Data Sheet
February 1993

AT&T Microelectronics

AT&T V32*x*-V42D V.32bis/FAX/V.42bis DeskTop Complete Modem Chip Sets

Introduction

The AT&T DeskTop Complete Modem Chip Set enables the modem designer to build a high-speed, fully featured modem with minimal design effort. The DeskTop Modem Chip Set is an integrated, high-performance, low-cost, full-duplex (FDX) modem that operates over either the general switched telephone network (GSTN) or leased lines with the appropriate line terminations. The DeskTop modem is intended for high-performance/low-cost applications such as desktop external or internal modems.

The DeskTop Complete Modem Chip Set conforms to telecommunication specifications in CCITT recommendations V.32bis (V32FB-V42D only), V.32, V.22bis, V.22, V.21, V.23, and is compatible with Bell 212A and 103 modems. Data mode speeds of 14400, 12000, 9600, 7200, 4800, 2400, 1200, and 300 bits/s are supported. And, with data compression, throughput up to 57600 bits/s can be achieved. The Group 3 FAX modulations standards V.17 14400/12000/9600/7200 bits/s, V.29 9600/7200 bits/s, V.27ter 4800/2400 bits/s, and V.21 Channel 2 300 bits/s are also supported.

An industry-standard AT command set interpreter is included. The AT command set allows operation with popular communications software packages. The DeskTop Complete Modem Chip Sets also support the EIA/TIA-578 Class 1 or Class 2 (August 1990) FAX Interface. The DeskTop modem device set provides CCITT V.42 error-control and CCITT V.42bis data compression. In addition to the international standards, it also supports *MNP* classes 2, 3, and 4 error control and *MNP* 5 data compression.

The AT&T V32x-V42D device set consists of a ROM-coded DSP16A Digital Signal Processor, an interface device (V32-INTFC), an AT&T T7525 Linear Codec, a DeskTop modem controller (DMC), and a DMSCC protocol accelerator.

Features

- Data modes:
  - — CCITT V.32bis (V32FB-V42D only): 14,400 (TCM), 12,000 (TCM), 7200 (TCM)
  - — CCITT V.32: 9600 (TCM), 4800 (QAM)
  - — CCITT V.22bis: 2400 (QAM)
  - — CCITT V.22: 1200 (DPSK)
  - — CCITT V.21: 300 (FSK)
  - — CCITT V.23: 75/1200 (FSK)
  - — Bell 212A: 1200 (DPSK)
  - — Bell 103: 300 (FSK)
- FAX modes:
  - — CCITT V.17 (V32FB-V42D only): 14,400 (TCM), 12,000 (TCM), 9600 (TCM), 7200 (TCM)
  - — CCITT V.29: 9600 (QAM), 7200 (QAM)
  - — CCITT V.27ter: 4800 (DPSK), 2400 (DPSK)
  - — CCITT V.21 Channel 2: 300 (FSK)
- V.42 error correction (LAPM and *MNP*)
- V.42bis and *MNP* 5 data compression
- V.42bis data compression over *MNP*
- Extensive AT command set
- EIA/TIA 578 Class 1 or Class 2 (August 1990) FAX Interface
- Single 5 V supply

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User Information

Ordering Information

Part Number	Features
V32F-V42D-MMMME	V.32 plus 9600 FAX (Class 1 and 2), AT Command Set, *MNP* 4/5, V.42/V.42bis
V32FB-V42D-MMMME	V.32bis plus 14400 FAX (Class 1 and 2), AT Command Set, *MNP* 4/5, V.42/V.42bis

General Description

DeskTop Complete Modem Chip Set Power Dissipation

Device	Typical	Max	Units
DSP16A DSP	565	730	mW
V32-INTF Interface Device	260	385	mW
T7525 Codec	125	165	mW
DMC Controller	125	300	mW
DMSCC Protocol Accelerator	55	80	mW
Total:	1130	1660	mW

DSP16A Digital Signal Processor

A ROM-coded DSP16A Digital Signal Processor is packaged in an 84-pin PLCC and performs the signal processing and control functions needed to implement the CCITT signal modulations: V.32bis (V32FB-V42D only), V.32, V.22bis, V.22, V.21, V.23, and Bell 212A and 103. It also implements Group 3 FAX modulations: V.17 (V32FB-V42D only), V.29, V.27ter, and V.21 ch. 2.

T7525 Codec

The AT&T T7525 Linear Codec comes in a 28-pin SOJ package. It is the analog front end of the data pump and incorporates sigma-delta technology.

V.32 Interface Device

The V32-INTFC device is packaged in a 68-pin PLCC. It provides the V.24, microprocessor bus, eye pattern, and line interfaces. The V32-INTFC device also performs the clock generation.

DMC Controller

The DMC (DeskTop modem controller) is packaged in a 68-pin PLCC. The DMC connects to the AT&T V.32 data pump via dedicated lines and an external bus. The external bus also connects to an OEM-supplied 128 Kbytes of read-only memory and 32 Kbytes of RAM.

DMSCC Protocol Accelerator

The DMSCC protocol accelerator is packaged in a 44-pin PLCC. The DMSCC handles high-speed SDLC/HDLC transfers.

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User Information (continued)

DMC Firmware

The DMC firmware performs processing of general modem control, AT command set, error correction, data compression, host interface, and external memory interface functions. The firmware is provided by AT&T in object code for the OEM to program into 128 Kbytes of external ROM.

Serial Interface

The DeskTop modem provides a V.24 (RS-232-D) compatible serial interface to the DTE. The signals between the modem and computer are at CMOS logic levels. (See Figure 1, part A.)

Parallel Interface

The user provides a 16550-type UART for interface to a PC parallel bus. (See Figure 1, part B.)

Serial EEPROM

A 4K x 1-bit serial EEPROM may be used for nonvolatile storage.

Speaker Interface

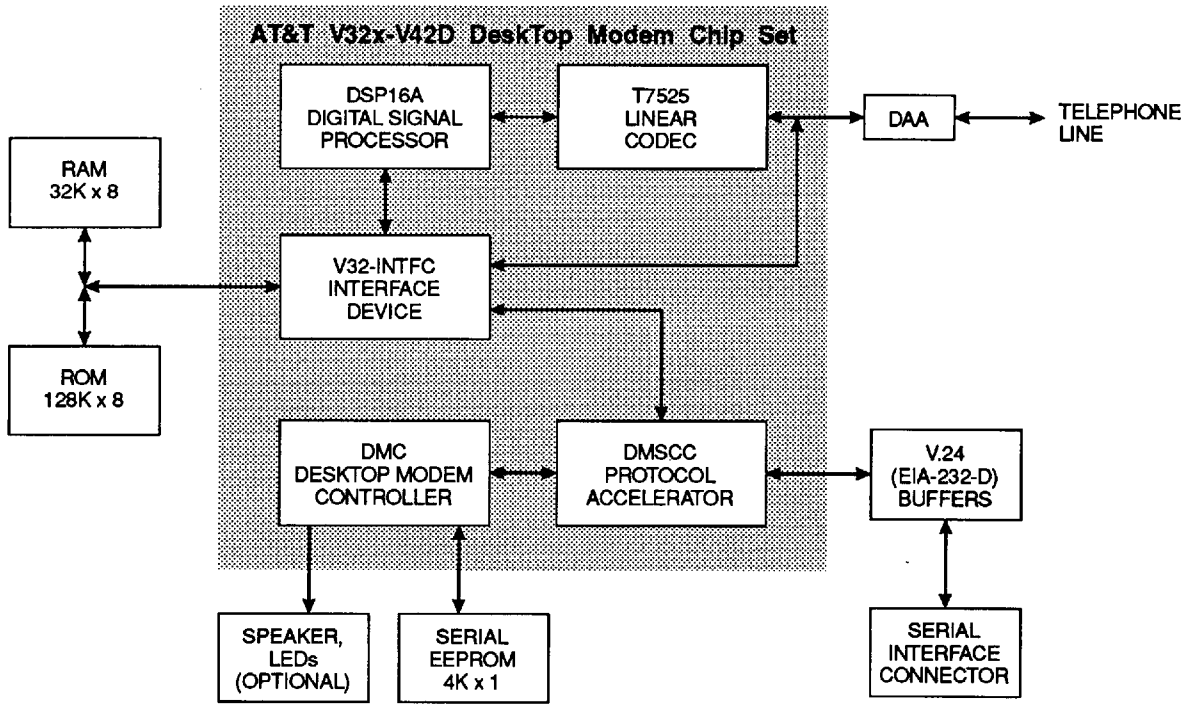
The DeskTop Complete Modem Chip Set supplies two speaker output signals: SPKRH and SPKRL. These signals control the speaker as follows:

Volume	SPKRH	SPKRL
Off	Low	Low
Low	Low	High
Medium	High	Low
High	High	High

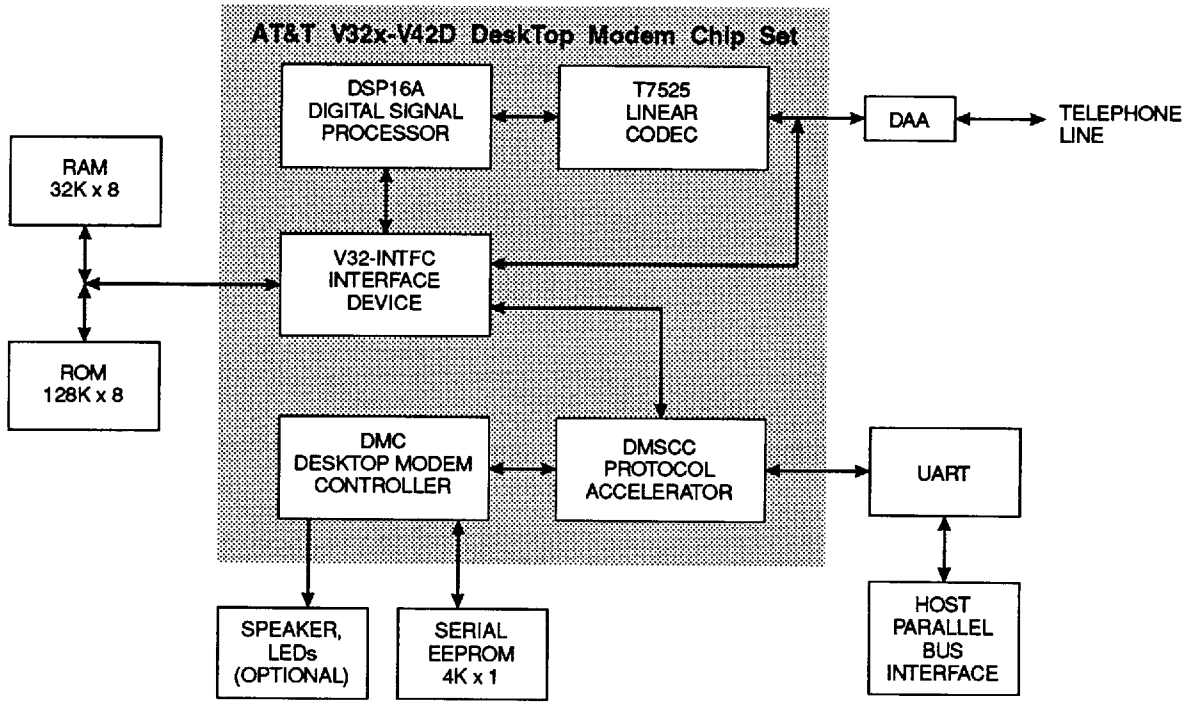
Environmental Requirements

Parameter	Value
Operating Temperature	0 °C to 70 °C
Storage Temperature	–25 °C to +70 °C

User Information (continued)



A. Serial Interface



B. Parallel Interface

Figure 1. AT&T DeskTop Complete Modem Block Diagram

User Information (continued)

AT Commands

A summary of the commands implemented by the modem are shown in Table 1. Commands may be executed when the modem is in COMMAND mode. COMMAND mode is entered upon one of the following conditions:

- After powerup.
- At the termination of a connection.
- After the execution of a command other than dial or answer commands.
- Upon the receipt of the ESCAPE SEQUENCE (three contiguous characters matching the contents of S register 2) while in on-line mode.
- Upon the on-to-off transition of DTR if &D1, &D2, or &D3 has been set.
- Upon the receipt of a break from the DTE if \K0, \K2, or \K4 has been set.

For a more detailed description of each command, see AT Command Set Reference on page 29.

User Information (continued)

Table 1. AT Command Set Summary (Data Mode)

Command	Description	Command	Description
A/	Repeat last command	&Rn	RTS/CTS option
A	Answer command	&Sn	DSR option
Bn	Communication standard	&Tn	Self-test commands
Cn	Carrier control option	&Un	Disable trellis coding
D	Dial command	&Vn	View active configuration/user profiles
En	Off-line echo command	&Wn	Store active configuration
Fn	On-line echo command	&Xn	Synch transmit clock source option
Hn	Switchhook control	&Yn	Select stored profile on powerup
In	ID/checksum option	&Zn=x	Store telephone number
Ln	Speaker volume	%An	Set autoreliable fall-back character
Mn	Speaker control	%Cn	Data compression
Nn	Select negotiate handshake	%En	Autoretrain
On	Go on-line	%Gn	Auto fallforward/fall-back enable
P	Enable pulse dialing	\An	Block size
Qn	Result code display option	\Bn	Transmit break
Sn	Select an S register	\Cn	Set autoreliable buffer
Sn=	Write to an S register	\Gn	Set modem port flow control
Sn?	Read an S register	\Jn	Bits/s rate adjust
T	Enable tone dialing	\Kn	Set break control
Vn	Result code form	\Nn	Set operating mode
Wn	Select extended result code	\O	Originate reliable link
Xn	Result code set/call progress	\Qn	Set serial port flow control
Yn	Long-space disconnect	\Tn	Set inactivity timer
Zn	Reset and recall stored profile	\U	Accept autoreliable link
&Bn	V.32 autoretrain	\Vn	Modify result code form
&Cn	DCD option	\Xn	Set XON/XOFF passthrough
&Dn	DTR option	\Y	Switch to reliable mode
&Gn	Guard tone option	\Z	Switch to normal mode
&Kn	Select flow control	–Cn	Set calling tone in data mode
&Ln	Dial up/leased line option	–Jn	Set V.42 detect phase
&Mn	Select communication mode	–V	Display version
&Pn	Dial pulse ratio	"Hn	V.42 bis compression control
&Qn	Communications mode option	"On	V.42 bis string length

Note: This table lists the AT commands available for data mode operation. For AT commands applicable to FAX operation, see Class 1 and Class 2 FAX Commands starting on page 36.

User Information (continued)

S Register Summary

Table 2 lists a summary of the modem registers. For a complete description of each register, refer to S Registers Reference on page 45.

Table 2. S Register Summary

Reg.	Default	Description
0	000	Ring to autoanswer on
1	000	Ring count
2	043	Escape character
3	013	Carriage return <CR> character code
4	010	Line feed <LF> character code
5	008	Back space <BS> character code
6	002	Wait before dialing
7	030	Wait for carrier
8	002	Pause time for command or dial modifier
9	006	Carrier recovery time
10	014	Lost carrier hang up delay
11	095	DTMF dialing speed
12	050	Guard time
14	AAH	Bit mapped options
16	00H	Modem test options
18	000	Modem test timer
21	30H	Bit mapped options
22	76H	Bit mapped options
23	0FH	Bit mapped options
25	005	Detect DTR change
26	001	RTS to CTS delay interval
27	40H	Bit mapped options
30	000	Inactivity timer value
37	000	Desired DCE speed
95	000	Extended result code bit map
108	001	Signal quality selector
109	062	V.32 bis carrier speed selector
110	002	V.32/V.32bis selector
112	000	DTE speed select during data transfer

User Information (continued)

Autobaud Operation

When the modem enters COMMAND mode, the autobaud operation is enabled. While autobaud is operating, the modem searches for the "A" or "a" which begins an "AT" command sequence. It determines the data rate from this character and tests the next character received to see if it is a "T" or "t". If the "AT" or "at" sequence is detected, parity and bit lengths are determined from the two, and the remainder of the command line is parsed after a carriage return is detected. If the command buffer overflows, or if a parity or framing error is detected, autobaud operation will resume.

The modem will autobaud to speeds of 300, 600, 1200, 2400, 4800, 7200, 9600, 14400, 19200, 38400, and 57600 bits/s. The following character formats are valid:

Data Bits	Parity	Stop Bits
7	N	2
7	O	1
7	E	1
8	N	1

Establishing Modem Connections

Connection Speeds

The supported data modem to modem connection modes/speeds and FAX modem to modem connection modes/speeds are listed in Table 3.

Table 3. Supported Data and FAX Modes

Data Modes	Data Rate (bits/s)
CCITT V.32bis (V32FB-V42L only)	14400
	12000
	7200
CCITT V.32	9600
	4800
CCITT V.22bis	2400
CCITT V.22	1200
CCITT V21	300
CCITT V.23	1200/75
Bell 212A	1200
Bell 103	300

FAX Modes	Data Rate (bits/s)
CCITT V.17 (V32FB-V42L only)	14400
	12000
	9600
	7200
CCITT V.29	9600
	7200
CCITT V.27ter	4800
	2400
CCITT V.21 ch 2	300

Dial Tone Detection

The detection frequency range is from 340 Hz to 640 Hz, and the detection level is greater than or equal to –43 dBm.

User Information (continued)

Blind Dialing

Blind dialing allows the modem to not detect dial tone prior to dialing. The modem can be configured to dial from 2 seconds to 255 seconds after going off-hook by changing the value in S register 6. The default time, as well as minimum time, is 2 seconds.

Pulse Dialing

The ATDP command designates that subsequent dialing operations will use pulse dialing. The modem pulse dials at a rate of 8—11 pulses/s. AT&P0 selects the default make/break ratio of 39% make to 61% break. AT&P1 selects an alternate ratio of 33% make to 67% break required in some countries.

DTMF Dialing

Table 4 lists the DTMF tone pairs used for tone dialing. All tones are generated within ±1.5%, conforming to Bell System Communications Technical Reference Publication 47001 dated August 1976.

Table 4. DTMF Tones

		High Frequency (Hz)			
		1209	1336	1477	1633
Low Frequency (Hz)	697	1	2	3	A
	770	4	5	6	B
	852	7	8	9	C
	941	*	0	#	D

Ring Detection

A ring signal between 15 Hz and 68 Hz will be detected.

Call Progress

Frequency:	340 Hz—640 Hz
Level:	On > –43 dBm
Busy Timing:	500 ms ± 10% (2 cycles) = Normal busy

Reference: Bell System Technical Reference PUB 61100.

Answer Tone Detection

The answer tone detection range for CCITT V.32bis, V.32, V.22bis, V.22, V.21, and V.23 is 2100 Hz ± 40 Hz. The detection range for Bell 212A and 103 is 2225 Hz ± 40 Hz. The detection level for both CCITT and Bell answer tones is greater than or equal to –43 dBm.

Billing Protection

The answering modem must remain silent for a period of time to allow the network administration to send billing information between central offices. After going off-hook, the modem must wait at least 2 seconds before sending answer tone.

User Information (continued)

Automode

Automode from V.32bis to V.22bis is implemented according to V.32 annex A (11/22/90), and automode to V.21, Bell 103, and Bell 212A is implemented according to the EIA.TIA draft standard from subcommittee TR-30.1.

Modem Handshaking Protocol

The calling modem aborts the call if it does not detect carrier after the time period defined in S register 7. The default time is 30 seconds.

Phone Number Dialing

The modem can dial numbers entered in the command buffer or dial stored numbers. When the **D** is detected in the command, the following characters in the command buffer are treated as digits or dial modifiers. The dial digits are 0—9, A, B, C, D, #, and *.

Dial Modifiers

P	Pulse dial (default).
T	Tone dial.
,	Pause for number of seconds in S register 8.
!	Hook-flash (on-hook for 1/2 second).
@	Wait for at least 1 ring followed by 5 seconds of silence.
W	Wait for dial tone for number of seconds in S register 7.
;	Return to COMMAND mode after dialing.
S=n	Dial stored number in directory entry n.
R	Originate in answer mode (go to answer mode after dialing).

Stored Numbers

The **AT&Z*n*=*x*** command sets the contents of directory entry ***n***, which can be 0 through 3, to be the dial string ***x***. Up to 36 characters can be stored in a directory entry. The only dial modifier which cannot be stored is **S**.

Answering

The modem will answer an incoming call when the ring counter (S register 1) equals the ring to answer on (S register 0), unless S register 0 = 0 or unless DTR is required and is not true. The **AT&Dn** commands govern the use of DTR. **AT&D2** causes the modem to disable autoanswer on an on-to-off transition of DTR—and to re-enable autoanswer on an off-to-on transition of DTR. The other **AT&Dn** commands cause DTR to not affect the autoanswer function. The modem may also be caused to answer manually with the **ATA** command.

Stored Profiles

After the user has set up the modem for a particular configuration, that configuration may be stored as one of two user profiles which can be recalled at any time. The **AT&W*n*** command will store the current modem configuration as user profile ***n***, where n can be 0 or 1. Either profile can be recalled at any time with the **ATZ*n*** command. Likewise, either profile can be designated to be the default configuration at powerup with the **AT&Y*n*** command. The **AT&V** command displays the active configuration and both stored profiles. The factory configuration can be made the active configuration with the **AT&F** command.

User Information (continued)

Data Mode

Flow Control

The modem provides the ability for the data terminal or computer port to pause the flow of data from the modem and for the modem to pause the flow of data from the data terminal or computer port. Flow control is required when a DTE cannot handle data as fast as it is received. Two types of flow control are provided: EIA flow control (RTS-CTS) and XON/XOFF flow control.

Escape Sequence Detection

S register 2 contains the decimal representation of the ASCII character used to enter COMMAND mode. The factory default is a decimal 043, the plus (+) character. A value of 128 or greater disables the escape function.

Break Detection

The modem detects a BREAK signal from either the DTE or the remote modem. The following table summarizes the modem's response to a received BREAK signal depending on the **AT\K** command. The default value is \K5.

(In connect state, if reliable mode or normal mode, then transmit break to remote)
- 0, 2, 4: Enter command state but do not send a break
- 1: Destructive/Expedited.
- 3: Nondestructive/Expedited.
- 5: Nondestructive/Nonexpedited.

(In command state and transmit break command issued, if reliable mode or normal mode, then transmit break to remote)
- 0, 1: Destructive/Expedited.
- 2, 3: Nondestructive/Expedited.
- 4, 5: Nondestructive/Nonexpedited.

(In connect state, if direct mode, then receive break at serial port)
- 0, 2, 4: Immediately send break and enter command state.
- 1, 3, 5: Immediately send break through.

(In connect state, if normal mode, receive break at modem port, send to serial port)
- 0, 1: Destructive/Expedited.
- 2, 3: Nondestructive/Expedited.
- 4, 5: Nondestructive/Nonexpedited.

Telephone Line Monitoring

Loss of Carrier

S register 10 specifies the amount of time (0 to 255 in 1 tenth of a second increments) needed to recognize the loss of carrier. The default is fourteen-tenths or 1.4 seconds.

Long-Space Disconnect

The **Y** command allows the user to control the operation of long-space disconnect. When enabled, the modem will terminate the connection if it receives a break 1.6 seconds in length, and will send a break four seconds in length prior to any controlled disconnect.

User Information (continued)

Error Control

At 1200 bits/s—14400 bits/s, the modem operates in full compliance with CCITT V.42, the international standard for point-to-point modem error control. Link access procedure for modems, more commonly referred to as LAPM, is the primary protocol, and annex A, the alternate protocol provides backward compatibility with *MNP* (Microcom Network Protocol) Classes 2 through 4. *MNP* and V.42 selections are performed via the \N commands. *MNP* or V.42 negotiation, if enabled, is automatic when a call is placed or received. The communicating modems will arrive at the highest class of *MNP* supported by both before data transmission begins.

Data Compression

The AT&T V32x-V42D supports CCITT V.42bis, the international standard for data compression which provides compression capabilities up to 4:1, for use by modems incorporating the V.42 LAPM error control standard. *MNP* Class 5 provides capabilities up to 2:1 compression. The "H3 command enables V.42bis data compression. The %C1 command enables *MNP* 5 data compression.

Programmable Inactivity Timer

The inactivity timer is the length of time the modem will wait before disconnecting when no data is sent or received. This timer is set using the \Tn command. It is programmable between 0 and 90 minutes. The default value is 0 (disabled).

Modem Testing

The following tests are available for testing the local modem and for testing of a remote modem.

Analog Loopback Tests

These tests verify the operation of a local modem without use of a telephone line or a remote modem.

Local Analog Loopback

These tests take characters from the local terminal and send them from the modem transmitter to the modem receiver, where they are echoed back to the terminal. The two tests are identical, except that AT&T1O tests the low-frequency channel of the modem and AT&T1A tests the high-frequency channel. Start the test with AT&T1O or AT&T1A. Type a few lines to test if the data echoes back correctly. Return to COMMAND mode via the escape sequence. Issue the AT&T0 command to stop the test.

Local Analog Loopback with Self-Test

Set the test timer to a number of seconds (1—255) to run the test. Start the test with AT&T8. The modem will generate a test message to its own receiver and verify its reception. At the end of the test, a number between 0 and 255 will be displayed indicating the numbers of errors during the test.

Digital Loopback Tests

These tests verify a local or remote modem's operation. By default, the modem will allow loopback tests ordered by a remote modem. This feature can be enabled and disabled by the user. The AT&T5 command will cause the modem to deny remote digital loopback (RDL) requests from the remote modem. The AT&T4 command will cause the modem to grant RDL requests from the remote modem.

Remote Digital Loopback (RDL)

This test commands the remote modem to send back all of the data it receives. Initiate a connection with the remote modem, and then enter COMMAND mode and issue the AT&T6 command. The data typed should echo back without error. Enter COMMAND mode and issue the AT&T0 command to end the test.

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User Information (continued)

Remote Digital Loopback with Self-Test

Set the test timer to a number of seconds (1—255) to run the test. Establish a connection with the remote modem and start the test with AT&T7. The local modem will generate a test message and send it to the remote modem. The remote modem will send back the data it receives. The local modem will verify its reception. At the end of the test, a number between 0 and 255 will be displayed indicating the numbers of errors during the test.

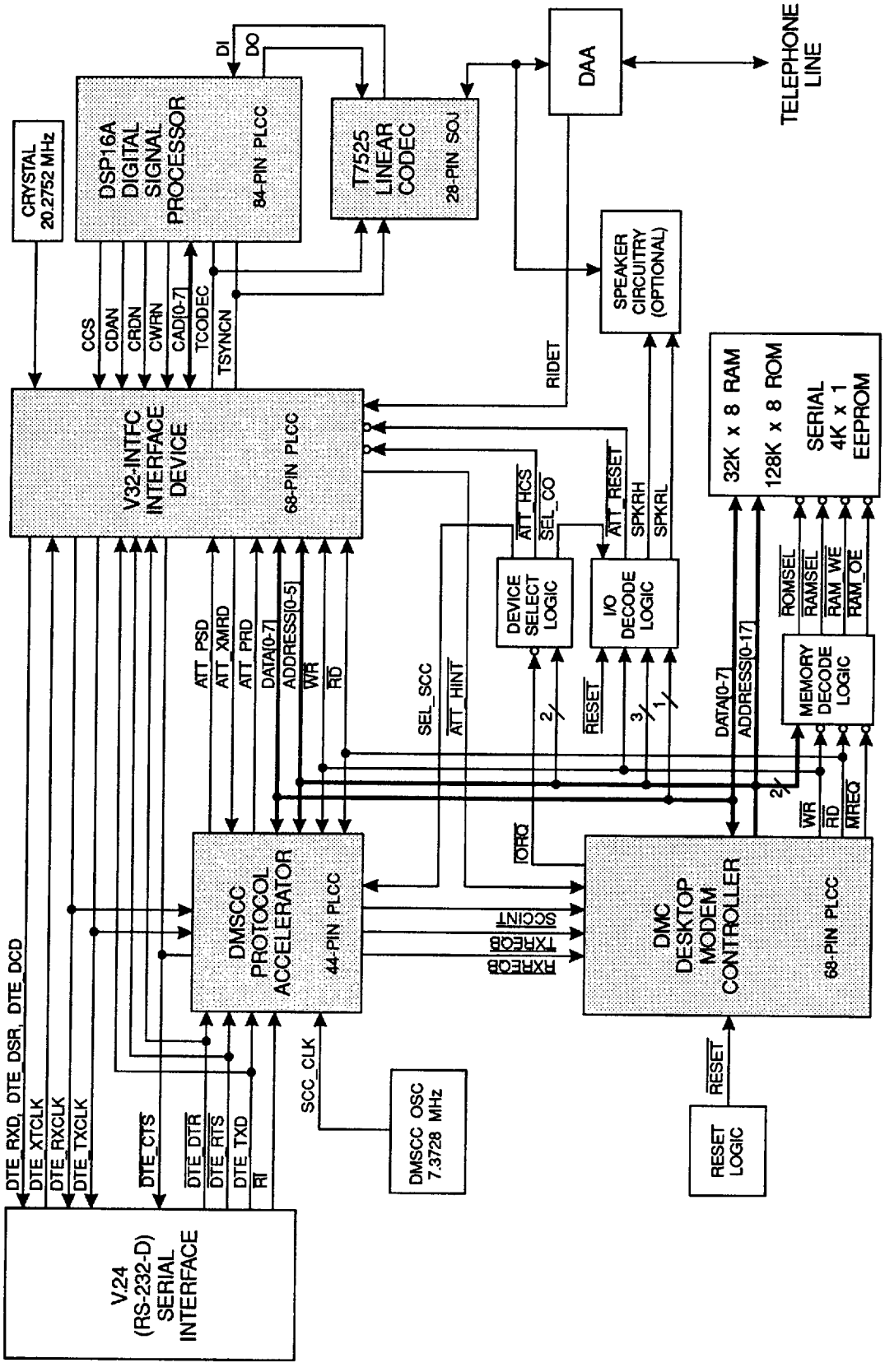
Local Digital Loopback

This test causes the local modem to send back everything it receives from the remote modem. Establish a connection with the remote modem, and then enter COMMAND mode and issue the AT&T3 command. The operator at the remote modem should type some data and verify that it echoes back properly. Enter COMMAND mode and issue AT&T0 to end the test.

Hardware Interface

The AT&T V32x-V42D hardware interface signals for the serial and parallel interfaces are shown in Figures 2 and 3.

Hardware Interface (continued)



Note: Shaded components are part of the AT&T DeskTop Complete Modem Chip Set. Unshaded blocks are purchased separately.

Figure 2. AT&T DeskTop Complete Modem Interface Signals — Serial Interface

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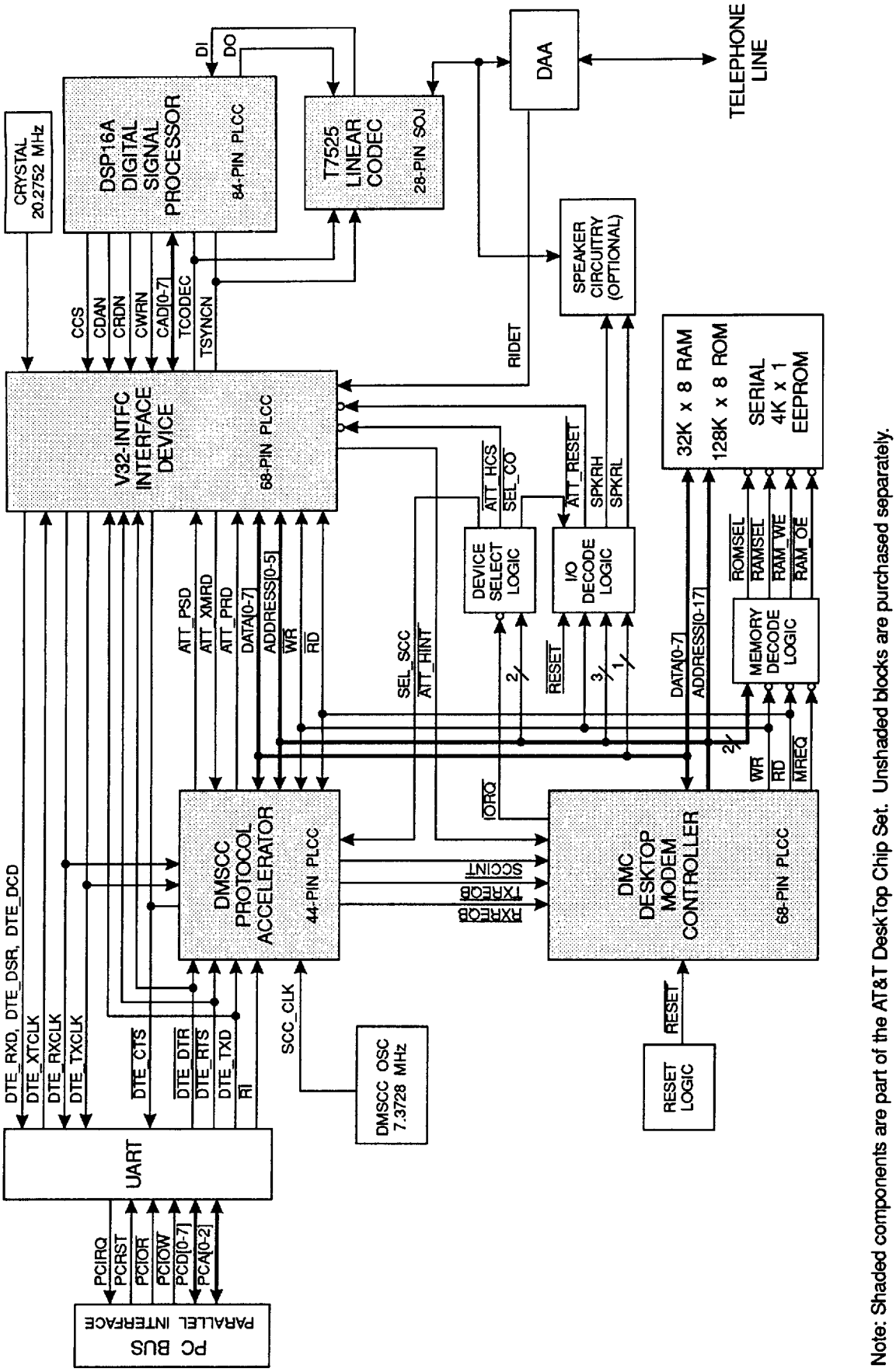
Hardware Interface (continued)



Note: Shaded components are part of the AT&T DeskTop Chip Set. Unshaded blocks are purchased separately.

Figure 3. AT&T DeskTop Complete Modem Interface Signals — Parallel Interface

Hardware Interface (continued)

Pin Information

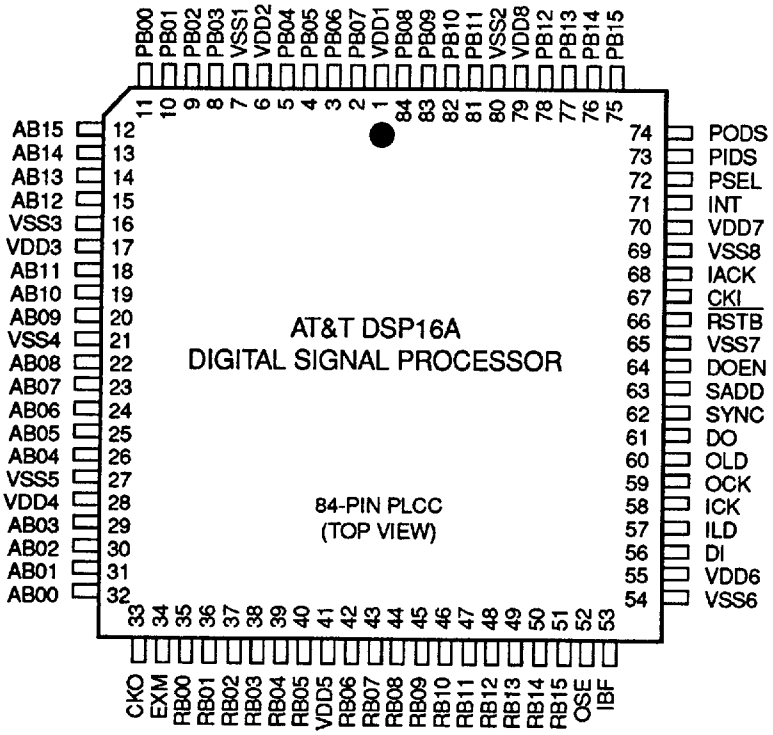


Figure 4. DSP16A Device Pin Locations

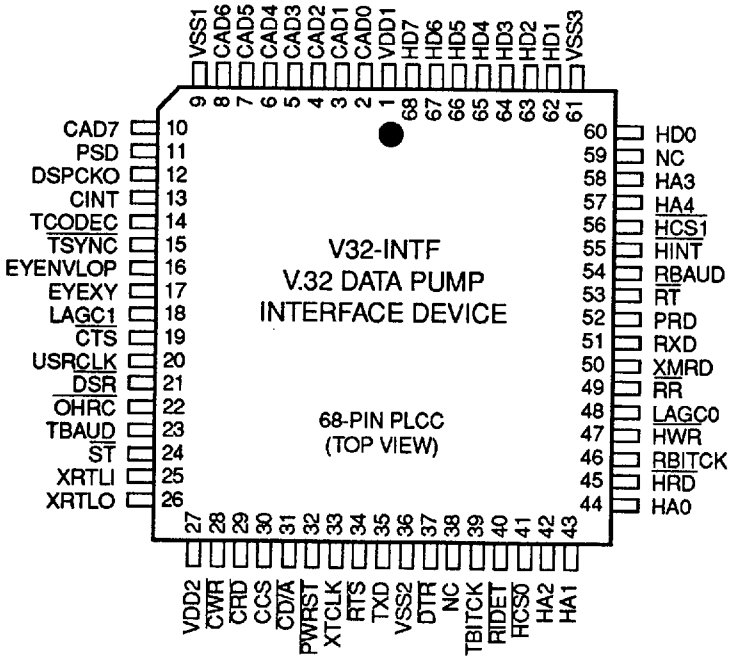


Figure 5. V32-INTF Device Pin Locations

Hardware Interface (continued)

Table 5. DSP16A Pin Signals

In the following table, I = input, O = output, and P = power.

Pin	Name	I/O	Pin	Name	I/O	Pin	Name	I/O
1	VDD1	P	29	AB03	O	57	ILD	I/O
2	PB07	I/O	30	AB02	O	58	ICK	I/O
3	PB06	I/O	31	AB01	O	59	OCK	I/O
4	PB05	I/O	32	AB00	O	60	OLD	I/O
5	PB04	I/O	33	CK0	O	61	DO	O
6	VDD2	P	34	EXM	I	62	SYNC	I/O
7	VSS1	P	35	RB00	I	63	SADD	I/O
8	PB03	I/O	36	RB01	I	64	DOEN	I/O
9	PB02	I/O	37	RB02	I	65	VSS7	P
10	PB01	I/O	38	RB03	I	66	$\overline{\text{RTSB}}$	I
11	PB00	I/O	39	RB04	I	67	CKI	I
12	AB15	O	40	RB05	I	68	IACK	O
13	AB14	O	41	VDD5	P	69	VSS8	P
14	AB13	O	42	RB06	I	70	VDD7	P
15	AB12	O	43	RB07	I	71	INT	I
16	VSS3	P	44	RB08	I	72	PSEL	O
17	VDD3	P	45	RB09	I	73	PIDS	I/O
18	AB11	O	46	RB10	I	74	PODS	I/O
19	AB10	O	47	RB11	I	75	PB15	I/O
20	AB09	O	48	RB12	I	76	PB14	I/O
21	VSS4	P	49	RB13	I	77	PB13	I/O
22	AB08	O	50	RB14	I	78	PB12	I/O
23	AB07	O	51	RB15	I	79	VDD8	P
24	AB06	O	52	OSE	O	80	VSS2	P
25	AB05	O	53	IBF	O	81	PB11	I/O
26	AB04	O	54	VSS6	P	82	PB10	I/O
27	VSS5	P	55	VDD6	P	83	PB09	I/O
28	VDD4	P	56	DI	I	84	PB08	I/O

Hardware Interface (continued)

Table 6. V.32 INTFC Pin Signals

In the following table, I = input, O = output, and P = power.

Pin	Name	I/O	Pin	Name	I/O	Pin	Name	I/O
1	VDD1	P	24	$\overline{ST}$	O	47	$\overline{HWR}$	I
2	CAD0	I/O	25	XRTLI	I	48	LAGCO	O
3	CAD1	I/O	26	XRTLO	O	49	$\overline{RR}$	O
4	CAD2	I/O	27	VDD2	P	50	XMRD	O
5	CAD3	I/O	28	$\overline{CWR}$	I	51	RXD	O
6	CAD4	I/O	29	$\overline{CRD}$	I	52	PRD	O
7	CAD5	I/O	30	$\overline{CCS}$	I	53	$\overline{RT}$	O
8	CAD6	I/O	31	$\overline{CD/A}$	I	54	RBAUD	O
9	VSS1	P	32	$\overline{PWRST}$	I	55	$\overline{HINT}$	O
10	CAD7	I/O	33	XTCLK	I	56	$\overline{HCS1}$	—
11	PSD	I	34	$\overline{RTS}$	I	57	HA4	I
12	DSPCK0	O	35	TXD	I	58	HA3	I
13	CINT	O	36	VSS2	P	59	NC	—
14	TCODEC	O	37	$\overline{DTR}$	I	60	HD0	I/O
15	$\overline{TSYNC}$	I/O	38	NC	—	61	VSS3	P
16	EYENVLOP	O	39	TBITCLK	O	62	HD1	I/O
17	EYEXY	O	40	$\overline{RIDET}$	I	63	HD2	I/O
18	LAGC1	O	41	$\overline{HCS0}$	I	64	HD3	I/O
19	$\overline{CTS}$	O	42	HA2	I	65	HD4	I/O
20	USRCLK	O	43	HA1	I	66	HD5	I/O
21	$\overline{DSR}$	O	44	HA0	I	67	HD6	I/O
22	$\overline{OHRC}$	O	45	$\overline{HRD}$	I	68	HD7	I/O
23	TBAUD	O	46	RBITCLK	O	—	—	—

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Hardware Interface (continued)

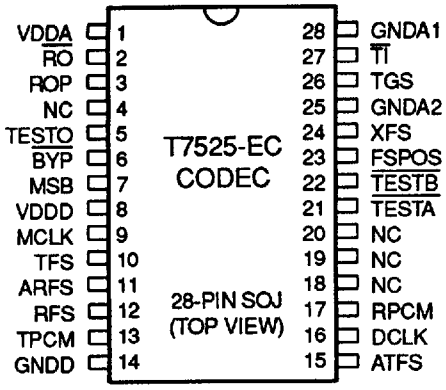

Figure 6. T7525 DevicePin Locations

Table 7. T7525 Codec Pin Signals

In the following table, I = input, O = output, and P = power.

Pin	Name	I/O	Pin	Name	I/O
1	VDDA	P	15	ATFS	I
2	$\overline{RO}$	O	16	DCLK	I
3	ROP	O	17	RPCM	I
4	NC	—	18	NC	—
5	TESTO	O	19	NC	—
6	$\overline{BYP}$	I	20	NC	—
7	MSB	I	21	$\overline{TSTA}$	I
8	VDDD	P	22	$\overline{TSTB}$	I
9	MCLK	I	23	FSPOS	I
10	TFS	I	24	XFS	O
11	ARFS	I	25	GNDA2	P
12	RFS	I	26	TGS	O
13	TPCM	O	27	$\overline{TI}$	I
14	GNDD	P	28	GNDA1	P

Note: NC = no connection; leave pin disconnected (open).

Hardware Interface (continued)

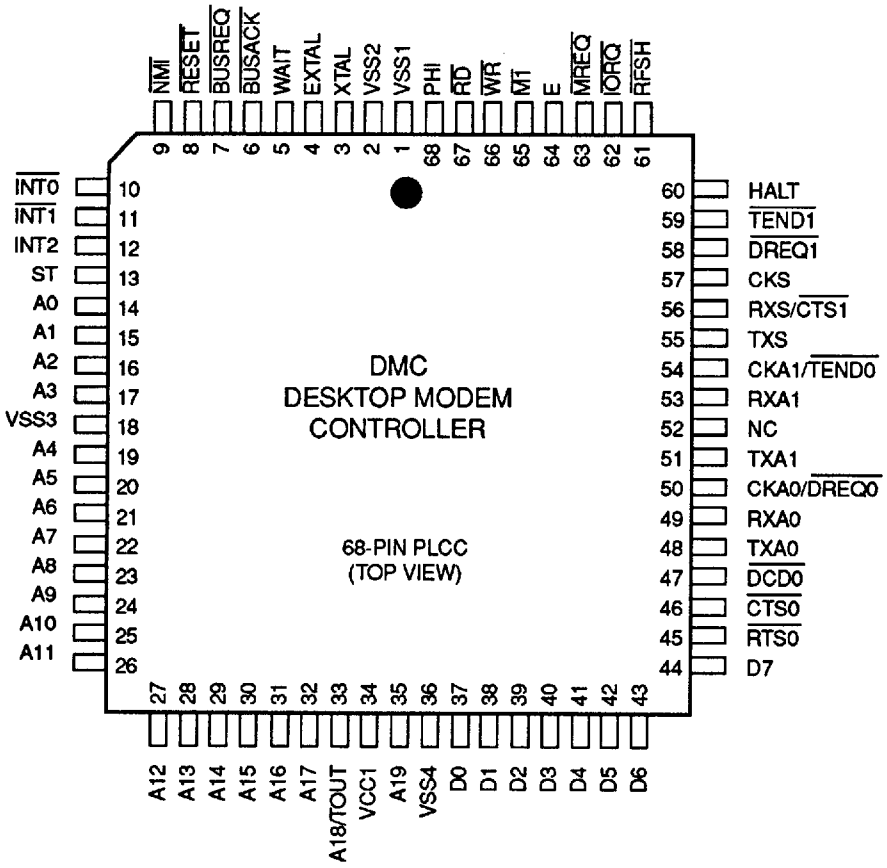

Figure 7. DMC Device Pin Locations

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Hardware Interface (continued)

Table 8. DMC Pin Signals

In the following table, I = input, O = output, and P = power.

Pin	Name	I/O	Pin	Name	I/O	Pin	Name	I/O
1	VSS1	P	24	A9	O	47	$\overline{\text{DCD0}}$	I
2	VSS2	P	25	A10	O	48	TXA0	O
3	XTAL	I	26	A11	O	49	RXA0	I
4	EXTAL	I	27	A12	O	50	CKA0/ $\overline{\text{DREQ0}}$	I
5	WAIT	I	28	A13	O	51	TXA1	O
6	$\overline{\text{BUSACK}}$	O	29	A14	O	52	NC	—
7	$\overline{\text{BUSREQ}}$	I	30	A15	O	53	RXA1	I
8	$\overline{\text{RESET}}$	I/O	31	A16	O	54	CKA1/ $\overline{\text{TEND0}}$	O
9	$\overline{\text{NMI}}$	I	32	A17	O	55	TXS	O
10	$\overline{\text{INT0}}$	I	33	A18/TOUT	O	56	RXS/ $\overline{\text{CTS1}}$	I
11	$\overline{\text{INT1}}$	I	34	VCC1	P	57	CKS	I/O
12	INT2	I	35	A19	O	58	$\overline{\text{DREQ1}}$	I
13	ST	O	36	VSS4	P	59	$\overline{\text{TEND1}}$	O
14	A0	O	37	D0	I/O	60	HALT	O
15	A1	O	38	D1	I/O	61	$\overline{\text{RFSH}}$	O
16	A2	O	39	D2	I/O	62	$\overline{\text{IORQ}}$	O
17	A3	O	40	D3	I/O	63	$\overline{\text{MREQ}}$	O
18	VSS3	O	41	D4	I/O	64	E	O
19	A4	O	42	D5	I/O	65	$\overline{\text{M1}}$	O
20	A5	O	43	D6	I/O	66	$\overline{\text{WR}}$	O
21	A6	O	44	D7	I/O	67	$\overline{\text{RD}}$	O
22	A7	O	45	$\overline{\text{RTS0}}$	O	68	PHI	I
23	A8	O	46	$\overline{\text{CTS0}}$	I	—	—	—

Hardware Interface (continued)

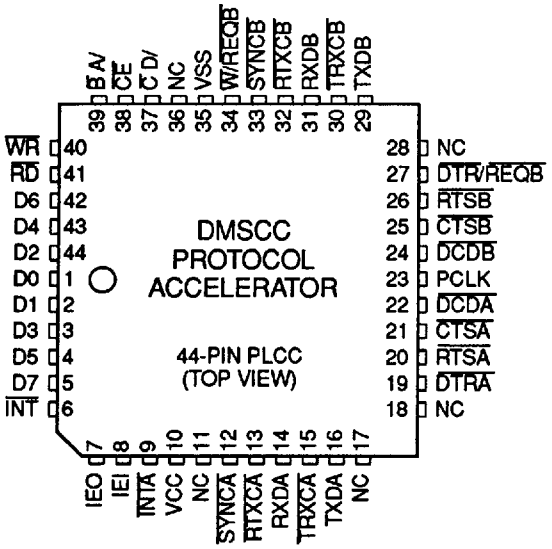

Figure 8. DMSCC Device Pin Locations

Table 9. DMSCC Protocol Accelerator Pin Signals

In the following table, I = input, O = output, and P = power.

Pin	Name	I/O	Pin	Name	I/O
1	D0	I/O	23	PCLK	I
2	D1	I/O	24	DCDB	I
3	D3	I/O	25	CTSB	I
4	D5	I/O	26	RTSB	O
5	D7	I/O	27	DTR/REQB	O
6	INT	O	28	NC	—
7	IEO	O	29	TXDB	O
8	IEI	I	30	TRXCB	I/O
9	INTA	I	31	RXDB	I
10	VCC	P	32	RTXCB	I
11	NC	—	33	SYNCB	I/O
12	SYNCA	I/O	34	W/REQB	O
13	RTXCA	I	35	VSS	P
14	RXDA	I	36	NC	—
15	TRXCA	I/O	37	C D/	I
16	TXDA	O	38	CE	I
17	NC	—	39	B A/	I
18	NC	—	40	WR	I
19	DTRA	O	41	RD	I
20	RTSA	O	42	D6	I/O
21	CTSA	I	43	D4	I/O
22	DCDA	I	44	D2	I/O

Hardware Interface (continued)

Hardware Interface Signals

Table 10. V.24/RS232D Interface Pins

Symbol	Type	Name/Description
$\overline{\text{DTE_RXD}}$	O	**Receive Data (Active-Low EIA).** This output is for digital data to the DTE that was received from the analog telephone line.
$\overline{\text{DTE_TXD}}$	I	**Transmitted Data (Active-Low EIA).** This input is for digital data from the DTE to be transmitted over the analog telephone line.
$\overline{\text{DTE_RTS}}$	I	**Request to Send (Active-Low EIA).** This input is generated by the DTE and represents request to send to the modem.
$\overline{\text{DTE_CTS}}$	O	**Clear to Send (Active-Low EIA).** This output to the DTE indicates the modem is clear to send data.
$\overline{\text{DTE_DTR}}$	I	**Data Terminal Ready (Active-Low EIA).** This input indicates to the modem that the DTE is ready.
$\overline{\text{DTE_XTCLK}}$	I	**External Clock.** This input is for the DTE supplying the external transmit data clock in synchronous mode.
DTE_RXCLK	O	**Receive Clock.** This output is the clock for RXD in synchronous mode.
DTE_TXCLK	O	**Transmit Clock.** This output is the clock for TXD in synchronous mode.
$\overline{\text{DTE_DSR}}$	O	**Data Set Ready (Active-Low EIA).** This output indicates to the DTE that the modem is ready.
$\overline{\text{DTE_DCD}}$	O	**Carrier Detect (Active-Low EIA).** This output indicates if the modem has detected carrier.
$\overline{\text{RI}}$	O	**Ring Detect (Active-Low EIA).** This output indicates the modem has detected a ring signal.

Table 11. Line Interface Pins

Symbol	Type	Name/Description
$\overline{\text{RO}}$	O	**Receive Output (Negative).** Inverting output of the power amplifier.
ROP	O	**Receive Output (Positive).** Noninverting output of the power amplifier.
TIN	I	**Transmit Input (Negative).** Inverting analog input to the input operational amplifier.
TGS	O	**Transmit Gain Setting.** Output terminal of the input operational amplifier; should be connected to external gain control network of resistors.

Table 12. Speaker Interface

Symbol	Type	Name/Description
SPKRH SPKRL	O O	**Speaker Volume Control.** SPKRH and SPKRL are outputs that control the speaker volume.

Level	SPKRH	SPKRL
Off	0	0
Low	0	1
Medium	1	0
High	1	1

Hardware Interface (continued)

Table 13. Memory Bus Interface Pins

Symbol	Type	Name/Description
A0—A17	I/O	**Address Bus Lines 0—17.** Address bus between DMC and memory.
D0—D7	I/O	**Data Bus Lines 0—7.** Data bus between DMC, memory, DMSCC protocol accelerator, and V32-INTFC interface device.
$\overline{\text{MREQ}}$	O	**Memory Request (Active-Low).** A low on this output selects the memory. Chip select decode circuitry selects RAM or ROM chip.
$\overline{\text{RD}}$	O	**Memory Read (Active-Low).** A low on this output enables data to be transferred from the address and data lines to the DMC.
$\overline{\text{WR}}$	O	**Memory Write (Active-Low).** A low on this output enables data to be transferred from the DMC to the address and data lines.

Table 14. Serial EEPROM Interface Pins

Symbol	Type	Name/Description
EE_SK	O	**Serial Data Clock.** This output is used to shift data to or from a serial EEPROM.
EE_CS	O	**EEPROM Chip Select.** A high on this output selects the EEPROM.
EE_DI	O	**Serial Data Output.** This serial output is used to write data to a serial 4K x 1 EEPROM.
EE_DO	I	**Serial Data Input.** This serial input is used to read data from a serial 4K x 1 EEPROM.

Table 15. Miscellaneous Pins

Symbol	Type	Name/Description
EXTAL XTAL	I O	**DMC Crystal Input.** The EXTAL pin must be connected to an external 20 MHz crystal and two 10 pF capacitors.
SEL_SCC	I	**DMSCC Clock.** SEL_SCC input is derived from a 7.3728 MHz crystal.
XRTLI	I	**Data Pump Oscillator Input.** This input requires a 40.5504 MHz crystal oscillator.
ATT_RESET	I	**Reset.** This input resets the AT&T chip set.

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Electrical Characteristics

The electrical characteristics in this data sheet are preliminary and are subject to change.

Electrical characteristics are presented here for the data pump (DSP16A, INTFC, and T7525), the DeskTop modem controller (DMC), and the protocol accelerator (DMSSC). Additional information regarding the DSP16A device and the T7525 Codec is available in their respective data sheets.

Data Pump Electrical Characteristics

These parameters are valid for the following conditions: T_A = 0 °C to 70 °C, V_{DD} = 5 V ± 5%, Vss = GND = GND_A = 0 V.

Parameter	Symbol	Min	Max	Unit
Input Voltage, CMOS inputs:				
Low	V_{IL}	—	0.75	V
High	V_{IH}	V_{DD} – 0.75	—	V
Input Voltage, Schmitt Trigger* (V32-INTFC pins: RDET, RTSN):				
Low	V_{ILC}	—	0.5	V
High	V_{IHC}	V_{DD} – 0.5	—	V
Output Low Voltage	V_{OL}	—	0.5	V
Output Low Current				
All pins except those noted below:	I_{OL}	3	—	mA
DSPCKO/POP1, PIP0/POP0, C16XCLK, TCODEC, TSYNCN:	I_{OL}	11	—	mA
OHRCN:	I_{OL}	18	—	mA
OHRCN (@ V_{OL} = 0.4 V):	I_{OLT}	24	—	mA
Output High Voltage	V_{OH}	V_{DD} – 0.5	—	V
Output High Current				
All pins except those noted below:	I_{OH}	—	–3	mA
DSPCKO/POP1, PIP0/POP0, C16XCLK, TCODEC, TSYNCN:	I_{OH}	—	–11	mA
OHRCN:	I_{OH}	—	–11	mA
OHRCN (@ V_{OH} = 2.4 V):	I_{OHT}	—	–24	mA
Input Leakage (No Pullup):				
Low (V_{IL} = 0.0 V)	I_{IL}	–5	—	µA
High (V_{IH} = V_{DDMAX})	I_{IH}	—	5	µA
Input Loading (50 KΩ Pullup):				
Low (V_{IL} = 0.0 V)	I_{LL}	–110	—	µA
High (V_{IH} = V_{DDMAX})	I_{LH}	—	5	µA
Output Hi-Z Current:				
Low (V_{OL} = 0.0V)	I_{OZL}	–10	—	µA
High ($V_{APPLIED}$ = V_{DDMAX})	I_{OZH}	—	10	µA
Input Capacitance	C_{IN}	—	6	pF
IOput Capacitance	C_{IO}	—	10	pF

* Schmitt Trigger has a maximum of 1.8 V hysteresis at 5 Volts.

Electrical Characteristics (continued)

Absolute Maximum Ratings

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

Voltage range on any pin with respect to ground ..... –0.3 V to Vcc + 0.3 V
Ambient temperature range ..... 0 °C to +70 °C
Storage temperature range ..... –65 °C to +150 °C

DMC Device Electrical Characteristics

These parameters are valid for the following conditions: T_A = 0 to 70 °C, V_{CC} = 5 V ± 5%, G_{NDA} = G_{NDD} = 0V.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage:						
Low (RESET/, EXTAL, NMI/)	V_{IL1}	—	–0.3	—	0.6	V
Low (all other pins)	V_{IL2}	—	–0.3	—	0.8	V
High (RESET/, EXTAL, NMI/)	V_{IH1}	—	V_{CC} – 0.6	—	V_{CC} + 0.3	V
High (all other pins)	V_{IH2}	—	2.0		V_{CC} + 0.3	V
Output Voltage:						
Low	V_{OL}	I_{OL} = +2.2 mA	—	—	0.45	V
High	V_{OH}	I_{OH} = –200 µA	2.4	—	—	V
		I_{OH} = –20 µA	V_{CC} – 1.2	—	—	V
Input Leakage Current (all inputs except XTAL, EXTAL)	I_{IL}	V_{IN} = 0.5 V_{CC} – 0.5	—	—	1.0	µA
3-state Leakage Current	I_{TL}	V_{IN} = 0.5 V_{CC} – 0.5	—	—	1.0	µA
Power Dissipation Normal*	I_{CC}	f = 10 MHz	—	25	60	mA
Power Dissipation STOP Mode			—	6.3	17.5	mA
Pin Capacitance	C_P	V_{IN} = 0 V f = 1 MHz, T_A = 25 °C	—	—	12	pF

*V_{IHn} = V_{CC} – 1.0 V, V_{ILmax} = 0.8 V (all output terminals are at no load).

Absolute Maximum Ratings

Vcc supply voltage range ..... –0.3 V to 7 V
Input voltage range ..... –0.3 V to Vcc + 0.3 V
Operating temperature range ..... 0 °C to 70 °C
Storage temperature range ..... –55 °C to +150 °C

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Electrical Characteristics (continued)

DMSCC Protocol Accelerator Electrical Characteristics

These parameters are valid for the following conditions: T_A = 0 °C to 70 °C, V_{CC} = 5 V ± 5%, GND_A = GND_D = 0 V.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage:						
Low	V_{IL}	—	–0.3	—	0.8	V
High	V_{IH}	—	2.2	—	V_{CC} + 0.3	V
Output Voltage:						
Low	V_{OL}	I_{OL} = +2.0 mA	—	—	0.4	V
High	V_{OH1}	I_{OH} = –1.6 mA	2.4	—	—	V
High	V_{OH2}	I_{OH} = –250 µA	V_{CC} – 0.8	—	—	V
Input Leakage	I_{IL}	0.4 V_{IN} + 2.4 V	—	—	±10.0	µA
Output Leakage	I_{OL}	0.4 V_{OUT} 4 V	—	—	±10.0	µA
V_{CC} Supply Current *	I_{CC1}	V_{CC} = 5 V; V_{IH} = 4.8; V_{IL} = 0 Crystal oscillators off	—	7	12 (at 10 MHz)	mA
Crystal OSC Current †	I_{CCOSC}	Current for each OSC in addition to I_{CC1}	—	4	—	mA

* Typical Icc was measured with oscillator off.
† No Icc (OSC) max is specified due to dependency on external circuit.

Absolute Maximum Ratings

V_{CC} supply voltage range ..... –0.3 V to +7 V
Voltages on all pin with respect to GND ..... –3 V to V_{CC} + 0.3 V
Storage temperature ..... –65 °C to +150 °C

AT Command Set Reference

In the following command descriptions, the default setting is shown in bold.

Command **Description**

A Answer command.

A/ Repeat last command (not preceded by AT).

Bn Communication standard option.
- 0: Selects CCITT V.22 mode when the modem is at 1200 bits/s, and CCITT V.21 when the modem is at 300 bits/s.
- **1: Selects Bell 212A when the modem is at 1200 bits/s, and Bell 103 when the modem is at 300 bits/s.**
- 2: Selects V.23 originate mode receive 1200 bits/s, transmit 75 bits/s; answer mode receive 75 bits/s, transmit 1200 bits/s. (S37 should be set to 5 to force V.23 mode.)
- 3: Selects V.23 originate mode receive 75 bits/s, transmit 1200 bits/s; answer mode receive 1200 bits/s, transmit 75 bits/s. (S37 should be set to 5 to force V.23 mode.)
- 15: Selects CCITT V.21 when the modem is at 300 bits/s.
- **16: Selects Bell 103 when the modem is at 300 bits/s.**
- **30: Selects V.22bis when the modem is at 2400 bits/s.**
- **41: Selects V.32 full duplex when the modem is at 4800 bits/s.**
- **52: Selects V.32bis full duplex when modem is at 7200 bits/s.**
- **60: Selects V.32 full duplex when the modem is at 9600 bits/s.**
- **70: Selects V.32bis full duplex when the modem is at 12000 bits/s.**
- **75: Selects V.32bis full duplex when the modem is at 14400 bits/s.**

Cn Carrier control option.
- 0: Transmit carrier always off (returns ERROR).
- **1: Normal transmit carrier switching.**

D Dial command.

Dial modifiers:

P	Pulse.
R	Originate call in answer mode.
S=n	n = 0—3. Dial stored telephone numbers.
T	Tone.
W	Wait for dial tone.
,	Pause.
!	Flash hook.
@	Wait for quiet answer.
;	Return to idle state.

En Off-line echo command.
- 0: Echo disabled.
- **1: Echo enabled.**

Fn On-line echo command.
- 0: Echo enabled (returns ERROR).
- **1: Echo disabled.**

Hn Switchhook control.
- 0: Go on-hook.
- 1: Go off-hook.

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Design Guide (continued)

In Identification/checksum option.
- 0: Report product code.
- 1: ROM checksum.
- 2: Verify ROM checksum.
- 3: Report ROM components.
- 4: Modem capabilities.

Ln Speaker volume.
- 0: Low speaker volume.
- 1: Low speaker volume.
- **2: Medium speaker volume.**
- 3: High speaker volume.

Mn Speaker control.
- 0: Speaker always off.
- **1: Speaker on until carrier present.**
- 2: Speaker always on.
- 3: Speaker off during dialing and on until carrier.

Nn Select negotiate handshake.
- 0: When originating or answering, handshake only at the communication standard specified by S register 37 and Bn.
- **1: When originating or answering, handshake only at the communication standard specified by S register 37 and Bn. During handshake, fall-back to a lower speed may occur.**

On Go on-line.
- 0: Returns modem to a previously established state.
- 1: Begins an equalizer retrain sequence, then returns to on-line state.
- 3: Issues rate renegotiation sequence, then returns to on-line state.

P Enable pulse dialing.

Qn Result code display option.
- **0: Result codes enabled.**
- 1: Result codes disabled.

Sn Selects an S register.
n = 0—112

Sn=x Write to an S register.
n = 0—112
x = 0—255

Sn? Read an S register.
n = 0—112

T Enable tone dialing.

Vn Result code form.
- 0: Numeric form.
- **1: Verbose form.**

Design Guide (continued)

Wn Select extended result code.
- **0: CONNECT result code reports DTE speed; if S register 95 = 0, disable all extended result codes.**
- 1: CONNECT result code reports DTE speed; if S register 95 = 0, enable the CARRIER and PROTOCOL extended result codes.
- 2: CONNECT result code reports DCE speed; if S register 95 = 0, disable all extended result codes.

Xn Result code set/call progress.
- 0: Result codes 0—4 enabled. Busy and dial tone detect disabled.
- 1: Result codes 0—5, 10 enabled. Busy and dial tone detect disabled.
- 2: Result codes 0—6, 10 enabled. Busy detect disabled and dial tone detect enabled.
- 3: Result codes 0—5, 7, 10 enabled. Busy detect enabled and dial tone detect disabled.
- **4: Result codes 0—7, 10 enabled. Busy and dial tone detect enabled.**

Yn Long-space disconnect.
- **0: Disable long-space disconnect**
- 1: Enable long-space disconnect.

Zn Recall stored profile.
- 0: Reset and recall user profile 0.
- 1: Reset and recall user profile 1.

&Bn V.32 autoretrain.
- 0: Hang up if bad line.
- **1: Retrain if bad line.**
- 2: Do not hang up and do not retrain (i.e., tolerate bad line).

&Cn Data carrier detect option.
(If &Q0 is selected)
- 0: State of carrier from remote modem is ignored. RLSD circuit is always on.
- **1: State of carrier from remote modem is tracked. RLSD circuit reflects the state of carrier.**

(If &Q1 is selected)
&Cn has no effect. RLSD shows current state of carrier.

&Dn Data terminal ready option.
- 0: Ignore DTR.
- 1: Go to COMMAND mode on on-to-off DTR transition.
- **2: Hang up and go to COMMAND mode on on-to-off DTR transition. Autoanswer is disabled if DTR is low.**
- 3: Reset on on-to-off DTR transition.

&F Load factory settings.

&Gn Guard tone option.
- **0: No guard tones.**
- 1: 550 Hz guard tone.
- 2: 1800 Hz guard tone.

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Design Guide (continued)

&Kn Set serial port flow control.
- 0: Disable flow control.
- 1: Reserved.
- 2: Reserved.
- **3: Enable bidirectional hardware flow control (RTS/CTS).**
- 4: Enable bidirectional XON/XOFF flow control.
- 5: Reserved.

&Ln Dial up/leased line option.
- **0: Dial Line.**
- 1: Leased Line.

&Mn Asynchronous mode.

	On-Line State	Idle State
0:	**Async**	**Normal**
1:	Sync	Normal
2:	Sync	Dial when DTR = 1
3:	Sync	Talk/Data, DTR = 0/1

&P Dial pulse ratio.
- **0: Make = 39%, Break = 61% for use in the United States.**
- 1: Make = 33%, Break = 67% for use in some other countries.

&Qn Communications mode option.

	On-Line State	Idle State
0:	**Async**	**Normal**
1:	Sync	Normal
2:	Sync	Dial when DTR = 1 Hang up when DTR = 0
3:	Sync	Talk/Data, DTR = 0/1

&Rn RTS/CTS option
- **0: CTS follows RTS (synchronous modes only).**
- 1: CTS always true.

&Sn Data set ready option.

(If &Q0 is selected)
- **0: DSR circuit always on.**
- 1: DSR circuit on during handshaking and off in test or idle mode; DSR is off when carrier is lost.

(If &Q1; &Q4 is selected)

DSR circuit on during handshaking and off in test or idle mode.

Design Guide (continued)

&Tn Self-test commands.
- 0: Terminate test.
- 1: Local analog loopback.
  - O: Low-frequency band.
  - A: High-frequency band.
- 3: Local activated remote digital loopback.
- 4: Grant request from remote for RDL.
- 5: Deny request from remote for RDL test.
- 6: Remote digital loopback test.
- 7: Remote digital loopback with self-test.
- 8: Local analog loopback with self-test.
  - O: Low-frequency band.
  - A: High-frequency band.

&Un Disable trellis coding.
- **0: Enable trellis coding.**
- 1: Disable trellis coding.

&Vn View active configuration and stored profile.
- 0: View stored profile 0.
- 1: View stored profile 1.

&Wn Store active profile.
- 0: Save active configuration as user profile 0.
- 1: Save active configuration as user profile 1.

&Xn Synch transmit clock source option.
- **0: The modem generates the transmit clock and applies it to pin 15 (RS232).**
- 1: The DTE generates the transmit clock on pin 24 (RS232) and applies it to pin 15 (RS232).
- 2: The modem derives the transmit clock from the receive carrier signal and applies it to pin 15 (RS232).

&Yn Select stored profile on powerup.
- **0: Recall user profile 0 on powerup.**
- 1: Recall user profile 1 on powerup.

&Zn=x Store telephone number (maximum 36 digits).
x = 0—9, A, B, C, D, #, *, T, P, R, W, @, comma, !, ;
n = 0—3

%An Set autoreliable fall-back character.
0—127 (ASCII character).
Default: 13

%Cn Data compression.
- 0: Disable *MNP* 5 compression.
- **1: Enable *MNP* 5 compression.**

%En Autoretrain (V.22bis and V.32 only).
- 0: DisableAuto-retrain.
- **1: Enable Autoretrain.**

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Design Guide (continued)

%Gn Auto fall-forward/fall-back enable (V.22bis and V.32 only).
- **0: Disabled.**
- 1: Enabled.

\An Block size.
- 0: Set maximum block size = 64 characters.
- 1: Set maximum block size = 128 characters.
- 2: Set maximum block size = 192 characters.
- **3: Set maximum block size = 256 characters.**

\Bn Transmit break.
n = 0—9: BREAK length in 100 ms.
Default: 0 (BREAK of 300 ms is transmitted).

\Cn Set autoreliable buffer
- **0: Does not buffer.**
- 1: Buffers data for 4 seconds, until 200 characters have been buffered, and then switches to normal mode and the buffered characters are passed to the serial port. If a SYN character is detected, reliable mode is attempted.
- 2: Does not buffer data. Switches to normal mode upon receipt of autoreliable character and passes it to serial port.

\Gn Set modem port flow control.
- **0: Disable port flow control.**
- 1: Enable port XON/XOFF flow control.

\Jn Bits/s rate adjust.
- **0: Disable port rate adjust. Serial port is independent of the connection.**
- 1: Enable port rate adjust. After a connection is made, the serial port adjusts to the rate of the connection.

\Kn Set break control.
Note: During a reliable connection, the sending modem's break control setting determines how the receiving modem handles a break.
(In connect state, if reliable mode or normal mode, then transmit break to remote)
- 0, 2, 4: Enter command state but do not send a break
- 1: Destructive/Expedited.
- 3: Nondestructive/Expedited.
- 5: Nondestructive/Nonexpedited.

(In command state and transmit break command issued, if reliable mode or normal mode, then transmit break to remote)
- 0, 1: Destructive/Expedited.
- 2, 3: Nondestructive/Expedited.
- 4, 5: Nondestructive/Nonexpedited.

(In connect state, if direct mode, then transmit break to remote)
- 0, 2, 4: Immediately send break and enter command state.
- 1, 3, 5: Immediately send break through.

(In connect state, if normal mode, receive break at modem port, send to serial port)
- 0, 1: Destructive/Expedited.
- 2, 3: Nondestructive/Expedited.
- 4, 5: Nondestructive/Nonexpedited.

Default: 5.

Design Guide (continued)

\Nn Set operating mode.
- 0: Normal mode.
- 1: Direct mode.
- 2: *MNP* reliable mode.
- **3: V.42 autoreliable mode.**
- 4: V.42 reliable mode.
- 5: LAPM to normal mode.

\O Originate reliable link.

\Qn Set serial port flow control.
- 0: Disable flow control.
- 1: Enable bidirectional XON/XOFF flow control.
- 2: Enable unidirectional hardware flow control.
- **3: Enable bidirectional hardware flow control (RTS/CTS).**

\Tn Set inactivity timer.
n = 0—90 Length in minutes.
Default: 0 minutes.

\U Accept autoreliable link.

\Vn Modify result code form.
- **0: Result codes based on Vn command.**
- 1: Append /ARQ to the verbose CONNECT result code when an error control connection is established.

\Xn Set XON/XOFF passthrough.
- **0: Process flow control characters.**
- 1: Process flow control characters and pass them through to the local or remote so they can process the characters.

\Y Switch to reliable mode.

\Z Switch to normal mode.

–Cn Set calling tone in data mode.
- **0: Disables calling tone.**
- 1: Enables calling tone.

–Jn Set V.42 detect phase.
- 0: Disables the V.42 detect phase.
- **1: Enables the V.42 detect phase.**

–V Display firmware version.

"Hn V.42bis compression control.
- 0: Disable V.42bis.
- 1: Enable V.42bis only when transmitting data.
- 2: Enable V.42bis only when receiving data.
- **3: Enable V.42bis for both directions.**

"On V.42bis string length.
n = 6—250 Number of characters.
Default: 32

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Design Guide (continued)

Class 1 and Class 2 FAX Commands

+FCLASS

Service class selection
Command syntax: +FCLASS=<value>

- 0: Data modem.
- 1: FAX Service Class I modem.
- 2: FAX Service Class II modem.

+FTS

Stop Transmission and Pause.
Command syntax: +FTS=<value>
value = 0—255 (10 ms intervals)

+FRS

Wait For Silence.
Command syntax: +FRS=<value>
value = 0—255 (10 msec intervals)

+FTM

FAX Data Transmit
Command syntax: +FTM=<value>

- 24: V.27ter 2400 bits/s.
- 48: V.27ter 4800 bits/s.
- 72: V.29 7200 bits/s.
- 73: V.17 7200 bits/s long train.
- 74: V.17 7200 bits/s short train.
- 96: V.29 9600 bits/s.
- 97: V.17 9600 bits/s long train.
- 98: V.17 9600 bits/s short train.
- 121: V.17 12000 bits/s long train.
- 122: V.17 12000 bits/s short train.
- 145: V.17 14400 bits/s long train.
- 146: V.17 14400 bits/s short train.

+FRM

FAX Data Receive.
Command syntax: +FRM=<value>

- 24: V.27ter 2400 bits/s.
- 48: V.27ter 4800 bits/s.
- 72: V.29 7200 bits/s.
- 73: V.17 7200 bits/s long train.
- 74: V.17 7200 bits/s short train.
- 96: V.29 9600 bits/s.
- 97: V.17 9600 bits/s long train.
- 98: V.17 9600 bits/s short train.
- 121: V.17 12000 bits/s long train.
- 122: V.17 12000 bits/s short train.
- 145: V.17 14400 bits/s long train.
- 146: V.17 14400 bits/s short train.

+FTH

FAX HDLC Frame Transmit.
Command syntax: +FTH=<value>

- 3: V.21 Channel 2 at 300 bits/s.

Design Guide (continued)

+FRH

FAX HDLC Frame Receive.
Command syntax: +FRH=<value>
3: V.21 Channel 2 at 300 bits/s.

+FCERROR

Reports Error — Used to indicate error condition.
Command syntax: +FCERROR
Numeric form: +F4

+FAA

FAX Autoanswer Enable.
Command syntax: +FAA=<value>
0: Answer as FAX modem of type specified by +FCLASS.
1: Automatically determine whether to answer as FAX or data modem.

+FAXERR

T.30 Session Error Report.
Command syntax: +FAXERR
Response syntax: +FAXERR=<value>

0—9 Call placement and termination.
- 0: Normal and proper end of connection.
- 1: Ring detected without successful handshake.
- 2: Call aborted, from +FK or <CAN>.
- 3: No loop current.

10—19 Transmit Phase A & misc errors.
- 10: Unspecified Phase A error.
- 11: No answer (T.30 T1 time-out).

20—39 Transmit Phase B hangup codes.
- 20: Unspecified transmit Phase B error.
- 21: Remote cannot receive or send.
- 22: COMREC error in transmit Phase B.
- 23: COMREC invalid command received.
- 24: RSPEC error.
- 25: DCS sent 3 times without response.
- 26: DIS/DTC received 3 times; DCE not recognized.
- 27: Failure to train at 2400 bits/s or +FMINSP value.
- 28: RSPREC invalid response received.

40—49 Transmit Phase C hangup codes.
- 40: Unspecified transmit Phase C error.
- 43: DTE to DCE data underflow.

50—69 Transmit Phase D hangup codes.
- 50: Unspecified transmit Phase D error.
- 51: RSPREC error.
- 52: No response to MPS repeated 3 times.
- 53: Invalid response to MPS.
- 54: No response to EOP repeated 3 times.
- 55: Invalid response to EOP.
- 56: No response to EOM repeated 3 times.
- 57: Invalid response to EOM.
- 58: Unable to continue after PIN or PIP.

(description continued on next page)

70—89 Receive Phase B hangup codes.
- 70: Unspecified receive Phase B error.
- 71: RSPREC error.
- 72: COMREC error.
- 73: T.30 T2 time-out, expected page not received.
- 74: T.30 T1 time-out after EOM received.

90—99 Receive Phase C hangup codes.
- 90: Unspecified receive Phase C error.
- 91: Missing EOL after 5 seconds.
- 92: *unused code.*
- 93: DCE to DTE buffer overflow.
- 94: Bad CRC or frame (ECM or BFT modes).

100—119 Receive Phase D hangup codes.
- 100: Unspecified receive Phase D error.
- 101: RSPREC invalid response received.
- 102: COMREC invalid response received.
- 103: Unable to continue after PIN or PIP.

120—255 Reserved codes.

+FBADLIN

Bad Line Threshold.
Command syntax: +FBADLIN=<value>
value = 0

+FBADMUL

Error Threshold Multiplier
Command syntax: +FBADMUL=<value>
Valid value = 0

+FBOR

Data Bit Order Selection.
Command syntax: +FBOR=<value>
- 0: Direct bit order for both Phase C data and for Phase B/D data.
- 1: Reversed bit order for Phase C data and direct bit order for Phase B/D data.
- 2: Direct bit order for Phase C data and reversed bit order for Phase B/D data.
- 3: Reversed bit order for both Phase C data and for Phase B/D data.

Note:

Direct bit order: First bit transferred of each byte on the DTE-DCE link is the first bit transferred in the PSTN data carrier.

Reversed bit order: Last bit transferred of each byte on the DTE-DCE link is the first bit transferred on the PSTN data carrier.

+FBUG

Session Message Reporting.
Command syntax: +FBUG=<value>
- **0: Disables HDLC frame reporting**
- 1: Enables the FAX code to report the contents of Phase B and Phase D HDLC frames to the DTE.

+FCQ

Copy Quality Checking.
Command syntax: +FCQ=<value>
- 0: Disables copy quality checking. The FAX code will generate Copy Quality OK (MCF) responses to complete pages and set +FPTS=1.

+FCR

Capability to Receive.
Command syntax: +FCR=<value>

0: Indicates the FAX code will not receive message data; the FAX code will not be able to poll a remote device.
1: Indicates the FAX code can receive message data.

+FCTCRTY

ECM Retry Count.
Command syntax: +FCTCRTY=<value>

0: Disable error correcting mode retries. Error correcting mode is not supported.

+FDCC

Fax Capability Parameters.
Command syntax: +FDCC=VR,RB,WD,LN,DF,EC,BF,ST
Valid values:

VR: Vertical resolution.
0: Normal, 98 lpi
1: Fine, 196 lpi

BR: Bit rate.
0: 2400 bits/s V.27ter
1: 4800 bits/s V.27ter
2: 7200 bits/s V.29 or V.17
3: 9600 bits/s V.29 or V.17
4: 12000 bits/s V.17
5: 14400 bits/s V.17

WD: Page width.
0: 1728 pixels in 215mm

LN: Page length.
0: A4, 297mm
2: Unlimited length

DF: Data compression format.
0: 1-D modified Huffman

EC: Error correction.
0: Disable ECM

BF: Binary file transfer.
0: Disable BFT

ST: Scan time/line.

	VR = normal	*VR = Fine*
0:	0 ms	0 ms
1:	5 ms	5 ms
2:	10 ms	5 ms
3:	10 ms	10 ms
4:	20 ms	10 ms
5:	20 ms	20 ms
6:	40 ms	20 ms
7:	40 ms	40 ms

Design Guide (continued)

+FDCS

Current Session Results.
Command syntax: +FDCS?
Response syntax: +FDCS=VR,BR,WD,LN,DF,EC,BF,ST
Valid values:

VR: Vertical resolution.
- 0: Normal, 98 lpi
- 1: Fine, 196 lpi

BR: Bit rate.
- 0: 2400 bits/s V.27ter
- 1: 4800 bits/s V.27ter
- 2: 7200 bits/s V.29 or V.17
- 3: 9600 bits/s V.29 or V.17
- 4: 12000 bits/s V.17
- 5: 14400 bits/s V.17

WD: Page width.
- 0: 1728 pixels in 215mm

LN: Page length.
- 0: A4, 297mm
- 2: Unlimited length

DF: Data compression format.
- 0: 1-D modified Huffman

EC: Error correction.
- 0: Disable ECM

BF: Binary file transfer.
- 0: Disable BFT

ST: Scan time/line.

	VR = normal	*VR = Fine*
0:	0 ms	0 ms
1:	5 ms	5 ms
2:	10 ms	5 ms
3:	10 ms	10 ms
4:	20 ms	10 ms
5:	20 ms	20 ms
6:	40 ms	20 ms
7:	40 ms	40 ms

The FAX code will return the negotiated T.30 parameters for the current session.

+FDFFC

Data Compression Format Conversion.
Command syntax: +FDFFC=<value>
- 0: Disable mismatch checking. The DTE must check the +FDCS:DF subparameter, and transfer matching data.

+FDR

Begin or Continue Phase C Receive Data.
Command syntax: +FDR

This command will initiate a transition to Phase C data reception. This will force a transition in the control software from command parsing to background processing.

+FDT

Begin Phase C Data Transmission.
Command syntax: +FDT[=DF,VR,WD,LN]

This command prefixes Phase C data transmission. This will force a transition in the control software from command parsing to background processing.

+FECM
Error Correction Mode Control.
Command syntax: +FECM=<value>
0: Error correcting mode disabled.

+FET
Transmit Page Punctuation.
Command syntax: +FET=<ppm>

0:	[PPS-]MPS	Another page next, same document.
1:	[PPS-]EOM	Another document next.
2:	[PPS-]EOP	No more pages or documents.
3:	PPS-NULL	Another partial page next.
4:	[PPS-]PRI-MPS	Another page, procedure interrupt.
5:	[PPS-]PRI-EOM	Another document, procedure interrupt.
6:	[PPS-]PRI-EOP	All done, procedure interrupt.
7:	CTC	Continue to correct.

This command is used to punctuate page and document transmission, after one or more +FDT commands.

+FK Session Termination.
Command syntax: +FK
This command causes the FAX software to terminate the session in an orderly manner.

+FLID
Local ID String
Command syntax: +FLID="<local ID string>"
Valid values: ASCII string can be up to 20 characters.
Response syntax: +FLID=?
Return value: (20),(32-127).

+FLNFC
Page Length Format Conversion
Command syntax: +FLNFC=<value>
0: Disables mismatch checking. The DTE must check the +FDCS:LN subparameter, and transfer matching data.

+FLPL
Indicate Document to Poll
Command syntax: +FLPL=<value>
0: Indicates that the DTE has no document to poll.

+FMDL
Request Model Identification.
Command syntax: +FMDL?
Response value: The information text cannot exceed 2048 characters.
This command causes the FAX software to send one or more lines of information text which is used to identify the product.

+FMFR
Manufacturer Identification.
Command syntax: +FMFR
Response value: The information text cannot exceed 2048 characters.
This command causes the FAX software to send one or more lines of information text which is used to identify the manufacturer.

+FREV

Request Product Revision Identification.
Command syntax: +FREV?
Response value: The information text cannot exceed 2048 characters.
This command causes the FAX software to send one or more lines of information text which is used to identify the version, revision level or data, or other pertinent information.

+FMINSP

Minimum Phase C Speed.
Command syntax: +FMINSP=<value>
0: 2400 bits/s V.27ter
1: 4800 bits/s V.27ter
2: 7200 bits/s V.29 or V.17
3: 9600 bits/s V.29 or V.17
4: 12000 bits/s V.17
5: 14400 bits/s V.17
This value determines the lowest negotiable speed for a session.

+FPHCTO

DTE Phase C Response Time-out.
Command syntax: +FPHCTO=<value>
value = 0—255 (100 ms units)
Default value: 30
This value determines how long the FAX code will wait for a command after reaching the end of data when transmitting in Phase C.

+FPTS

Page Transfer Status.
Command syntax: +FPTS=<ppr>
0: PPR Partial page errors.
1: MCF Page good.
2: RTN Page good; retrain requested.
3: RTP Page good; retrain requested.

+FRBC

Phase C Receive Data Block Size.
Command syntax: +FRBC=<value>
0: Stream mode, Phase C data is terminated by <DLE><ETX>.

+FREL

Phase C Received EOL Alignment.
Command syntax: +FREL=<value>
0: Indicates that EOL patterns are aligned as received.

+FSPL

Request to Poll.
Command syntax: +FSPL=<value>
0: Indicates that the DTE does not want to poll.

+FTBC

Phase C Transmit Data Block Size.
Command syntax: +FTBC=<value>
0: Stream mode, Phase C data is terminated by <DLE><ETX>.

Design Guide (continued)

Class 1 and Class 2 FAX Responses

+FCIG
Reports the Remote ID.
Syntax: +FCIG:"<CIG ID string>"
Usage: Reports the Remote (polling station's) ID.

+FCFR
Indicate Confirmation to Receive.
Syntax: +FCFR
Usage: Indicates the reception of an acceptable TCF training burst and valid DCS signal from the remote machine.

+FCON
Facsimile Connection Response.
Syntax: +FCON
Usage: Indicates connection with a FAX machine. Generated in response to an originate command or answer command.

+FCSI
Reports the Remote ID.
Syntax: +FCSI:"<CSI ID string>"
Usage: Reports the Called Station's ID.

+FDCS
Reports DCS Frame Information.
Syntax: +FDCS:VR,BR,WD,LN,DF,EC,BF,ST
Usage: Reports negotiated parameters for the current session. The subparameters are described in the +FDCS command description.

+FDIS
Reports DIS Frame Information.
Syntax: +FDIS:VR,BR,WD,LN,DF,EC,BF,ST
Usage: Reports remote FAX capabilities and intentions. The subparameters are described in the +FDCS command description.

+FDTC
Reports DTC Frame Information.
Syntax: +FDTC:VR,BR,WD,LN,DF,EC,BF,ST
Usage: Reports remote FAX capabilities and intentions. The subparameters are described in the +FDCS command description.

+FET
Post Page Message Response.
Syntax: +FET:<ppm>
Usage: Generated by the receiving FAX software after the end of Phase C reception, on receipt of the post-page message from the transmitting station. The <ppm> codes are described in the +FET command description.

+FHNG
Call Termination with Status.
Syntax: +FHNG:<hangup status code>
Usage: Indicates that the call has been terminated. The <hangup status code> values are described in the +FAXERR command description.

Design Guide (continued)

+FHR

Report Received HDLC Frames.
Syntax: +FHR:<received HDLC frame octets>
Usage: Reports the HDLC data that was received from the remote FAX machine.

+FHT

Report Transmitted HDLC Frames.
Syntax: +FHT:<transmitted HDLC frame octets>
Usage: Reports the HDLC data transmitted to the remote FAX machine.

+FNSC

Report Received Non Standard Negotiation Frames.
Syntax: +FNCS:<NSC FIF string>
Usage: Reports a received nonstandard command frame.

+FNSF

Report Received Non Standard Negotiation Frames.
Syntax: +FNSF:<NSF FIF string>
Usage: Reports a received nonstandard facilities frame.

+FNSS

Report Received Non Standard Negotiation Frames.
Syntax: +FNSS:<NSS FIF string>
Usage: Reports a received nonstandard setup frame.

+FPOLL

Remote Polling Indication.
Syntax: +FPOLL
Usage: Indicates that the remote machine has a document to poll.

+FPTS

Receive/Transmit Page Transfer Status.
Syntax: +FPTS:<ppr>
Usage: Reports a <ppr> number representing the copy quality and related post-page message. The valid <ppr> values are defined in the +FPTS command description.

+FTSI

Report the Remote ID.
Syntax: +FTSI:"<TSI ID string>"
Usage: Reports the transmitting station's ID.

Design Guide (continued)

S Registers Reference

Reg	Description	Range	Default	Units
0	Ring to autoanswer on	0—255	000	rings
1	Ring count	0—255	000	rings
2	Escape character	0—255	043	ASCII
3	Carriage return character	0—127	013	ASCII
4	Line feed character	0—127	010	ASCII
5	Backspace character	0—127	008	ASCII
6	Wait before dialing	2—255	002	seconds
7	Wait for carrier	1—255	030	seconds
8	Pause time for command or dial modifier	0—255	002	seconds
9	Carrier recovery time	1—255	006	0.1 s
10	Lost carrier hang up delay	1—255	014	0.1 s
11	DTMF dialing speed	50—255	095	0.001 s
12	Guard time	0—255	050	0.02 s
14	Bit mapped options Bit 0 reserved Bit 1 0 E0 is selected 1 E1 is selected * Bit 2 0 Q0 is selected * 1 Q1 is selected Bit 3 0 V0 is selected 1 V1 is selected * Bit 4 0 dumb mode off (normal) 1 dumb mode on Bit 5 0 T is selected 1 P is selected * Bit 6 reserved Bit 7 0 answer 1 originate*	—	*	bits

* Default.

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Design Guide (continued)

Reg	Description	Range	Default	Units
16	Modem test options Bit 0 0 local ALB disabled * 1 local ALB enabled (&T1) Bit 1 0 reserved Bit 2 0 local DL disabled * 1 local DL enabled (&T3) Bit 3 0 RDL off * 1 RDL in progress (&T6) Bit 4 0 RDL not active * 1 RDL request from distant end is in service Bit 5 0 RDL w/ self-test disabled * 1 RDL w/ self-test enabled (&T7) Bit 6 0 ALB w/ self-test disabled * 1 ALB w/ self-test enabled (&T8) Bit 7 0 reserved	—	*	bits
18	Modem test timer	0—255	000	s
21	Bit mapped options Bit 0 reserved Bit 1 reserved Bit 2 0 &R0 is selected * 1 &R1 is selected Bit 4,3 00 &D0 is selected 01 &D1 is selected 10 &D2 is selected * 11 &D3 is selected Bit 5 0 &C0 is selected 1 &C1 is selected * Bit 6 0 &S0 is selected * 1 &S1 is selected Bit 7 0 Y0 is selected * 1 Y1 is selected	—	*	bits

* Default

Design Guide (continued)

Reg	Description	Range	Default	Units
22	Bit mapped options Bit 1, 0 00 reserved 01 L0 or L1 is selected 10 L2 is selected * 11 L3 is selected Bit 3, 2 00 M0 is selected 01 M1 is selected * 10 M2 is selected 11 M3 is selected Bit 6, 5, 4 000 X0 is selected 001 reserved 010 reserved 011 reserved 100 X1 is selected 101 X2 is selected 110 X3 is selected 111 X4 is selected * Bit 7 0 &P0 is selected * 1 &P1 is selected	—	*	bits
23	Bit mapped options Bit 0 0 &T5 is selected 1 &T4 is selected * Bit 3, 2, 1 000 0—600 bits/s 001 1200 bits/s 010 2400 bits/s 011 4800 bits/s 100 7200 bits/s 101 9600 bits/s or 14.4 Kbits/s 110 19.2 Kbits/s 111 38.4 Kbits/s or 57.6 Kbits/s * Bit 5, 4 00 even parity * 01 space parity/no parity 10 odd parity 11 mark Bit 7, 6 00 &G0 is selected * 01 &G1 is selected 10 &G2 is selected 11 reserved	—	*	bits
25	Detect DTR change (on-line state) Detect DTR change	0—255 0—255	005 005	0.01 s s
26	RTS to CTS delay interval	0—255	001	0.01 s

* Default

Design Guide (continued)

Reg	Description	Range	Default	Units
27	Bit mapped options Bit 1, 0 00 &Q0 is selected * 01 &Q1 is selected 10 &Q2 is selected 11 &Q3 is selected Bit 2 0 &L0 is selected * 1 &L1 is selected Bit 3 reserved Bit 5, 4 00 &X0 is selected * 01 &X1 is selected 10 &X2 is selected 11 reserved Bit 6 0 B0 is selected 1 B1 is selected * Bit 7 reserved	—	*	bits
30	Inactivity timer value	0—90	000	minutes
37	Desired DCE speed 0 = Attempt to connect at the last AT speed 3 = Attempt a 300 bits/s connection 5 = Attempt a 1200 bits/s connection 6 = Attempt a 2400 bits/s connection 7 = Attempt a 4800 bits/s connection 8 = Attempt a 7200 bits/s connection 9 = Attempt a 9600 bits/s connection 10 = Attempt a 12000 bits/s connection 11 = Attempt a 14400 bits/s connection	—	000	—
95	Bit mapped options Bit 0 Verbose CONNECT result code indicates the DCE speed (rather than the DTE speed) Bit 1 Append /ARQ to the verbose CONNECT result code when an error control connection is established. Bit 2 Enable the CARRIER result code Bit 3 Enable the PROTOCOL result code Bit 4 Reserved Bit 5 Enable COMPRESSION result codes Bit 6 Enable PROTOCOL result codes 81—83 for *MNP* connections (in place of result code 80)	—	000	—

* Default

Design Guide (continued)

Reg	Description	Range	Default	Units
108	Signal quality selector 0 No limit 1 Low quality 2 Medium limit 3 High quality	—	001	—
109	V.32bis carrier speed selector (Bit mapped options) Bit 0 Reserved Bit 1 4800 bits/s * Bit 2 7200 bits/s * Bit 3 9600 bits/s * Bit 4 12.0 Kbits/s * Bit 5 14.4 Kbits/s * Bit 6 Reserved Bit 7 Reserved	—	*	bits
110	V.32/V.32bis selector 0 V.32 enabled 1 V.32bis enabled 2 V.32bis and automatic rate renegotiation enabled	—	002	—
112	DTE speed select during data transfer 0 Last AT speed 1 Reserved 2 300 bits/s 3 1200 bits/s 4 2400 bits/s 5 4800 bits/s 6 7200 bits/s 7 9600 bits/s 8 12.0 Kbits/s 9 14.4 Kbits/s 10 16.8 Kbits/s 11 19.2 Kbits/s 12 38.4 Kbits/s 13 57.6 Kbits/s 14 600 bits/s	—	000	—

* Default

— A T & T MELEC (I C) 64E D ■ 0050026 0009479 275 ■ATT2

Design Guide (continued)

Result Codes

Numeric	Verbose	Description
0	OK	Command executed.
1	CONNECT	Connection at 0—300, 1200, 2400, 9600, or 19200 bits/s if X0 selected; otherwise, connection at 0—300 bits/s.
2	RING	Ring signal detected.
3	NO CARRIER	Carrier signal not detected or lost.
4	ERROR	Invalid command, checksum, error in command line, or command line too long.
5	CONNECT 1200	Connection at 1200 bits/s. Disabled by X0.
6	NO DIALTONE	No dial tone detected. Enabled by X2, X4, or W dial modifier.
7	BUSY	Busy detected. Enabled by X3 or X4.
8	NO ANSWER	No silence detected when dialing a system not providing a dial tone. Enabled by @ dial modifier.
10	CONNECT 2400	Connection at 2400 bits/s.
11	CONNECT 4800	Connection at 4800 bits/s.
12	CONNECT 9600	Connection at 9600 bits/s.
13	CONNECT 14400	Connection at 14400 bits/s.
14	CONNECT 19200	Connection at 19200 bits/s. Enabled by W0.
18	CONNECT 57600	Connection at 57600 bits/s. Enabled by W0.
24	CONNECT 7200	Connection at 7200 bits/s.
25	CONNECT 12000	Connection at 12000 bits/s.
26	CONNECT 1200/75	Connection at 1200 bits/s / 75 bits/s.
27	CONNECT 75/1200	Connection at 75 bits/s / 1200 bits/s.
28	CONNECT 38400	Connection at 38400 bits/s.

Design Guide (continued)

Negotiation Progress Messages

(Displayed when W1 is set.)

Numeric	Verbose	Description
40	CARRIER 300	Carrier detected at 300 bits/s.
42	CARRIER 75/1200	Carrier detected at 75 bits/s / 1200 bits/s.
43	CARRIER 1200/75	Carrier detected at 1200 bits/s / 75 bits/s.
46	CARRIER 1200	Carrier detected at 1200 bits/s.
47	CARRIER 2400	Carrier detected at 2400 bits/s.
48	CARRIER 4800	Carrier detected at 4800 bits/s.
49	CARRIER 7200	Carrier detected at 7200 bits/s.
50	CARRIER 9600	Carrier detected at 9600 bits/s.
51	CARRIER 12000	Carrier detected at 12000 bits/s.
52	CARRIER 14400	Carrier detected at 14400 bits/s.
66	COMPRESSION:CLASS5	*MNP* compression negotiated.
67	COMPRESSION:V42BIS	V.42bis compression negotiated.
69	COMPRESSION:NONE	No compression negotiated.
70	PROTOCOL:NONE	Asynchronous mode.
77	PROTOCOL:LAP-M	V.42 LAPM.
80	PROTOCOL:*MNP*	*MNP* negotiated.
81	PROTOCOL:*MNP2*	*MNP* Class 2 negotiated. *
82	PROTOCOL:*MNP3*	*MNP* Class 3 negotiated. *
83	PROTOCOL:*MNP4*	*MNP* Class 4 negotiated. *

* These codes are enabled by setting bit 6 of S register 95.

Design Guide (continued)

Crystal/Oscillator Specifications

Table 16. Data Pump Crystal Specification

Parameter	Value
Nominal Frequency at 25 °C	20.2752 MHz
Frequency Tolerance	20 ppm
Oscillator Mode	Fundamental
Calibration Mode	Parallel resonant
Load Capacitance	12 pF
Temperature Stability	30 ppm
Resistance	125 Ω max
Suggested Manufacturer	FOX
Part Number	FOX #HC49U-20.2752MHZ

Table 17. DMSCC Oscillator Specification

Parameter	Value
Frequency	7.3728 MHz
Type	CMOS
Clock Stability and Tolerance	50 ppm
Suggested Manufacturers	NDK or Conner-Winfield
Part Numbers	NDK- 329B1-7.3728 Conner-Winfield #H42-7.3728

Design Guide (continued)

Bill of Materials — DeskTop Modem Parallel Version

Note: It is not recommended that modifications be made to this parts list without prior consultation with the AT&T DSP Modem Marketing Group. Any substitutions to the parts list are made at the customer's risk.

Table 18. AT&T V32x-V42D Complete Modem Devices

Quantity	Reference	Part
1	U3	DMC-10, 68-pin PLCC, DeskTop modem controller, AT&T part of #V32F-V42D chip set
1	U4	DMSCC-10, 44-pin PLCC, protocol accelerator, AT&T part of #V32F-V42D chip set
1	U9	V32-INTFC, 68-pin PLCC, data pump interface chip, AT&T part of V32F-V42D chip set
1	U10	DSP16A, 84-pin PLCC, DSP, AT&T part of V32F-V42D chip set
1	U11	T7525-EC, 28-pin SOJ, codec, AT&T part of V32F-V42D chip set

Table 19. Other Essential Devices

Quantity	Reference	Part
1	U1	93LC66, 8-pin EIAJ small outline package, 4096-bit serial EEPROM, Exel #XLS93LC66JR
1	U2	74ACT32, 14-pin SO, quad 2-input POS-OR gate, TI #SN74ACT32D
1	U5	28F010, 32-pin PLCC, 1 Mbit(131, 072 x 8) CMOS EPROM, AMD #AM28F010-95C3JC
1	U6	62256, SOW-28, 32Kx8 SRAM, MotorolA #MCM60L256A-F10 or Mosel #MS62256L10
1	U7	74HCT259, 16-pin SOW, 8-bit addressable latch, Motorola #MC74HCT259A
1	U13	LF353, 8-pin SO, wide band dual opamp, National #LF353M
1	U14	LM386, 8-pin SO (PACKAGE M), low voltage audio power amp, National #LM386M-1
1	U16	LM1458, SO-8, dual opamp, National #LM1458M
1	U17	PAL20L8-FN, 28-pin PLCC, PAL, TI #TIBPAL20L8-15CFN or -25CFN
1	U18	74HCT245, 20-pin SOW, octal bus transceiver noninverting 3T, Motorola #MC74HCT245A
1	U19	16550, 44-pin PLCC, UART with FIFOS (NS package #V44A), National #PC16550CV
1	U20	74LS368, SO-16, hex bus driver with 3-state outputs, TI #74LS368D
1	U21	4N35, 6-pin DIP, GAAS IRED & photo-trans, Motorola #4N35 or Harris #4N35
1	U26	PAL16L8B-4FN, 20-pin PLCC SO, 8 output combinatorial pal, TI #TIBPAL16L8-15CFN or -25CFN

Table 20. Crystals and Oscillators

Quantity	Reference	Part
1	Y1	7.3728 MHz, 8-pin DIP, crystal oscillator, Connor-Winfield #H42-7.3728
1	Y3	20.2752 MHz, pin thru-radial, crystal, Fox #HC49U-20.2752 MHz

Design Guide (continued)

Bill of Materials — DeskTop Modem Parallel Version (continued)

Table 21. Miscellaneous Circuitry

Quantity	Reference	Part
28	C3, C4, C5, C6, C7, C8, C9, C10, C14, C15, C16, C17, C18, C20, C21, C24, C25, C34, C36, C37, C40, C43, C45, C46, C47, C48, C49, C50	0.1 µF, 1206, 25 V 10% X7R, Novacap#1206-B104K-250-NT or Venkel#C1206X7R250-104KNE
2	C12, C13	10 pF, 0805, 25 V 5% NPO, Novacap #0805-N100J-250-NT
1	C19	10.0 µF, 6032 EIA, 16 V 10% tantalum, Kemet #T491C106K016AS
2	C22, C56	150 pF, 0805, 25 V 5% X7R, Novacap #0805-B151J-250-NT or Rohm #MCH215A151JK
1	C23	4.7 nF, 0805, 25 V 10% X7R, Novacap #0805-B482K-250-NT or KCK #CE472K2NR
1	C26	0.47 µF, 2225, 250 V 10% X7R, Novacap #2225-B474J-251-ST
1	C27	10.00 µF, D0.315XL0.453, 100 WV 20%, Illinois Capacitor 106BPS100M
1	C28	0.470 µF, 1812, 50 V 10% X7R, Novacap #1812-B474K-500-N
1	C29	6.8 µF, T491, 10 WV, Kemet #T491B685K010AS or Matsuo #267M1002-685-K-533
1	C30	2.4 nF, 0805, 50 V 10% X7R
1	C31	1.8 nF, 0805, 50 V 10% X7R
1	C33	0.01 µF, 0805, 25 V 10% NPO, Novacap #0805-N103J-250-NT or Rohm #MCH215C103KK
1	C35	0.047 µF, 0805, 25 V 10% X7R, Rohm #MCH212C473KPN
5	C41, C44, C51, C52, C53	10 µF, T491, 25 V 10% polarized, Kemet #T491D106K025AS
1	C42	220 µF, radial leads (0.100), 10 V 20% aluminum electrolytic, Illinois #227RSS010
2	C54, C55	1000 pF, 6.5x3, 1 KV 20%, CAP RAD CD Z5U, Philips #D102P29Z5UNAAEM
2	D2, D1	5228, SOT-23 (STYLE 8), Zener 3.9 VZ/225 mW, Motorola #MMBZ5228BLT1 or Philips #PMBZ5228B
2	D4, D3	5252, SOT-23 (STYLE 8), Zener 24 V/225 mW, Motorola #MMBZ5252BL or Philips #PMBZ5252B
1	D5	5257, SOT-23 (style 8), Zener 32 V/225 mW, Motorola #MMBZ5257BLT1
4	D6, D7, D8, D9	1N4003, LL41, 800 mA/240 V, Rohm #RLR4003
1	D10	1N4148, LL34, 100 V/0.5 W, Rohm #RLS4148 or LL4148F
1	F1	fuse, SMD EIA#7343, 250 mA/125 V, Littelfuse #R459.250
2	J1, J2	RJ-11, 6-pin standard, phone jack, Molex #15-43-6063
1	J3	IBM CONN
2	L1, L2	bead, thru-hole, ferrite bead, Fair-Rite #2943666651
1	MOV1	250 VRMS, SMD (0.010L x 0.008W), MOV 1.2 KA/300 Vdc/250 VRMS, Harris #V390CH8
1	PCJ1	header 2x4, dual 4-pin row, 0.100 cntr sq posts, Samtec #TSW-104-07-T-D or #TSW-108-07-T-S

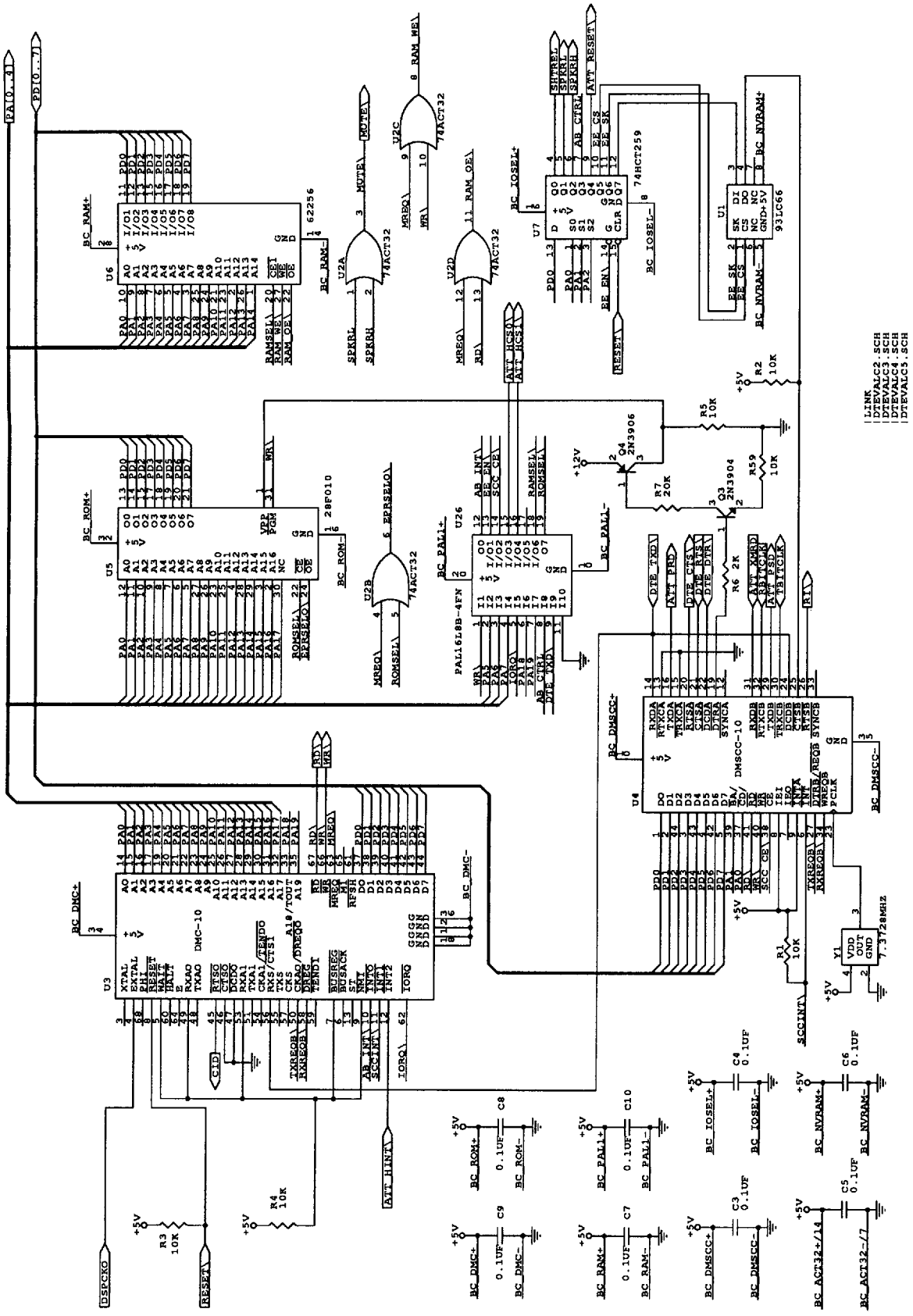
Design Guide (continued)

Bill of Materials — DeskTop Modem Parallel Version (continued)

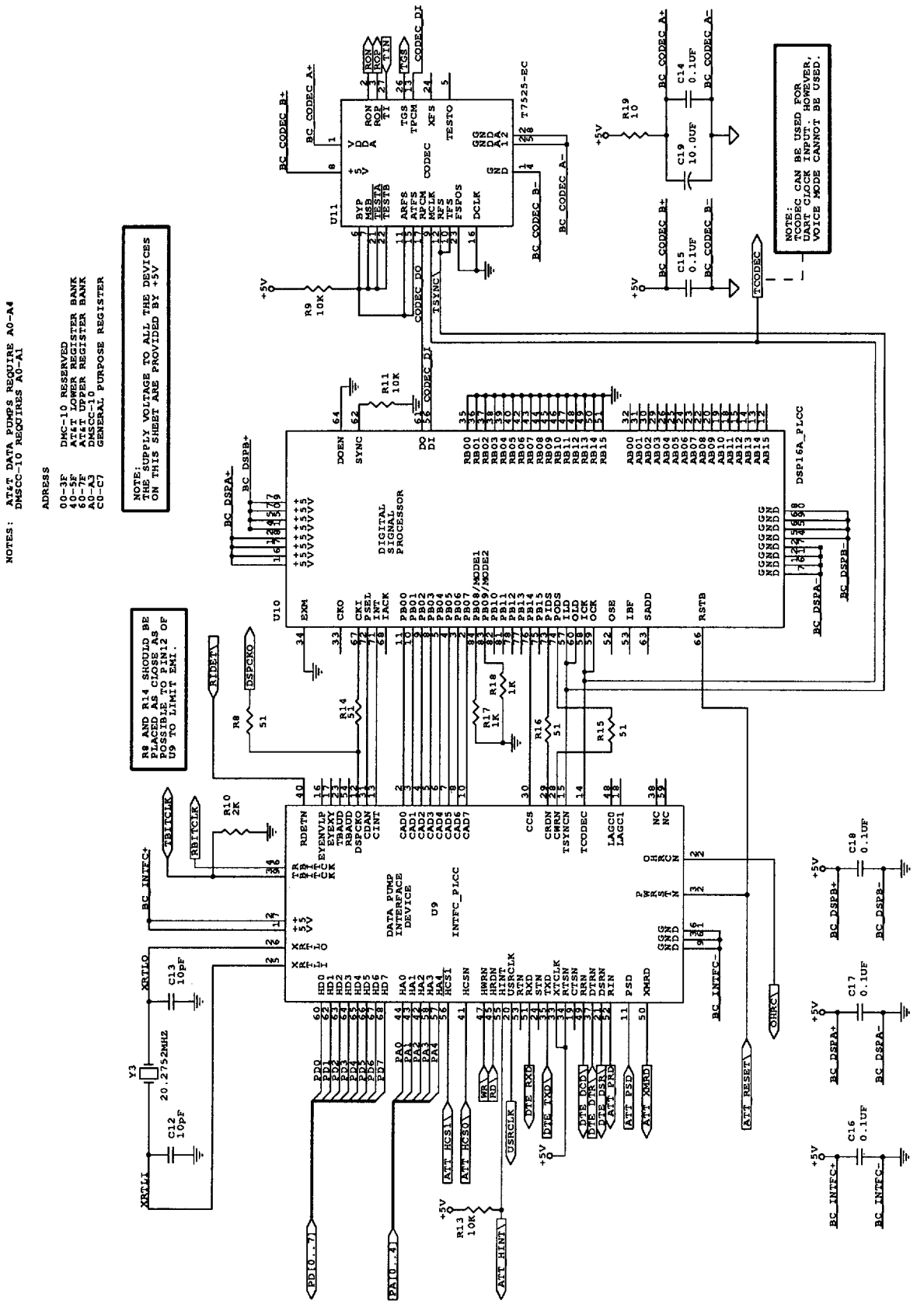
Table 21. Miscellaneous Circuitry (continued)

Quantity	Reference	Part
1	Q1	2N6427L, SOT-23 (style 6), Darlington transistor NPN, Motorola #MMBT6427LT1
5	Q2, Q4, Q5, Q6, Q7	2N3906, SOT-23 (style 6), small signal PNP transistor, Motorola #MMBT3906LT1
1	Q3	2N3904, SOT-23 (style 6), small signal NPN transistor, Motorola #MMBT3904LT1
10	R1, R2, R3, R4, R5, R9, R11, R13, R23, R59	10K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW103
2	R6, R10	2K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW202
7	R7, R42, R43, R51, R52, R53, R54	20K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW203
5	R8, R14, R15, R16, R28	51, 0805, 5% 0.1 W carbon, Rohm #MCR10JW510
9	R17, R18, R29, R30, R48, R57, R58, R62, R63	1K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW102 or KCK #RCA1001F
3	R19, R22, R50	10, 0805, 5% 1.0W carbon, Rohm #MCR10J 100
2	R20, R21	22.1K, 0805, 1% 0.1 W metal, Rohm #MCR10FX2212
1	R24	464, 1206, 1% 0.125W metal, Rohm #MCR18FX4640
1	R25	42.2K, 0805, 1% 0.1 W metal, Rohm #MCR10FX4222
1	R26	20.5K, 0805, 1% 0.1 W metal, Rohm #MCR10FX2052
1	R27	29.4K, 0805, 1% 0.1 W metal, Rohm #MCR10FX2942
1	R31	7.50K, 2512, 5% 1.0W carbon, Rohm #MCR100J752
2	R32, R33	10.0K, 0805, 1% 0.1 W metal, Rohm #MCR10FX103
1	R34	27.4K, 0805, 1% 0.1 W metal, Rohm #MCR10FX2742
1	R35	18.7K, 0805, 1% 0.1 W metal, Rohm #MCR10FX1872
1	R36	40.2K, 0805, 1% 0.1 W metal, Rohm #MCR10FX4022
1	R38	35.7K, 0805, 1% 0.1 W metal, Rohm #MCR10FX3572
1	R39	34.8K, 0805, 1% 0.1 W metal, Rohm #MCR10FX3482
1	R40	33.2K, 0805, 1% 0.1 W metal, Rohm #MCR10FX3322
1	R41	TBD, 0805, 1% 0.1 W metal, Rohm #MCR10FXXXXX
1	R44	100K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW104 or KCK #RCA104J
1	R45	6.8K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW682
1	R46	13.7K, 0805, 1% 0.1 W carbon, Rohm #MCR10FX1372
1	R47	9.09K, 0805, 1% 0.1 W carbon, Rohm #MCR10FX9091
1	R49	750, 0805, 5% 0.1 W carbon, Rohm #MCR10JW751
2	R56, R55	0, 0805, 5% 0.1 W carbon, Rohm #MCR10J 000
1	R60	5.6K, 0805, 5% 0.1 W carbon, Rohm #MCR10JW5602
1	R61	499, 0805, 1% 0.1 W carbon, Rohm #MCR10FX4990
1	SPK1	8 OHM, PC mount, 8 OHM speaker, Star Micronics #QMB-01
1	SSR2	LH1505, 8-pin SMT, SPST/DPST HV solid-state relay, AT&T #LH1505AAC
1	SSR3	LH1518, 6-pin SMT gull-wing, HVSS relay, AT&T #LH1518AAC
1	T1	2769A, SMT or thru-hole, V.32bis transformer, AT&T #2769A

Design Guide (continued)

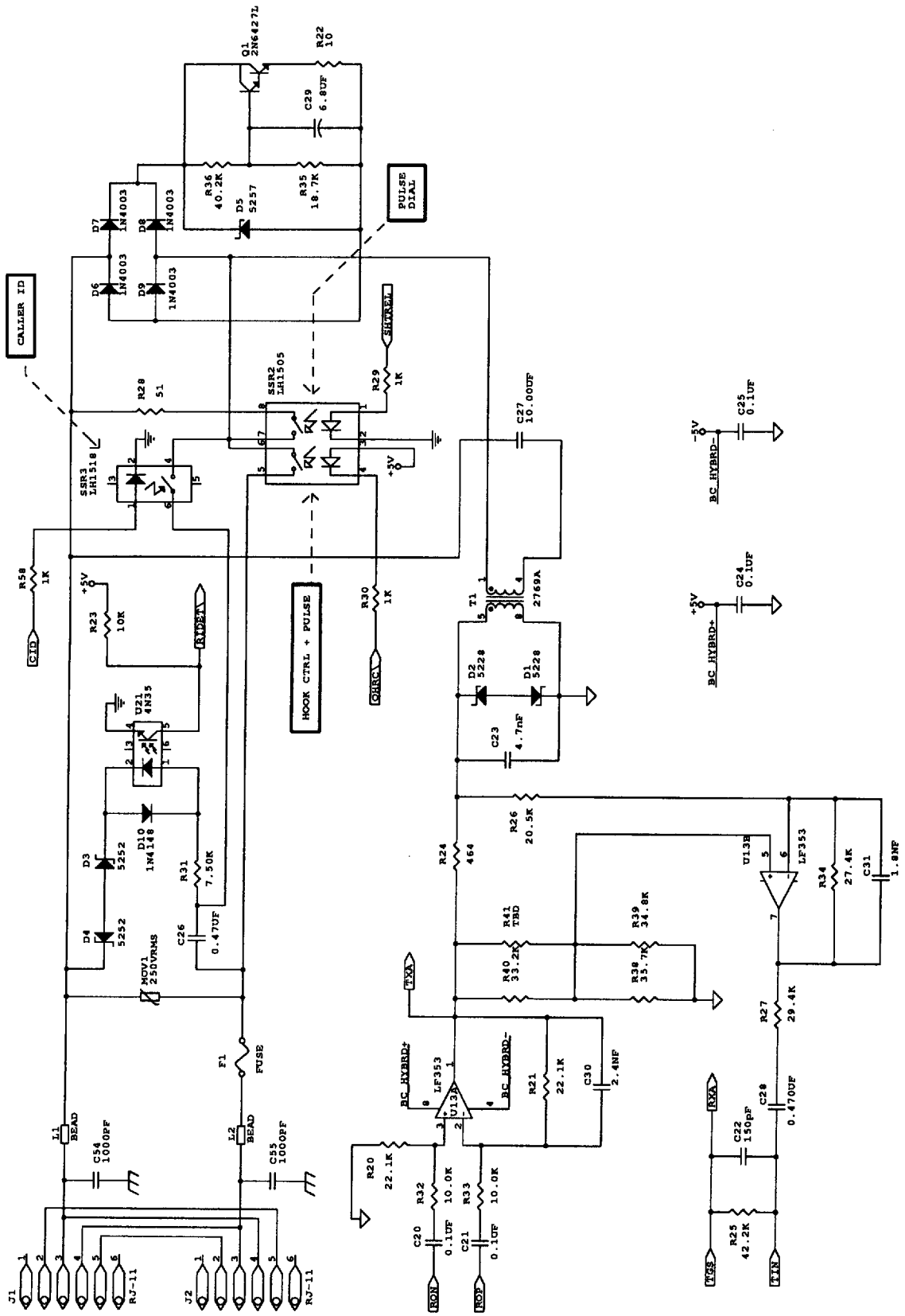


DeskTop Modem Parallel Version Schematics — Sheet 1: Micro-controller Logic.

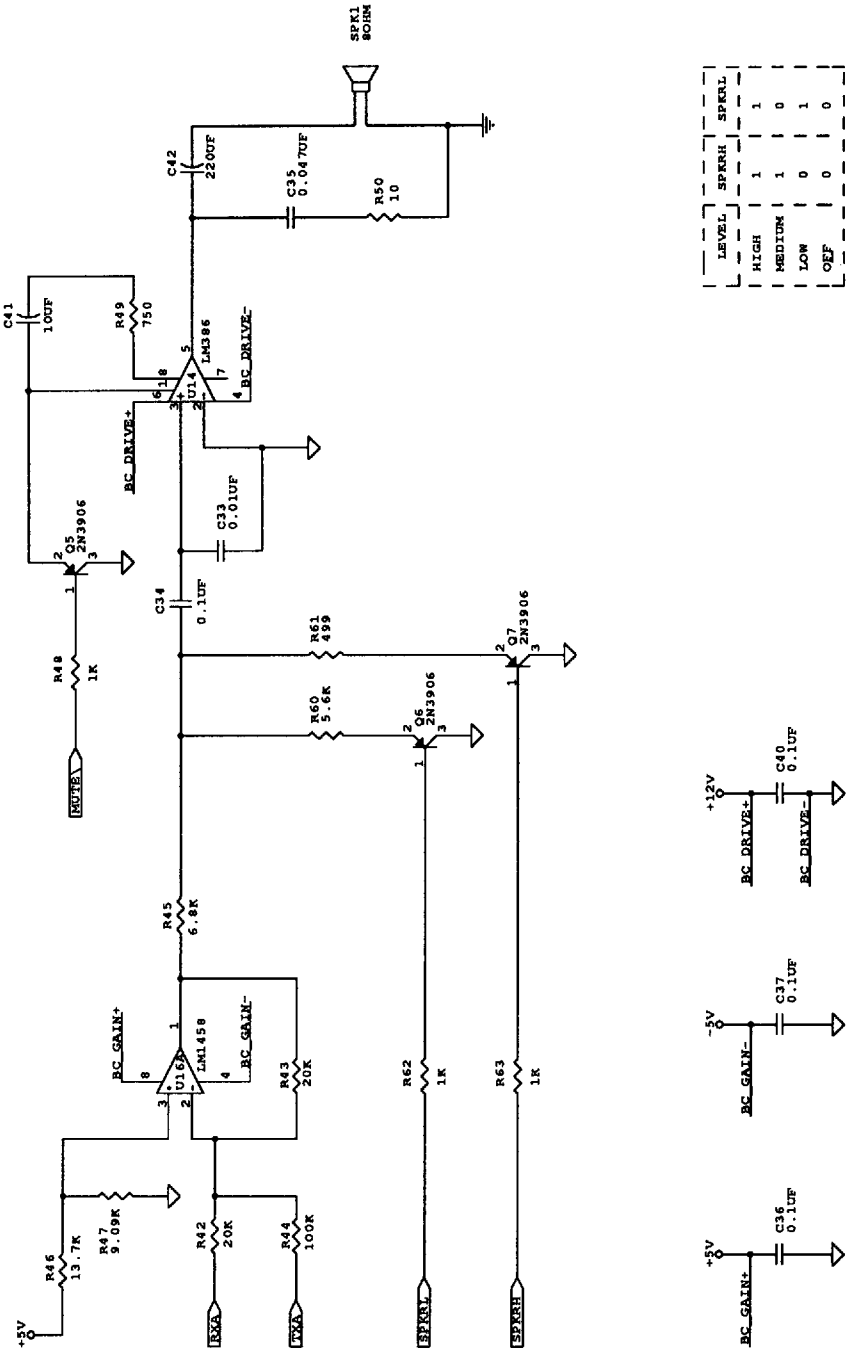


DeskTop Modem Parallel Version Schematics — Sheet 2: Data Pump.

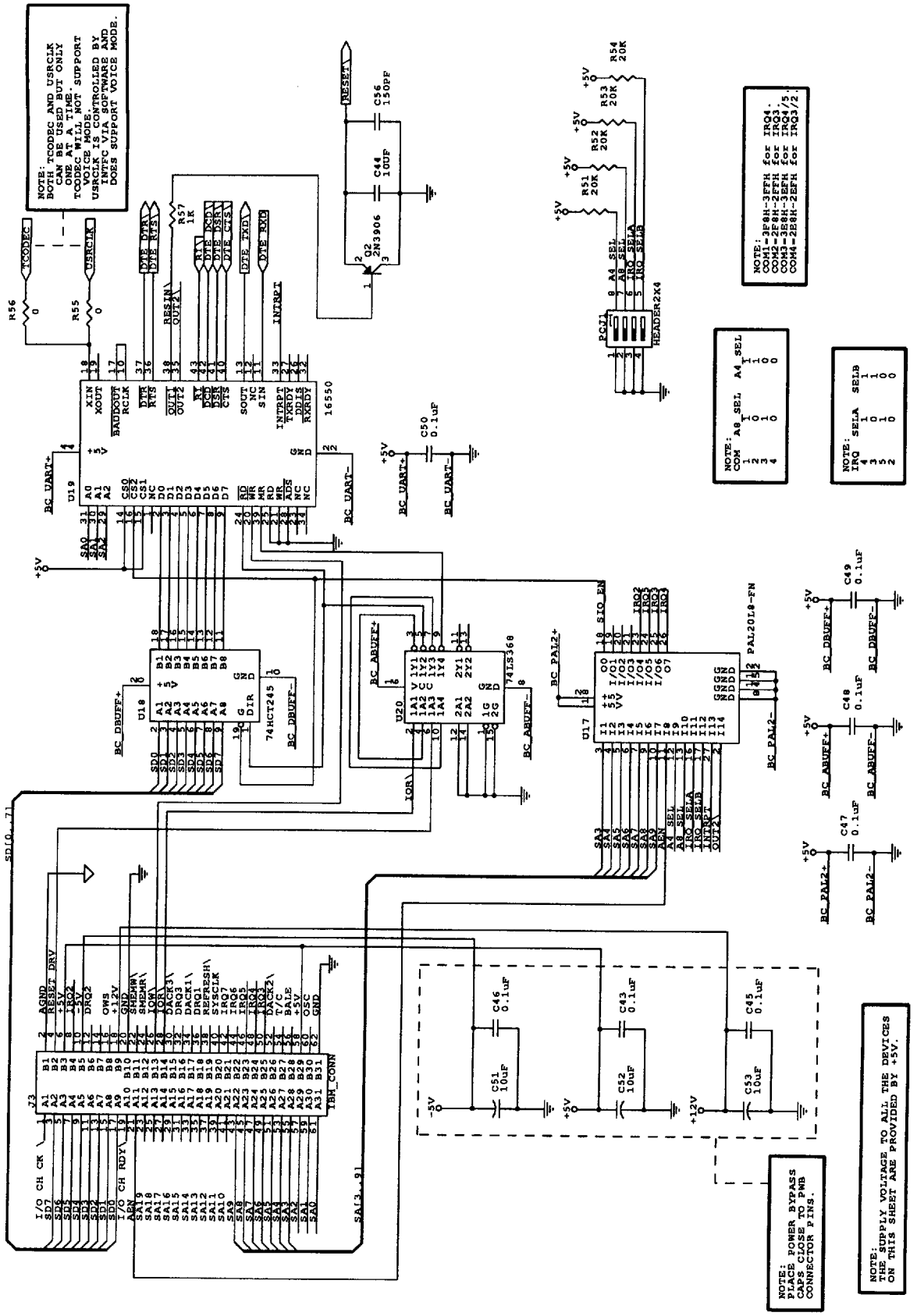
Design Guide (continued)



DeskTop Modem Parallel Version Schematics — Sheet 3: DAA.



DeskTop Modem Parallel Version Schematics — Sheet 4: Speaker Circuitry (optional).



DeskTop Modem Parallel Version Shematics — Sheet 5: Parallel Interface.

A T & T MELEC (I C) 64E D 0050026 0009490 936 ATT2

Design Guide (continued)

Bill of Materials — DeskTop Modem Serial Version

Note: It is not recommended that modifications be made to this parts list without prior consultation with the AT&T DSP Modem Marketing Group. Any substitutions to the parts list are made at the customer's risk.

Table 22. AT&T V32x-V42D DeskTop Complete Modem Devices

Quantity	Reference	Part
1	U3	DMC-10, 68-pin PLCC, DeskTop Modem Controller, AT&T part of #V32F-V42D chip set
1	U4	DMSCC-10, 44-pin PLCC, protocol accelerator, AT&T part of #V32F-V42D chip set
1	U9	V32-INTFC, 68-pin PLCC, data pump interface chip, AT&T part of V32F-V42L chip set
1	U10	DSP16A, 84-pin PLCC, DSP, AT&T part of V32F-V42D chip set
1	U11	T7525-EC, 28-pin SOJ, codec, AT&T part of V32F-V42D chip set

Table 23. Essential Devices

Quantity	Reference	Part
1	U1	93LC66, 8-pin EIAJ small outline package, 4096-bit serial EEPROM, Exel #XL93LC66JR
1	U2	74ACT32, 14-pin SO, quad 2-input POS-OR gate, TI #SN74ACT32D
1	U5	27010, 32-pin PLCC, 1 Mbit(131, 072 X 8) CMOS EPROM, AMD #AM27C010-105DC
1	U6	62256, 28-pin SOG (case 751H-02), 32Kx8 SRAM, Motorola #MCM60L256A-F10 or Mosel #MS62256L10FC
1	U7	74HCT259, 16-pin SOW, 8-bit addressable latch, Motorola #MC74HCT259A
1	U13	LF347N, 14-pin DIP, op-amp, Motorola LF347N
1	U14	LM386, 8-pin SO (package M), low-voltage audio power amp, National #LM386M-1
1	U21	4N35, 6-pin DIP, GAAS IRED & photo-trans, Motorola #4N35 or Harris #4N35
1	U22	1489A, 14-pin SO, quad line receivers, Motorola #MC1489AD
1	U23	74ACT86, SO-14, EX OR, Motorola #MC74ACT86D
2	U24, U25	1488, 14-pin SO, quad line driver, Motorola #MC1488D
1	U26	PAL16L8B-4FN, 20-pin PLCC SO, 8-output combinatorial PAL, AMD PAL16L8B-4FN

Table 24. Crystals and Oscillators

Quantity	Reference	Part
1	Y1	7.3728 MHz, 8-pin DIP, crystal oscillator, NDK #NDK-1329B1-7.3728
1	Y3	20.2752 MHz, pin thru-radial, crystal, Fox #HC49U-20.2752 MHz

Design Guide (continued)

Bill of Materials — DeskTop Modem Serial Version (continued)

Table 25. Miscellaneous Circuitry

Quantity	Reference	Part
23	C3, C4, C5, C6, C7, C8, C9, C10, C14, C15, C16, C17, C18, C24, C25, C40, C54, C55, C56, C57, C58, C59, C79	0.1 µF, 1206, 25 V 10% X7R, Novacap#1206-B104K-250-NT or Venkel#C1206X7R250-104KNE
2	C12, C13	10 pF, 1206, 25 V 5% NPO, Novacap #1206-N100J-250-NT
1	C19	10.0 µF, 0.197DX0.354L, 16 V 10% tantalum, Nemco TB10/25K2
2	C20, C21	0.2 µF, 1206, 25 V 10% X7R, Novacap#1206-B204K-250-NT or Venkel#C1206X7R250-204KNE
2	C22, C92	150 pF, 1206, 25 V 5% X7R, Novacap #1206-B151J-250-NT
1	C23	5.6 nF, 1206, 25 V 10% X7R, Novacap #1206-B562K-250-NT or KCK #CE562K2NR
1	C26	0.47 µF, 0.75X0.4D, 250 V 10%, NIC NTM474K250R
1	C27	6.80 µF, 0.3X11, 10 WV 10%, NNR685K50-0.3X11
1	C28	0.470 µF, 1206, 25 V +80/-20 Y5 V, Rohm #MCH312F474ZP
1	C29	6.8 µF, T491, 10 WV, Kemet #T491B685K010AS or Matsuo #267M1002-685-K-533
1	C30	1.0 µF, 1206, 50 V 10% X7R
1	C31	1.5 nF, 1206, 50 V 10% X7R
1	C33	0.01 µF, 1206, 25 V 10% NPO, Novacap #1206-N103J-250-NT
1	C35	0.047 µF, 1206, 25 V 10% X7R, Rohm #MCH212C473KPN
2	C41, C74	10 µF, 0.197DX0.354L, 25 V 10% Tantalum, Nemco TB10/25K2
1	C42	220 µF, radial leads (0.100), 10 V 20% aluminum electrolytic, Illinois #227RSS010
2	C70, C73	1000 pF, 6.5x3, 1 kV 20%, CAP RAD CD Z5U
12	C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91	1000.0 pF, 1206, 25 V 10% NPO, Novacap #1206-N10000J-250-NT
2	D2, D1	5228, SOT-23 (STYLE 8), 3.9 VZ/225 mW, Motorola #MMBZ5228BLT1 or Philips #PMBZ5228B
2	D4, D3	5252, SOT-23 (STYLE 8), Zener 24 V/225 mW, Motorola #MMBZ5252BL or Philips #PMBZ5252B
1	D5	5257, SOT-23 (STYLE 8), Zener 32 V/225 mW, Motorola #MMBZ5257BLT1
4	D6, D7, D8, D9	1N4003, LL41, 800 mA/240 V, Rohm #RLR4003
4	D10, D13, D14, D15	1N4148, LL34, 100 V/0.5 W, Rohm #RLS4148 or LL4148F
1	F1	fuse, SMD EIA#7343, 250 mA/125 V, Littelfuse #R459.250
2	J1, J2	Molex, 13X14.5, 6-pin phone jack, Molex 52018-6415
1	J4	DSUB25, 2.1X0.5, D-sub right angle PCB mount receptacle, Molex 82009-8350
2	L3, L1	bead, thru-hole, 3 turns Z = 750, Fair-Rite #2943666631
1	MOV1	265DC, TO-92, Sidactor, Teccor Electronics P1500EA70

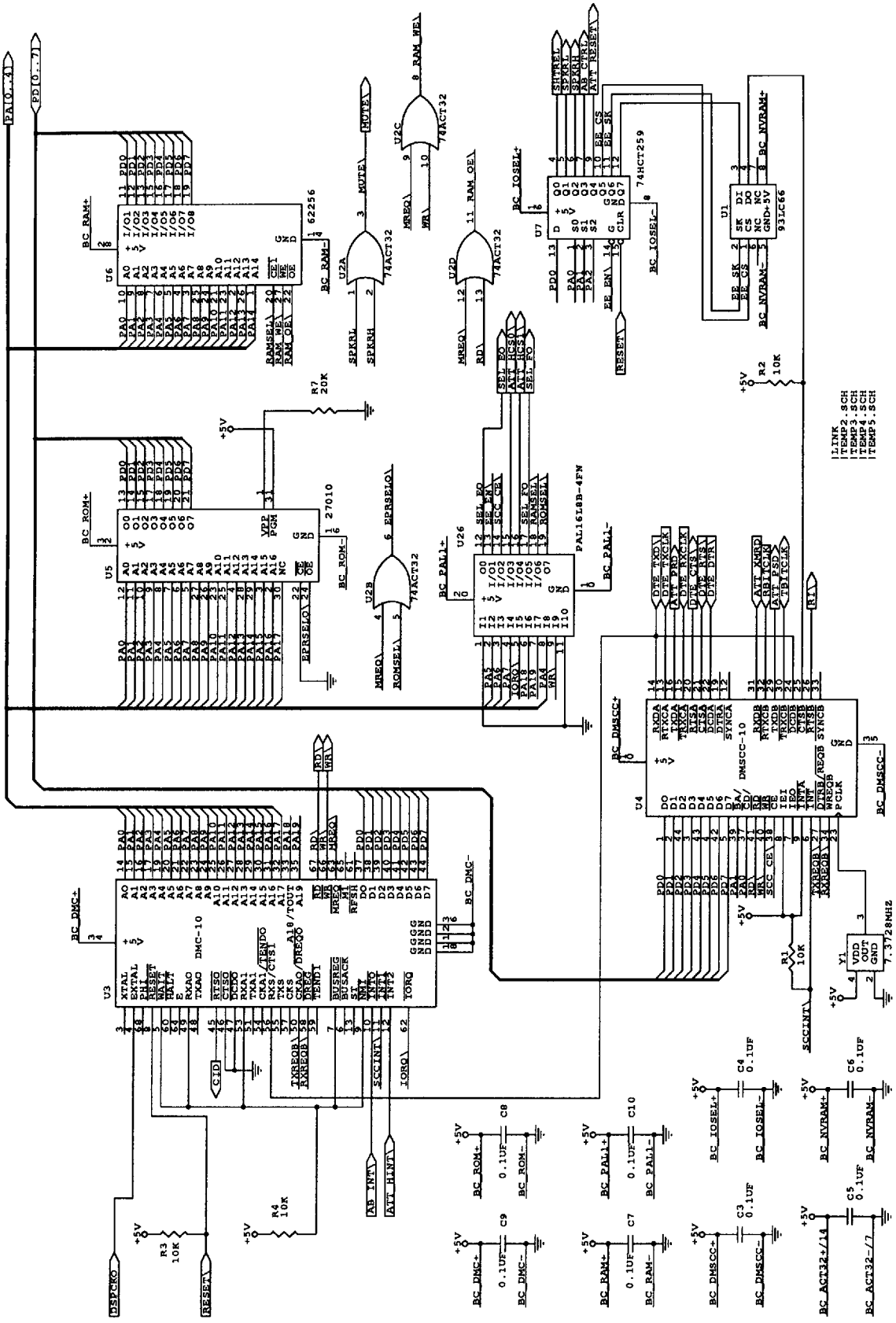
Design Guide (continued)

Bill of Materials — DeskTop Modem Serial Version (continued)

Table 25. Miscellaneous Circuitry (continued)

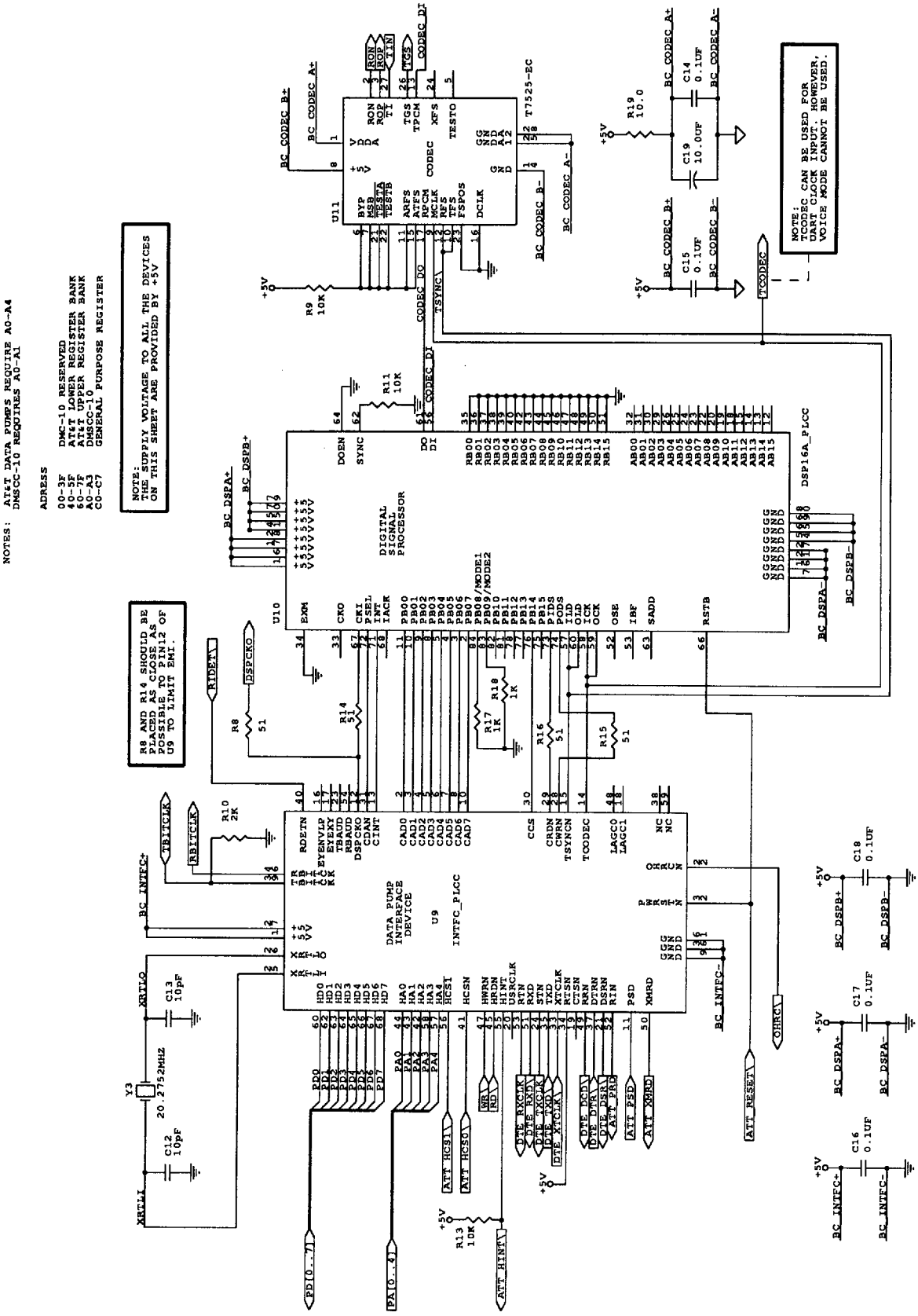
Quantity	Reference	Part
1	Q1	2N6427L, SOT-23 (STYLE 6), Darlington transistor NPN, Motorola #MMBT6427LT1
2	Q2, Q4	2N3904, SOT-23 (STYLE 6), NPN transistor, Motorola #MMBT3904LT1
5	Q3, Q5, Q6, Q7, Q8	2N3906, SOT-23 (STYLE 6), PNP transistor, Motorola #MMBT3906LT1
9	R1, R2, R3, R4, R9, R11, R13, R23, R68	10K, 1206, 5% 0.1 W carbon, Rohm #MCR18JW103
1	R7	20K, 1206, 5% 0.1 W carbon, Rohm #MCR18JW203
6	R8, R14, R15, R16, R28, R60	51, 1206, 5% 0.1 W carbon, Rohm #MCR18JW510
1	R10	2K, 1206, 5% 0.1 W carbon, Rohm #MCR18JW202
8	R17, R18, R29, R30, R59, R71, R73, R74	1K, 1206, 5% 0.1 W carbon, Rohm #MCR18JW102
2	R19, R50	10.0, 1206, 5% 0.1 W carbon, Rohm #MCR18JW100
2	R20, R21	45.3K, 1206, 1% 0.1 W metal, Rohm #MCR18FX4532
1	R22	10, 1206, 5% 1.0 W carbon, Venkel #2512-1 W-100T
1	R24	374, 1206, 1% 0.125 W metal, Rohm #MCR18FX3740
1	R25	41.2K, 1206, 1% 0.1 W metal, Rohm #MCR18FX4122
2	R26, R66	20.5K, 1206, 1% 0.1 W metal, Rohm #MCR18FX2052
1	R27	29.4K, 1206, 1% 0.1 W metal, Rohm #MCR18FX2942
1	R31	7.50K, 2512, 5% 1.0 W carbon, Rohm #MCR100J752
2	R32, R33	22.1K, 1206, 1% 0.1 W metal, Rohm #MCR18FX2212
2	R40, R34	33.2K, 1206, 1% 0.1 W metal, Rohm #MCR18FX3322
1	R35	18.7K, 1206, 1% 0.1 W metal, Rohm #MCR18FX1872
1	R36	40.2K, 1206, 1% 0.1 W metal, Rohm #MCR18FX4022
1	R39	24.3K, 1206, 1% 0.1 W metal, Rohm #MCR18FX2432
1	R49	750, 1206, 5% 0.1 W carbon, Rohm #MCR18JW751
1	R67	7.5K, 2512, 5% 0.1 W carbon, Rohm #MCR18JW752
1	R69	4.7K, 1206, 5% 0.1 W carbon, Rohm #MCR18FX472
1	R70	464, 1206, 1% 0.125 W metal, Rohm #MCR18FX4640
1	R75	9K, 1206, 1% 0.1 W metal, Rohm #MCR18FX902
1	R76	13.5K, 1206, 1% 0.1 W metal, Rohm #MCR18FX1352
1	SP1	CHIA, 28X4, 8 OHM PC mount speaker, Chia Ping CP-28CL
3	SSR2, SSR3, SSR4	HAM3300, 1.00x0.375 relay, SPDT, Hamlin #SD1A05
1	T1	MIDCOM8025, SMT or thru-hole, V.32bis transformer, MIDCOM8025

Design Guide (continued)



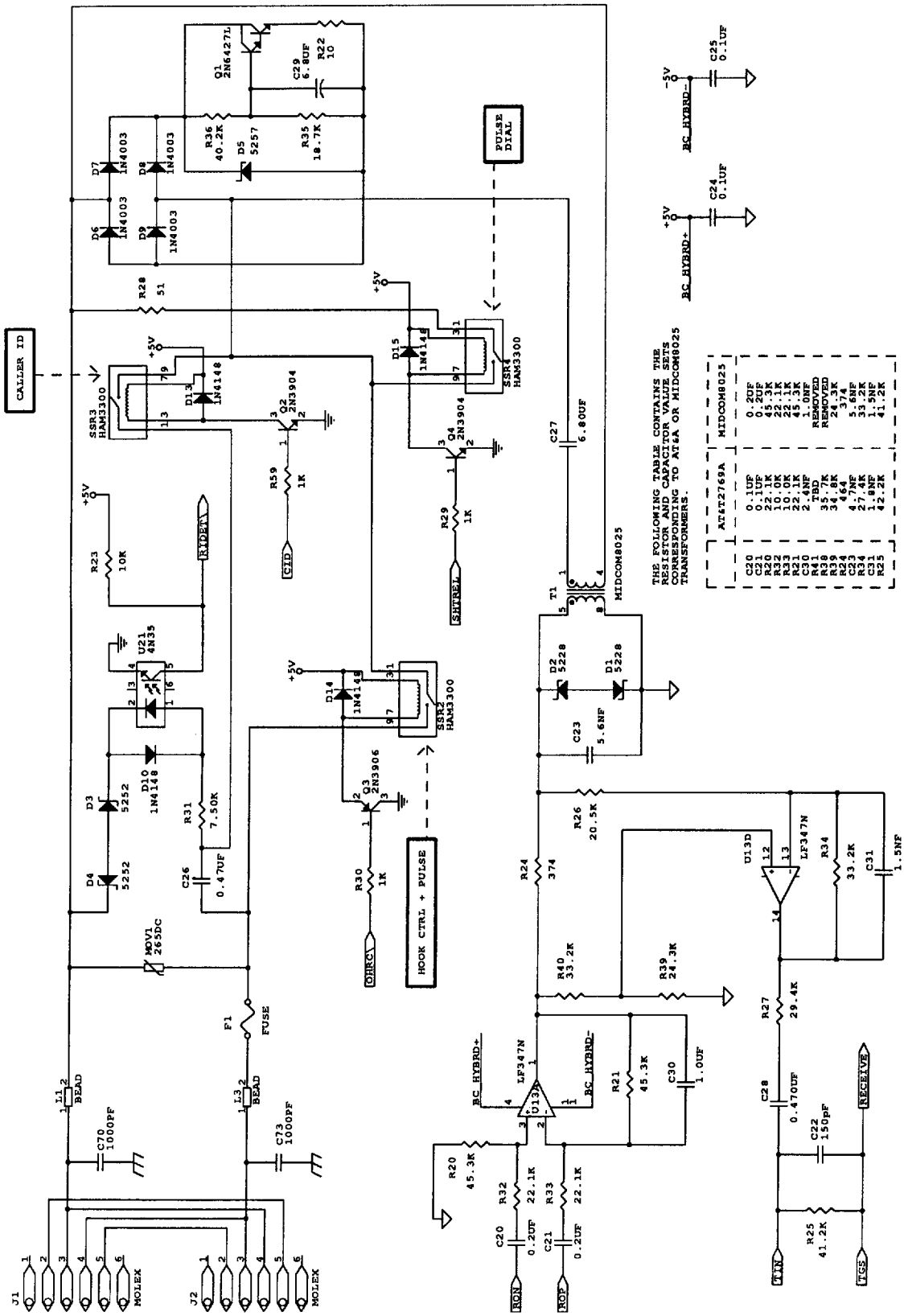
DeskTop Modem Serial Version Shematics — Sheet 1: Micro-controller Logic.

Design Guide (continued)



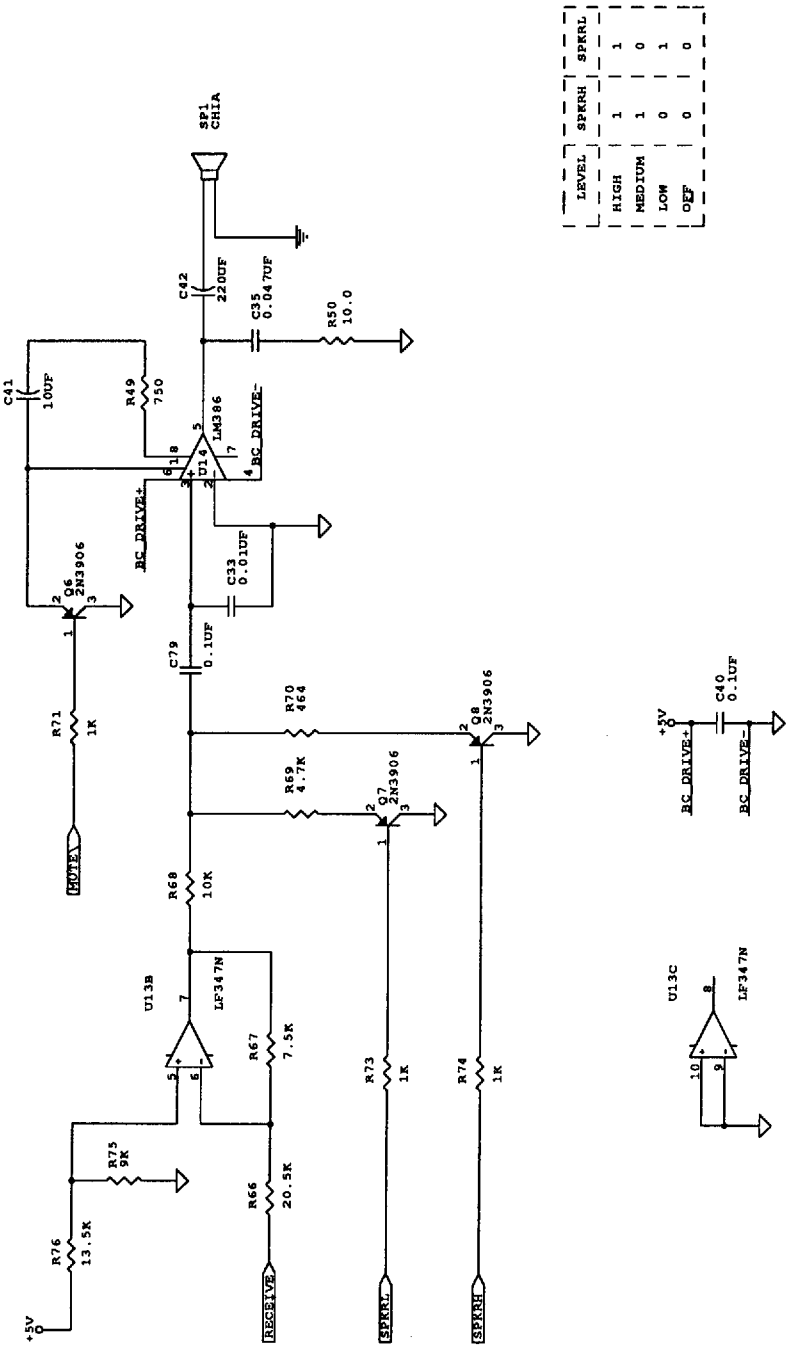
DeskTop Modem Serial Version Shematics — Sheet 2: Data Pump.

Design Guide (continued)



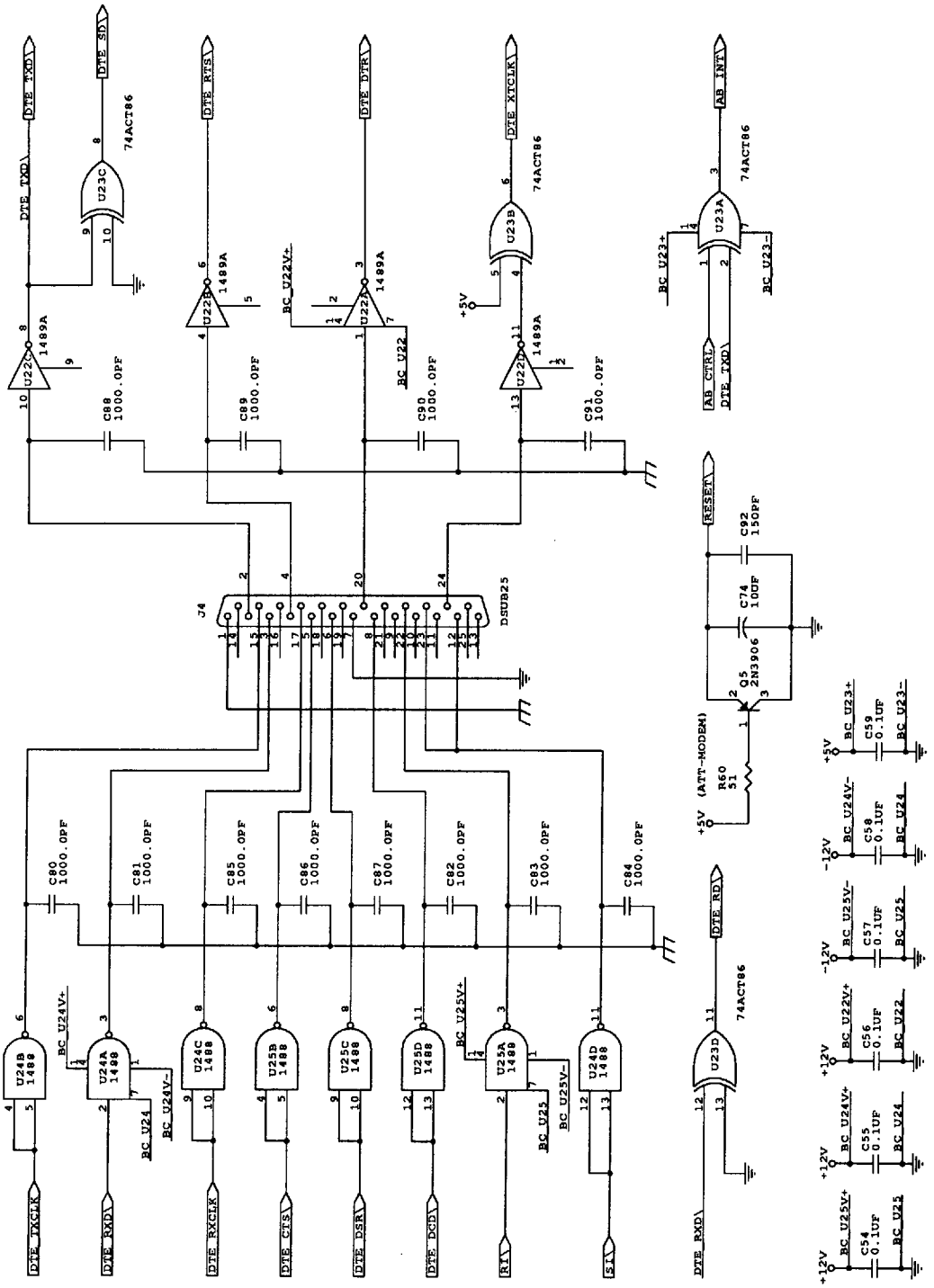
DeskTop Modem Serial Version Shematics — Sheet 3: DAA.

Design Guide (continued)



DeskTop Modem Serial Version Shematics — Sheet 4: Speaker Circuitry (optional).

Design Guide (continued)



DeskTop Modem Serial Version Shematics — Sheet 5: Serial Interface.

Design Guide (continued)

PAL Definitions for DeskTop Schematics

Definition for PAL 1 (Designated U17 on Schematics)

```
include P20L8;                    /* PAL20L8-FN pinout is for PLCC. */
                                  /* PAL speed < 30 ns for DMC-10.  */

/* input signals */
define  SA3     = pin2;          /* PC Address A3     - Combinatorial Input.*/
define  SA4     = pin3;          /* PC Address A4     - Combinatorial Input.*/
define  SA5     = pin4;          /* PC Address A5     - Combinatorial Input.*/
define  SA6     = pin5;          /* PC Address A6     - Combinatorial Input.*/
define  SA7     = pin6;          /* PC Address A7     - Combinatorial Input.*/
define  SA8     = pin7;          /* PC Address A9     - Combinatorial Input.*/
define  SA9     = pin8;          /* PC Address A10    - Combinatorial Input.*/
define  AEN     = pin9;          /* PC AEN            - Combinatorial Input.*/
define  A4      = pin10;         /* COM SELECT        - Combinatorial Input.*/
define  A8      = pin11;         /* COM SELECT        - Combinatorial Input.*/
define  IRQA    = pin13;         /* IRQ SELECT        - Combinatorial Input.*/
define  IRQB    = pin14;         /* IRQ SELECT        - Combinatorial Input.*/
define  INTRPT  = pin23;         /* UART IRQ          - Combinatorial Input.*/
define  OUT2    = pin1;          /* UART IRW ENABLE   - Combinatorial Input.*/

/* output signals */
define  SIO_EN = pin15;          /* UART Chip Enable      - Combinatorial Output.*/
define  NC1_    = pin16;         /* UNUSED OUTPUT         - Combinatorial Output.*/
define  NC2     = pin17;         /* UNUSED OUTPUT         - Combinatorial Output.*/
define  NC3     = pin18;         /* UNUSED OUTPUT         - Combinatorial Output.*/
define  IRQ2    = pin19;         /* PC IRQ2               - Combinatorial Output.*/
define  IRQ5    = pin20;         /* PC IRQ5               - Combinatorial Output.*/
define  IRQ3    = pin21;         /* PC IRQ3               - Combinatorial Output.*/
define  IRQ4    = pin22;         /* PC IRQ4               - Combinatorial Output.*/

/* Boolean Equation Segment */
! SIO_EN  =    (SA3 & SA5 & SA6 & SA7 & SA9 & !AEN &  SA8 &  SA4 &  A8 &  A4)
             | (SA3 & SA5 & SA6 & SA7 & SA9 & !AEN & !SA8 &  SA4 & !A8 &  A4)
             | (SA3 & SA5 & SA6 & SA7 & SA9 & !AEN &  SA8 & !SA4 &  A8 & !A4)
             | (SA3 & SA5 & SA6 & SA7 & SA9 & !AEN & !SA8 & !SA4 & !A8 & !A4);
! IRQ4    = !(INTRPT);
! IRQ3    = !(INTRPT);
! IRQ5    = !(INTRPT);
! IRQ2    = !(INTRPT);
  IRQ4.oe = (!OUT2 &  IRQB &  IRQA);
  IRQ3.oe = (!OUT2 & !IRQB &  IRQA);
  IRQ5.oe = (!OUT2 &  IRQB & !IRQA);
  IRQ2.oe = (!OUT2 & !IRQB & !IRQA);
```

Design Guide (continued)

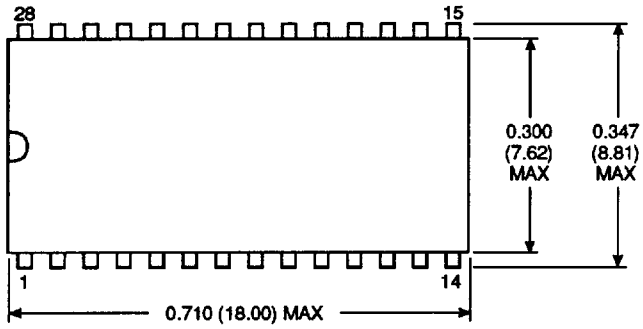
Definition for PAL 2 (Designated U26 on Schematics)

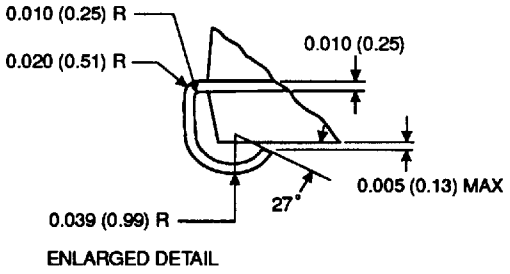
```
include P16L8;                    /* PAL16L8B-4FN pinout is for PLCC. */
                                  /* PAL speed < 37ns for DMC-10.     */

/* input signals */
define  WR       = pin1;          /* DMC-10 WR\              - Combinatorial Input.*/
define  PA5      = pin2;          /* DMC-10 Address A5       - Combinatorial Input.*/
define  PA6      = pin3;          /* DMC-10 Address A6       - Combinatorial Input.*/
define  PA7      = pin4;          /* DMC-10 Address A7       - Combinatorial Input.*/
define  IORQ     = pin5;          /* DMC-10 IORQ\            - Combinatorial Input.*/
define  PA18     = pin6;          /* DMC-10 Address A18      - Combinatorial Input.*/
define  PA19     = pin7;          /* DMC-10 Address A19      - Combinatorial Input.*/
define  AB_CTRL  = pin8;          /* Decoded DMC-10 INT0\    - Combinatorial Input.*/
define  DTE_TXD  = pin9;          /* DMSCC-10 RXDA           - Combinatorial Input.*/
define  NC1      = pin11;         /* No Connection 1         - Combinatorial Input.*/

/* output signals */
define  AB_INT   = pin12;         /* DMC-10 INT0\            - Combinatorial Output.*/
define  EE_EN    = pin13;         /* NVRAM Enable w/ WR\     - Combinatorial Output.*/
define  RAMSEL   = pin18;         /* RAM Chip Enable         - Combinatorial Output.*/
define  ROMSEL   = pin19;         /* To Derive EPRSEL0\      - Combinatorial Output.*/
define  SCC_CE   = pin14;         /* DMSCC-10 Chip Enable    - Registered Output.*/
define  ATT_HCS0 = pin15;         /* INTFC Low Bank Select   - Registered Output.*/
define  ATT_HCS1 = pin16;         /* INTFC High Bank Select  - Registered Output.*/
define  NC2      = pin17;         /* No Connection 2                            .*/

/* Boolean Equation Segment */
! AB_INT     =  AB_CTRL == DTE_TXD;
! EE_EN      =  ( !IORQ & !WR & PA7 & PA6 );
! RAMSEL     =  (  PA18 & PA19 );
! ROMSEL     =  ( !PA18 & !PA19 );
! SCC_CE     =  ( !IORQ & PA7 & !PA6);
! ATT_HCS0   =  ( !IORQ & !PA7 & PA6 & PA5);
! ATT_HCS1   =  ( !IORQ & !PA7 & PA6 & !PA5);
```

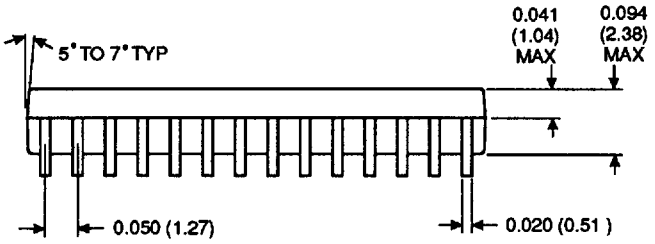
Package Outline Diagrams

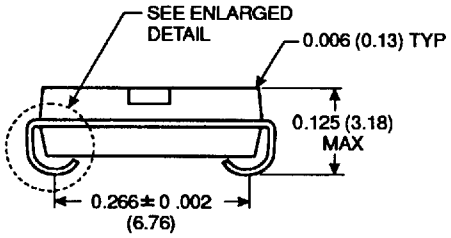
28-Pin SOJ

Dimensions are in inches and (millimeters).







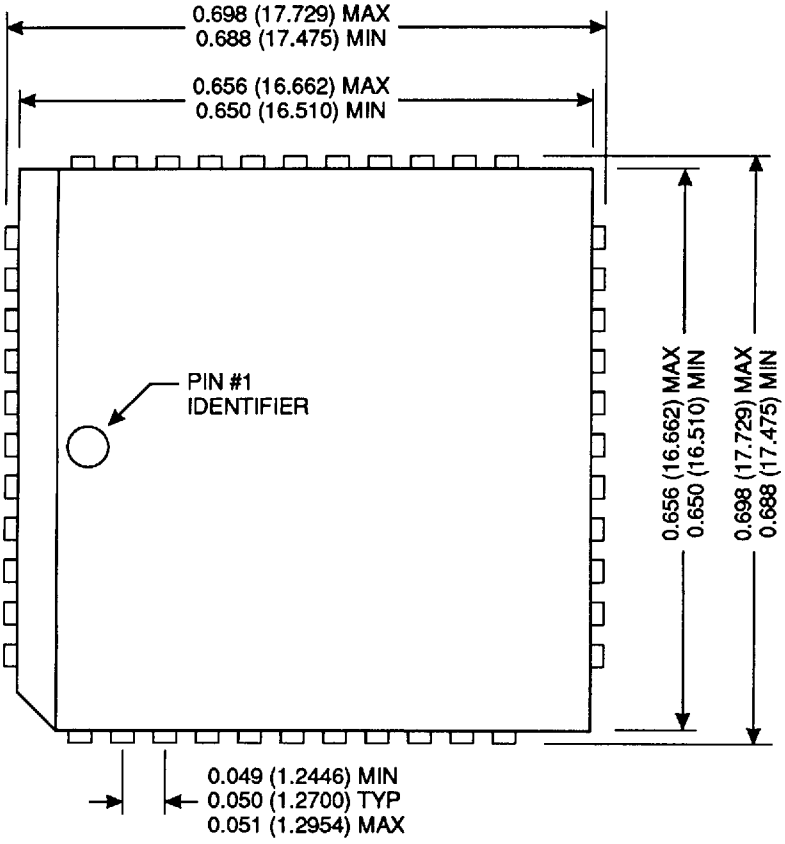


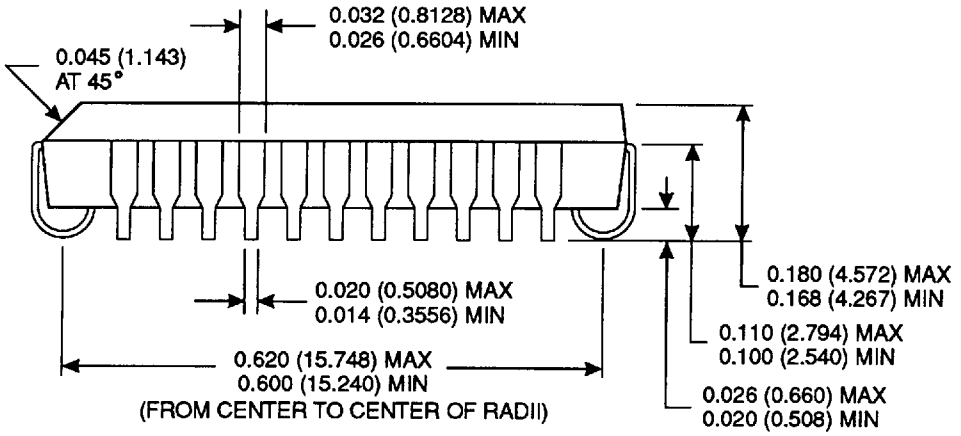
Note: Chip die to ambient thermal resistance is 75° C/W.

Package Outline Diagrams (continued)

44-Pin PLCC

Dimensions are in inches and (millimeters).

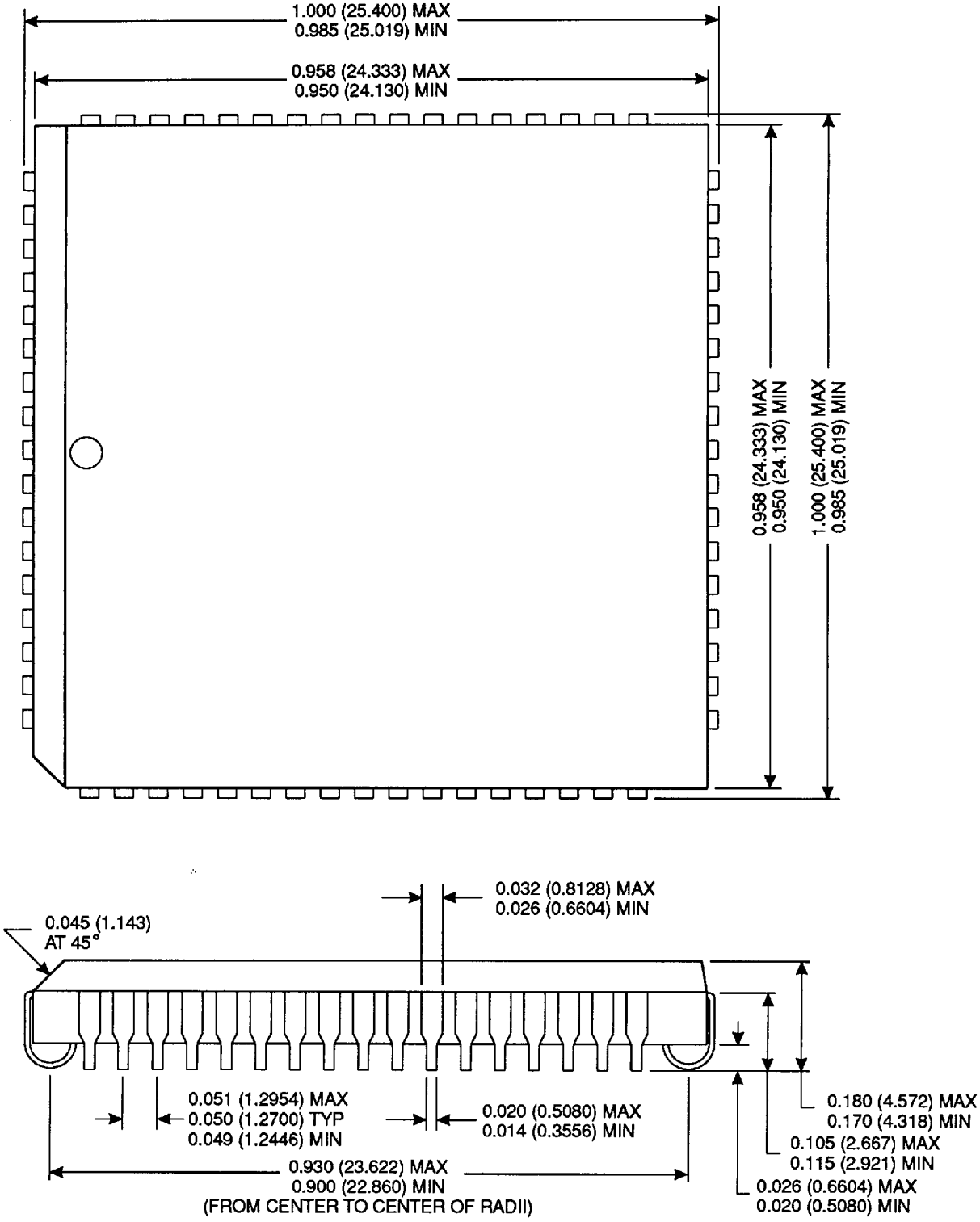




Package Outline Diagrams (continued)

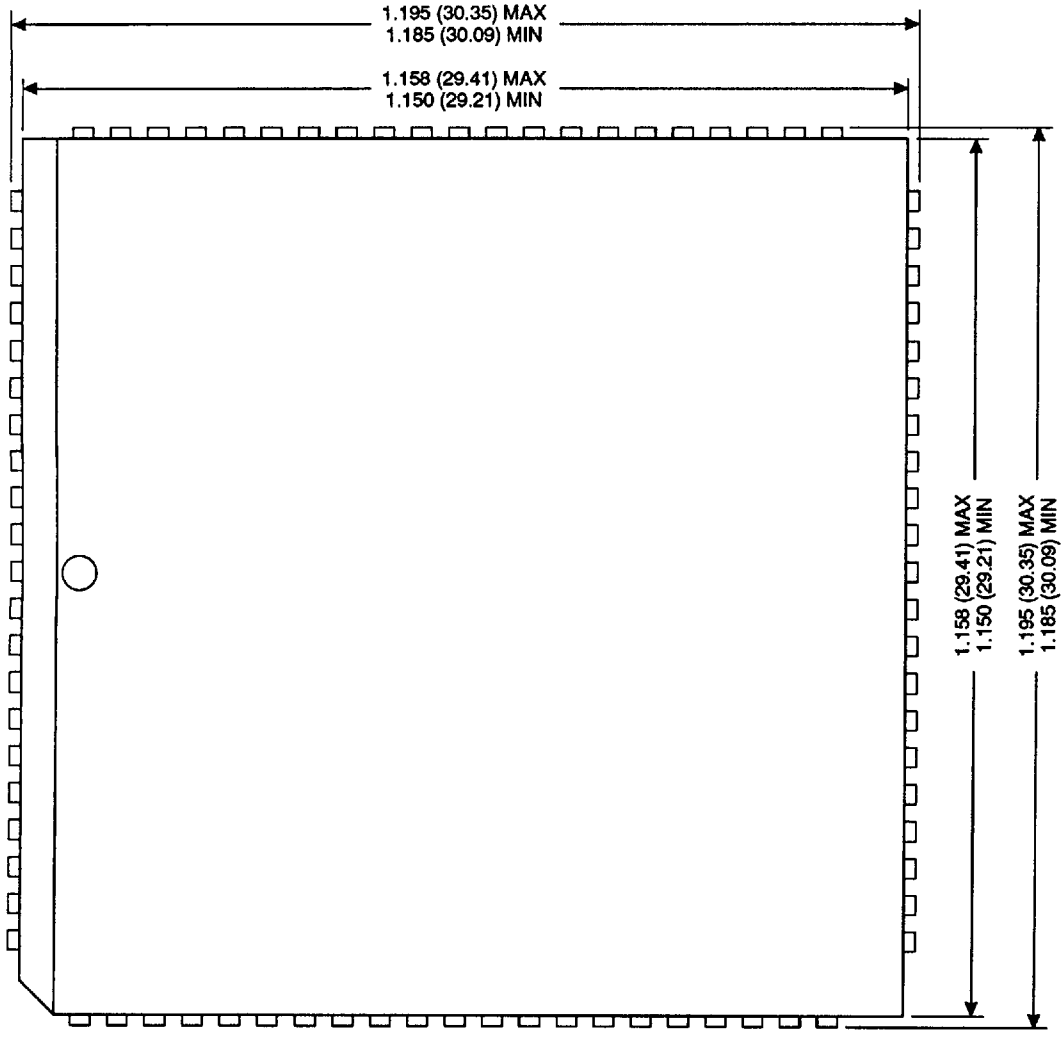
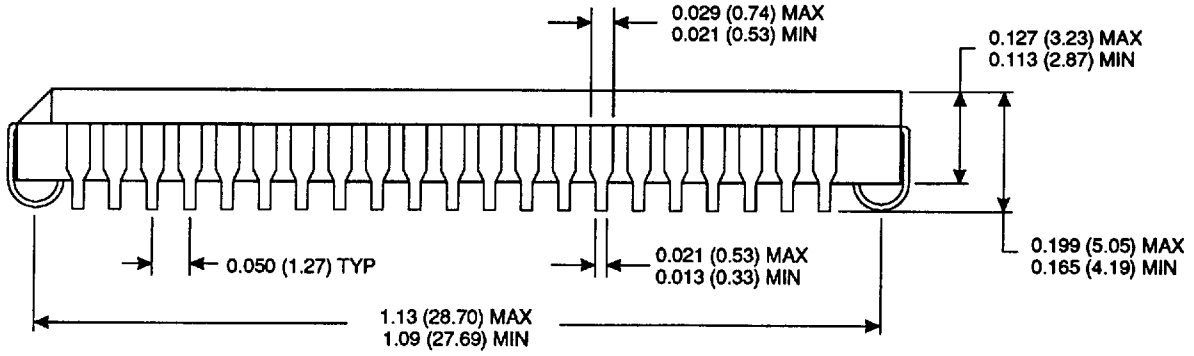
68-Pin PLCC

Dimensions are in inches and (millimeters).



A T & T MELEC (I C) 64E D 0050026 0009503 314 ATT2

Package Outline Diagrams (continued)

84-Pin PLCC

Dimensions are in inches and (millimeters).