ISDN Terminal Adapter with NT1 and Channel Bonding

Description

The XEISDNB integrated ISDN Terminal Adapter offers an easy to use, high performance, component-level solution for equipment designs needing access to ISDN service. The module can directly connect to a host processor through its on-board serial TTL level interface and link to the ISDN subscriber line U interface with its integrated NT1.

The device is designed for the ISDN Basic Rate Interface (BRI) which consists of two 64 k bps bearer (B) channels for data or voice and one delta (D) channel for signaling. The module can provide a full 128k bps synchronous data channel by combining the two bearer channels.

Alternatively, one 64k bps channel can be dedicated to data while the other can be made available for analog phone/fax/modem calls with the addition of the XEISDNP Analog Telephone (POTS) Equipment Interface. Together these provide the user with a complete ISDN terminal adapter function in two compact modules.

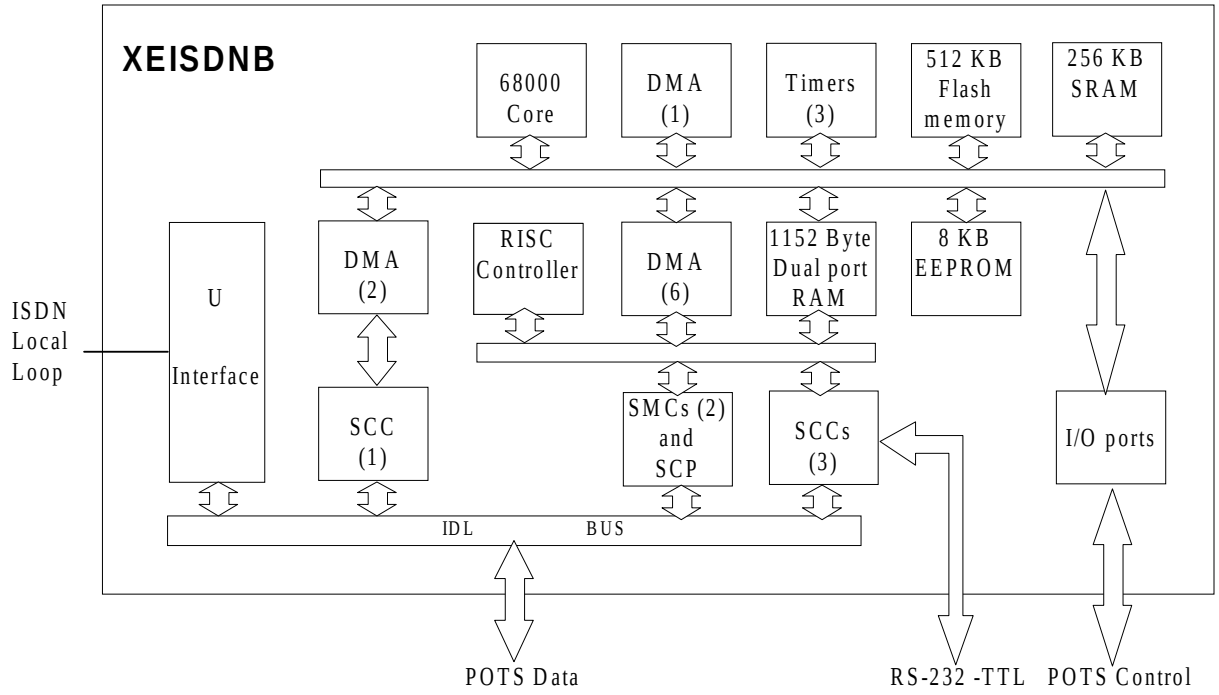
Built-in ISDN control firmware supports all the functions necessary for setup and configuration of the terminal adapter and the ISDN line. Configuration can be accomplished via an extended AT command set, a menu-driven setup utility, or factory default/user stored configuration profiles.

The built-in ISDN Monitor firmware has fifteen commands supporting customer program development and download. The 256Kx16 Flash memory is designed to support custom control program downloading. By changing a configuration pin the XEISDNB can boot-up from the ISDN-Monitor or a user developed program as well as the built-in ISDN control program.

Features

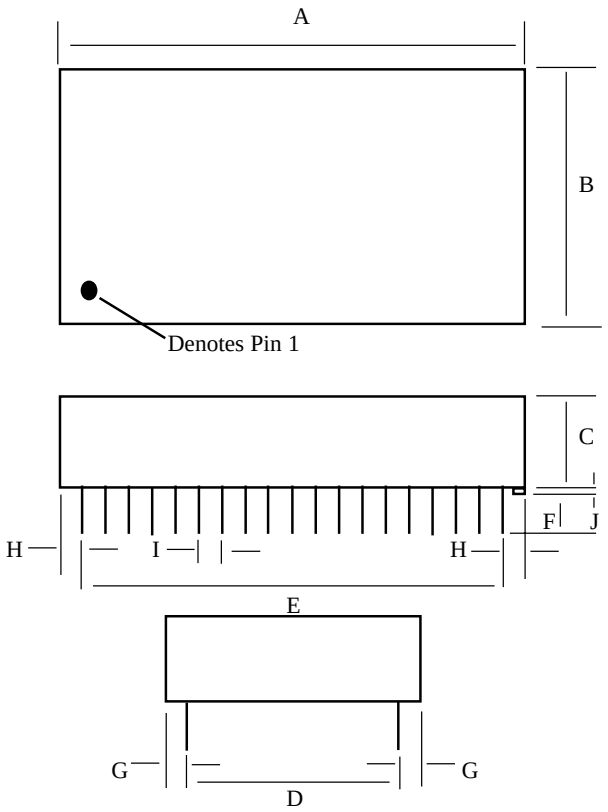
- Small size: 2.75" x 1.38" x 0.42"
- Motorola MC68302 Integrated Multi-protocol Processor with RISC controller. 128K x 16 SRAM, 256K x 16 Flash Memory and 8K x 8 EEPROM included
- ISDN line U interface (integrated NT1) with 2B1Q encoding (ANSI T1.601) for North American usage
- V.120 rate adaptation, point to point protocol (PPP), Multi-link PPP, Asynchronous Inverse Multiplexing (AIM), and synchronous BONDING protocol
- ISDN control program allows connection with AT&T 5ESS, Northern Telecom DMS 100 and National ISDN-1 central office switches
- EIA-232E/V.24 ready serial interface at TTL levels (RS-232-TTL)
- 300 to 115,200 bps asynchronous, 1200 to 64,000 bps synchronous data rate; up to 128k bps with BONDING protocol
- Menu-driven and stored configurations
- Control outputs to interface with XEISDNP Analog Telephone (POTS) Equipment Interface module
- On-board ISDN Monitor supports user program downloading and system debugging
- Jumper configurable memory addressing allows easy change from Development to Application mode (using built-in ISDN control program or user developed program)

XEISDNB Block Diagram

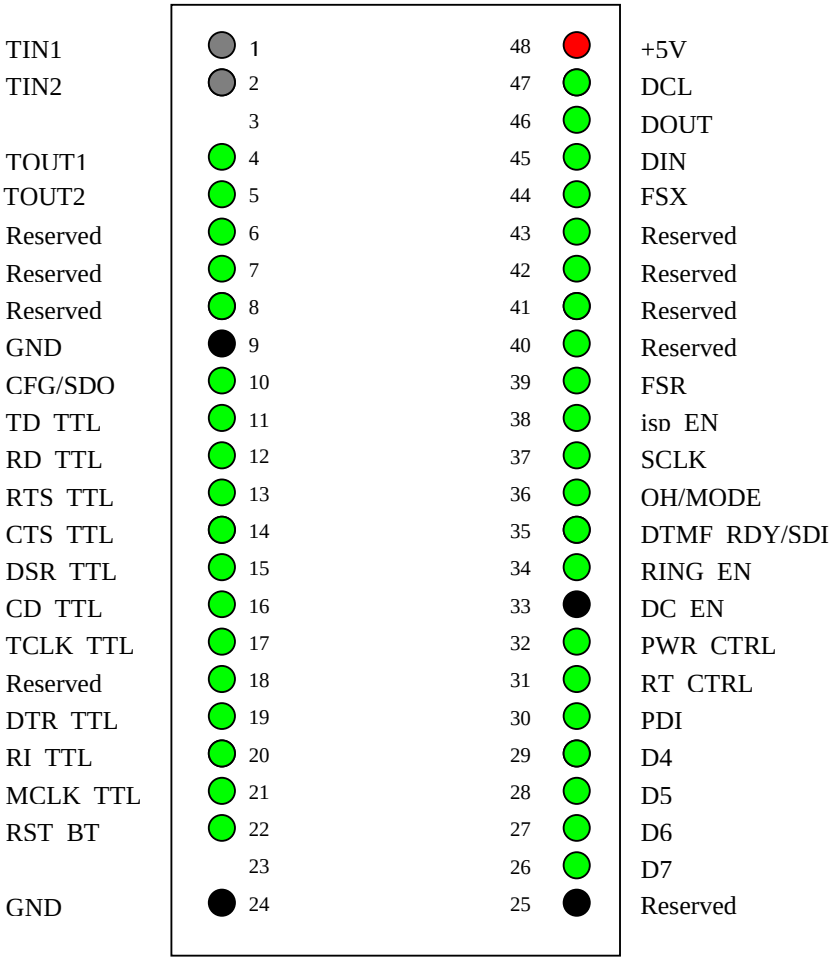


Mechanical Specifications

	INCHES		METRIC (MM)	
	MIN	**MAX**	**MIN**	**MAX**
A	2.740	2.760	69.60	70.10
B	1.370	1.390	34.80	35.31
C	0.420	0.430	10.67	10.92
D	1.190	1.210	30.23	30.73
E	2.290	2.310	58.17	58.67
F	0.125	0.200	3.18	5.08
G	0.080	0.100	2.03	2.54
H	0.215	0.235	5.46	5.97
I	0.090	0.110	2.29	2.79
J	0.020	0.025	0.51	0.64



Pin Configuration



Pin Descriptions

Pin Name	Pin #	Direction	Description
TIN1	1		ISDN U transformer primary A
TIN2	2		ISDN U transformer primary B
No Pin	3	N/A	No pin
TOUT1	4		ISDN U transformer secondary A
TOUT2	5		ISDN U transformer secondary B
Reserved	6	N/A	No user connection allowed
Reserved	7	N/A	No user connection allowed
Reserved	8	N/A	No user connection allowed
GND	9	Ground	Power & signal ground
CFG/SDO	10	Input/Output	Configuration setup. See Modes of Operation. When re-programming the In-System Programmable (ISP) CPLD, this pin is used for the cascade connections and should not be pulled low or high.
TD_TTL	11	Input	RS-232C, Transmitted Data, TTL Level
RD_TTL	12	Output	RS-232C, Received Data, TTL Level

RTS_TTL	13	Input	RS-232C, Request to Send, TTL Level
CTS_TTL	14	Output	RS-232C, Clear to Send, TTL Level
DSR_TTL	15	Output	RS-232C, Data Communications Equipment (DCE) Ready, TTL Level
CD_TTL	16	Output	RS-232C, Received Line Signal Detect, TTL Level
TCLK_TTL	17	Output	RS-232C, Transmit Clock, TTL Level
Reserved	18	N/A	No User Connection Allowed
DTR_TTL	19	Input	RS-232C, Data Terminal Ready, TTL Level
RI_TTL	20	Output	RS-232C, Ring Indicator, TTL Level
MCLK_TTL	21	Input	RS-232C, Master Clock, Transmitter Signal Timing (DTE Source)
RST_BT	22	Input	Optional on-board processor Reset button
No Pin	23	N/A	No Pin
GND	24	Ground	Power & signal ground
Reserved	25	N/A	No User Connection Allowed
D7	26	Input	Data bus line 7 for CODEC Data
D6	27	Input	Data bus line 6 for CODEC Data
D5	28	Input	Data bus line 5 for CODEC Data
D4	29	Input	Data bus line 4 for CODEC Data
PDI	30	Output	CODEC Power Down Control
RT_CTRL	31	Output	CODEC Voice Signal Route Control
PWR_CTRL	32	Output	POTS Phone Set Power Control
DC_EN	33	Output	Enable DC Source for RING generation
RING_EN	34	Output	RING Signal Enable for POTS module
DTMF_RDY/SDI	35	Input	DTMF Signal Ready from POTS module. When used with the In System Programmable CPLD, It becomes the SDI
OH/MODE	36	Input	Off Hook Signal from POTS module. When used with In System Programmable CPLD it becomes the Mode Control
SCLK	37	Input	SCLK for In System Programmable CPLD
ISP_EN	38	Input	In System Programmable CPLD Enable Signal
FSR	39	Output	CODEC Frame Sync. Receive
Reserved	40	N/A	No User Connection Allowed
Reserved	41	N/A	No User Connection Allowed
Reserved	42	N/A	No User Connection Allowed
Reserved	43	N/A	No User Connection Allowed
FSX	44	Output	Frame Synchronization
DIN	45	Input	Data In
DOUT	46	Output	Data Out
DCL	47	Output	Data Clock
+5V	48	Power	+5 Volt power supply

Electrical Specifications

ABSOLUTE MAXIMUM RATINGS	
Parameter	**Maximum Value**
Supply Voltage VCC (+5V)	+6.5 Volts
DC input voltage (TTL inputs)	-0.6 Volts to +6.5 Volts
Storage Temperature Range	-25C to +85C
Lead Temperature (soldering, 2 sec/wave)	+260C
Operating Temperature Range	0 to 70C

* Exceeding these values may result in permanent damage to the device

POWER SUPPLY CHARACTERISTICS (Ta = +70C)

Symbol	Parameter	Min	Typ	Max	Unit	Notes
Vcc	Supply Voltage	4.75	5.0	5.25	Volts	
Icc	Vcc Supply Current		200		mA	

I/O Characteristics

ISDN U - INTERFACE	
Parameter	**Specification**
Line interface (with recommended components)	ANSI T1.601, 2B1Q encoding, U reference point
ISDN Switch Compatibility	National ISDN-1, Northern Telecom DMS-100,Lucent 5ESS
B Channel Protocols	V.120, PPP, Multi-link PPP, Async inverse multiplexing, BONDING

RS-232-TTL Interface

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Input High Voltage	V sub IH	2.0		5.0	Volts	
Input Low Voltage	V sub IL	-0.3		0.8	Volts	
Input Leakage Current	I sub IL			20	MA	
Output High Voltage	V sub OH	3.875			Volts	Vcc = 5 Volts
Output Low Voltage	Vsub OL			0.5	Volts	Vcc = 5 Volts

Recommended Components List

Component	Qty	Value	Supplier	Part Number	Phone Number
Transformer	1		Midcom	671-7834	605-886-4385
			Schott	671 46720	615-889-8800
			Pulse Engineering	PE 68628	619-674-8100
Resistor	2	6 Ohm, ¼ W			
Capacitor	1	3300 pF			
Connector	1	8 pin (pins 4,5 active)		RJ45	

Design Considerations

ISDN Capability

Integrated Services Digital Network (ISDN) is a powerful, flexible, high-speed service now available from most local phone service providers in North America, Asia, and Europe. It provides two 64k bps digital bearer channels (B channels) and one 16k bps signaling channel (D channel) over a single pair of copper wires. Typically the installed base of subscriber loop wiring is adequate for this service, making ISDN the most cost effective means of delivering high speed digital dial-up service to homes and businesses.

Because ISDN is a digital service, connection of computer equipment does not require a modem like a conventional analog line. However a terminal adapter is required to translate the physical signal levels and the protocols of the Data Terminal Equipment into those of the ISDN lines and switches. External ISDN Terminal Adapters have been available for some time. The XEISDNB provides a simple means for designers to implement an internal TA function without dedicating an entire board and a significant firmware investment to this purpose.

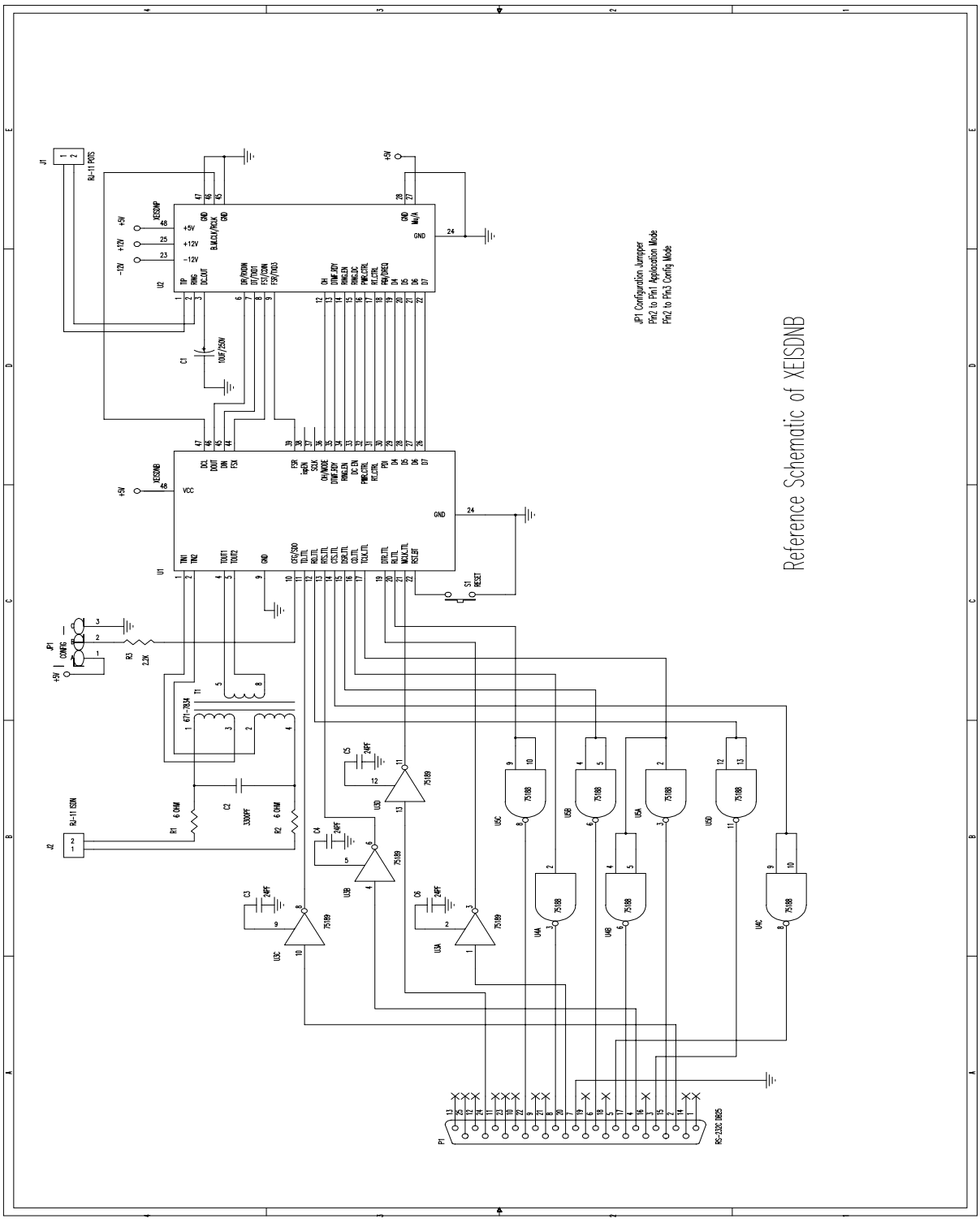
Terminal Adapter Function

The XEISDNB integrated ISDN Terminal Adapter Module is designed to provide a compact, simple design solution for adding ISDN service access to industrial, medical, computer, business, and consumer products which need to communicate with remote computers or networks at high data rates. Only four passive components must be added to implement the hardware interface, signaling and protocols for the North American ISDN standard interface to the local telephone company.

When used alone the XEISDNB module presents a high speed digital data channel to the local host equipment through an RS-232E-ready (TTL) serial interface. This channel can be configured by the designer or user for high speed synchronous or asynchronous applications. Async Inverse Multiplexing (AIM) or Multi-link PPP provides up to 115.2k bps asynchronous throughput. BONDING protocol provides a 128k synchronous channel.

When combined with the XEISDNP Analog Telephone Equipment Interface, the XEISDNB can provide either B channel (on the same physical ISDN line) for simultaneous use by an independent analog phone, fax, or modem designed for “Plain Old Telephone Service” (POTS). Thus the user can place voice calls over the same ISDN line as data calls, and his investment in existing analog phone equipment is preserved.

Typical Application Circuit



Modes of Operation

Application Mode

The normal mode of operation of the XEISDNB is Application Mode. This would typically be the only mode visible to the equipment end user. When the CFG/SDO (pin 10) is pulled high, the XEISDNB module is in the Application mode. The ISDN configuration and control program supplied by Xecom or the equipment designer's specially developed control program will boot-up upon power-on. In this mode the control program can occupy up to 240K x 16 of the 256K x 16 Flash memory.

Development Mode (ISDN Monitor)

XEISDNB also provides a development tool for designers who wish to write their own firmware control code. When the CFG/SDO (pin 10) is pulled low, the module will boot-up from the on board ISDN Monitor program. The xecom ISDN Monitor has fifteen debugging commands including program downloading, memory contents display and Flash memory operation. The complete command set is listed in the Configuration Guide.

After the designer program has been developed and tested using the ISDN Monitor utility it can be downloaded into non-volatile Flash memory. The module is then reconfigured to the Application Mode, and the program is ready to run.

Configuration and Setup

An ISDN telephone line presents a significantly more powerful and complex interface to the user than a standard analog (POTS) line. Unlike an analog line, the digital ISDN line requires special setup, demultiplexing, and signal processing to separate its two 64k bps data channels (B channels) and its 16k bps signaling channel (D channel) at the user interface. In order to establish a connection to an ISDN line, certain parameters must be exchanged between the telephone company switch and the local data communication equipment to initialize the call. It is assumed here that the user has access to an already installed ISDN line and the configuration parameters (Dial Numbers, Service Profile Identifiers, Switch Type, Switch Version, Long Distance Carrier) provided by the phone company for that line. Further information on these parameters is contained in the Configuration Guide.

In addition to the remote switch configuration, the local terminal adapter (TA), like an analog modem, must be set up properly to operate. There are several parameters which must be set compatibly at the TA and the switch to specify the exact services to be provided over the line. These parameters will vary with the application. The XEISDNB implements these functions based on setup information provided by the user. There are three methods for configuration of the link.

AT Command Configuration

The most basic configuration technique is through AT commands. The user interface is similar to that of an analog modem with an extended command set. The user communicates this information to the module through the RS-232E serial port. A PC running standard VT100 compatible serial communications software is typically used for this purpose. The AT command set of the XEISDNB is designed to enable configuration and testing for both the remote switch and the terminal adapter.

Like an analog modem, the XEISDNB operates in two modes: data mode and command mode. In data mode the device sends all data received at its data ports down the ISDN link. In command mode the TA interprets these inputs as configuration and setup commands and processes them locally. Commands are communicated to the TA via its RS-232 serial interface from the local host processor. The TA enters command mode upon power-on, any time the Escape command "+++" is received, or when a call is terminated.

The commands for TA configuration are modeled on the standard set used for analog modems with extensions for the new ISDN functions. Commands for remote switch configuration and the unique ISDN functions required of the terminal adapter have been added. The XEISDNB firmware contains an AT Command Help listing which can be displayed by typing "AT&H" while in command mode. The module will respond with a listing of AT commands with brief definitions of each. The complete command set listing appears in the Configuration Guide along with examples of configuration profiles for typical applications.

Menu Configuration

The second configuration method uses a group of Setup Menus built into the XEISDNB firmware. These menus are accessed by entering the AT command "@SETUP" while the module is in Command Mode. Keyboard commands from a PC in VT100 terminal emulation mode allow the user to move through the complete set of configuration choices, enter variable data, and store the results. Operation of the Setup Menus are explained in the Configuration Guide.

Stored Configurations

A complete set of configuration parameters must be in place each time the XEISDNB places a call. However the current parameters are held in volatile memory and are lost when the host equipment power is interrupted. Also, once a working configuration has been established for a particular ISDN line, terminal equipment set, and service type there is no need to change it for each call. To speed up and/or automate the call setup process stored configurations are provided in the XEISDNB.

Two types of stored configurations are provided: factory defaults and user defined configurations. Factory defaults are stored in Flash memory while user defined sets are stored in EEPROM. The factory default configuration sets provided represent setups for common applications. Descriptions of these are contained in the Configuration Guide. There are provisions for two user defined configuration sets. In addition the settings associated with switch parameters are stored and accessed separately to help prevent accidental changes. Extended AT commands are provided to store and load these configuration sets upon power up or separately. These commands are detailed in the Configuration Guide.

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Xecom Incorporated
374 Turquoise Street, Milpitas, CA 95035
Ph:408-945-6640 Fax:408-942-1346
Email: info@xecom.com