Am186™CC Communications Controller ISDN TA Reference Design

User's Manual

Order #22033A

AMD

Am186™CC Microcontroller ISDN TA Reference Design Manual, order #22033A

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About the Am186™CC Communications Controller ISDN TA Reference Design

The Am186™CC communications controller ISDN terminal adapter (TA) reference design is designed as a small, cost-effective ISDN solution for embedded communications applications. This design is intended to reduce the time to market for ISDN designers using the Am186CC communications controller. Figure 0-1 shows a block diagram of the ISDN TA reference design.

The ISDN TA reference design is a fully functional ISDN TA that illustrates the benefits of using the Am186CC communications controller ISDN TA reference design. The Am186CC communications controller has a number of integrated features required in many communication applications. These features include four high-level data link controller (HDLC) channels and a universal serial bus (USB) peripheral controller with an internal transceiver. The HDLC channels support GCI/IOM-2, PCM, and DCE interfaces. Other integrated features include four general-purpose DMA channels, eight SmartDMA™ controller channels, four time slot assigners (TSAs), UART, High-Speed UART with autobaud, and an integrated DRAM controller.

The ISDN TA reference design illustrates how to use many of the integrated peripherals to provide a small, low-cost, ISDN TA. The reference design supports either an ISDN 2B+D U or S/T network interface by a component population option. You can interface to a PC using either the High-Speed UART connection at up to 230 kbps, or by using a full-speed USB connection at 12 Mbps.

Note that the High-Speed UART is capable of 460 kbps, but is limited by the reference design's UART transceiver, which is only capable of 230 kbps, and also by the PCs that the ISDN TA would connect because most of them are only capable of speeds up to 115 kbps or 230 kbps.

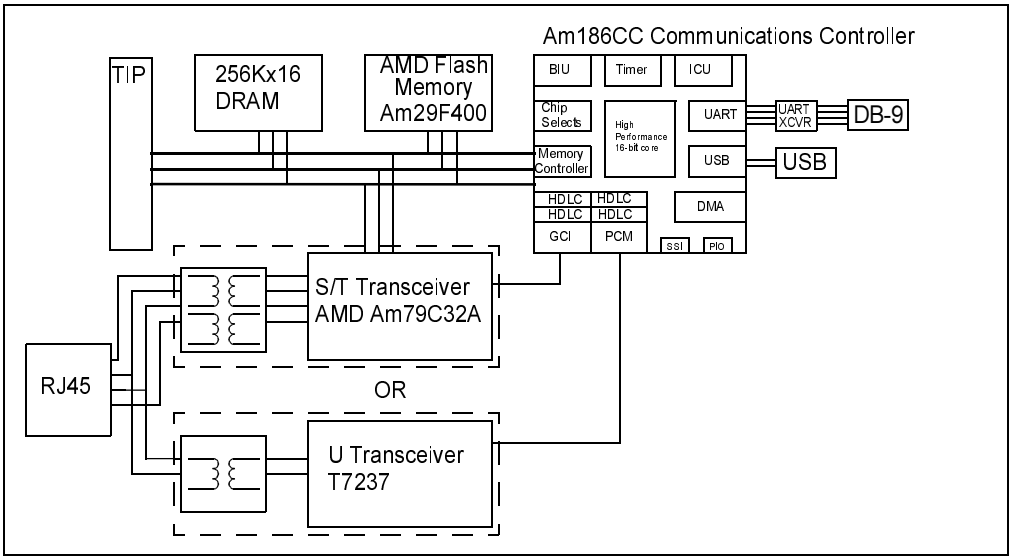


Figure 0-1. ISDN TA Reference Design Block Diagram

Theory of Operation

The ISDN TA reference design demonstrates the processor's functionality in an ISDN application. You can use this design as a reference to create your own ISDN designs. The small size and simplicity of this design highlight the benefits of the Am186CC communications controller ISDN TA reference design's many integrated peripherals.

Am186CC Microcontroller ISDN TA Reference Design Features

The ISDN TA reference design provides the following features:

- 2B+D ISDN network interface (For more information about ISDN, see “ISDN Background” on page xii)
  - ISDN U interface available by population option
  - ISDN S/T interface available by population option
- High-Speed, 230-kbps, serial PC interface
- 12-Mbps, USB PC interface
- Single, +5V AC/DC wall-adapter power supply
- Very small form factor
- Four-layer printed circuit board (two signal, V_{CC}, GND)

ISDN Background

ISDN (integrated services digital network) is an alternative to analog phone lines. ISDN provides greater performance than analog and is still affordable to consumers. There are many different variations of ISDN available, but the most common is 128-kbps data transfer rate over two B (bearer) channels, plus 16 kbps of signaling data over the D channel; this is the 2B+D configuration, the configuration used by the ISDN TA reference design discussed in this manual. Another configuration uses a single B channel and transfers data at 64 kbps. Broadband ISDN is available and can achieve data rates in the 100-Mbps range.

There are a number of reference points in an ISDN system. Figure 0-2 shows a graphical representation of the ISDN reference points. The U reference point is the local loop between the LE (local exchange) and the NT (network termination) device. The U interface is a two-wire interface, which in North America and Asia is typically supplied by a telecommunications service provider. The U interface operates in 2B1Q (two binary, one quaternary) format, and can travel for miles without repeaters. The T reference point is used only with customer premises switching equipment (NT2). The S/T reference point is the four-wire interface between the network termination device (NT1) and the terminal equipment (TE1) or terminal adapter (TA). The S/T interface is offered in Europe, and is also used with stand-alone NT1 devices.

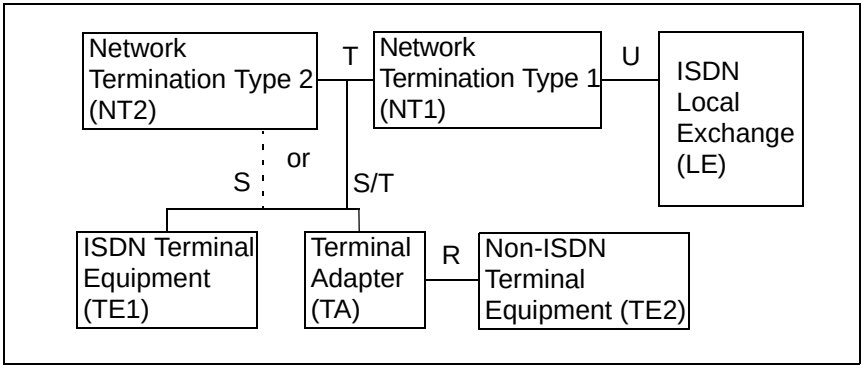


Figure 0-2. ISDN Reference Point Diagram

Documentation

The *Am186*™CC Microcontroller ISDN TA Reference Design *User's Manual* provides information on the system and board features, functionality, and ISDN interfaces. Additional information can be found in the documentation listed on page xiv.

About this Manual

Chapter 1, "Quick Start" provides installation information for the ISDN TA reference design.

Chapter 2, "System Features and Components" contains descriptions of the reference design features and components, ISDN interfaces, power supply, test interface port, and ISDN TA pin usage.

Chapter 3, "Product Support" provides information on reaching and using the AMD Corporate Applications technical support services, product information available through AMD's World Wide Web site, and support tools for the embedded E86 family.

Appendix A, "Bill of Materials (BOM) and Schematics" shows the bill of materials for the reference design and the actual CAD schematics used to build the board.

Appendix B, "Glossary of Terms" contains definitions of terms used in this manual.

Suggested Reference Material

- *Am186™CC Communications Controller User's Manual*
  Advanced Micro Devices, order #21914
- *Am186™CC Communications Controller Data Sheet*
  Advanced Micro Devices, order #21915
- *Am186™CC Communications Controller Register Set Manual*
  Advanced Micro Devices, order #21916
- *Am186™ and Am188™ Family Instruction Set Manual*
  Advanced Micro Devices, order #21076
- *E86™ Family Products and Development Tools CD*
  Advanced Micro Devices, order #21508
- ISDN Concepts, Facilities, and Services
  Gary C. Kessler, ISBN: 0-07-034242-3
- ISDN For Dummies®, 2nd Edition
  David Angell, ISBN: 0-7645-0064-3
- ISDN Implementor's Guide: Standards, Protocols, Services
  Charles K. Summers, ISBN: 0-07-069416-8
- International Telecommunication Union Standards at www.itu.ch

Chapter 1

Quick Start

This chapter provides information that helps you quickly setup and install the ISDN TA reference design.

- For information on how to connect the ISDN TA reference design to a PC (high-speed serial connection or full-speed USB connection), see page 1-2.
- For information on how to locate other sources of information, see page 1-3.
- For information on invoking the software supported by the reference design, refer to the Software Quick Start information, included in your kit.

Connecting to a PC

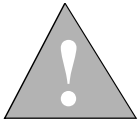
The procedure in this section describes how to connect the ISDN TA reference design to a PC using either a USB or serial port. Follow the steps below to connect the ISDN TA reference design board to your PC. For information on how to invoke the software, see the Software Quick Start document included in your kit.

Installation Requirements

The items listed below are necessary to install and run the ISDN TA:

- PC with an available COM port
- Terminal emulation software (such as Microsoft®Windows® Terminal or ProComm Plus) that supports ASCII file transfers, software flow control (Xon/Xoff), and *send break* capability
- Dial-up networking configured as per your ISP's recommendations
- Power source for universal power supply (47–63 Hz, 100–250 VAC)

Board Installation



CAUTION: As with all computer equipment, the ISDN TA may be damaged by electrostatic discharge (ESD). Please take proper ESD precautions when handling any board.

1. Remove the board from the shipping carton. Visually inspect the board to verify that it was not damaged during shipment.
2. Connect the ISDN TA board's DB-9 serial port to an available COM port. Use the serial cable included in the ISDN TA kit and note that a DB-9 to DB-25 serial connector adapter is provided if your host system requires it. If using your own cable, use a straight through cable, *not a null modem cable.*

DANGER: Make sure the power supply is *not* plugged into an electrical outlet before connecting it to the ISDN TA.

3. Plug the AC adapter into a power source. Connect the 5 V_{DC} from the AC adapter to the ISDN TA through the barrel connector.
4. If you are using a USB PC interface, connect the USB cable into the USB Type-B connector on the ISDN TA.
5. When all of the power and PC connections have been made, apply power by toggling the switch located at the back of the ISDN TA. The power LED (PWR LED) turns on when power is correctly applied.

For More Information...

If you need more information about:

- The Am186CC communications controller ISDN TA reference design hardware,
  see Chapter 2.
- Problems with the reference design,
  see page iii.
- The Am186CC communications controller ISDN TA reference design board layout,
  see Chapter 2.
- The Am186CC communications controller ISDN TA reference design schematics,
  see Appendix A.
- The Am186CC microcontroller,
  see the *Am186™CC Communications Controller Data Sheet and the Am186™CC Communications Controller User's Manual included in your kit.*
- The latest release and updates, see Demo Board Updates at www.amd.com/products/lpd/lpd.html.

Chapter 2

System Features and Components

The ISDN TA reference board provides a small, low-cost, stand-alone system for use by ISDN developers using the Am186CC communications controller.

The following sections explain the operation of the board in detail:

Layout and Placement

The ISDN TA reference design emphasizes the small board size that can be obtained by using the Am186CC communications controller in an embedded communications application. Refer to Figure 2-1 on page 2-4 for layout and component placement.

The ISDN TA reference design board has the Flash memory, DRAM, and TIP connector located close to the processor to provide a linear, logical signal flow for the address and data bus. The connectors and the power switch are located at the back of the board, and the status indicator LEDs are located at the front of the board. This placement makes it possible to manufacture the board in a small enclosure. The ISDN interface devices are overlapped where possible to minimize board size. In Table 2-1, all of the parts are identified by part number and part description.

Table 2-1. ISDN TA Reference Design Parts List

Part Number	Part Description	Part Location
U1	Am186CC communications controller	B-1
U2	EDO DRAM - Mosel Vitelic, 256Kx16	A-2
U3	Flash memory - Am29F400, 256Kx16	A-1
U4	ISDN S/T transceiver - Am79C32A	A-2
U5	ISDN S transformer	B-3
U6	ISDN S choke	C-3
U7	Optocoupler	B-3
U8	ISDN DC termination IC	B-3
U9	ISDN U transceiver - Lucent T7237	A-3
U10	ISDN U transformer	B-3
U13	High-Speed UART transceiver	C-2
U14	74ACT04	C-1
U15	3.-V LDO	C-1

Table 2-1. ISDN TA Reference Design Parts List (Continued)

Part Number	Part Description	Part Location
CR2–CR8	Status indicator LEDs	A-1–A-3
P1	RJ-45 connector	C-3
P2	DB-9 connector	C-2
P3	USB type-B connector	C-2
P4	Power connector	C-1
P5	TIP connector	B-1
SW1	Power switch	C-1
SW2	Reset button	C-2
JP1	Flash memory CS jumper	A-1
JP2	x8 boot jumper	A-1
F1	ISDN U interface line fuse	C-3
F2	1.5-A power supply main fuse	C-1

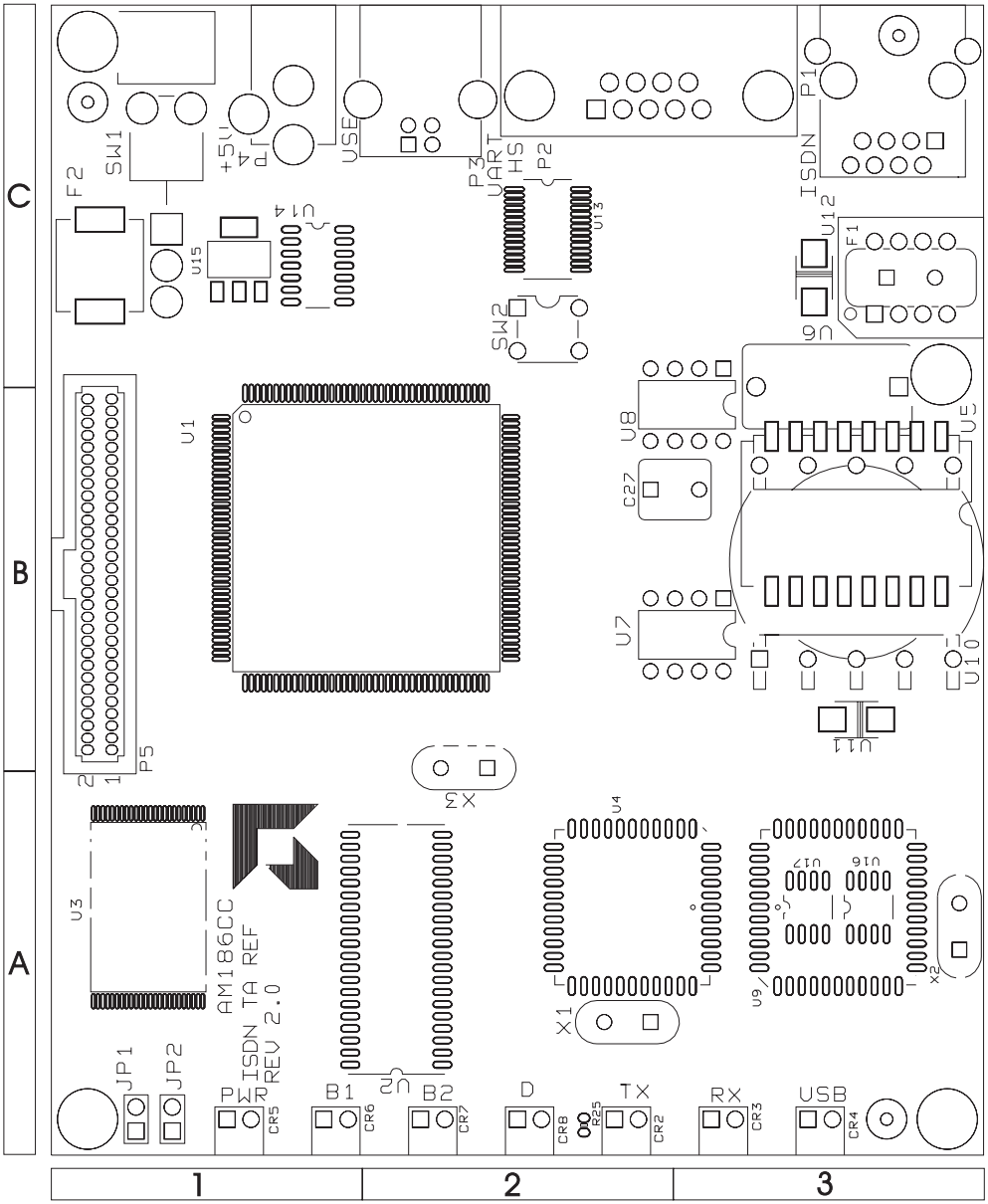


Figure 2-1. ISDN TA Reference Design Circuit Board Layout

The ISDN TA reference design was designed to fit in a very small desktop enclosure. The circuit board is 3.85” x 4.75”, and fits into a variety of enclosures. There are mounting holes on three corners; the fourth is on the side.

Am186CC Microcontroller

The ISDN TA reference design is used to control the ISDN TA. A block diagram of the ISDN TA reference design is shown in Figure 2-2. The many integrated features of the Am186CC communications controller make it ideal for an ISDN application. The integrated DRAM controller allows a glueless interface to the system memory. You can use the built-in High-Speed UART with autobaud to communicate with the PC. You can also use the full-speed USB peripheral controller with built-in transceiver for a 12-Mbps PC interface. The HDLCs provide a glueless interface to either the S/T transceiver or the U transceiver.

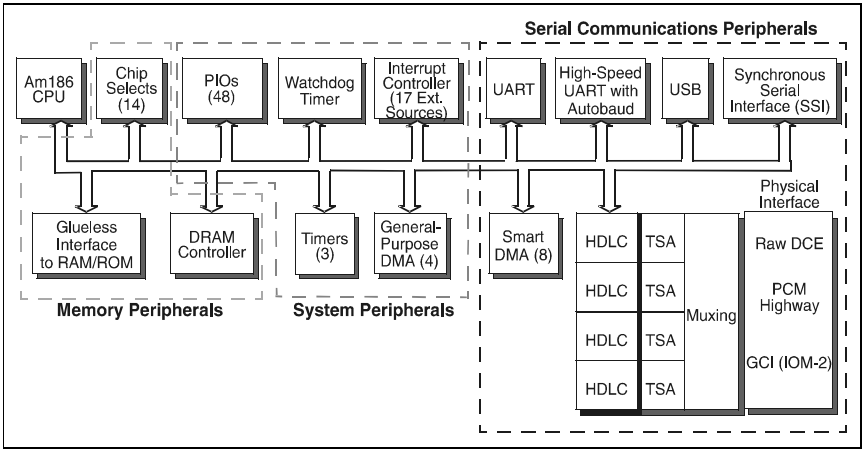


Figure 2-2. Am186CC Microcontroller ISDN TA Reference Design Block Diagram

The system uses a single 24-MHz crystal. This design uses an internal 2x PLL which provides a 48-MHz system clock and the required 48-MHz USB clock. Because the USB clock is derived from the system PLL, the USB crystal input, USBX1, is terminated. The clock generation circuit is shown in Figure 2-3.

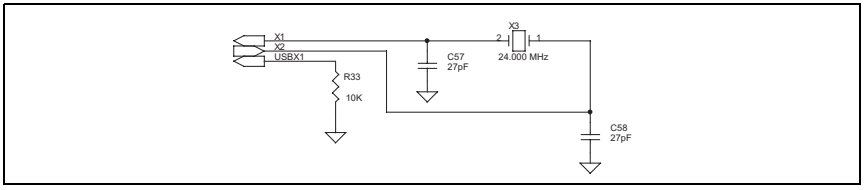


Figure 2-3. ISDN TA Clock Generation Circuit

System Memory

This design uses 512 Kbyte of AMD Flash memory for code space located from 0x80000h–0xFFFFFh, and 512 Kbyte of DRAM. The memory schematic is shown in Figure 2-4. The Am29F400 Flash memory is used in a 256k x 16 configuration. The Am29F400 is byte/word selectable using the BYTE# pin. In case the 512 Kbyte of Flash memory is not sufficient, PIO 35 is routed to the chip to act as a bank select. This allows drop in compatibility for larger Flash memory, such as the 29F800 device.

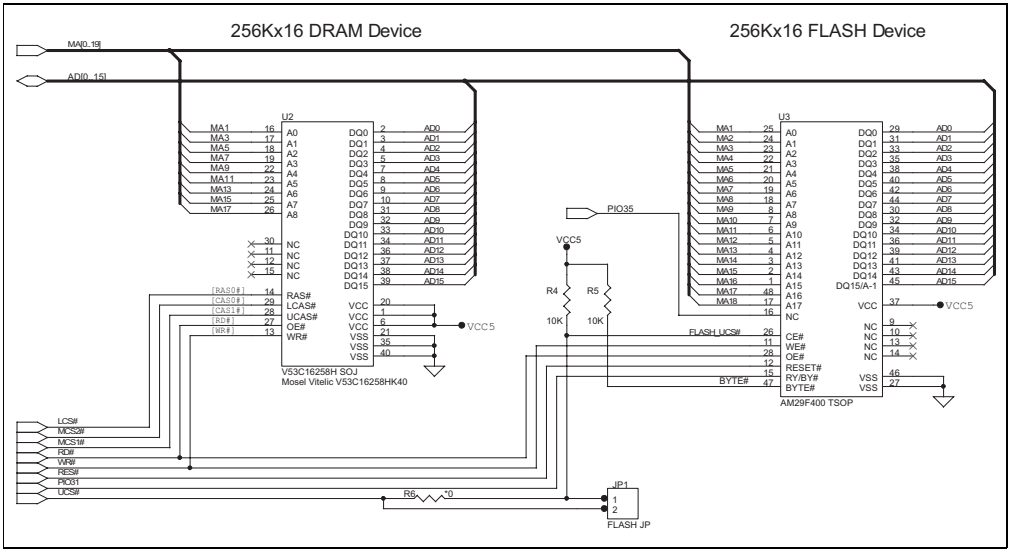


Figure 2-4. ISDN TA System Memory

DRAM was chosen over SRAM as main memory in this application because DRAM is more cost effective than SRAM and because the ISDN TA reference design has an integrated DRAM controller that makes a glueless DRAM interface simple to use. The Am186CC communications controller DRAM interface allows zero-wait state operation at 48 MHz using a 40-ns DRAM. This DRAM device is located from 0x00000h–0x7FFFFh in low memory space and is selected using LCS/RAS0.

ISDN S/T Interface

The Am79C32A IDC (ISDN data controller) circuit is used to provide the four-wire 2B+D S/T interface. This device has a general circuit interface (GCI) or IOM-2 serial microprocessor interface, which is used to transfer B channel data to and from the Am186CC microcontroller's integrated HDLC controller. The Am186CC communications controller-based ISDN TA reference design provides a full-duplex path between the terminal equipment (TE) and the network termination (NT) device. The controller processes the ISDN basic rate interface (BRI) bit stream, which consists of two 64-kbps B channels and a single 16-kbps D channel. The schematic for the S/T interface block is shown in Figure 2-5.

The Am79C32A IDC circuit includes a D-channel HDLC controller which is used by software to send and receive data on the D channel.

The four-wire ISDN S/T interface is first directed through an S transformer and line filtering devices These isolate and protect the modem from the outside lines. The crystal is used to generate MCLK, which can be used as a master clock output and as the system clock for the microprocessor.

The signals SBIN, SBOUT, SCLK, SFS, and BCL/CH2STRB can be configured for serial bus port (SBP) or GCI. SBP is used by the current terminal adapter software and is connected to HDLC Channel A on the Am186CC communications controller.

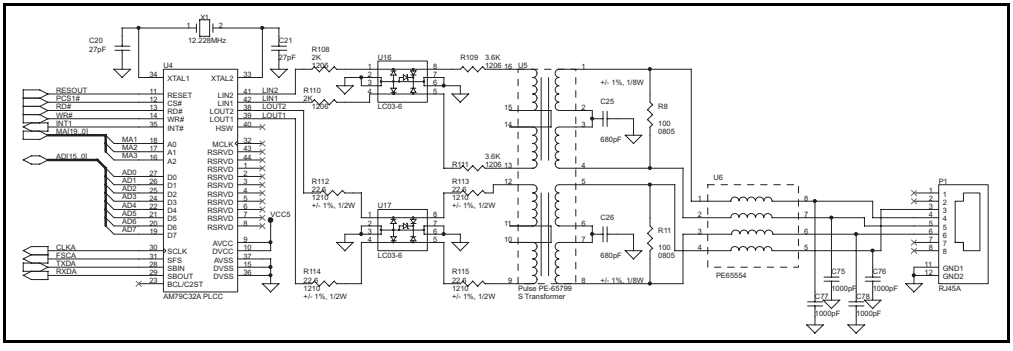


Figure 2-5. ISDN TA S/T Interface

ISDN U Interface

The Lucent T7237 circuit is used to provide the two-wire 2B+D U interface. This device has a PCM serial microprocessor interface and an SSI (synchronous serial interface). These interfaces are used to transfer data to and from the Am186CC microcontroller using it's integrated HDLC. This chip provides the two-wire network termination. It processes the ISDN BRI bit stream that consists of two 64-kbps B channels and a single 16-kbps D channel. The schematic for the U interface block is shown in Figure 2-6. The U-interface circuit includes a line fuse, U transformer, DC termination IC, and opto-isolation circuitry. The LED shown in Figure 2-6 is used to indicate device status. The four states of the LED are Low, High, 1 Hz, and 8 Hz. Refer to the Lucent T7237 device data sheet for a complete description.

The U-interface data is in 2B1Q format, which provides a four-level (quaternary) amplitude modulation. A single quaternary symbol represents two binary bits. The quaternary symbols are ± 3, ± 1, which represent 00, 01, 10, and 11 in binary.

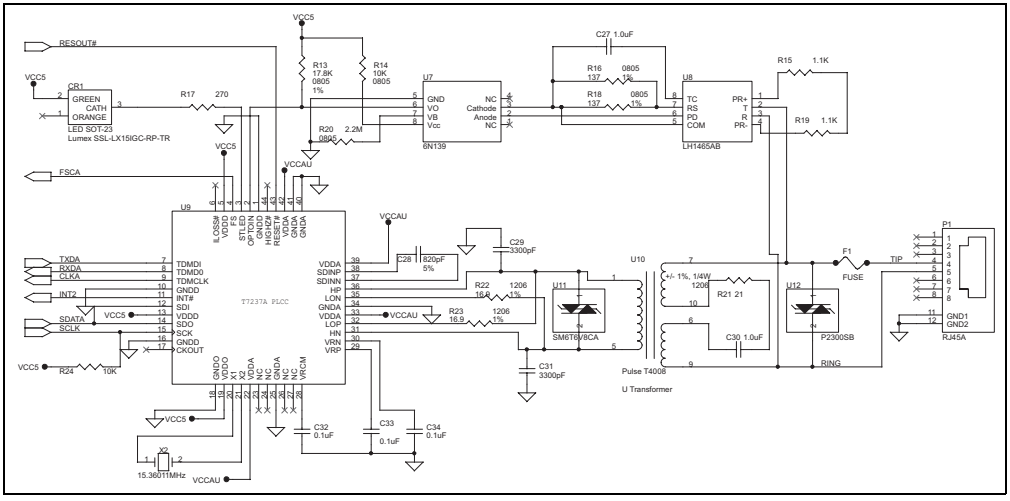


Figure 2-6. ISDN TA U Interface Circuit

Serial PC Interface

The serial port may be used for communication with a PC. The Sipex high-speed RS-232 transceiver is used to provide serial data rates up to 230 kbps. The DCE serial connection is made through a standard female DB-9, which uses a straight-through serial cable. PIO1 and PIO28 are used to provide extra flow control signaling to support Plug and Play (PnP) operation. The two LEDs are used to indicate transmit and receive activity. The schematic for the serial interface is shown in Figure 2-7.

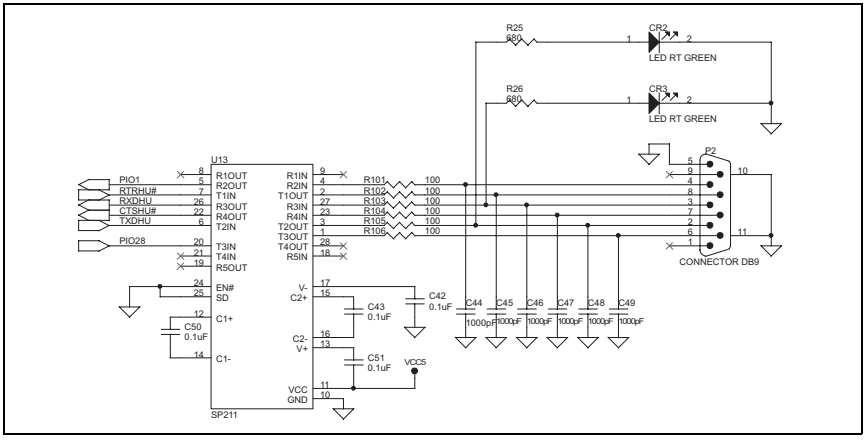


Figure 2-7. ISDN TA High Speed Serial Interface

USB PC Interface

The ISDN TA reference design has an integrated USB peripheral controller with a built in transceiver; differential USB signals connect directly to the controller without requiring an external transceiver. A USB type B connector is used for connection to a PC. The N MOSFETs are used with the two PIOs for V_{CC} attach and detach. The attach and detach steps are listed below. The USB interface transfers data at up to 12 Mbps. The schematic for the USB interface is shown in Figure 2-8.

Attach

1. Am186CC microcontroller polls USB_Detect (PIO42) for logic High to detect when an active host USB port is connected.
2. Am186CC microcontroller drives USB_Vcc (PIO43) High to enable Q1 and pulls up the USBD+ line to indicate to the host that this is a full-speed device.

Detach

1. Am186CC microcontroller polls USB_Detect for logic Low to detect a disconnect of the host.
2. Am186CC microcontroller three-states USBD± in response to a disconnect.
3. Am186CC microcontroller removes USB_V_{CC} to disable Q1; Q2 isolates USB_Detect in response to a disconnect.

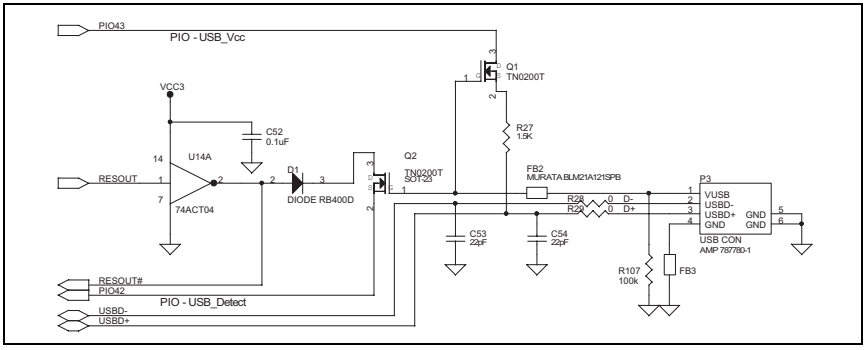


Figure 2-8. ISDN TA USB Interface

Power Supply

This design requires only two voltages, +5 V and +3.3 V. The associated currents and power estimates are included in Table 2-2. A 5-V, 500-mA, regulated, wall-mount AC adapter is used to supply system power. The AC adapter is connected to the system using a standard 5.5-mm barrel connector. A Raychem 750-mA fuse is used to protect the circuit from any surge in current. To reset the fuse, unplug the board and allow the fuse to cool. Most of the devices on the board require 5 V. The 5 V is used directly from the regulated supply. The Am186CC microcontroller and the inverter chip are the only 3.3-V devices on this board. The 3.3 V is obtained from the LDO (Low Drop Out) linear regulator. The power supply and reset schematics are shown in Figure 2-9.

Table 2-2. Current and Power Estimates for the ISDN TA

Volt (V)	Device	I_{typ}(ma)	I_{max}(ma)	P_{typ}(mw)	P_{max}(mw)
3.3	Am186CC controller	-	288	-	950
5	DRAM	65	99	650	990
5	Flash memory	-	60	-	300
5	UART Xcvr	20	30	100	150
5	ISDN S/T Xcvr	31	38	155	190
5	ISDN U Xcvr	54	70	270	350
3.3	Total	-	288	-	950
5	Total	-	297	-	1980

The reset circuit consists of a push button, a diode, and an RC circuit used to provide a time delay. The reset circuit is shown in Figure 2-9. The $\overline{\text{RES}}$ signal into the Am186CC microcontroller must be held Low for at least 1 ms to allow the internal circuitry to settle. The Am186CC microcontroller begins fetching instructions 6.5 CLKOUT periods after $\overline{\text{RES}}$ is deasserted.

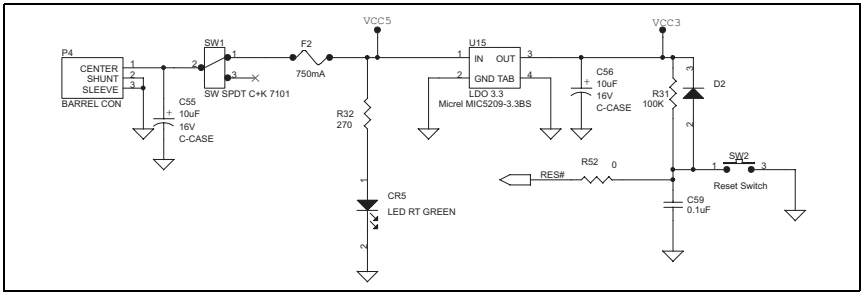


Figure 2-9. ISDN TA Power Supply and Reset Circuit

CAUTION: If using your own power supply, ensure that it is a 5-V supply. Using a 9-V or 12-V supply will permanently damage the board.

Test Interface Port (TIP)

The test interface port (also available from AMD, but not included with the ISDN TA reference design) provides an interface to a low-cost AMD development board. This board is useful for testing, debugging, and developing software on AMD's reference designs. It contains an 8-bit Flash memory device, LEDs, hexadecimal displays, an LCD, serial ports, a parallel port, and an Ethernet controller.

In the event of a Flash memory failure on the main board, you can boot the ISDN TA from an external TIP board. Refer to the *Am186™CC Communications Controller Test Interface Port (TIP) User's Manual* for more information. Note that the TIP board and user's manual are available from AMD, but are not included in your kit. The TIP connector circuit and pinout are shown in Figure 2-10.

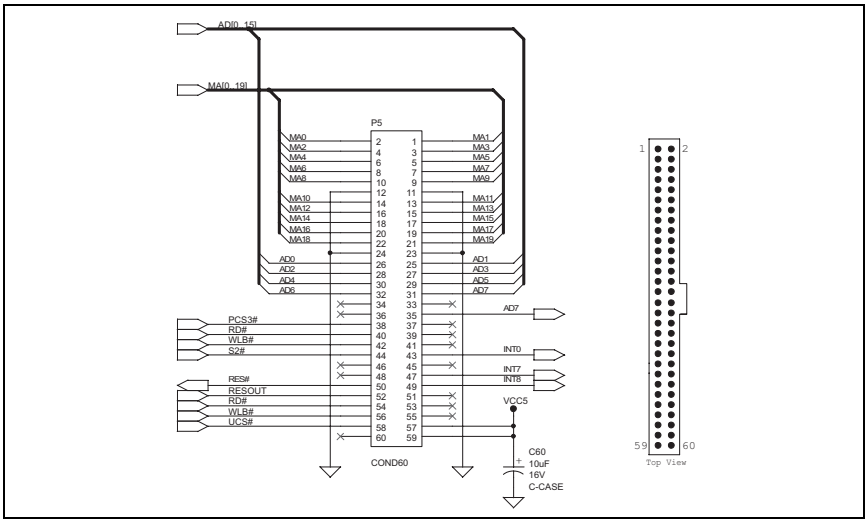


Figure 2-10. Test Interface Port (TIP) Connector Circuit

To boot from the TIP board, the Am186CC microcontroller must be reset in x8 boot mode, and the UCS signal must be routed to the TIP Flash memory. The x8 boot is accomplished by using JP2 to pull the MCS0# signal to ground during reset (see Figure 2-11). To route the UCS signal to the TIP Flash memory, remove the jumper on JP1 and install the jumper on the TIP. When booting from the on-board Flash memory, use only JP1; this routes UCS to the ISDN TA Flash memory.

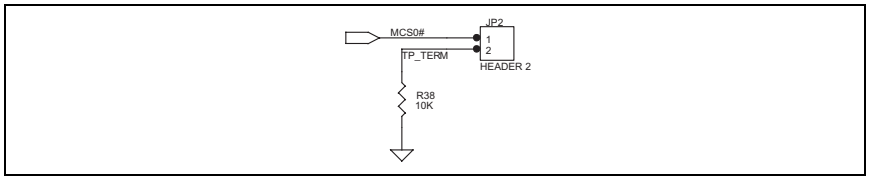


Figure 2-11. Flash Memory Jumper for x8 Boot (JP2)

To boot from the TIP Flash memory, perform the following:

- Disconnect UCS from on board Flash memory (remove JP1).
- Route UCS to the TIP Flash memory (install UCS jumper on TIP).
- Boot in x8 mode (install JP2).

To boot from on-board Flash memory, perform the following:

- Route UCS to the on board Flash memory (install JP1).
- Boot in x16 mode (remove JP2).

A corrupted Flash memory on the main board can be restored by booting from the TIP board, entering the Z command, changing the jumpers to the settings for booting from the main board, then following the prompts from the Z command.

ISDN TA Pin Usage

Table 2-3 shows the Am186CC microcontroller multiplexed pin usage for the ISDN TA.

- [] indicates an alternate pin function.
- {} indicates a reset configuration (pinstrap).
- **boldface** denotes the pin function.

Table 2-3. Pin Usage for the ISDN TA

Pin Name	Usage
TMROUT1 **[PIO1]**	DCE serial port flow control for Plug and Play
ARDY **[PIO8]**	USB active LED
RTRA# **[PIO18]**	ISDN B1-Channel active LED
TMROUT0 **[PIO28]**	DCE serial port flow control for Plug and Play
PCS7# **[PIO31]**	Flash memory RY/BY
PCS6# **[PIO32]**	ISDN D-Channel active LED
SRDY **[PIO35]**	Flash memory A18
RTRB# **[PIO39]**	ISDN B2-Channel active LED
RXDC [RXDC] **[PIO42]**	USB detect
TXDC [TXDC] **[PIO43]**	USB VCC enable
INT0	TIP - Ethernet IRQ
INT1	ISDN S/T transceiver interrupt
INT2	ISDN U transceiver interrupt
INT7 [PIO7]	TIP - serial port 1 interrupt
INT8 [PWD] [PIO6]	TIP - serial port 0 interrupt
UCS# [ONCE#]	Flash memory CE#
LCS# **[RAS0#]**	DRAM RAS#

Table 2-3. Pin Usage for the ISDN TA (Continued)

Pin Name	Usage
MCS0# **{UCSX8#}** [PIO4]	x8 TIP boot
MCS1# **[CAS1#]**	DRAM LCAS#
MCS2# **[CAS0#]**	DRAM UCAS#
PCS1# {USBSEL1} [PIO14]	S/T-transceiver chip select
PCS3#	TIP
RXDA [DDA] **[RXDA]**	HDLC Channel A interface to ISDN components
TXDA [DUA] **[TXDA]**	HDLC Channel A interface to ISDN components
RCLKA [DCLA] **[CLKA]**	HDLC Channel A interface to ISDN components
TCLKA [FSCA] **[FSCA]**	HDLC Channel A interface to ISDN components
RXDHU [PIO16]	High-Speed UART receive data
TXDHU	High-Speed UART transmit data
CTSHU# [CTSD#] [TSCD#] [PIO46]	High-Speed UART clear to send
RTRHU# [RTRD#] [PIO47]	High-Speed UART ready to receive
SCLK [PIO11]	ISDN U transceiver synchronous serial interface
SDATA [PIO12]	ISDN U transceiver synchronous serial interface

RESCON Configuration

The RESCON register provides a way to make design-specific hardware configuration information available to software. The RESCON register is read from AD[0..15] during reset. Because the Am186CC communications controller has weak internal pulldowns, the default value is logic Low. Setting a bit requires a 10-kΩ pullup resistor. Figure 2-12 shows the RESCON register bits.

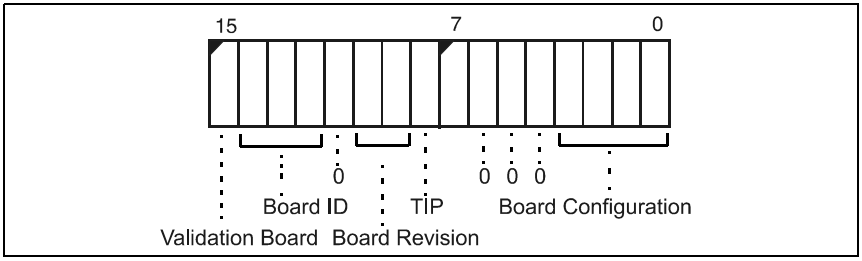


Figure 2-12. RESCON Register Bits

- Validation Board - Identifies if the board is a validation board.
- Board ID - Unique board identifier that is used to determine what features are available to the software.
- 0 - Bits are reserved for future use.
- Panic Bit - Used by software to boot in a safe mode (not currently supported).
- TIP - Identifies the TIP board as being present in the system.
- Board Configuration - Identifies particular population option for the board.

Figure 2-13 shows the schematic for the RESCON configuration. The Board ID for the ISDN TA is 0x100. The Board Configuration for the ISDN U interface population option is 0x0000. The S interface Board Configuration is 0x0001.

NOTE: The components designated with an asterisk (*) are not populated.

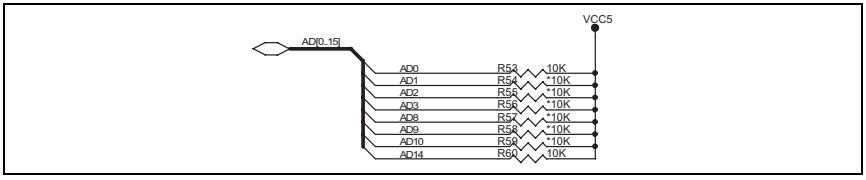


Figure 2-13. ISDN TA RESCON Configuration

Appendix A

Bill of Materials (BOM) and Schematics

The ISDN TA, S/T interface, reference design board bill of materials begins on page A-2.

The ISDN TA, U interface, reference design board bill of materials begins on page A-7.

The actual schematics used to build the Am186CC microcontroller ISDN TA reference design board can be found on the following pages:

Table A-1. ISDN TA S/T Interface Board BOM

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
1	1	CR1	LED SOT-23	Lumex SSL-LX15IGC-RP-TR	SOT-23
2	7	CR2,CR3,CR4,CR5, CR6,CR7,CR8	LED RT green	SLI 5608F5	TH-2
3	1	C1	3.3 µF	Tantalum, B CASE, 16V	B-CASE
4	8	C2,C14,C44,C45,C46 ,C47,C48, C49	1000 pF	± 10%, X7R, 16V	603
5	9	C3,C15,C35,C36, C37,C38,C39,C40, C41	0.01 µF	± 10%, X7R, 16V	603
6	26	C4,C5,C6,C7,C8,C9, C10,C11,C12,C13, C32,C33,C34,C42, C43,C50,C51,C52, C59,C61,C62,C63, C64,C65,C66,C67	0.1 µF	± 10%, X7R, 16V	603
7	4	C16,C17,C18,C19	0.33 µF	± 10%, X7R, 16V	805
8	2	C21,C20	27 pF[1]	± 10%, COG, 25V	603
9	1	C22	10 µF[1]	Tantalum, C CASE, 16V	C-CASE
10	2	C23,C24	0.1 µF[1]	± 10%, X7R, 16V	603
11	2	C25,C26	680 pF[1]	± 10%, X7R, 16V	603

Table A-1. ISDN TA S/T Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
12	1	C27	1.0 µF	Phillips 2222 370 75105	TH-2
13	1	C28	820 pF	± 5%, X7R, 16V	603
14	2	C29,C31	3300 pF	± 10%, X7R, 16V	603
15	1	C30	1.0 µF	Phillips 2222 373 41105, or Vitramon VJ9253Y105K XPM	TH-2
16	2	C54,C53	22 pF	± 10%, COG, 25V	603
17	3	C55,C56,C60	10 µF	Tantalum, C CASE, 16V	C-CASE
18	2	C57,C58	27 pF	± 10%, COG, 25V	603
19	4	C75,C76,C77, C78	1000 pF[1]	± 10%, X7R, 16V	603
20	2	D2,D1	Diode RB400D	ROHM RB400D	SOT-23
21	1	FB1	FB	MURATA BLM31P500SP B	1206
22	2	FB3,FB2	FB	MURATA BLM21A121SP B	805
23	1	F1	Fuse	Raychem TR600-150	TH-2

Table A-1. ISDN TA S/T Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
24	1	F2	750 mA	Raychem SMD075	SMT-2
25	1	JP1	Flash JP	AMP 103186-1	TH-2
26	1	JP2	Header 2	AMP 103186-1	TH-2
27	1	P1	RJ45A	AMP 555153-1	TH-12
28	1	P2	Connector DB9	AMP 787844-5	TH-11
29	1	P3	USB connector	AMP 787780-1	TH-4
30	1	P4	Barrel connector	KYCON KLD-0202-BC	TH-3
31	1	P5	COND60	AMP 104068-6	TH-2x30
32	2	Q1,Q2	TN0200T	Temic TN0200T	SOT-23
33	24	R1,R4,R5,R24,R33, R38,R45,R46,R47, R48,R49,R50,R60, R84,R87,R89,R91, R93,R94,R95,R97, R98,R99,R100	10K	± 5%, 1/10W	603
34	1	R6	0[1]	± 5%, 1/10W	603
35	2	R11,R8	100[1]	± 1%, 1/8W	805
36	1	R13	17.8K	± 1%, 1/8W	805
37	1	R14	10K	± 5%, 1/8W	805
38	2	R15,R19	1.1K	Dale WSC-2	SMT-2
39	2	R16,R18	137	± 1%, 1/8W	805

Table A-1. ISDN TA S/T Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
40	6	R17,R30,R32,R35, R36,R37	270	± 5%, 1/10W	603
41	1	R20	2.2M	± 5%, 1/8W	805
42	1	R21	21	± 1%, 1/4W	1206
43	2	R22,R23	16.9	± 1%, 1/4W	1206
44	2	R25,R26	680	± 5%, 1/10W	603
45	1	R27	1.5K	± 5%, 1/10W	603
46	5	R28,R29,R43,R44, R52	0	± 5%, 1/10W	603
47	2	R31,R107	100k	± 5%, 1/10W	603
48	1	R51	10	± 5%, 1/10W	603
49	7	R53,R54,R55,R56, R57,R58,R59	10K[1]	± 5%, 1/10W	603
50	29	R61,R62,R63,R64, R65,R66,R67,R68, R69,R70,R71,R72, R73,R74,R75,R76, R77,R78,R79,R80, R81,R82,R83,R85, R86,R88,R90,R92, R96	56	± 5%, 1/10W	603
51	6	R101,R102,R103, R104,R105,R106	100	± 5%, 1/10W	603
52	2	R110,R108	2K[1]	± 5%, 1/4W	1206
53	2	R109,R111	3.6K[1]	± 5%, 1/4W	1206
54	4	R112,R113,R114, R115	22.6[1]	± 1%, 1/2W	1210

Table A-1. ISDN TA S/T Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
55	1	SW1	SW SPDT C+K 7101	C&K 7101J1AV2BE2	TH-3
56	1	SW2	Reset switch	Alcoswitch FSM4J	TH-4
57	1	U1	Am186CC	AM186CC	PQFP-160
58	1	U2	V53C16258H SOJ	Mosel Vitelic V53C16258HK 40	SOJ-40
59	1	U3	Am29F400 TSOP	AM29F400BT-55EC	TSOP-48
60	1	U4	Am79C32A PLCC[1]	AM79C32AJC	PLCC-44
61	1	U5	S Transformer[1]	Pulse PE-65799	SMT-16
62	1	U6	PE65554[1]	Pulse PE65554	TH-8
63	1	U7	6N139	Siemens 6N139	DIP-8
64	1	U8	LH1465AB	Lucent LH1465AB	DIP-8
65	1	U9	T7237A PLCC	Lucent T7237A--ML-DT	PLCC-44
66	1	U10	UTransformer	Pulse T4008	TH-10
67	1	U11	SM6T6V8CA	SGS-Thomson SM6T6V8CA	SMB
68	1	U12	P2300SB	Teccor P2300SB,or SGS-Thomson SMP100-200	SMB

Table A-1. ISDN TA S/T Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
69	1	U13	SP211	Sipex SP211ECA	SSOP-28
70	1	U14	74ACT04	National 74ACT04SC	SOIC-14
71	1	U15	LDO 3.3	Micrel MIC5209-3.3BS	SOT-223
72	2	U16,U17	LC03-6[1]	Semtech LC03-6	SO-8
73	1	X1	12.228MHz[1]	Ecliptek EC1-12.228M-CL100	HC-49
74	1	X2	15.36011MHz	Saronix SRX5144	HC-49
75	1	X3	24.000 MHz	Ecliptek EC2-24.000M-CL100	HC-49

1. This part is not populated.

Table A-2. ISDN TA U Interface Board BOM

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
1	1	CR1	LED SOT-23	Lumex SSL-LX15IGC-RP-TR	SOT-23
2	7	CR2,CR3,CR4,CR5, CR6,CR7,CR8	LED RT green	SLI 5608F5	TH-2
3	1	C1	3.3 µF	Tantalum, B CASE, 16V	B-CASE

Table A-2. ISDN TA U Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
4	8	C2,C14,C44,C45, C46,C47,C48,C49	1000 pF	± 10%, X7R, 16V	603
5	9	C3,C15,C35,C36, C37,C38,C39,C40,C41	0.01 µF	± 10%, X7R, 16V	603
6	26	C4,C5,C6,C7,C8,C9, C10,C11,C12,C13, C32,C33,C34,C42, C43,C50,C51,C52, C59,C61,C62,C63, C64,C65,C66,C67	0.1 µF	± 10%, X7R, 16V	603
7	4	C16,C17,C18,C19	0.33 µF	± 10%, X7R, 16V	805
8	2	C21,C20	27 pF[1]	± 10%, COG, 25V	603
9	1	C22	10 µF[1]	Tantalum, C CASE, 16V	C-CASE
10	2	C23,C24	0.1 µF[1]	± 10%, X7R, 16V	603
11	2	C25,C26	680pF[1]	± 10%, X7R, 16V	603
12	1	C27	1.0 µF	Phillips 2222 370 75105	TH-2
13	1	C28	820 pF	± 5%, X7R, 16V	603
14	2	C29,C31	3300 pF	± 10%, X7R, 16V	603

Table A-2. ISDN TA U Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
15	1	C30	1.0 µF	Phillips 2222 373 41105,or Vitramon VJ9253Y105 KXPM	TH-2
16	2	C54,C53	22 pF	± 10%, COG, 25V	603
17	3	C55,C56,C60	10 µF	Tantalum, C CASE, 16V	C-CASE
18	2	C57,C58	27 pF	± 10%, COG, 25V	603
19	4	C75,C76,C77,C78	1000 pF[1]	± 10%, X7R, 16V	603
20	2	D2,D1	Diode RB400D	ROHM RB400D	SOT-23
21	1	FB1	FB	MURATA BLM31P500S PB	1206
22	2	FB3,FB2	FB	MURATA BLM21A121 SPB	805
23	1	F1	Fuse	Raychem TR600-150	TH-2
24	1	F2	750 mA	Raychem SMD075	SMT-2
25	1	JP1	Flash JP	AMP 103186-1	TH-2
26	1	JP2	Header 2	AMP 103186-1	TH-2

Table A-2. ISDN TA U Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
27	1	P1	RJ45A	AMP 555153-1	TH-12
28	1	P2	Connector DB9	AMP 787844-5	TH-11
29	1	P3	USB Conn.	AMP 787780-1	TH-4
30	1	P4	Barrel conn.	KYCON KLD-0202-BC	TH-3
31	1	P5	COND60	AMP 104068-6	TH-2x30
32	2	Q1,Q2	TN0200T	Temic TN0200T	SOT-23
33	24	R1,R4,R5,R24,R33, R38,R45,R46,R47, R48,R49,R50,R60, R84,R87,R89,R91, R93,R94,R95,R97, R98,R99,R100	10K	± 5%, 1/10W	603
34	1	R6	0[1]	± 5%, 1/10W	603
35	2	R11,R8	100[1]	± 1%, 1/8W	805
36	1	R13	17.8K	± 1%, 1/8W	805
37	1	R14	10K	± 5%, 1/8W	805
38	2	R15,R19	1.1K	Dale WSC-2	SMT-2
39	2	R16,R18	137	± 1%, 1/8W	805
40	6	R17,R30,R32,R35, R36,R37	270	± 5%, 1/10W	603

Table A-2. ISDN TA U Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
41	1	R20	2.2M	± 5%, 1/8W	805
42	1	R21	21	± 1%, 1/4W	1206
43	2	R22,R23	16.9	± 1%, 1/4W	1206
44	2	R25,R26	680	± 5%, 1/10W	603
45	1	R27	1.5K	± 5%, 1/10W	603
46	5	R28,R29,R43,R44, R52	0	± 5%, 1/10W	603
47	2	R31,R107	100k	± 5%, 1/10W	603
48	1	R51	10	± 5%, 1/10W	603
49	7	R53,R54,R55,R56, R57,R58,R59	10K[1]	± 5%, 1/10W	603
50	29	R61,R62,R63,R64, R65,R66,R67,R68, R69,R70,R71,R72, R73,R74,R75,R76, R77,R78,R79,R80, R81,R82,R83,R85, R86,R88,R90,R92, R96	56	± 5%, 1/10W	603
51	6	R101,R102,R103, R104,R105,R106	100	± 5%, 1/10W	603
52	2	R110,R108	2K[1]	± 5%, 1/4W	1206
53	2	R109,R111	3.6K[1]	± 5%, 1/4W	1206
54	4	R112,R113,R114, R115	22.6[1]	± 1%, 1/2W	1210

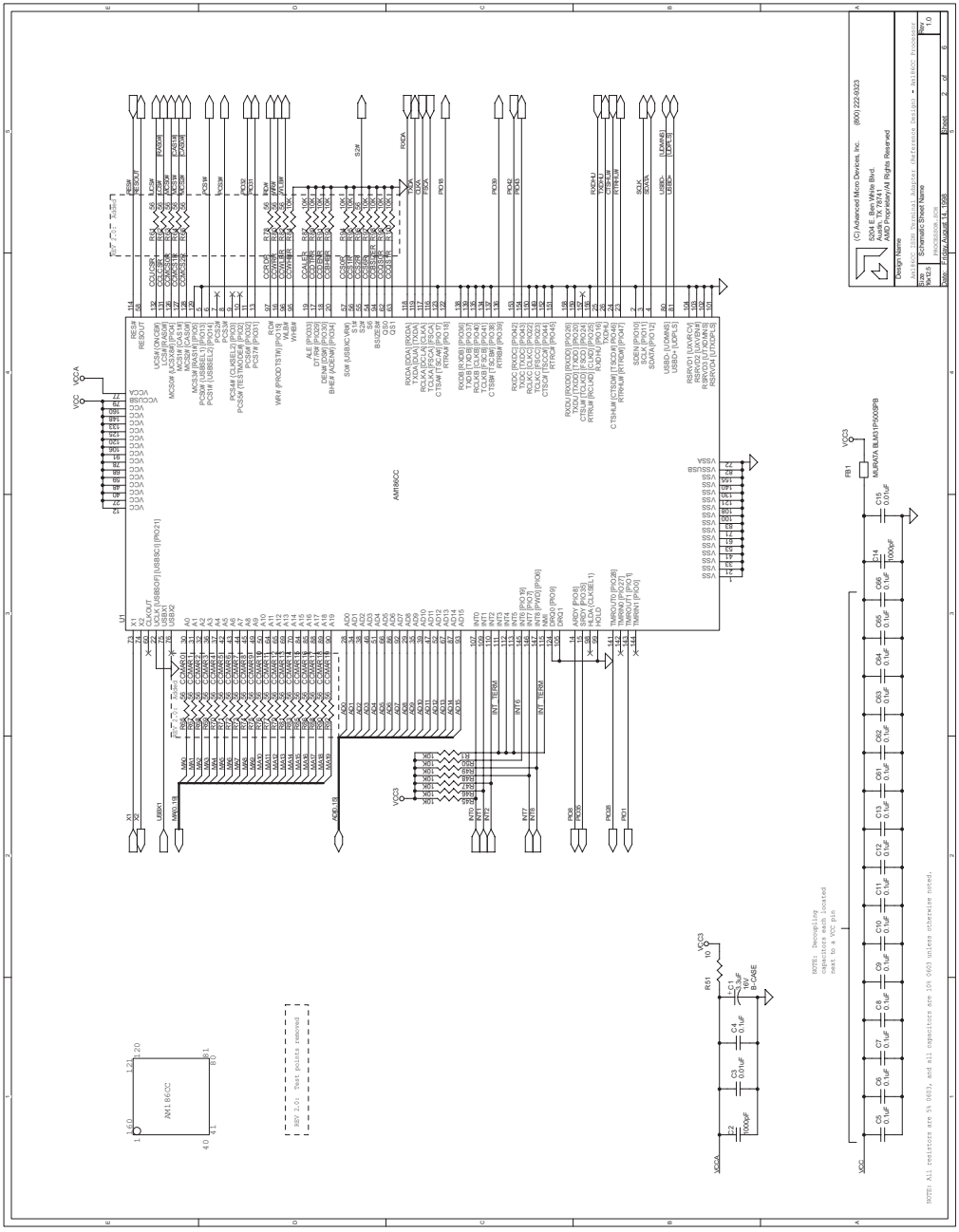
Table A-2. ISDN TA U Interface Board BOM (Continued)

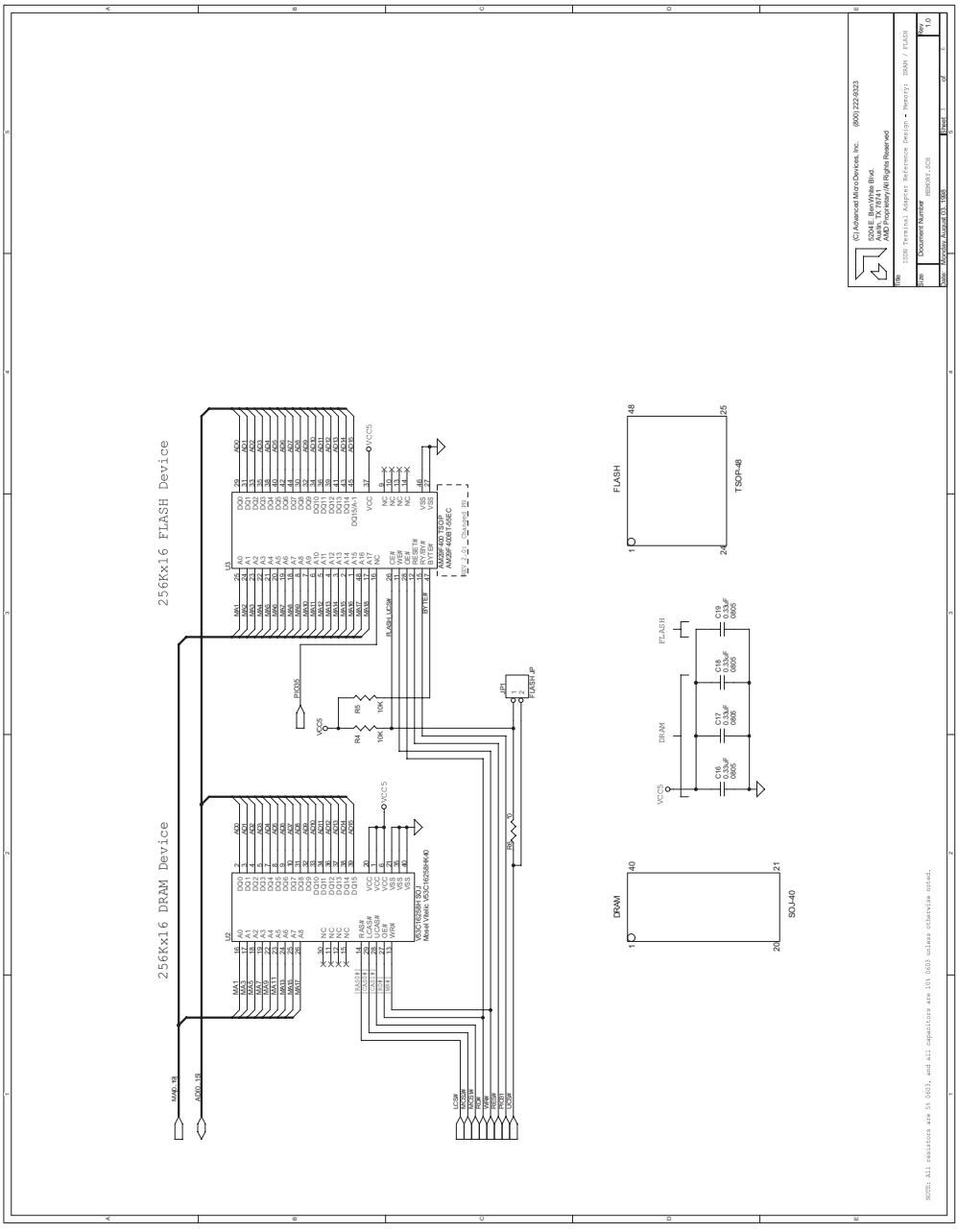
Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
55	1	SW1	SW SPDT C+K 7101	C&K 7101J1AV2B E2	TH-3
56	1	SW2	Reset Switch	Alcoswitch FSM4J	TH-4
57	1	U1	Am186CC	AM186CC	PQFP-160
58	1	U2	V53C16258H SOJ	Mosel Vitelic V53C16258H K40	SOJ-40
59	1	U3	Am29F400 TSOP	AM29F400B T-55EC	TSOP-48
60	1	U4	Am79C32A PLCC[1]	AM79C32AJ C	PLCC-44
61	1	U5	S Transformer[1]	Pulse PE-65799	SMT-16
62	1	U6	PE65554[1]	Pulse PE65554	TH-8
63	1	U7	6N139	Siemens 6N139	DIP-8
64	1	U8	LH1465AB	Lucent LH1465AB	DIP-8
65	1	U9	T7237A PLCC	Lucent T7237A- -ML-DT	PLCC-44
66	1	U10	U Transformer	Pulse T4008	TH-10
67	1	U11	SM6T6V8CA	SGS-Thomson SM6T6V8CA	SMB

Table A-2. ISDN TA U Interface Board BOM (Continued)

Item	Quantity	Reference	Part	Part Spec.	PCB Footprint
68	1	U12	P2300SB	Teccor P2300SB,or SGS-Thomson SMP100-200	SMB
69	1	U13	SP211	Sipex SP211ECA	SSOP-28
70	1	U14	74ACT04	National 74ACT04SC	SOIC-14
71	1	U15	LDO 3.3	Micrel MIC5209-3.3BS	SOT-223
72	2	U16,U17	LC03-6[1]	Semtech LC03-6	SO-8
73	1	X1	12.228MHz[1]	Ecliptek EC1-12.228M-CL100	HC-49
74	1	X2	15.36011MHz	Saronix SRX5144	HC-49
75	1	X3	24.000 MHz	Ecliptek EC2-24.000M-CL100	HC-49

1. This part is not populated.




256Kx16 DRAM Device
256Kx16 FLASH Device
MA0..18
A00..18
U2
U3
JP3
FLASH_JP
R3
10K
R4
10K
R5
0
P1035
VCC5
DRAM
FLASH
C16
0.1uF
0805
C17
0.1uF
0805
C18
0.1uF
0805
C19
0.1uF
0805
TSOP-48
SOJ-40
(C) Advanced Micro Devices, Inc. (800) 222-9323
Austin, TX 78741
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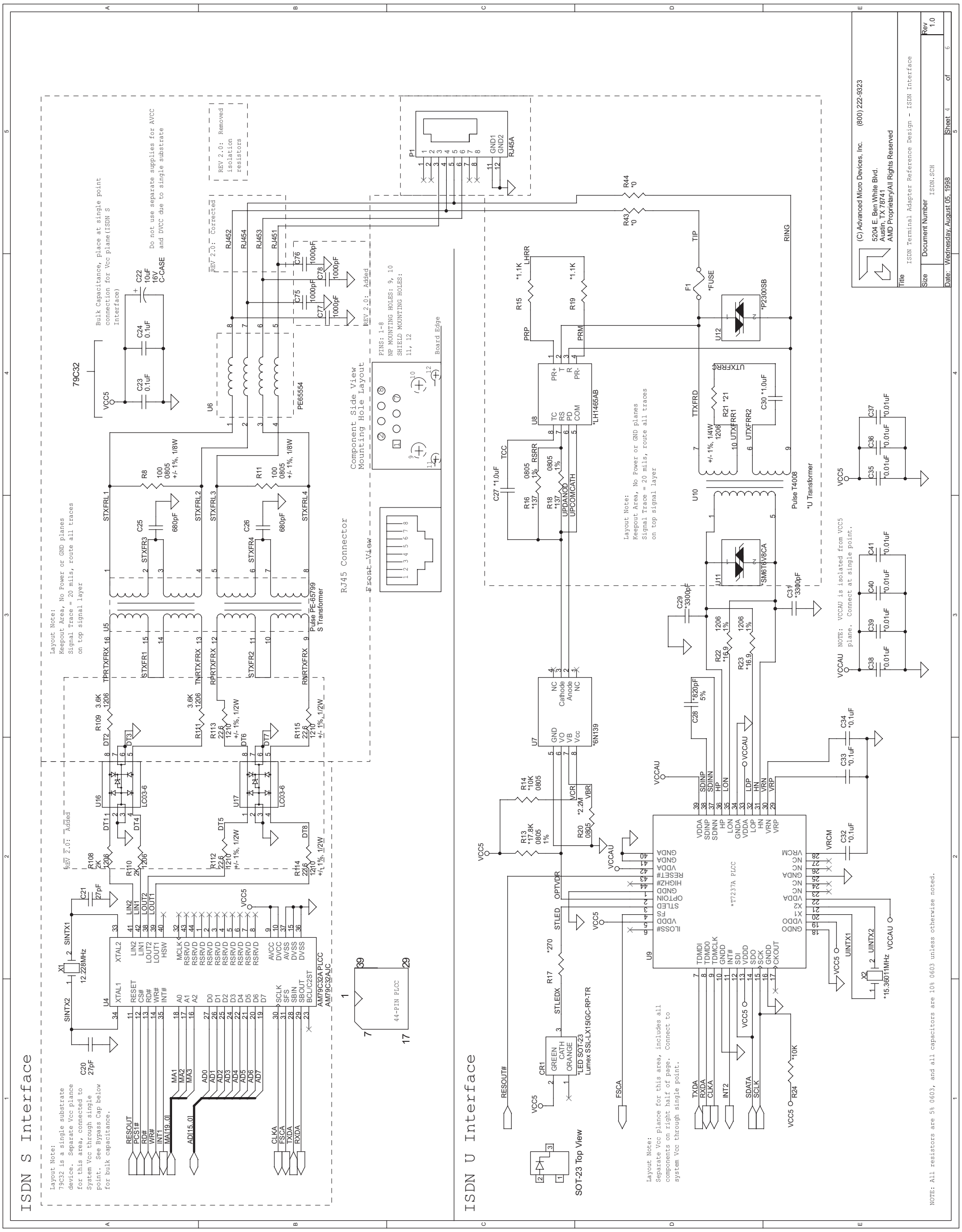
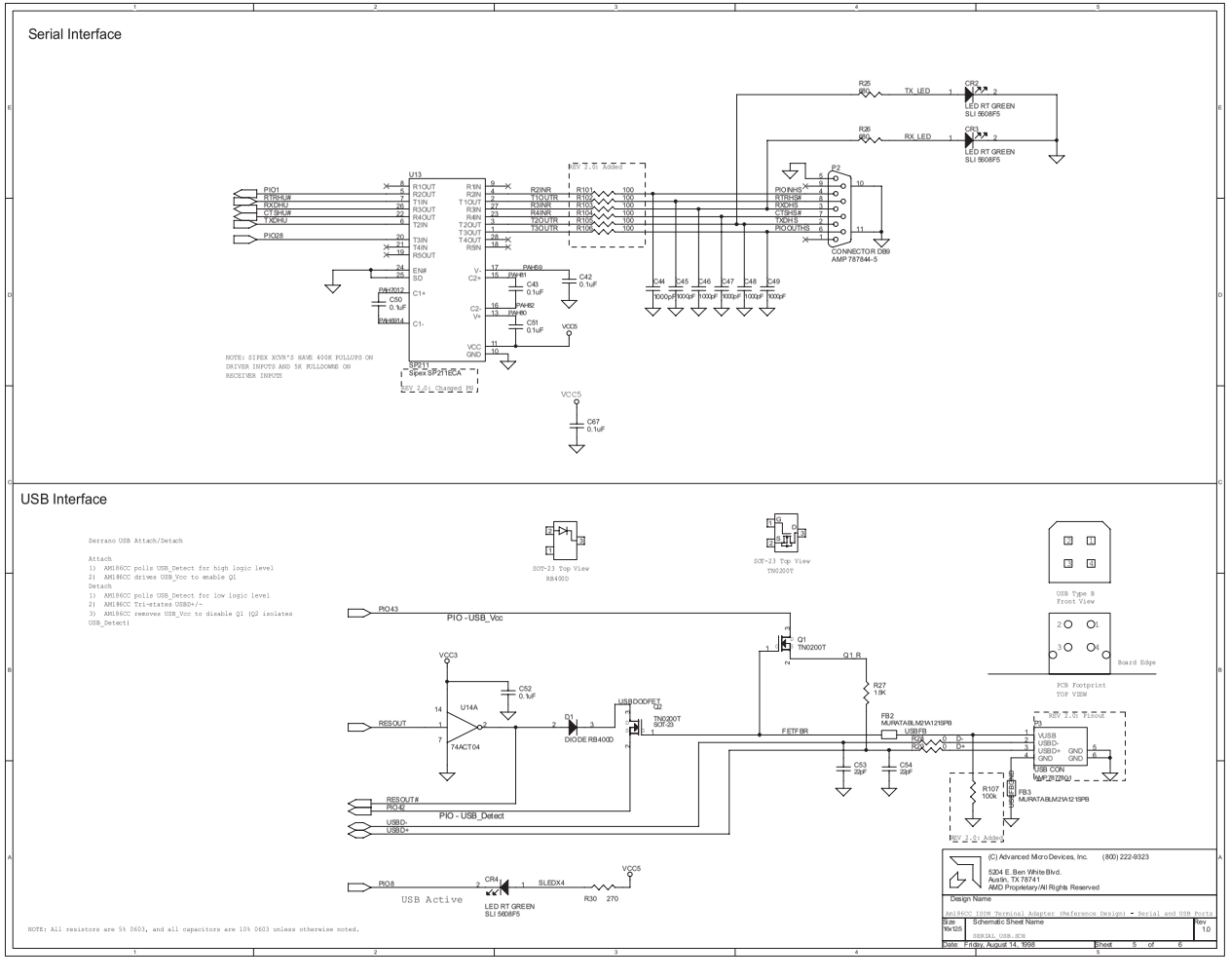
Document Number
Monday, August 09, 1993
NOTES: All resistors are 5% 0603, and all capacitors are 10% 0603 unless otherwise noted.


ISDN S Interface
ISDN U Interface
(C) Advanced Micro Devices, Inc. (800) 222-9323
5204 E. Ben White Blvd.
Austin, TX 78741
AMD Proprietary/All Rights Reserved
Title ISDN Terminal Adapter Reference Design - ISDN Interface
Size Document Number ISDN.SCH
Rev 1.0
Date Wednesday, August 05, 1998
Sheet 4 of 6
NOTE: All resistors are 5% 0603, and all capacitors are 10% 0603 unless otherwise noted.
RJ45 Connector
Component Side View
Mounting Hole Layout
Front View
SOT-23 Top View


Serial Interface
R25
TX_LED
CR2
LED RT GREEN
SLI 5608F5
R26
RX_LED
CR3
LED RT GREEN
SLI 5608F5
U13
PIO1
RTRHLW
RXDHU
CTSHUW
TXDHU
PIO28
R1OUT
R2OUT
T1IN
R3OUT
R4OUT
T2IN
T3IN
T4IN
R5OUT
ENW
SD
C1+
C1-
R1IN
R2IN
T1OUT
R3IN
R4IN
T2OUT
T3OUT
T4OUT
R5IN
V-
C2+
C2-
V+
VCC
GND
SP213
Sipex SP213ECA
R2INR
T1OUTR
R3INR
R4INR
T2OUTR
T3OUTR
R101
R102
R103
R104
R105
R106
100
P2
PIONHS
RTRHS#
RXDHS
CTSHS#
TXDHS
PIOUTHS
CONNECTOR DB9
AMP 787844-5
C43
0.1uF
C42
0.1uF
C50
0.1uF
C51
0.1uF
C44
C45
C46
C47
C48
C49
1000pF
VCC5
C67
0.1uF
NOTE: SIPEX XCVR'S HAVE 400K PULLUPS ON
DRIVER INPUTS AND 5K PULLDOWNS ON
RECEIVER INPUTS
USB Interface
Serrano USB Attach/Detach
Attach
1) AM186CC polls USB_Detect for high logic level
2) AM186CC drives USB_Vcc to enable Q1
Detach
1) AM186CC polls USB_Detect for low logic level
2) AM186CC Tri-states USBD+/-
3) AM186CC removes USB_Vcc to disable Q1 (Q2 isolates
USB_Detect)
SOT-23 Top View
RB400D
SOT-23 Top View
TN0200T
USB Type B
Front View
PCB Footprint
TOP VIEW
Board Edge
PIO43
PIO - USB_Vcc
Q1
TN0200T
Q1_R
VCC3
C52
0.1uF
U14A
74ACT04
RESOUT
USBDODFET
Q2
TN0200T
SOT-23
D1
DIODE RB400D
R27
1.5K
FB2
MURATA/BLM21A121SPB
USBFB
R24
R25
0
FETFBR
C53
22pF
C54
22pF
J3
VUSB
USBD-
USBD+
GND
USB CONN
AMP 2FC2B2Q
R107
100k
FB3
MURATA/BLM21A121SPB
RESOUT#
PIO42
PIO - USB_Detect
USBD-
USBD+
PIO8
USB Active
CR4
LED RT GREEN
SLI 5608F5
SLEDX4
R30
270
VCC5
(C) Advanced Micro Devices, Inc. (800) 222-9323
5204 E. Ben White Blvd.
Austin, TX 78741
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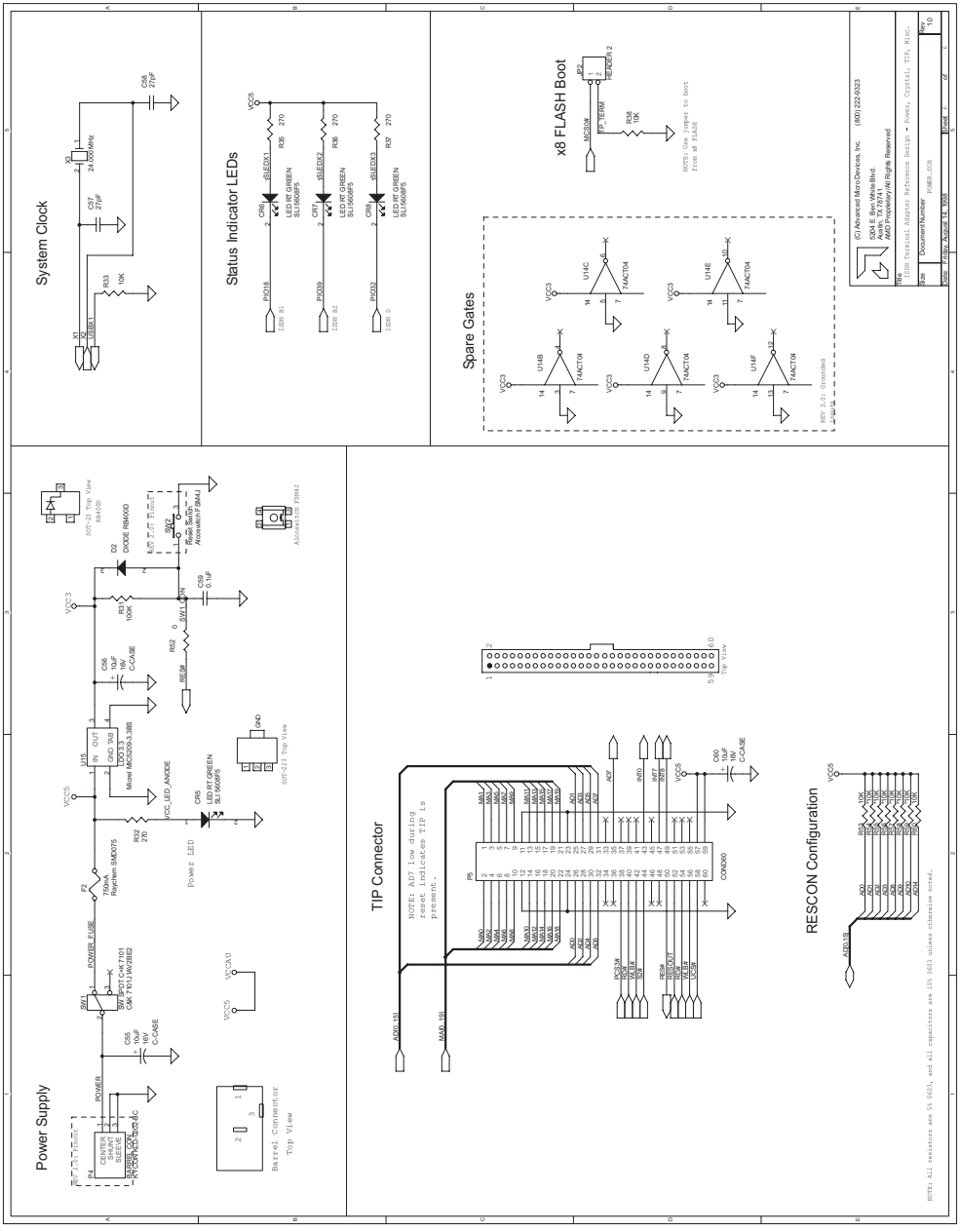
Design Name
Am186CC ISDN Terminal Adapter (Reference Design) - Serial and USB Ports
Size
16x325
Schematic Sheet Name
SERIAL_USB_ADB
Rev
1.0
Date: Friday, August 14, 1998
Sheet 5 of 6
NOTE: All resistors are 5% 0603, and all capacitors are 10% 0603 unless otherwise noted.


System Clock
Status Indicator LEDs
Spare Gates
x8 FLASH Boot
Power Supply
TIP Connector
RESCON Configuration
Power LED
Barrel Connector
Top View
NOTE: All resistors are 5% 0603, and all capacitors are 10% 0603 unless otherwise noted.
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ISDN Terminal Adapter Reference Design - Power, Crystal, TIP, Misc.
Document Number
Friday, August 13, 1999

Appendix B

Glossary of Terms

2B+D - Describes the BRI configuration for ISDN of two bearer channels and one D channel.

2B1Q - Two binary, one quaternary, data format for the U-interface. One quaternary symbol (±3, ±1) represents two bits.

B Channel - Bearer channel, 64kbps voice/data channel for ISDN.

bps - Bits per second.

BRI - Basic Rate Interface. The simple 2B+D access method defined by CCITT recommendation I.430.

CCITT/ITU - International Telegraph and Telephone Consultative Committee / International Telecommunications Union. ITU is an agency of the UN. CCITT is a committee of the ITU which makes recommendations for network communications.

C.O. - Central Office.

CPE - Customer Premises Equipment. Devices such as the NT1, designated to be the customer's responsibility to provide.

D Channel - 16kbps channel used to carry out-of-band network signaling or packet-mode user data. (Refer to the ITU standards found at www.itu.ch.)

FCC - Federal Communications Commission. Regulates the U.S. telephone industry.

GCI - General Circuit Interface.

HDLC - High-Level Data-Link Controller. ISO standard for layer-2 data bit-oriented communications protocol. HDLC is used for LAPB, LAPD, V.120 and SS7.

IDC - ISDN Data Controller. Performs D channel processing on the S/T reference point data.

IOM-2 - Industry standard serial bus developed by Siemens.

ISDN - Integrated Services Digital Network.

ISO - International Standardization Organization. Developed the OSI reference model and HDLC standards.

LAPB - Link Access Procedure Balanced. The X.25 data link layer protocol. X.25 is a special case of HDLC.

LAPD - Link Access Procedures on the D channel. ISDN data link layer protocol defined by CCITT. LAPD is a special case of HDLC

LE - Local Exchange. Class 5 C.O.

MPI - Microprocessor Interface.

NT1 - Network Termination Type 1. Termination device located on the customer premises that converts the two wire U-interface to a four wire S/T-interface.

NT2 - Network Termination Type 2. Termination device separating the S and T reference points used for customer-controlled communication distribution (such as PBX or LAN)

OSI - Open Systems Interconnection reference model. Seven layer architecture developed by ISO for open system communications.

PBX - Private Branch Exchange. Customer site switch, incorporating the use of an NT2 device.

PCM - Pulse Code Modulation.

PIO - Programmable Input/Output.

R -Interface - Reference point between non-ISDN devices and terminal adapters.

SBP - Serial Bus Port. The simple PCM highway used by the Am79C32A device.

SS7 - Signal System 7. High-speed, common channel interoffice signaling system necessary for ISDN implementation.

S/T-interface - The reference point comprising the 4 wire interface between the network termination device (NT1) and the terminal equipment (TE1) or terminal adapter (TA). If an NT2 is used for on-site switching, the S and T reference points are considered to be separated at the NT2 device. The T reference point is between the NT1 and NT2, and the S reference point is between the NT2 and the TE1 or TA.

TA - Terminal Adapter. Converts analog information from a TE2 device to digital format which can be used for ISDN.

TDM - Time Division Multiplexing.

TE - Terminal Equipment. Equipment that may be placed on ISDN (directly or indirectly).

TE1 - Terminal Equipment Type 1. ISDN compatible terminal equipment.

TE2 - Terminal Equipment Type 2. Non-ISDN compatible terminal equipment, which requires a terminal adapter.

U-interface - Reference point comprising the two-wire interface between the LE and NT device.

USB - Universal serial bus. Intel standard; used for PC-to-peripheral communication.

Index

Q

R

S

T

U

W