PIKA TECHNOLOGIES INC.

PIKA WARP the Appliance

Hardware Manual

Table of Contents

1 Copyright Information

2 Contacting PIKA Technologies

Customer Care

PIKA Technologies provides free technical support to all customers. For support issues, phone or e-mail our Customer Care department at the following:

Tel: +1-613-591-1555

FAX: +1-613-591-9295

Email: support@pikatech.com

International Headquarters

PIKA Technologies Inc.
535 Legget Drive, Suite 400
Ottawa, Ontario, Canada K2K 3B8

Tel: +1-613-591-1555

FAX: +1-613-591-9295

Email: sales@pikatech.com

Internet

Visit our website at **www.pikatechnologies.com** for the latest news, product announcements, downloads, online community, documentation updates, and contact information.

3 Introduction

This document describes the hardware components of PIKA WARP the Appliance.

Guide Organization:

Overview (pg. 4) - Describes the high level features of the appliance

Regulatory Information (pg. 5) - Describes regulatory bodies and conformance to the applicable regulations

Appliance Description (pg. 10) - Describes the functionality of the base board and available plug-in modules

Technical Specifications (pg. 18) - Detailed technical information about the base board and plug-in modules

Glossary (pg. 24) - Description of terms and acronyms

3.1 Related Documents

The following documents are related to the PIKA WARP the Appliance Hardware Manual. These documents are linked together and constitute the complete set of documentation for the PIKA WARP the Appliance product. All documents are available at **http://www.pikatechnologies.com/appliancedownloads**.

PIKA Application Development Suite (PADS) User Manual: This guide describes the software development kit to develop software for PIKA WARP the Appliance.

PIKA WARP the Appliance User Guide: This guide describes installation and configuration of the appliance.

PIKA WARP the Appliance Release Notes - These notes describe the contents of the release, including known product issues.

4 Overview

The appliance is a flexible, self-contained platform for voice processing systems. The Appliance accommodates VoIP traffic, and up to two line interface modules. Three types of modules are currently available: a 4 FXS/Station (plus PFT) module, a 4 FXO/Trunk (plus Power Failure Transfer port) and a BRI module. All signal processing functions such as conferencing, audio playback/record and echo cancellation are performed on the internal PPC440EP processor. The analog line interface hardware is software programmable to interface with North American or European telecommunications standards.

Interfaces

The PIKA Appliance provides the following analog and digital interfaces:

- 10/100BT network port
- One FXS/Station port
- Up to a total of two modules of the following types:
  - 4 port FXS/Station (plus power failure transfer (PFT) port) module
  - 4 port FXO/Trunk (plus power failure transfer port) module
  - 2 port BRI module
- Audio In/Out ports
- USB 1.1 port
- Removable SD flash card interface

MAC Address and Serial Number

Each appliance has a MAC address and a serial number, found on the bottom label. The MAC address is hexadecimal, in the format AB:CD:EF:12:34:56. The serial number format is PIK-123-45678.

5 Regulatory Information

Regulatory Warnings

Industry Canada (IC)

Equipment Attachment Limitations

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective and operational safety requirements. The department does not guarantee that the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to connect to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable connection method. The customer should be aware that compliance with the above conditions might not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

For their own protection, users should ensure that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION:	Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority, or electrician, as appropriate.

Federal Communications Commission (FCC)

This section contains information applicable to system integrators, to ensure that the use of the appliance complies with FCC part 68.

1. The appliance must be mounted into the final assembly so it is isolated from exposure to any hazardous voltages with the assembly. Adequate separation and restraint of cables and cords must be provided.

2. The TIP/RING leads from the appliance must be wired to the telephone lines in wiring that carries no other circuitry than that specifically allowed in FCC Part 68 rules. Any board traces carrying TIP/RING leads should have sufficient spacing to avoid surge breakdown.

3. The appliance must be connected to the supplied LPS compliant power adapter to be safety compliant.

Consumer Information

The following information applies to consumers, and should be included by system integrators in their customer documentation.

1. The appliance complies with Part 15 and Part 68 of the FCC rules. It is verified to comply with the limits for Class “A” Digital Device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial, industrial or business environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference in which case the user will be required to correct the interference at his own expense. The label on the bottom of the PIKA Applianc contains the FCC registration number and REN for this equipment. If requested, provide this information to your telephone company.

2. The REN is useful to determine the number of devices you may connect to your telephone line and still have all of those devices ring when your number is called. In most, but not all areas, the sum of the RENs of all devices should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should contact your local telephone company to determine the maximum REN for your calling area.

3. While the appliance conforms to the applicable telecommunications network regulations, if a malfunction occurs, it may cause harm to the telephone network. In this case, the telephone company may discontinue your service temporarily.

4. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment.

5. If you experience trouble with the appliance, please contact PIKA Technologies for repair/warranty information (see **Contacting PIKA Technologies (pg. 2)**). The telephone company may ask you to disconnect this equipment from the network until the problem has been corrected or you are sure the equipment in not malfunctioning.

6. The appliance may not be used on coin service provided by the telephone company. Connection to a party line is subject to state tariffs. Contact your state public utility company or corporation commission for information.

European Telecommunications Standards Institute (ETSI)

TBR 21: 1998, Clause 4.8.1 stipulates restrictions on equipment with an automatic seizing and dialing function.

TBR 21: 1998, Clause 4.8.3 stipulates restrictions on equipment with automatic repeated call attempt ability.

TBR 21: 1998, Clause 4.7.3 stipulates limitations of sending levels for transmission signals.

The appliance is dependant on a third party application for the above clauses and therefore compliance with these requirements cannot be guaranteed.

PIKA Technologies hereby declares this product is not intended for connection to the public telephone network unless all aspects of compliance are addressed.

5.1 Compliance

The appliance is certified compliant for use in the United States, Canada, and European Union countries. The following tables list approval information for EMC/EMI, Telecom, and Safety standards. Testing for all regulatory disciplines was performed at the Nemko product certification and compliance test facility. The tables list each country or region, its approval standard, registered approval numbers (if any), and a short description of the approval standard.

Note:	The term self-declared indicates that the board was tested by a third-party test facility, but does not require an official approval number by a country or region's approval standard authority. For the TBR21 Telecom specification, testing was performed by an in-house test facility.

EMC/EMI

EMC/EMI standards govern the amount of electromagnetic interference and immunity of electrical

devices. The following table lists the EMC/EMI approval information for the appliance.

Country / Region	Approval Standard	Approval Number	Approval Description
United States	FCC 47 CFR Part 15, Subpart B	Self-declared	Rules for EMC/EMI emissions
Canada	ICES-003 Issue 4 Feb 2004	Self-declared	Rules for EMC/EMI emissions
Europe	EN55022: 1998	Self-declared	Limits and measurement of EM Emissions
Europe	EN55024: 1998 + ammend. A1, A2	Self-declared	Limits and measurement of EM Immunity

Telecom

Telecom standards govern the necessary electrical signals and protocols of telecommunications devices. The following table lists the Telecom approval information for the Analog Trunk/FXO board.

Country / Region	Approval Standard	Approval Number	Approval Description
United States	TIA-968-A (-1 to -5)	6PRIS01B9900910	Rules for registration of telephone equipment
Canada	CS-03 Issue 9	1689A-9900910	Standard for terminal Equipment connected to wireline facilities

Safety

Safety standards govern the human safety of all electrical devices. The following table lists the safety approval information for the Analog Trunk/FXO board.

Country / Region	Approval Standard	Approval Number	Approval Description
United States / Canada	CSA C22.2 No. 950 NRTL/C	1115017 (LR105564-4)	Safety standard for IT and telecom equipment
Europe	EN60950	Self-declared	Safety of IT and electrical business equipment

The following table lists the approval information for the BRI module.

Country/Region	Approval Standard	Approval Number	Approval Description
Europe	EN60950	Self-declared	Safety of IT and electrical business equipment

NOTE:	In order for the appliance to comply with safety regulations, a user-supplied power adapter must NOT be substituted for the PIKA-provided adapter. Additionally, the unit must be positioned horizontally with the product label at the bottom, or secured to a wall, with the interface connectors at the bottom.

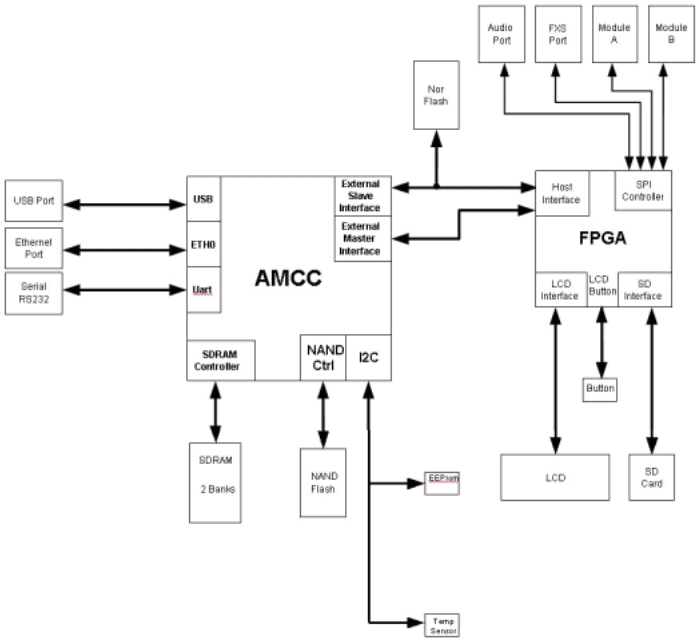
6 Appliance Description

The following sections provide a detailed description of the Appliance's functionality, including the following information:

- **Base Board (pg. 10)** – high-level overview of the base board circuitry
- **Appliance Enclosure Mechanical Description (pg. 12)** – physical dimensions of the appliance enclosure
- **Jumper settings (pg. 14)** – jumper setting for NOR Flash reprogramming using a JTAG tool
- **Connector pinouts (pg. 14)** – description of electrical connection on connectors
- **Appliance Modules (pg. 15)** – description of available daughter boards

6.1 Base Board

The following figure is a high-level functional diagram of the appliance.



The PPC440EP is a multi-bus processor with many peripheral options. Instructions and volatile data are transferred across a dedicated DDR SDRAM bus. USB, ethernet and serial ports are directly pinned out

of the processor. All other peripheral functions, including communications with the modules are mediated through the FPGA.

The FPGA implements all TDM data transfer, synchronization, and auxiliary functions for the board.

The baseboard FXS port, audio ports and module ports share a common common 4.096 MHz, 64-slot stream. Each line interface contains its own codec and other line circuitry. Digital audio is transmitted over the shared stream to and from the codec. The digital audio is then converted into an analog signal and processed by the analog line circuitry, which interfaces to the telephone network.

Appliance Reset Button

In the event that an application causes an unrecoverable error, a small pointed object (such as a pen) can be inserted into the hole on the left hand side of the SD card slot. This will activate a momentary switch that performs a hardware reset.

LCD and Display Button

A graphic LCD with software backlight control is provided with the appliance. Various software-controlled display features are controlled by a "touchless" switch, which is found on the right-hand side of the LCD display.

Power/Health LED

A bi-colour LED located on the right-hand side of the LCD indicates that the appliance is powered and functioning. When the appliance first powers on, the LED lights up red. As soon the boot sequence begins, it turns red-green. If appliance boots successfully (the bootloader downloads the FPGA and completes the power on self test (POST)), the LED turns green. Subsequent run-time errors, such as the unit overheating or undetectable hardware, may revert the LED to red or red-green.

USB Port

The USB port on the appliance is a USB 1.1 compliant host port. It connects directly to the PPC440EP processor and is protected by a reset-able fuse.

Secure Digital Card Slot

The SD card slot supports only cards that are fully SD compliant, bear the SD logo and do not require SPI mode for initialization. High capacity (HC) cards are supported.

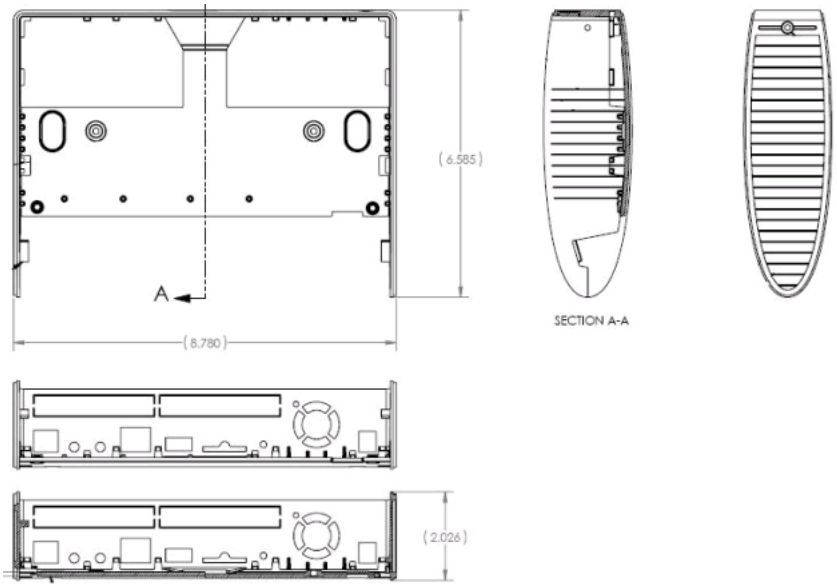
Audio Ports

The appliance is outfitted with an audio in port for music on hold, and an audio out port for paging. The ports use the standard 3.5 mm audio jacks found on many commercial devices, such as MP3 players. Although the audio paths are mono, the audio in path sums a stereo source, and the audio out path plays out the audio on both left and right outputs.

6.2 Appliance Enclosure Mechanical Description

The following figure shows a diagram of the dimensions of the board: Three views are shown:

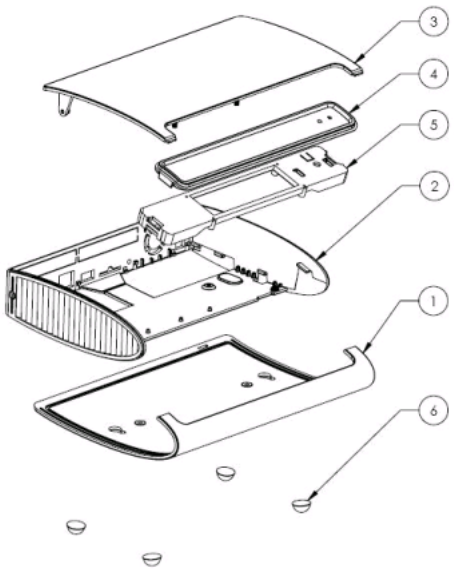
- Top view (looking down on the board).
- Side view (looking at the side with line interface modules).
- End view (looking straight at the end with the connector).



Note:	All measurements are imperial values.

The following diagram shows the exploded view of the appliance enclosure. The table below shows the legend for the diagram.

No.	Part Number	Description
1	PIK-04-00004-PIKA-Enclosure-Bottom	Enclosure Bottom
2	PIK-04-00002-PIKA-Enclosure-Frame-Insert-Assembly	Appliance Enclosure Frame Insert Assembly
3	PIK-04-00000-PIKA-Enclosure-Top-Insert-Assembly	Appliance Enclosure Top Insert Assembly
4	PIK-04-00006-PIKA-Enclosure-Window	Enclosure Window
5	PIK-04-00005-PIKA-Enclosure-Component-Mount	Appliance Enclosure Component Mount
6	X925-Foot-Dome-U2	Spherical Rubber Good



Thermal Management

Due to varying operating conditions, an internal fan ensures that the appliance is kept within its internal operating temperature range of 0 C (32 F) to 65 C (149 F). Once the internal temperature reaches 50 C (122 F), the fan will turn on at low speed, then increase speed as needed to maintain the operating

temperature range. Once the temperature goes below 50 C (122 F), the fan will reduce its speed and will eventually turn off if this temperature can be maintained.

6.3 Jumper Settings

The appliance has one jumper, J13, which is used when programming the NOR flash with some JTAG tools, such as Macraigor. Under normal circumstances, this method of programming the NOR flash is not required.

6.4 Connector Pinouts

RJ-11 Telecom Ports

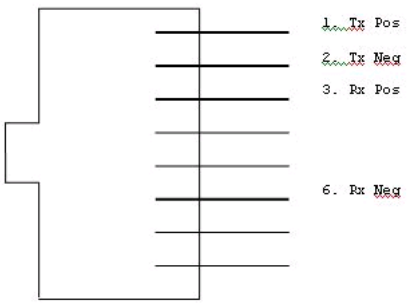
The appliance provides connectivity to each of the analog line interfaces through RJ-21 connectors. The primary tip-ring pair is used (refer to **Appliance Modules (pg. 15)**).

The appliance provides connectivity to the BRI interfaces through RJ-45 connectors. A straight-through cable is required. Refer to **BRI Module (pg. 17)** for more details.

RJ-45 Ethernet 10/100BT Port

The Ethernet port uses the standard TX and RX twisted pairs, as per TIA/EIA-568-B. The ethernet port supports auto-MDI/MDIX capabilities and will work with either a straight-through or crossover cable.

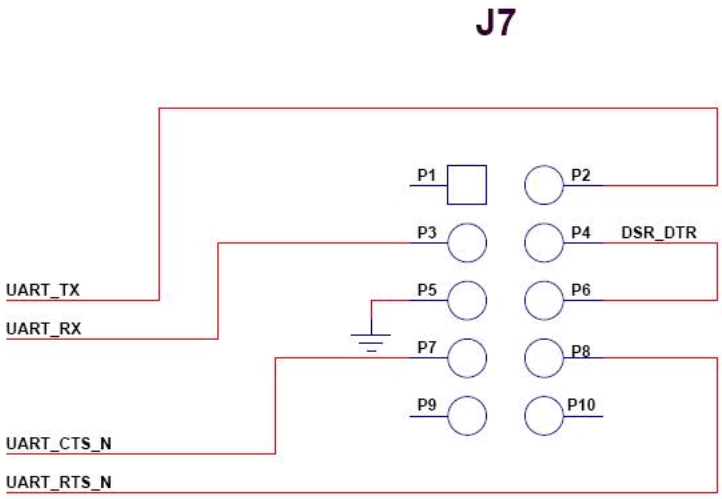
The following figure shows the connector pin-out.



RS-232 Port

A serial port is provided via shrouded connector J7 on the baseboard. It is set up as 115,200 baud, 8 data bits, no parity, 1 stop bit and no flow control.

The following figure shows the connector pin-out:



6.5 Appliance Modules

The following sections describe the plug-in modules available for the appliance. For information about module installation and removal, refer to section **Hardware Installation** in the PIKA Warp the Appliance User Manual for more information.

NOTE:	Screws must be used to secure the modules to the base board at all times to provide proper contact for frame grounding.

6.5.1 FXO Module

The Analog Trunk/FXO board provides connectivity to analog central office loop start trunk line analog interfaces.

Typically, a phone is connected to a loop start line from the telephone company and is, by default, in an on-hook state. When the phone goes off-hook, the phone completes the line circuit and current flows through the line. The telephone company provides an audible dial tone to the phone and accepts dual-tone multi-frequency (DTMF) digits from the caller.

The FXO module is equipped with four FXO ports and a power fail transfer port. If a power failure occurs, the power fail port is directly switched to FXO port 0 (adjacent to the PF port). If power is restored and the PF port is in use, port 0 is not disconnected from the PF port until the phone is hung up on the PF port.

The loop start analog interface provides the following features:

- Ringing Detection
- Loop Disconnect Detection
- Loop Reversal Detection
- Loop Voltage and Current Monitoring
- Detects when tip/ring voltage crosses a set voltage when on-hook or off-hook (called DC triggering)
- Can accommodate private branch exchange (PBX) with –24 V or –48 V battery voltage
- Voltage detection threshold is software programmable
- Surge protected
- Onhook audio reception with or without battery feed

6.5.2 FXS Module

The Analog Station/FXS module provides connectivity to standard analog phones. Typically, a phone is connected to a station interface and is, by default, in an on-hook state. When the phone goes off-hook, the phone completes the line circuit and current flows through the line.

The FXS module is equipped with four FXS ports and a power fail transfer port. If a power failure occurs, the power fail port is directly switched to FXS port 0 (adjacent to the PFT port). If power is restored and port 0 is in use, the PFT port is not disconnected from port 0 until the phone is hung up on port 0.

The analog station interface provides the following features:

- Ringing Generation and Ringing Trip
- Loop Closure Detection
- Loop Disconnect
- Loop Reversal
- Loop Voltage and Current Monitoring

- On-hook and Off-hook Transmission
- Hook-flash Detection
- DTMF Signaling
- Programmable Impedance
- Programmable Audio Gain
- On-board Power Generation

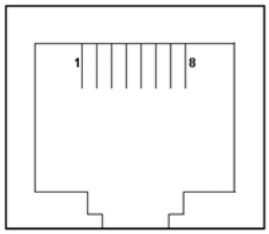
6.5.3 BRI Module

The BRI board provides connectivity to various devices that support BRI interfaces. Each module has two usable ports, each providing a single span 2B+D interface for a total of 4 channels per module. RJ-45 dust jacks are inserted into the unused ports.

The BRI interface provides the following features:

- 2 S/T Interfaces (2B+D per interface)
- TE/NT mode support (software selectable on a per port basis)
- 100 ohm termination support (software selectable on a per port basis)
- Point to Point and Point to Multipoint Support (software selecteable on a per port basis)
- 4 x RJ45 Connectors (2 unused)
- Power consumption .096 watts

Connector Pinouts



Pinout

Pin 1 - N.C.
Pin 2 - N.C.
Pin 3 - Tip1
Pin 4 - Tip2
Pin 5 - Ring2
Pin 6 - Ring1
Pin 7 - N.C.
Pin 8 - N.C.

7 Technical Specifications

This section describes the technical specifications for the main base board, the FXS, FXO, and BRI telephony modules.

7.1 Base Board

Base Board

Processor	AMCC Power PC 440EP Embedded Processor
Flash	Internal flash 4 MB NOR memory (uboot) plus 256 MB NAND (OS + apps)
RAM	256 MB DDR SDRAM
Removable storage	External removable SD flash memory
Network	10/100BT Ethernet port
USB	One USB 1.1 host port (v1.1)
Telecom FXS port	48V
Reset Button	Recessed hard reset button
Serial Interface	Onboard RS232 connector (internal)

Audio In/Out Ports

Input Impedance	15 K Ohm
Input Hardware Gain	+3 dB
Output Impedance	100 Ohm
Output Hardware Gain	-3 dB
Maximum Signal (dBm0)	3.14 dBm0
Maximum Signal (V)	0.762 Vrms

Physical Properties

Dimensions (Metric)	223 mm W x 52 mm H x 168 mm D
Dimensions (Imperial)	8.780” W x 2.026” H x 6.585” D

Note: All dimensions are approximate.

Power Requirements

Power consumption from 12V adapter	24 W max
Power consumption from LS lines	North America 1.4 W/line European Union 2.0 W/line

Environment Requirements

Ambient Temperature	0 °C to +45 °C (32 to 113 °F)
Storage Temperature	-20 °C to +85 °C (-4 to 118 °F)
Humidity, non-condensing	5 % to 95 %

The unit can only be positioned horizontally with the product label at the bottom, or secured to a wall, with the interface connectors at the bottom. Setting the unit on its side will impede proper ventilation.

WARNING: Proper system cooling must be ensured to maintain system stability and reliability. All fan and louvre openings on the back and side of the appliance must be kept unobstructed and the ambient temperature must be between 0 and 45 degrees Celsius (32 and 113 degrees Fahrenheit) non-condensing.

Life Expectancy

The flash technology used in the appliance is an important factor in the longevity of the product. How many erase/write cycles the devices undergo determines how many years the devices are usable. For NAND technology, the device allows at least 100,000 program/erase cycles for each sector. However, the part can be used well beyond these numbers by using a file system that uses a wear-levelling algorithm, preventing the repeated use of the same sectors if other free sectors are available. First and foremost, the longevity of the flash will vary according to the flash programming frequency of the

application.

Mean Time Between Failure (MTBF)

Base board with no modules	30.6 years
Base board with two modules (FXO/FXS)	19.1 years
Power supply	20.44 years

7.2 FXO Module

Loop Start (FXO) Telephony Module Loop Start (FXO) Analog Module

AC Impedance (in audio band)

Off-Hook	600 ohms
On-Hook Metallic (Tip to Ring)	>300 k ohms
Return Loss	>26.8 dB

DC Current

Loop Current Range	13 – 110 mA

DC Resistance

Longitudinal (tip to ground, ring to ground)	>9.8 M ohms
On-Hook Metallic (Tip to Ring)	>6.5 M ohms
Off-Hook Metallic (Tip to Ring)	310 ohms @ 20 mA 117 ohms @ 100 mA

Ringing

Ring Detection	14 Vrms @16 Hz 14 Vrms @20 Hz 12 Vrms @68 Hz
Ringer Impedance (20 Hz)	> 26 M ohms
Ringer Equivalence Number (REN)	1

Gain Tolerance (Linearity)

On-hook In (2 to 4 wire) NA	0.0 to 0.8 dB (300 to 3400 Hz)
Off-hook In (2 to 4 wire) NA	-1.5 to -0.4 dB (300 to 3400 Hz)
Off-hook Out (4 to 2 wire)	-4.8 to -0.7 dB (300 to 3400 Hz)

Gain Range

Fixed - On-hook H/W Gain In (2 to 4 wire)	-1.6 dB
Fixed - Off-hook H/W Gain In (2 to 4 wire)	-0.75 dB
Fixed - Off-hook H/W Gain Out (4 to 2 wire)	+0.24 dB
On-hook Signal overload level @0 dB gain In (2 to 4 wire)	+4.77 dBm
Off-hook Signal overload level @0 dB gain In (2 to 4 wire)	+3.92 dBm

Miscellaneous

Trans-hybrid loss (THL)	>27 dB (300-3400)
On-hook Common Mode Gain	-52.9 dBm0 avg.
Signal to Noise Ratio (15 dBm, 1 kHz reference)	> 38 dB
On-Hook Inter Hybrid (Interface) Crosstalk	No measurable crosstalk
Off-Hook Inter Hybrid (Interface) Crosstalk	No measurable crosstalk
Idle Channel Noise	6 dBrnc
Transverse Balance	> 57 dB

Supervision	Ring Detection, Loop Disconnect, Reversal Detection, Loop Voltage, Loop Current
Signaling	Off Hook,Flash, DTMF, Pulse Dial
Onhook Audio Detect	Caller ID, DTMF, Audio Logging

7.3 FXS Module

Analog Station (FXS) Telephony Module

AC Impedance (in audio band)

Off-hook	600 ohms or TBR21 complex impedance
Return Loss	>30 dB

DC Current

Constant Loop Current	20 mA

Ringing

Ringing Amplitude	Vrms
Ringing Frequency	20 Hz
DC Bias	0 V
Supported Ringer Equivalence Number (REN)	1

Gain Tolerance (Linearity)

On-hook Out (4 to 2 wire)	+/- 0.5 dB (300 to 3000 Hz)
Off-hook In (2 to 4 wire) NA	+/- 0.5 dB (300 to 3000 Hz)
Off-hook Out (4 to 2 wire)	+/- 0.5 dB (300 to 3000 Hz)

Gain Range

Fixed - On-hook H/W Gain Out (4 to 2 wire)	+1.2 dB
Fixed - Off-hook H/W Gain In (2 to 4 wire)	-3.9 dB
Fixed - Off-hook H/W Gain Out (4 to 2 wire)	-3.7 dB
On-hook Signal Overload Level (Due to fixed H/W gain, max digital level is +2 dBm0 with 0 dB of digital gain. If maximum PCM transmission level of +3.2 dBm0 is required, digital gain should be set to -1.2 dB.)	+3.2 dBm
Off-hook Signal Overload Level	+7.1 dBm

Miscellaneous

Trans-hybrid loss (THL)	>30 dB (300 to 3400 Hz)
Signal-to-Noise + Distortion Ratio (signal power from +3.14 to –30 dBm0)	> 35.5 dB
On-hook Inter-Hybrid (Interface) Crosstalk	> -85 dB
Off-hook Inter-Hybrid (Interface) Crosstalk	-92 dB
Idle Channel Noise	12 dBrnc

8 Glossary

Term	Definition
dB	**Decibel** - A logarithmic unit used to describe a ratio.
dBm	An abbreviation for the power ratio in decibel (dB) of the measured power referenced to one milliwatt (mW).
dBm0	An abbreviation for the power in dBm measured at a zero transmission level point.
DDR	**Double Data Rate -** A type of signaling that transfers data on both the rising and falling edges of the clock signal.
DTMF	**Dual Tone Multi-Frequency -** Telephone signaling used over the line in the voice-frequency band
LS	**Loop Start** - A method of starting (seizing) a telephone line or trunk by sending a supervisory signal (going off-hook) to the Central Office. With loop start, you seize a line by bridging through a resistance the tip and ring (both wires) of your telephone line.
CODEC	**Coder/Decoder -** Converts analog signals to digital signals.
CSA	**Canadian Standards Association** - An independent organization that establishes and tests safety standards for electronic components and systems for the Canadian marketplace.
EMC	**ElectroMagnetic Compatibility**.- The sensitivity of a system to EMI.
EMI	**ElectroMagnetic Interference** - The interference in signal transmission and reception caused by electrical and magnetic fields.
FCC	**Federal Communications Commission -** The government agency responsible for regulating telecommunications in the United States.
FPGA	**Field Programmable Gate Array -** A semiconductor device containing programmable logic components, called "logic blocks", and programmable interconnects.
FXO	**Foreign Exchange Office -** A telephone signaling interface that receives POTS, or "plain old telephone service".
FXS	**Foreign Exchange Station -** A telephone interface which provides battery power, sends dialtone, and generates ringing voltage.
IVR	**Interactive Voice Response -** A phone technology allowing a telephone caller to select options from a voice menu and interact with the phone system.

JTAG	**Joint Test Action Group** - IEEE 1149.1 standard entitled Standard Test Access Port and Boundary-Scan Architecture for test access ports used for testing printed circuit boards using boundary scan and programming non-volatile storage.
LCD	**Liquid Crystal Display -** A thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
LED	**Light Emitting Diode -** A semiconductor diode that emits incoherent narrow-spectrum light.
LPS	**Limited Power Source -** A type of power supply that must limit its current at a given voltage by following a V-I curve provided by Safety regulatory bodies.
MDI/MDIX	**Medium Dependent Interface** - An Ethernet port connection typically used on the Network Interface Card (NIC) or Integrated NIC port on a PC. The X stands for a crossover, where the transmit and receive pairs are swapped.
MTBF	**Mean Time Between Failure** - The estimated average time before a failure occurs in a component.
NAND	A type of flash memory based on "not AND" logic gates.
NOR	A type of flash memory based on "not OR" logic gates.
NRTL	**Nationally Recognized Testing Laboratory** - The U.S. government body that determines if products meet safety standards to provide the assurance these products are safe for use in the workplace.
Ohm	The SI unit of electrical impedance or, in the direct current case, electrical resistance.
PCM	**Pulse Code Modulation -** A digital representation of an analog signal used in digital telephone systems.
PFT	**Power Failure Transfer -** In the event of a power failure or a low-voltage battery condition at a subscriber location, a type of port that supplies power to pre-designated subscriber equipment via the central office trunk.
POST	**Power On Self Test** - Pre-boot sequence that identifies and verifies memory, interfaces and devices for booting.
RAM	**Random Access Memory -** A form of integrated circuits that allow the stored data to be accessed in any order.
REN	**Ringer Equivalency Number** - A number that denotes the loading a telephone ringer has on the line.
RJ	**Registered Jack -** RJ are telephone and data jacks registered with the FCC.
SD	**Secure Digital -** A flash (non-volatile) memory card format for use in portable devices.

SDRAM	**Synchronous Dynamic Random Access Memory** - A type of computer memory that uses a synchronous interface, meaning that it waits for a clock signal before responding to its control inputs.
SPI	**Serial Peripheral Interface -** A synchronous serial data link standard named by Motorola that operates in full duplex mode. Devices communicate in master/slave mode where the master device initiates the data frame.
THL	**Trans-hybrid Loss -** In a carrier telephone system, the transmission loss at a given frequency measured across a hybrid circuit joined to a given two-wire termination and balancing network.
USB	**Universal Serial Bus -** A standard for providing serial access to interface devices.

Index