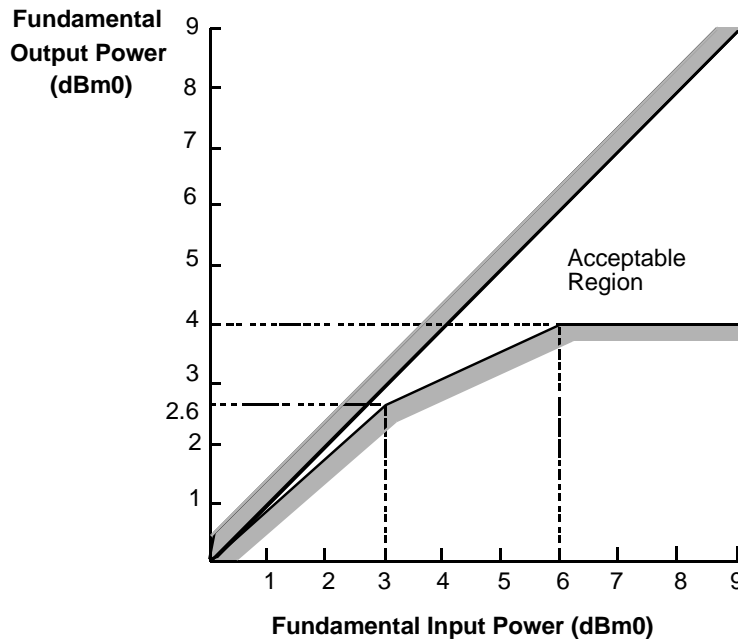


Figure 6. A/A Overload Compression

SWITCHING CHARACTERISTICS

Microprocessor Interface

Min. and Max. values are valid for all digital outputs with a 100 pF load, except DU which is valid with 8 loads, (see note 2).

Table 7. Microprocessor Interface

| No. | Symbol | Parameter | Min. | Typ. | Max. | Units | Note |
|-----|-----------|-----------------------|--------------|------|--------------|---------|------|
| 1 | t_{FSW} | FS High pulse width | 130 | | | ns | |
| 2 | t_{FSR} | FS rise time of clock | | | 60 | ns | |
| 3 | t_{FSF} | FS fall time of clock | | | 60 | ns | |
| 4 | t_{FSS} | FS setup time | 70 | | $t_{DCL}-50$ | ns | |
| 5 | t_{FSH} | FS hold time | 50 | | | ns | |
| 6 | t_{DDC} | Output delay from DCL | | | 100 | ns | |
| 7 | t_{DDF} | Output delay from FS | | | 150 | ns | |
| 8 | t_{IDS} | Input data setup time | $t_{DCH}+20$ | | | ns | |
| 9 | t_{IDH} | Input data hold time | 50 | | | ns | |
| 10 | t_{RST} | Reset pulse width | 50 | | | μ s | |

Data Clock

For 2.048 MHz \pm 100 ppm or 4.096 MHz \pm 100 ppm

Table 8. Data Clock

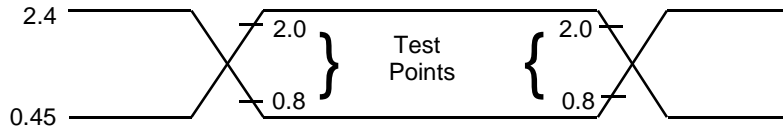
| No. | Symbol | Parameter | Min. | Typ. | Max. | Units | Note |
|-----|-----------|-------------------------------|------|--------|------|-------|------|
| 11 | t_{DCY} | Data clock period (2.048 MHz) | 478 | 488.28 | 498 | ns | 2 |
| | | Data clock period (4.096 MHz) | 239 | 244.14 | 249 | ns | |
| 12 | t_{DCR} | Rise time of clock | | | 60 | ns | |
| 13 | t_{DCF} | Fall time of clock | | | 60 | ns | |
| 14 | t_{DCH} | DCL High pulse width | 90 | | | ns | 1 |
| 15 | t_{DCL} | DCL Low pulse width | 90 | | | ns | 1 |

Notes:

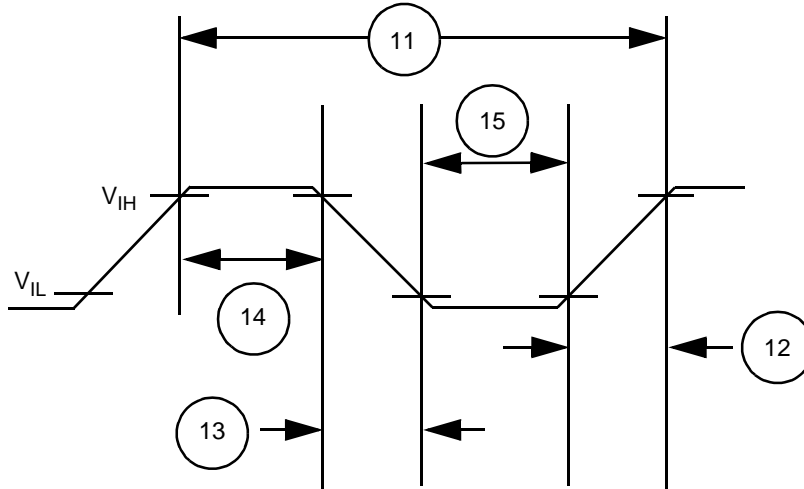
1. The Data Clock (DCL) may be stopped in the High or Low state indefinitely without loss of information.
2. The drive capability of the GCI interface allows eight ASLAC devices per linecard (eight subscriber lines) without using external buffers.

SWITCHING WAVEFORMS

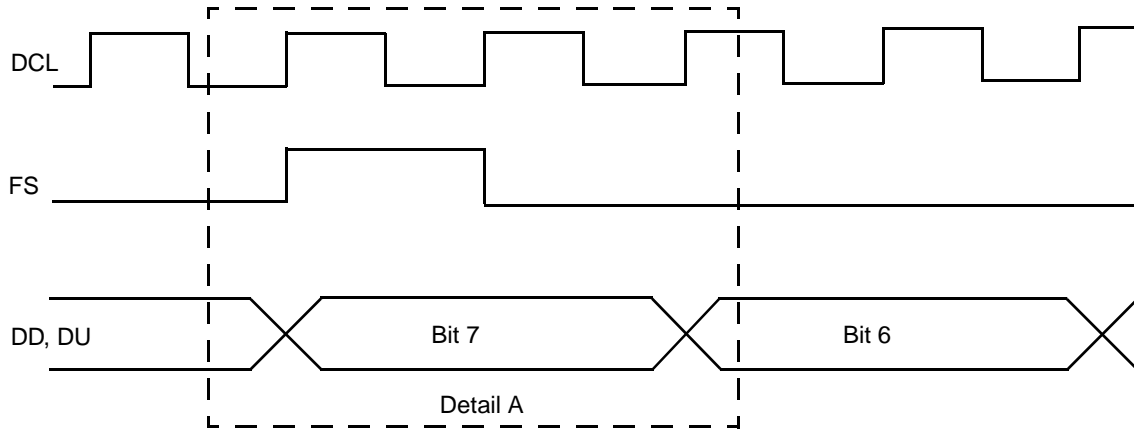
Input and Output Waveforms for AC Tests



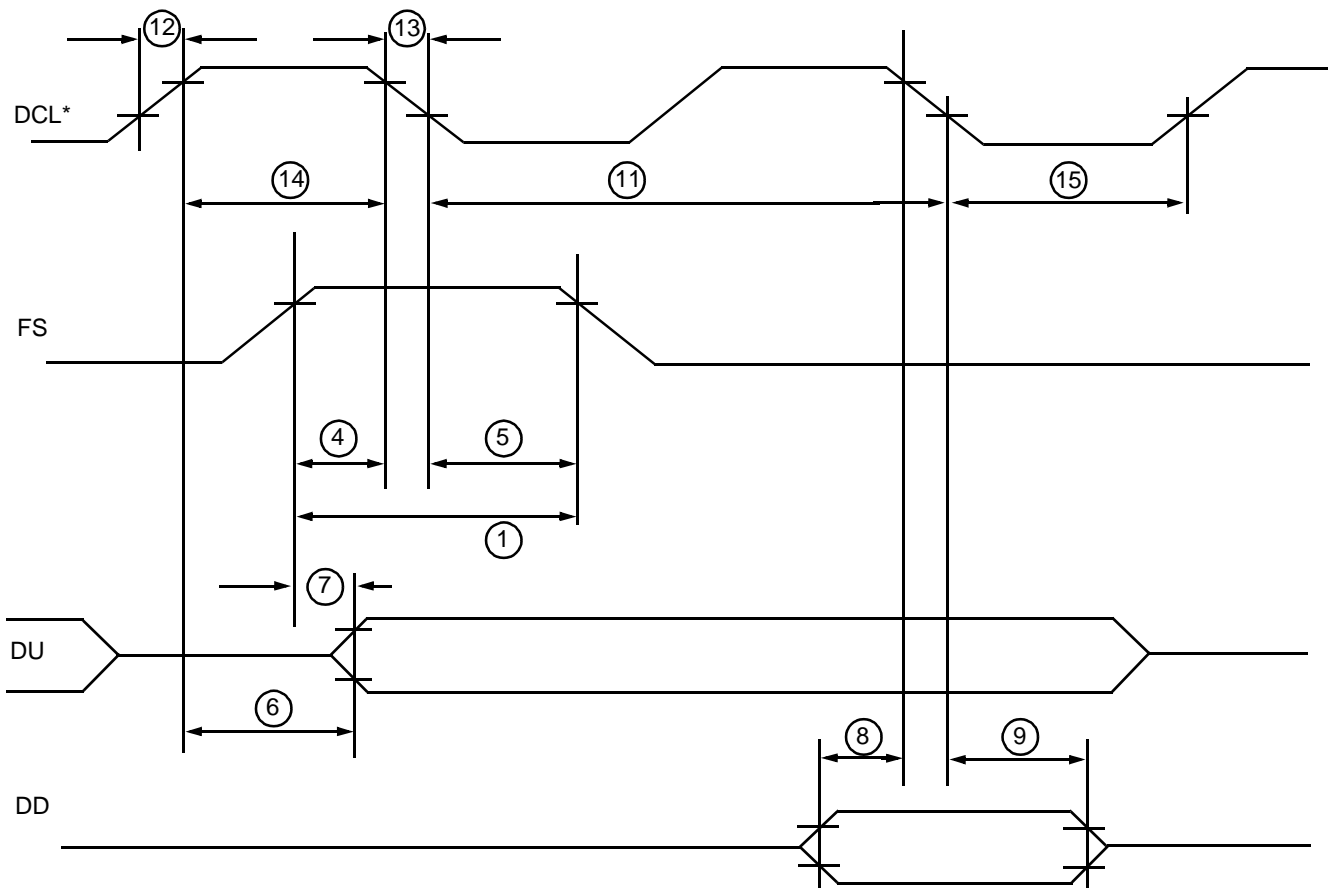
Data Clock Timing – DCL



GCI Waveforms



GCI Timing (Detail A)



* Timing diagram valid for $f_{DCL} = 4096 \text{ kHz}$

Table 9. User-Programmable Components

| | |
|--|--|
| $Z_T = 63.5 \cdot (Z_{2WIN} - 2R_F)$ | Z_T is connected between the VTX and RSN pins. The fuse resistors are R_F . Z_{2WIN} is the desired 2-wire AC input impedance. When computing Z_T , the internal current amplifier pole and any external stray capacitance between VTX and RSN must be taken into account. |
| $Z_{RX} = \frac{Z_L}{G_{42L}} \cdot \frac{254 \cdot Z_T}{Z_T + 63.5 \cdot (Z_L + 2R_F)}$ | Z_{RX} is connected from VRX to RSN. Z_T is defined above, and G_{42L} is the desired receive gain. |
| Thermal Management Equations (Normal Active and Tip Open States) | |
| $R_{TMG} = \frac{V_{BAT} - V_{OFF}}{I_{LOOP}}$ | R_{TMG} is connected from TMG to VBAT and is used to reduce power dissipation within the ASLIC device in normal Active and Tip Open states. |
| $P_{RTMG} = \frac{(V_{BAT} - V_{OFF} - (I_{LOOP} \cdot R_L))^2}{R_{TMG}}$ | Power dissipated in the thermal management resistor, R_{TMG} , during normal Active and Tip Open states |
| $P_{SLIC} = V_{BAT} \cdot I_{LOOP} - P_{RTMG} - R_L \cdot (I_{LOOP})^2 + 0.12 \text{ W}$ | Power dissipated in the ASLIC device while in normal Active and Tip Open states |
| Thermal Management equations (Polarity Reverse State) Note: ASLIC device die temperature should not exceed 140°C. | |
| $P_{SLIC} = V_{BAT} \cdot I_{LOOP} - (R_L \cdot (I_{LOOP})^2) + 0.12 \text{ W}$ | Power dissipated in the ASLIC device while in the polarity reverse state |
| $T_{SLIC} = P_{SLIC} \cdot \theta_{jA} + T_{AMBIENT}$ | Total die temperature |
| $\theta_{jA}(\theta_{jA}) = 43^\circ\text{C}/\text{watt}$ | Thermal impedance of the 32-pin plastic leaded chip carrier package |

ASLIC/ASLAC DEVICES LINECARD

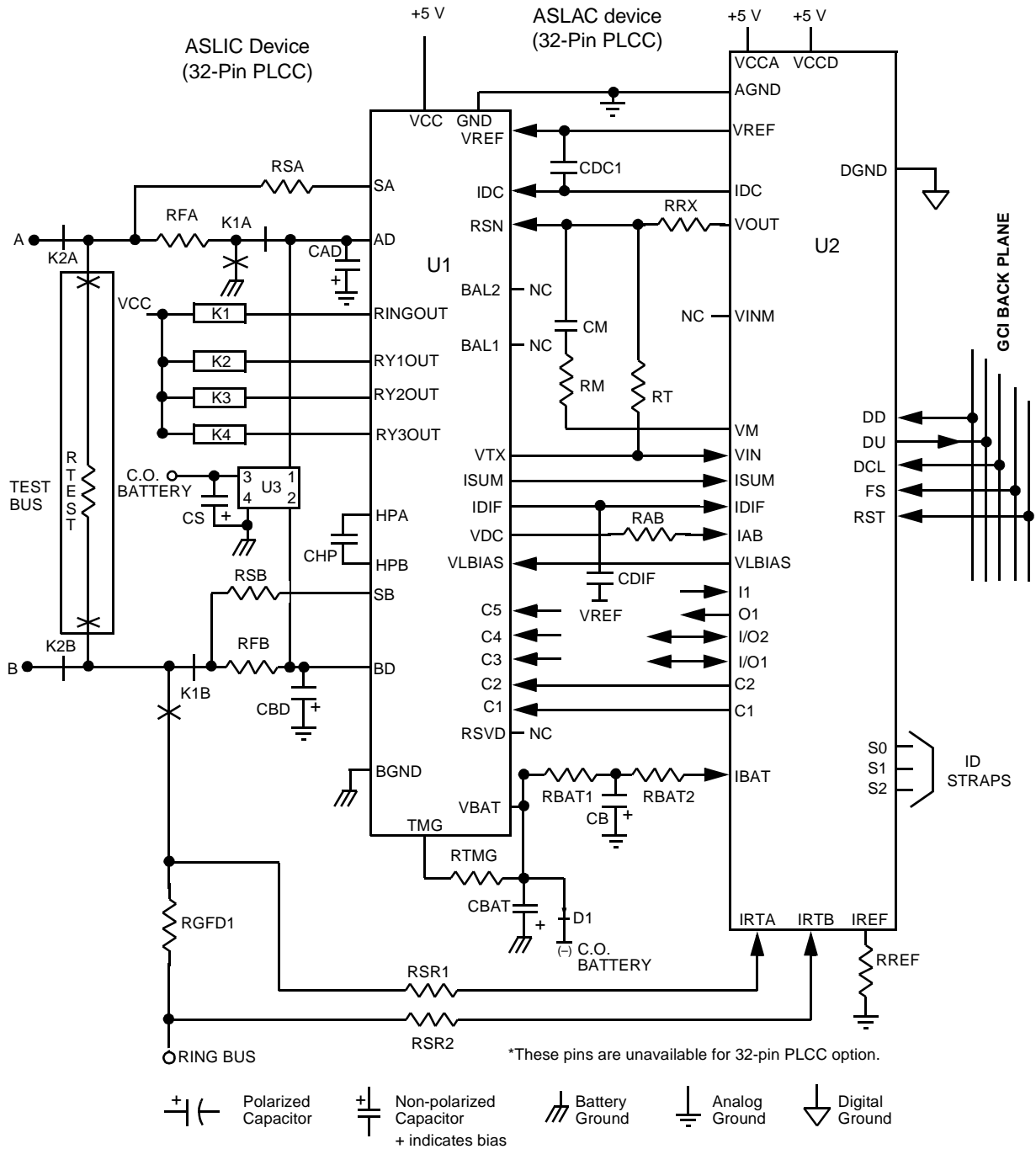


Figure 7. ASLIC/ASLAC Typical Linecard Schematic

Table 10. ASLIC/ASLAC Devices Linecard Parts List

| Item | Type | Value | Tol. | Rating | Comments |
|----------------|--------------|-----------------|------|--------|--|
| U1 | ASLIC device | | | | |
| U2 | ASLAC device | | | | |
| U3 | LCP150S | | | | Transient Voltage Suppressor, SGS-Thomson |
| D1 | Diode | 100 mA | | 100 V | 50 ns |
| RFA, RFB | Resistor | 50 Ω | 2% | 2 W | Fusible protection resistors |
| RSA, RSB | Resistor | 200 k Ω | 2% | 1/4 W | Sense resistors |
| RSR1, RSR2 | Resistor | 750 k Ω | 2% | 1/4 W | Matched to within 0.2% for initial tolerance and 0°C to 70°C ambient temperature range.** 17 mW typ |
| RGFD1 | Resistor | 510 Ω | 2% | 2 W | 1.2 W typ |
| RRX, RT* | Resistor | 16.9 k Ω | 1% | 1/8 W | <1 mW |
| RBAT1, RBAT2 | Resistor | 365 k Ω | 1% | 1/8 W | 2.5 mW typ |
| RAB | Resistor | 35.7 k Ω | 1% | 1/8 W | <1 mW |
| RREF | Resistor | 7.87 k Ω | 1% | 1/8 W | <1 mW |
| RTMG * | Resistor | 1200 Ω | 5% | 4 W | Application dependent |
| RM* | Resistor | 3.16 k Ω | 1% | 1/8 W | <1 mW |
| RTEST | Resistor | 3 k Ω | 1% | 5 W | Used only if ringing tests are required |
| CDIF | Capacitor | 10 nF | 20% | 5 V | Ceramic |
| CAD, CBD * | Capacitor | 22 nF | 10% | 100 V | Ceramic, not voltage sensitive |
| CBAT | Capacitor | 150 nF | 20% | 100 V | Ceramic, VBAT typ |
| CHP | Capacitor | 220 nF | 20% | 100 V | Ceramic, VBAT typ |
| CB | Capacitor | 100 nF | 20% | 100 V | Ceramic, 0.5 Vbat typ |
| CDC1 | Capacitor | 1.0 μ F | 20% | 5 V | Ceramic |
| CM* | Capacitor | 1.8 nF | 10% | 5 V | Ceramic |
| CS * | Capacitor | 100 nF | 20% | 100 V | Protector speed up capacitor |
| K1, K2, K3, K4 | Relay | 5 V coil | | | DPDT |

Notes:

* Value can be adjusted to suit application.

** Can be looser for relaxed ring trip requirements. 1% match (each resistor $\pm 0.5\%$) gives 1.275 mA uncertainty in ringing current sensing.

REVISION SUMMARY**Revision A to Revision B**

- Under Connection Diagrams, Top View, fixed the ASLIC device to read Am79212 instead of Am79C212.
- Minor changes were made to the data sheet style and format to conform to AMD standards.