Rockwell

SM224ATF SocketModem™ Family

INTRODUCTION

The Rockwell SM224ATF is a combination V.22 bis data and Group 3 facsimile (fax) CMOS modem in a compact socket-mountable module. This complete solution allows OEMs to bring new features to market immediately, with minimal engineering resources. Its socketable design provides system designers the flexibility to include optional modem functionality in any system product. The small size of the modem module makes it ideally suited for use directly on portable computer motherboards, in pocket modems, or anywhere users demand computer communications on the go.

The SM224ATL is identical to the SM224ATF except that fax modes are not included. In this document, all references to the SM224ATF apply to the SM224ATL except for fax modes and where otherwise stated.

Data modes, controlled by an industry standard 2400 "AT" command set, can transmit and receive up to 2400 bps.

Fax modes, controlled by a built-in EIA-578 Class 1 command interface, provide Group 3 transmit and receive functions.

Full error correction (V.42 LAPM, MNP2–4) and data compression (V.42 bis, MNP 5) capabilities are supported in both the SM224ATF and the SM224ATL through the Rockwell Protocol Interface (RPI™) and host communication software supporting the RPI. A list of communication software supporting the RPI can be obtained from your local Rockwell sales representative.

The SocketModem with the on-board modular DAA is a complete, self-contained modem engine, requiring only an OEM-supplied ROM, TIP and RING connections to the telephone line, and interface circuitry to the host computer. The SocketModem without the on-board modular DAA also requires an OEM-supplied external DAA.

The SM224ATF SocketModem is available with or without an on-board modular DAA, and is configured for either serial-RS-232, serial-TTL, or parallel host interface, and for either a simple, inexpensive sounducer or a voice-quality speaker circuit.

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FEATURES

- Data modes
  - CCITT V.22 bis (2400 bps), V.22 (1200 bps)
  - Bell 212A (1200 bps) and 103 (300 bps)
  - Enhanced AT commands
- Group 3 fax modes
  - V.29 (9600/7200 bps) transmit
  - V.27 ter (4800/2400 bps) transmit and receive
  - V.21 Channel 2 (300 bps) transmit and receive
- EIA-578 Service Class 1 commands
- V.42/MNP2–4 and V.42 bis/MNP 5 support (through RPI™ and host software) without additional hardware
- Data/fax discriminator and auto answering
- Communications software compatible
- Integrated call progress and dialing
- No external microcomputer or memory required
- Parallel or serial asynchronous DTE interface
- A/A1 relay control
- NVRAM interface allows storage of two user configurations and four 36-digit dial strings
- Automatic adaptive/ fixed compromise equalization
- Programmable sleep mode
- Full-duplex data mode test capabilities: Analog loop, local digital loop, and remote digital loop
- Half-duplex fax mode test capabilities
- Sounducer or voice-quality speaker circuit supported
- Automatic format/speed sensing
- Low power consumption (typical):

Interface	Operating	Sleep
Serial EIA-232:	365 mW	255 mW
Serial TTL:	175 mW	53 mW
Parallel:	170 mW	53 mW

- Single +5VDC power supply

ROCKS059

ORDERING INFORMATION

Part Number: **SMn-Hm-Dx-Ay-Pz**

n: Device Function	m: Host Interface	x: DAA Configuration	y: Audio Output	z: Pin Length
SM224ATF	**H0** = Parallel	**D0** = Customer Designed DAA	**A0** = SPKR2 Direct	**P0** = 0.400"
SM224ATL	**H1** = TTL Serial	**D1** = Off-board modular DAA	**A 1** = SPKR1 Sounducer	**P1** = 0.310"
	H2 = RS232 Serial	**D2** = Designer's Guide External HS DAA		
		D3 = Designer's Guide External LS DAA		
		D 4 = Modular DAA on SocketModem		

TECHNICAL SPECIFICATIONS

General

The SM224ATF modem is a full-featured, self-contained data/fax solution. No external microcontroller for data or fax control functions is required. Dialing, call progress, and telephone line interface functions are fully supported and controlled through the AT command set.

Data modes perform complete handshake and data rate negotiations. All tone and pattern detection required by the applicable CCITT or Bell standard are supported.

Fax modes support Group 3 fax requirements. Fax data and fax control (V.21 300 bps) performed by the modem is controlled and monitored through the fax EIA-578 Class 1 command interface. Full HDLC formatting, flag insertion/deletion, and CRC generation/checking is provided.

Both transmit and receive fax data is buffered within the modem. Data transfer to and from the DTE is flow controlled by XON/XOFF.

Configurations and Rates

The supported modem configurations and signalling rates are listed in Table 1. In data modes with serial interface selected, DTE rate offsets of +1%, -2.5% are accommodated by adding/deleting stop bits as required. In fax modes, the DTE rate is 19200 bps.

Operation

Modem operation is controlled by AT commands (Table 2), fax service class 1 commands (Table 3), and supporting S registers (Table 4). Result codes and messages are listed in Table 5.

Data Modes: Data rate selection is determined by the spee of the originating and answering modems:

Connect Speed Based on Originate Modem Answer Modem Rate (bps) Rate (bps)	300	1200	2400
300	300	300	300
1200	1200	1200	1200
2400	1200	1200	2400

Fax modes: Fax modes are negotiated as defined in T.30 and are implemented by AT+F commands. The AT+FCLASS=1 command causes entry into the fax mode from the data mode. Most other fax class 1 commands, which start with the AT+F prefix, are valid only in the fax mode. All data commands are valid in the fax mode except A/, On, &Tn, and the escape sequence (+++). The AT+FCLASS=0 command terminates the fax mode and causes entry into the data mode.

Table 1. Configurations and Rates

Configuration	Modulation	Transmitter Carrier Frequency (Hz) ±0.01%		Data Rate (bps)	Baud (Symbols/Sec.)	Bits Per Symbol	Constellation Points
Data Mode		**Answer**	**Originate**				
V.22bis	QAM	2400	1200	2400	600	4	16
V.22	DPSK	2400	1200	1200	600	2	4
Bell 212A	DPSK	2400	1200	1200	600	2	4
Bell 103	FSK	2225 M 2025 S	1270 M 1070 S	300	300	1	1
Fax Mode		**Receive**	**Transmit**				
V.29	QAM	N/A	1700	9600	2400	4	16
	QAM	N/A	1700	7200	2400	3	8
V.27ter	DPSK	1800	1800	4800	1600	3	8
	DPSK	1800	1800	2400	1200	2	4
V.21	FSK	1650 M 1850 S	1650 M 1850 S	300	300	1	1

Notes:

Legend:
QAM = Quadrature Amplitude Modulation
DPSK = Differential Phase Shift Keying
FSK = Frequency Shift Keying
M = Mark condition
S = Space Condition
N/A = Not Applicable

Table 2. "AT" Command Set Summary

Command	Function
A/	Re-execute command
A	Answer a call
Bn	Select CCITT or Bell Mode
Cn	Carrier control
Dn	Dial modifier
En	Command echo
F1	On-line character echo option
Hn	Disconnect (hangup)
In	Identification
Ln	Speaker volume
Mn	Speaker control
On	Go on-line
P	Force pulse dialing
Qn	Quiet Result codes control
Sn	Select S register as default
Sn=v	Set default S register to value
Sn?	Return the value of S register
T	Force DTMF dialing
Vn	Report codes form
Xn	Extended result codes
Yn	Long space disconnect
Zn	Soft reset and restore profile
&Cn	RLSD (DCD) option
&Dn	DTR option
&F	Recall (restore) factory profile
&Gn	Select guard tone
&Jn	Telephone jack control
&L0	Dial-up line operation
&M0	Asynchronous mode
&Pn	Pulse dial make/break ratio
&Q0	Asynchronous mode
&Sn	DSR override
&Tn	Test and diagnostic
&V	Display current configurations
&Wn	Store current configuration
&X0	Asynchronous data transmission
&Yn	Select default profile
&Zn=x	Store dial string to location n
%Dn	DTMF Level Attenuation
%J	Load Secondary Defaults
%Ln	Transmit Level Attenuation

Dial Modifier	Function
P	Pulse Dial
R	Originate Call in Answer Mode
S=n	Dial Stored Number
T	Tone Dial
W	Wait for Dial Tone
;	Return to Idle State
@	Wait for Quiet Answer Command
!	Flash Hook
,	Pause
0-9, A, B, C, D, #, *	Dial Digits/Characters

Table 3. Fax Command Set Summary

Fax Command	Function
+FCLASS=n	Service class
+F<command>?	Report Active Configuration
+F<command>=?	Report Operating Capabilities
+FAA=n	Data/Fax Auto Answer
+FF	Enhanced Flow Control
+FTS=n	Stop Transmission and Wait
+FRS=n	Receive Silence
+FTM=n	Transmit Data
+FRM=n	Receive Data
+FTH=n	Transmit Data with HDLC Framing
+FRH=n	Receive Data with HDLC Framing
+FRTn	Receive Test Data
+FTTn=m	Transmit Test Data
+Hn	Rockwell Protocol Interface (RPI) Enable

Table 4. S Register Summary

Register	Function
S0*	Rings to Auto-Answer
S1	Ring Counter
S2	Escape Character
S3	Carriage Return Character
S4	Line Feed Character
S5	Backspace Character
S6	Maximum time to Wait for Dial Tone
S7	Wait for Carrier
S8	Pause Time for Comma
S9	Carrier Detect Response Time
S10	Carrier Loss Disconnect Time
S11	DTMF Dialing Speed
S12	Escape Code Guard Time
S14*	General Bit Mapped Options
S16	Test Mode Bit Mapped Options (&T)
S17	Fax Mode Null Byte Timer
S18*	Test Timer
S19	Rockwell Protocol Interface Speed
S20	Fax Mode Inactivity Timer
S21*	General Bit Mapped Options
S22*	General Bit Mapped Options
S23*	General Bit Mapped Options
S24	Sleep Inactivity Timer
S25*	Delay to DTR Off
S26*	RTS-to-CTS Delay
S27*	General Bit Mapped Options
S28*	General Bit-Mapped Options

* Register value may be stored in one of two user profiles with the AT&W command.

Table 5. Result Codes and Messages

Digit Code	Word Code	Meaning
0	OK	Command line executed without errors
1	CONNECT	Connection at 300 bps
2	RING	Ringing signal detected
3	NO CARRIER	Carrier lost or never present
4	ERROR	Invalid command, checksum, error in command line, or command line exceeds 40 characters
5	CONNECT 1200	Connection at 1200 bps
6	NO DIALTONE	No dialtone detected
7	BUSY	Busy signal detected
8	NO ANSWER	No silence detected when dialing a system not providing a dialtone
10	CONNECT 2400	Connection at 2400 bps
+F4	+FCERROR	Fax carrier error
13	DATA	Connected as data modem during auto answer
15	FAX	Connected as fax modem during auto answer

Data/Fax Auto Answering

The modem can automatically determine if the incoming call is from a data or fax modem, make the appropriate connection, and inform the DTE of the connection type.

AT Command Format

Each command line must start with the AT prefix and be terminated with a carriage return (CR). Several commands may be included on one command line. A command line may contain up to 40 characters excluding the AT prefix and the terminating CR. A separator is not required between data commands. A semicolon (;) separator is required between fax commands.

AT commands are composed of 10-bit ASCII encoded asynchronous characters. The character format in data mode is 8 data bits with no parity, or 7 data bits with even, odd, or no (two stop bits) parity, at a data rate of 19200, 2400, 1200, or 300 bps. The character format in fax mode is 8 data bits with no parity at 19200 bps.

Data Modulation

The data modulation conforms to V.29, V.27 ter, V.22 bis, V.22, V.21, Bell 212A, or Bell 103, depending on the selected configuration. Transmitter and receiver spectrum shaping is provided in accordance with the applicable standard.

Equalization

Automatic adaptive equalization as well as fixed compromised equalization is provided to compensate for line distortions and to minimize the effects of intersymbol interference.

Scrambler/Descrambler

The modem incorporates a self-synchronizing scrambler/descrambler satisfying the applicable CCITT or Bell requirements.

Transmit Level

The transmit level is –10 dBm ±1 dB (at TIP and RING).

Transmit Tones

Answer Tone: An answer tone of 2100 Hz (V.22 bis, V.22, or T.30) or 2225 Hz (Bell 212A or 103) is generated.

Guard Tone: An 1800 Hz guard tone can be generated in all data modes.

Calling Tone: A 1100 Hz (0.5 seconds on, 3 seconds off) calling tone (T.30) is generated in the originate fax mode.

Receive Level

The receiver satisfies performance requirements for a received signal from –9 dBm to –43 dBm. The carrier detect is ON at –43 dBm and OFF at –48 dBm with a minimum of 2 dB hysteresis.

Receiver Tracking

The modem can accommodate carrier frequency offset up to ±7 Hz, and a transmit timing error of ± 0.01% (V.22 bis or V.27 ter) or ± 0.02% (V.22 or Bell 212A).

Low Power Sleep Mode

To conserve power, the SM224ATF is configured for Idle (power down) mode. Idle mode is entered whenever the modem is inactive beyond the time value specified by S24.

The Idle mode allows reduced power consumption with automatic recovery without additional circuitry. The modem exits Idle mode and returns to full operation whenever a ring signal occurs, the DTE writes to the modem (parallel interface), or DTR/ or TXD/ is asserted (serial interface).

HARDWARE INTERFACE

Parallel Interface

A 16450 UART-compatible parallel interface is provided.

Host Bus Interface. Eight data lines, three address lines, and four control lines are supported.

Serial/Indicator Interface

A DTE serial interface and indicator outputs are supported.

Serial Interface. An 8-line V.24/EIA-232-D or TTL logic serial interface to the DTE is supported.

LED Indicator Interface. Four direct connect LED indicator outputs are supported.

Speaker Interface

A speaker output, controlled by AT or V.25 bis commands, is provided for an optional OEM-supplied speaker or sounducer.

Line Interface

The SocketModem connects to the line interface circuitry in one of two ways: if an on-board modular DAA is used, the SocketModem connects to the telco line via a receive analog input, a transmit analog output, and a ring signal output.

If an external DAA is used, the SocketModem connects to the line interface circuitry via a receive analog input, two transmit analog outputs, and a ring signal input.

The SocketModem provides three relay control outputs to the line interface. These outputs may be used to control relays such as off-hook, A/A1, and talk/data.

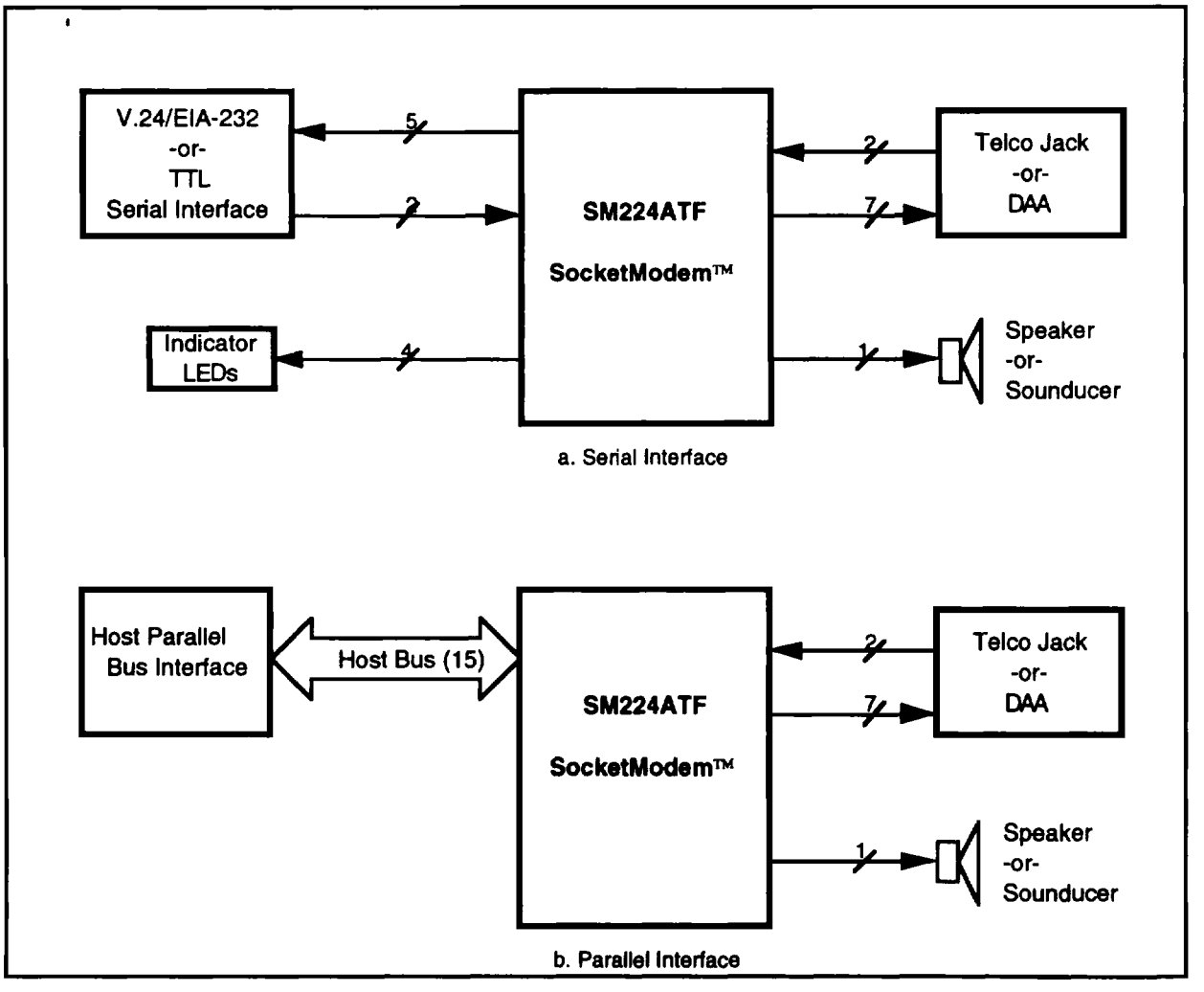

Figure 1. SocketModem Integrated System Block Diagram

LOW POWER MODES

Sleep Mode

Entry. The modem will enter the low power sleep mode when no line connection exists and no host activity occurs for the period of time specified in the S24 register. All SocketModem circuits are turned off except the internal MCU clock circuitry in order to consume lower power but are able to immediately wake up and resume normal operation.

Wake-up - Parallel Interface Configuration. Wake-up occurs when a ring signal occurs, or the host writes to the modem.

Wake-up - Serial Interface Configuration. Wake-up occurs when a ring signal occurs, or the DTE sends a character to the modem.

ADDITIONAL INFORMATION

Additional information is described in the SocketModem™ Designer's Guide (Order No. 1009) and the RC224ATF Modem Designer's Guide (Order No. 821).

HARDWARE INTERFACE

HARDWARE INTERFACE SIGNALS

The modem hardware interface signals for serial EIA-232, serial TTL, and parallel interface configurations are shown in Figures 2, 3 and 4, respectively.

The SocketModem pin assignments for serial EIA-232 interface selected are shown in Figure 2 and are listed in Table 6.

The SocketModem pin assignments for serial TTL interface selected are shown in Figure 3 and are listed in Table 7.

The SocketModem pin assignments for parallel interface selected are shown in Figure 4 and are listed in Table 8.

The SocketModem hardware interface signals are defined in Table 9.

The digital electrical characteristics for the hardware interface signals are listed in Table 10.

The analog electrical characteristics for the hardware interface signals are listed in Table 11.

The current and power requirements are listed in Table 12.

The absolute maximum ratings are listed in Table 13.

Table 14 shows the parallel interface registers and the corresponding bit assignments.

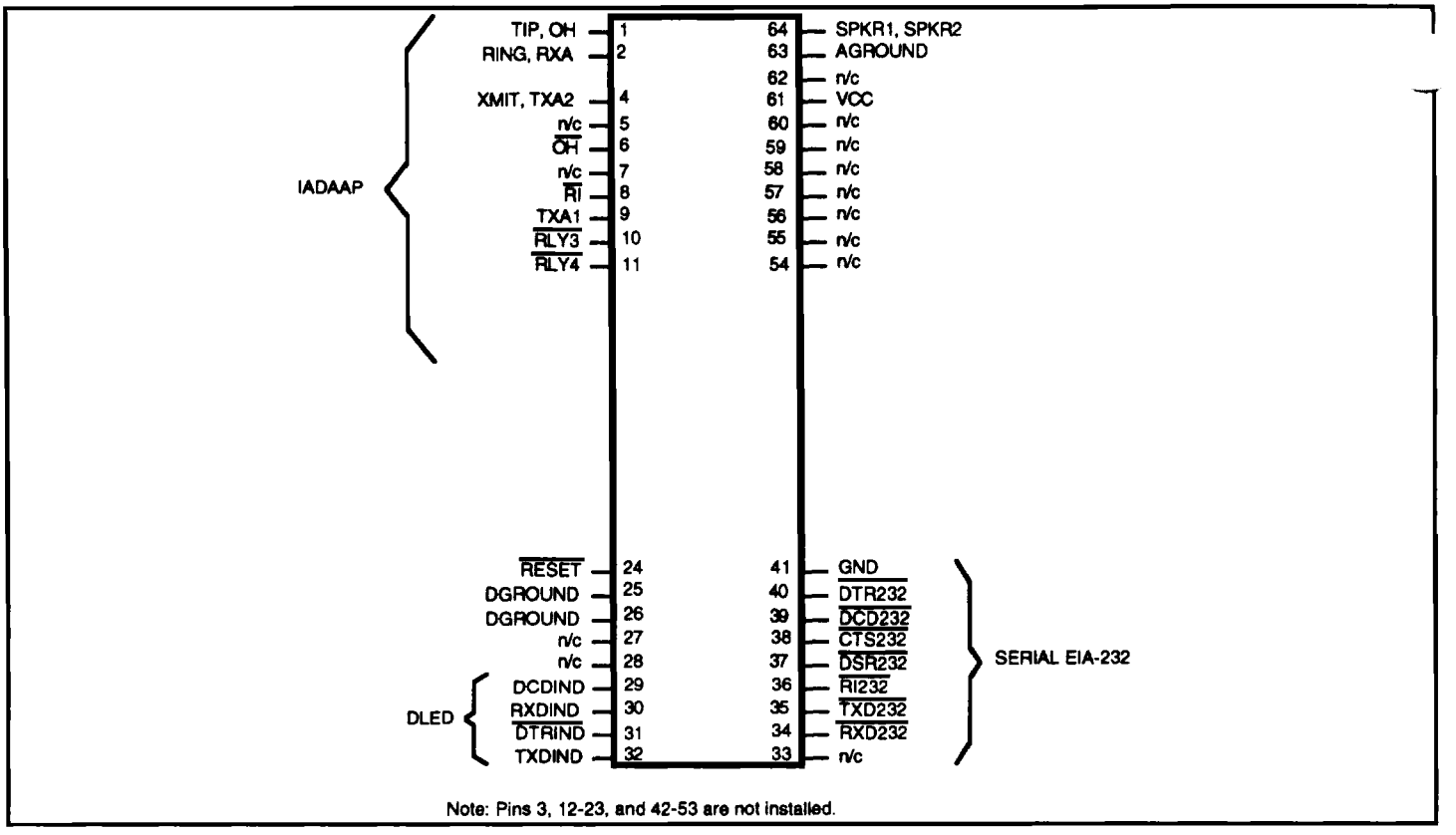

Figure 2. Serial EIA-232 Pinout

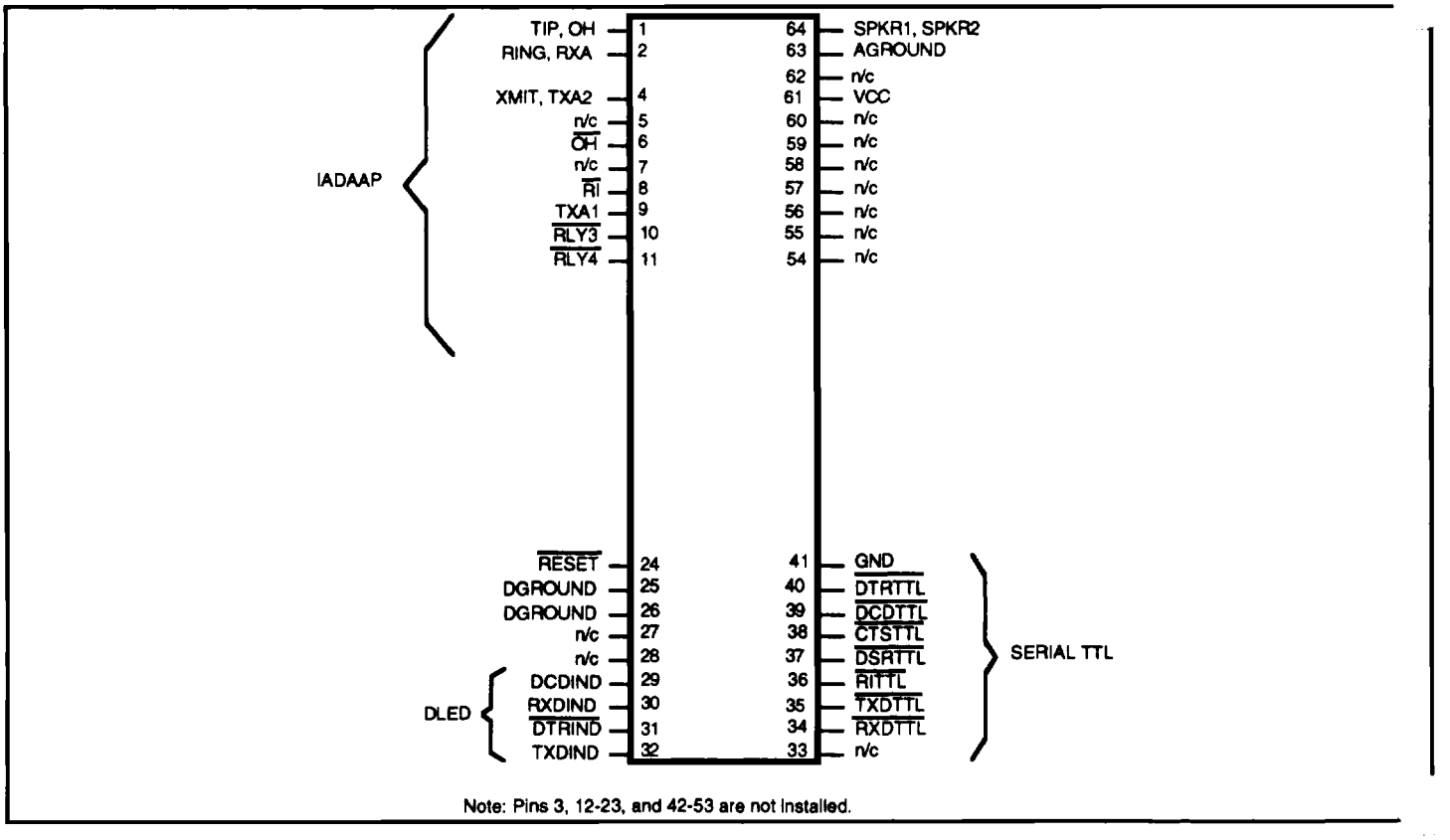

Figure 3. Serial TTL Pinout

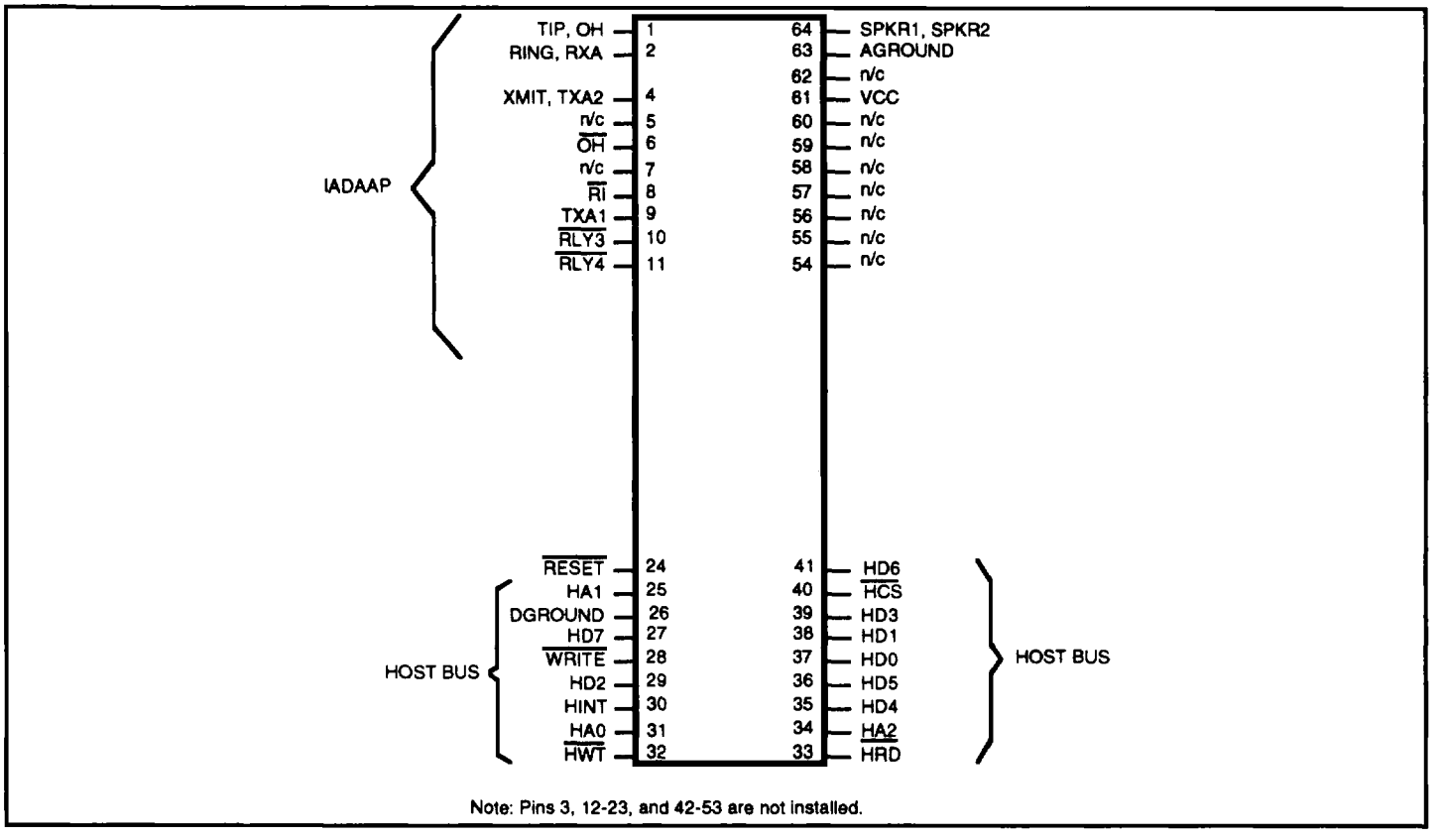

Figure 4. Parallel Pinout

Table 6. Serial EIA-232 Signals

Pin	Signal	I/O Type
1	TIP, OH	IF, IA
2	RING, RXA	IF, I(DA)
3	NO PIN	-
4	XMIT, TXA2	O(DD), O(DD)
5	N/C	-
6	OH/	OA
7	N/C	-
8	RI/	IA, OA
9	TXA1	O(DD)
10	RLY3/	OA
11	RLY4/	OA
12	NO PIN	-
13	NO PIN	-
14	NO PIN	-
15	NO PIN	-
16	NO PIN	-
17	NO PIN	-
18	NO PIN	-
19	NO PIN	-
20	NO PIN	-
21	NO PIN	-
22	NO PIN	-
23	NO PIN	-
24	RESET/	IC
25	DGROUND	-
26	DGROUND	GND
27	N/C	-
28	N/C	-
29	DCDIND	OG
30	RXDIND	OG
31	DTRIND/	OG
32	TXDIND	OG

Pin	Signal	I/O Type
33	N/C	-
34	RXD232/	OH
35	TXD232/	IH
36	RI232/	OH
37	DSR232/	OH
38	CTS232/	OH
39	DCD232/	OH
40	DTR232/	IH
41	GND	GND
42	NO PIN	-
43	NO PIN	-
44	NO PIN	-
45	NO PIN	-
46	NO PIN	-
47	NO PIN	-
48	NO PIN	-
49	NO PIN	-
50	NO PIN	-
51	NO PIN	-
52	NO PIN	-
53	NO PIN	-
54	N/C	-
55	N/C	-
56	N/C	-
57	N/C	-
58	N/C	-
59	N/C	-
60	N/C	-
61	VCC	PWR
62	N/C	-
63	AGROUND	GND
64	SPKR1, SPKR2	O(DF), O(DG)

Table 7. Serial TTL Signals

Pin	Signal	I/O Type
1	TIP, OH	IF, IA
2	RING, RXA	IF, I(DA)
3	NO PIN	-
4	XMIT, TXA2	O(DD), O(DD)
5	N/C	-
6	OH/	OA
7	N/C	-
8	RI/	IA, OA
9	TXA1	O(DD)
10	RLY3/	OA
11	RLY4/	OA
12	NO PIN	-
13	NO PIN	-
14	NO PIN	-
15	NO PIN	-
16	NO PIN	-
17	NO PIN	-
18	NO PIN	-
19	NO PIN	-
20	NO PIN	-
21	NO PIN	-
22	NO PIN	-
23	NO PIN	-
24	RESET/	IC
25	DGROUND	-
26	DGROUND	GND
27	N/C	-
28	N/C	-
29	DCDIND	OG
30	RXDIND	OG
31	DTRIND/	OG
32	TXDIND	OG

Pin	Signal	I/O Type
33	N/C/	-
34	RXDTTL/	OA
35	TXDTTL/	IA
36	RITTL/	OA
37	DSRTTL/	OA
38	CTSTTL/	OA
39	DCDTTL/	OA
40	DTRTTL/	IA
41	GND	GND
42	NO PIN	-
43	NO PIN	-
44	NO PIN	-
45	NO PIN	-
46	NO PIN	-
47	NO PIN	-
48	NO PIN	-
49	NO PIN	-
50	NO PIN	-
51	NO PIN	-
52	NO PIN	-
53	NO PIN	-
54	N/C	-
55	N/C	-
56	N/C	-
57	N/C	-
58	N/C	-
59	N/C	-
60	N/C	-
61	VCC	PWR
62	N/C	-
63	AGROUND	GND
64	SPKR1, SPKR2	O(DF), O(DG)

Table 8. Parallel Signals

Pin	Signal	I/O Type
1	TIP, OH	IF, IA
2	RING, RXA	IF, I(DA)
3	NO PIN	-
4	XMIT, TXA2	O(DD), O(DD)
5	N/C	-
6	OH/	OA
7	N/C	-
8	RI/	IA, OA
9	TXA1	O(DD)
10	RLY3/	OA
11	RLY4/	OA
12	NO PIN	-
13	NO PIN	-
14	NO PIN	-
15	NO PIN	-
16	NO PIN	-
17	NO PIN	-
18	NO PIN	-
19	NO PIN	-
20	NO PIN	-
21	NO PIN	-
22	NO PIN	-
23	NO PIN	-
24	RESET/	IC
25	HA1	IA
26	DGROUND	GND
27	HD7	IA/OA
28	N/C	-
29	HD2	IA/OA
30	HINT	OA
31	HA0	IA
32	HWT/	IA

Pin	Signal	I/O Type
33	HRD/	INPUT
34	HA2	INPUT
35	HD4	IA/OA
36	HD5	IA/OA
37	HD0	IA/OA
38	HD1	IA/OA
39	HD3	IA/OA
40	HCS/	INPUT
41	HD6	IA/OA
42	NO PIN	-
43	NO PIN	-
44	NO PIN	-
45	NO PIN	-
46	NO PIN	-
47	NO PIN	-
48	NO PIN	-
49	NO PIN	-
50	NO PIN	-
51	NO PIN	-
52	NO PIN	-
53	NO PIN	-
54	N/C	-
55	N/C	-
56	N/C	-
57	N/C	-
58	N/C	-
59	N/C	-
60	N/C	-
61	VCC	PWR
62	N/C	-
63	AGROUND	GND
64	SPKR1, SPKR2	O(DF), O(DG)

Table 9. Signal Descriptions

Label	I/O	Signal Name/Description
Vcc	PWR	**+5VDC ± 5%.**
DGROUND	GND	**Digital Ground.** Connect to Digital Ground on the interface circuit.
RESET/	IC	**Modem Reset.** The active low RESET/ input resets the SocketModem logic and returns the AT command set to the original factory default values and to "stored values" in NVRAM.
AGROUND	GND	**Analog Ground.** Connect to Analog Ground on the interface circuit.
TIP, OH	IF, OA	**TIP Signal From Telephone Line.** If an on-board modular DAA is used, this pin is TIP signal from the line jack. OH Signal from DAA. If external DAA is used, this pin is the OH off-hook signal.
RING, RXA/	IF, I(DA)	**RING Signal From Telephone Line.** If an on-board modular DAA is used, this pin is RING signal from the line jack. **RXA Signal from DAA.** If external DAA is used, this pin is the RXA analog receive signal.
XMIT, TXA2	O(OD), O(OD)	**XMIT.** If a modular DAA is used, this pin is XMIT, a single-ended transmit signal obtained by the sum of TXA1 and the inverted TXA2 input to the modular DAA. **TXA2.** If an external DAA circuit is used, this pin is TXA2. The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
TXA1	O(OD)	**TXA1.** The TXA1 and TXA2 outputs are differential outputs 180 degrees out of phase with each other.
RI/	IA, OA	**Ring Indicate.** If an on-board modular DAA is used, RI/ is an active-low ring-indicator output. If an external DAA is used, RI/ is an active-low ring-indicator input.
OH/	OD	**OH/ Relay Control.** OH/ is an open-drain output which can directly drive a relay with greater than 360Ω coil resistance and having a "must operate" voltage of no greater than 4.0 VDC. A heavier load, such as an electro-mechanical relay, requires the use of an external transistor. An external diode should be provided across the relay coil. The OH/ output is clamped off during power-on reset or the sleep mode. In a typical application, OH/ ON closes the normally-open Off-Hook relay and connects the modem to the telephone line (off-hook).
RLY3/	OA	**Relay 3 Control (A-A1/).** The active low RLY3/ output can be used to control the normally open key telephone hold indicator (A-A1) relay. A-A1/ active closes the normally open relay when the modem is connected to the line. Although TTL compatible, this output can be used to sink up to 5 mA with VOL≤0.65 V, making it suitable for opto relay control without external buffering.
RLY4/	OA	**Relay 4 Control (TLKRLY/).** RLY4/ is an open-drain output which can directly drive a relay with greater than 360Ω coil resistance and having a "must operate" voltage of no greater than 4.0 VDC. A heavier load, such as an electro-mechanical relay, requires the use of an external transistor. An external diode should be provided across the relay coil. The RLY4/ output is clamped off during power-on reset or the sleep mode. The RLY4/ output is activated and deactivated at the same time as the OH/ output. In a typical application, RLY4/ ON opens the normally-closed Talk/Data relay and disconnects the handset from the telephone line.

Table 9. Signal Descriptions (Cont'd)

Label	I/O	Signal Name/Description
HA0-HA2	IA	**Host Bus Address Lines 0-2.** During a host read or write operation, HA0-HA2 select an internal 16C450-compatible register. The state of the divisor latch access bit (DLAB) affects the selection of certain registers.
HD0-HD7	IA/OA	**Host Bus Data Lines 0-7.** HD0-HD7 are comprised of eight three-state input/output lines providing bi-directional communication between the host and the SocketModem. Data, control words, and status information are transferred through HD0-HD7.
HCS/	IA	**Host Bus Chip Select.** HCS/ input low selects the host bus.
HRD/	IA	**Host Bus Read.** HRD/ is an active low, read control input. When HCS/ is low, HRD/ low allows the host to read status information or data from a selected SocketModem register.
HWT/	IA	**Host Bus Write.** HWT/ is an active low, write control input. When HCS/ is low, HWT/ low allows the host to write data or control words into a selected SocketModem register.
HINT	OA	**Host Bus Interrupt.** HINT output is set high when the receiver error flag, received data available, transmitter holding register empty, or modem status interrupt has an active high condition. HINT is reset low upon the appropriate interrupt service or master reset operation.
		The Serial Interface signals are either TTL-level or EIA-232-level signals.
RXDTTL/, RXD232/	OA, OH	**Received Data.** Active low. The modem uses the RXD/ line to send data received from the telephone line to the DTE and to send modem responses to the DTE. During command mode, RXD/ data represents the modem responses to the DTE. Modem responses take priority over incoming data when the two signals are in competition for RXD/.
TXDTTL/, TXD232/	IA, IH	**Transmitted Data.** Active low. The DTE uses the TXD/ line to send data to the modem for transmission over the telephone line or to transmit commands to the modem. The DTE should hold this circuit in the mark state when no data is being transmitted or during intervals between characters.
RITTL/, RI232/	OA, OH	**Ring Indicate.** Active low. RI/ output ON (low) indicates the presence of an ON segment of a ring signal on the telephone line. The modem will not go off-hook when RI/ is active; the modem waits for RI/ to go inactive before going off-hook. For US models, RI/ will respond to ring signals in the frequency range of 15.3 Hz to 68 Hz. The ring signal cycle is typically two seconds ON, four seconds OFF. The OFF (high) condition of the RI/ input should be maintained during the OFF segment of the ring cycle (between rings) and at all other times when ringing is not being received.
DSRTTL/, DSR232/	OA, OH	**Data Set Ready.** Active low. DSR/ indicates modem status to the DTE. DSR/ OFF (high) indicates that the DTE is to disregard all signals appearing on the interchange circuits except Ring Indicator (RI/). DSR/ output is controlled by the AT&Sn command. If the AT&S1 option is selected, DSR/ will come ON in the handshaking state when carrier is detected in the originate mode or when carrier is first sent in the answer mode. In addition, if a test mode is entered (AT&T1, AT&T3, AT&T6-AT&T8), DSR/ will go off while the test is running. DSR/ goes OFF if DTR/ goes OFF. If AT&Q0 and AT&S0 are selected, DSR/ will remain on at all times regardless of the modem's current state.
CTSTTL/, CTS232/	OA, OH	**Clear To Send.** Active low. CTS/ is controlled by the modem to indicate whether or not the modem is ready to transmit data. CTS/ OFF indicates to the DTE that it should not transfer data across the interface on TXD. In data modes, the CTS/ output is always ON. In fax modes, CTS/ is optionally used for flow control.
DCDTTL/, DCD232/	OA, OH	**Data Carrier Detect.** Active low. When AT&C0 command is not in effect, DCD/ output is ON when a carrier is detected on the telephone line or OFF when carrier is not detected. DCD/ can be strapped ON using AT&C0 command.
DTRTTL/, DTR232/	IA, IH	**Data Terminal Ready.** Active low. The DTR/ input is turned ON (low) by the DTE when the DTE is ready to transmit or receive data. DTR/ ON prepares the modem to be connected to the telephone line, and maintains the connection established by the DTE (manual answering) or internally (automatic answering). DTR/ OFF places the modem in the disconnect state under control of the &Dn and &Qn commands. The effect of DTR/ ON and DTR/ OFF depends on the &Dn and &Qn commands. Automatic answer is enabled when DTR/ is ON if the "Answer Ring count" selectable option is not set to 0. Regardless of which device is driving DTR/, the modem will respond to an incoming ring by going off-hook and beginning the handshake sequence. The response of the modem to the DTR/ signal is very slow (up to 10 ms) to prevent noise from falsely causing the modem to disconnect from the telephone line.

Table 9. Signal Descriptions (Cont'd)

Label	I/O	Signal Name/Description
GND	GND	**Ground**
		LED drivers are open-drain inverter-driven (74HCT05) lines with 1.5KΩ, 1/10W pull-up resistors on-board.
DCDIND	OG	**DCD LED Indicator.** Active high DCD status.
RXDIND	OG	**RXD LED Indicator.** Active high RXD status.
DTRIND/	OG	**DTR LED Indicator.** Active how DTR status.
TXDIND	OG	**DCD LED Indicator.** Active high TXD status.
SPKR1, SPKR2	O(DF), O(DG)	**Speaker Analog Output.** The SPKR output reflects the received analog input signal. The SPKR is controlled by the ATMn command. SPKR1 output can drive an impedance as low as 300Ω. In a typical application, the SPKR output is an input to a sounducer, such as Star QMX-05. SPKR2 is a high-quality output from the SPKR pin of the data pump, and connects to an external speaker driver circuit.

Table 10. Digital Interface Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions[1]
Input High Voltage	V_{IH}				Vdc	
Type IA		2.0	–	V_{CC}		
Type IC		3.5	–	V_{CC}		
Type IH		-30	-	30		
Input Low Voltage	V_{IL}				Vdc	
Type IA and IC		–0.3	-	0.8		
Input Low Voltage	V_{IL}				Vrms	
Type IF		38	-	-		Note 2
Input Leakage Current	I_{IN}				µAdc	V_{IN} = 0 to V_{CC}
IA and IC		–	–	±10		
Output High Voltage	V_{OH}				Vdc	
Type OA		2.4	–	–		I_{LOAD} = – 100 µA
Type OD		–	–	V_{CC}		I_{LOAD} = 0 mA
Type OG		-	-	V_{CC}		
Type OH		5	8	-		
Output Low Voltage	V_{OL}				Vdc	
Type OA		–	–	0.4		I_{LOAD} = 1.6 mA
Type OB		–	–	0.4		I_{LOAD} = 0.8 mA
Type OD		–	0.75	–		I_{LOAD} = 15 mA
Type OG		0.5	-	-		I_{LOAD} = 8 mA
Type OH		-8	-5	-		
Three-State (Off) Current	I_{TS}			±25	µAdc	V_{IN} = 0.8 V to 4.5V

Notes:

1. Test Conditions: V_{CC} = 5V ± 5%, T_A = 0°C to 70°C (unless otherwise stated).

   Output loads: 50 pF + one TTL.

2. AC V_{rms} voltage between Tip and Ring, using the on-board modular DAA.

Table 11. Analog Characteristics

Name	Type	Characteristic	Value
RXA	I (DA)	Input Impedance	> 50KΩ
		Voltage Range	2.5 ±1.6V
TXA1, TXA2	O (DD)	Minimum Load	300Ω
		Maximum Capacitive Load	0.01 µF
		Output Impedance	10Ω
		Output Voltage	2.5 ±1.6V
		D.C. Offset	< 200 mV
SPKR2	O (DF)	Minimum Load	300Ω
		Maximum Capacitive Load	0.01 µF
		Output Impedance	10Ω
		Output Voltage	2.5 ±1.6V
		D.C. Offset	< 20 mV

Table 12. Current and Power Requirements

Mode	Current (ID)		Power (PD)	
	Typical Current @ 25°C	Maximum Current @ 0°C	Typical Power @ 25°C	Maximum Power @ 0°C
Serial EIA-232				
Normal mode	73 mA	75 mA	365 mW	395 mW
Sleep mode	51 mA	53 mA	255 mW	265 mW
Serial TTL				
Normal mode	35 mA	37 mA	175 mW	195 mW
Sleep mode	11 mA	12 mA	55 mW	65 mW
Parallel TTL				
Normal mode	34 mA	36 mA	170 mW	190 mW
Sleep mode	11 mA	12 mA	55 mW	63 mW

Notes:

1. Test conditions: VDD = 5.0 VDC for typical values; VDD = 5.25 VDC for maximum values.

Table 13. Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Supply Voltage	V_{DD}	-0.5 to +7.0	V
Input Voltage	V_{IN}	-0.5 to +5VD +0.5	V
Analog Inputs	V_{IN}	-0.3 to +5VA + 0.3	V
Voltage Applied to Outputs in High Z State	V_{HZ}	-0.5 to +5VD + 0.5	V
DC Input Clamp Current	I_{IK}	±20	mA
DC Output Clamp Current	I_{OK}	±20	mA
Static Discharge Voltage (@ 25°C)	V_{ESD}	±3000	V
Latch-Up Current (@ 25°C)	I_{TRIG}	±200	mA
Operating Temperature Range	T_A	-0 to +70	°C
Storage Temperature Range	T_{STG}	-55 to +125	°C

Table 14. Parallel Interface Registers

Register No.	Register Name	Bit No.							
		7	6	5	4	3	2	1	0
7	Scratch Register (SCR)	Scratch Register							
6	Modem Status Register (MSR)	Data Carrier Detect (DCD)	Ring Indicator (RI)	Data Set Ready (DSR)	Clear to Send (CTS)	Delta Data Carrier Detect (DDCD)	Trailing Edge of Ring Indicator (TERI)	Delta Data Set Ready (DDSR)	Delta Clear to Send (DCTS)
5	Line Status Register (LSR)	0	Transmitter Empty (TEMT)	Transmitter Buffer Register Empty (THRE)	Break Interrupt (BI)	Framing Error (FE)	Parity Error (PE)	Overrun Error (OE)	Receiver Data Ready (DR)
4	Modem Control Register (MCR)	0	0	0	Local Loopback	Out 2	Out 1	Request to Send (RTS)	Data Terminal Ready (DTR)
3	Line Control Register (LCR)	Divisor Latch Access Bit (DLAB)	Set Break	Stick Parity	Even Parity Select (EPS)	Parity Enable (PEN)	Number of Stop Bits (STB)	Word Length Select Bit 1 (WLS1)	Word Length Select Bit 0 (WLS0)
2	Interrupt Identify Register (IIR) (Read Only)	0	0	0	0	Pending Interrupt ID Bit 2	Pending Interrupt ID Bit 1	Pending Interrupt ID Bit 0	"0" if Interrupt Pending
1 **DLAB = 0**	Interrupt Enable Register (IER)	0	0	0	0	Enable Modem Status Interrupt (EDSSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETBEI)	Enable Received Data Available Interrupt (ERBFI)
1 **DLAB = 0**	Interrupt Enable Register (IER)	0	0	0	0	Enable Modem Status Interrupt (EDSSI)	Enable Receiver Line Status Interrupt (ELSI)	Enable Transmitter Holding Register Empty Interrupt (ETBEI)	Enable Received Data Available Interrupt (ERBFI)
0 **DLAB = 0**	Transmitter Buffer Register (THR)	Transmitter Buffer Register (Write Only)							
0 **DLAB = 0**	Receiver Buffer Register (RBR)	Receiver Buffer Register (Read Only)							
1 **DLAB = 1**	Divisor Latch MSB Register (DLM)	Divisor Latch MSB							
0 **DLAB = 1**	Divisor Latch LSB Register (DLL)	Divisor Latch LSB							

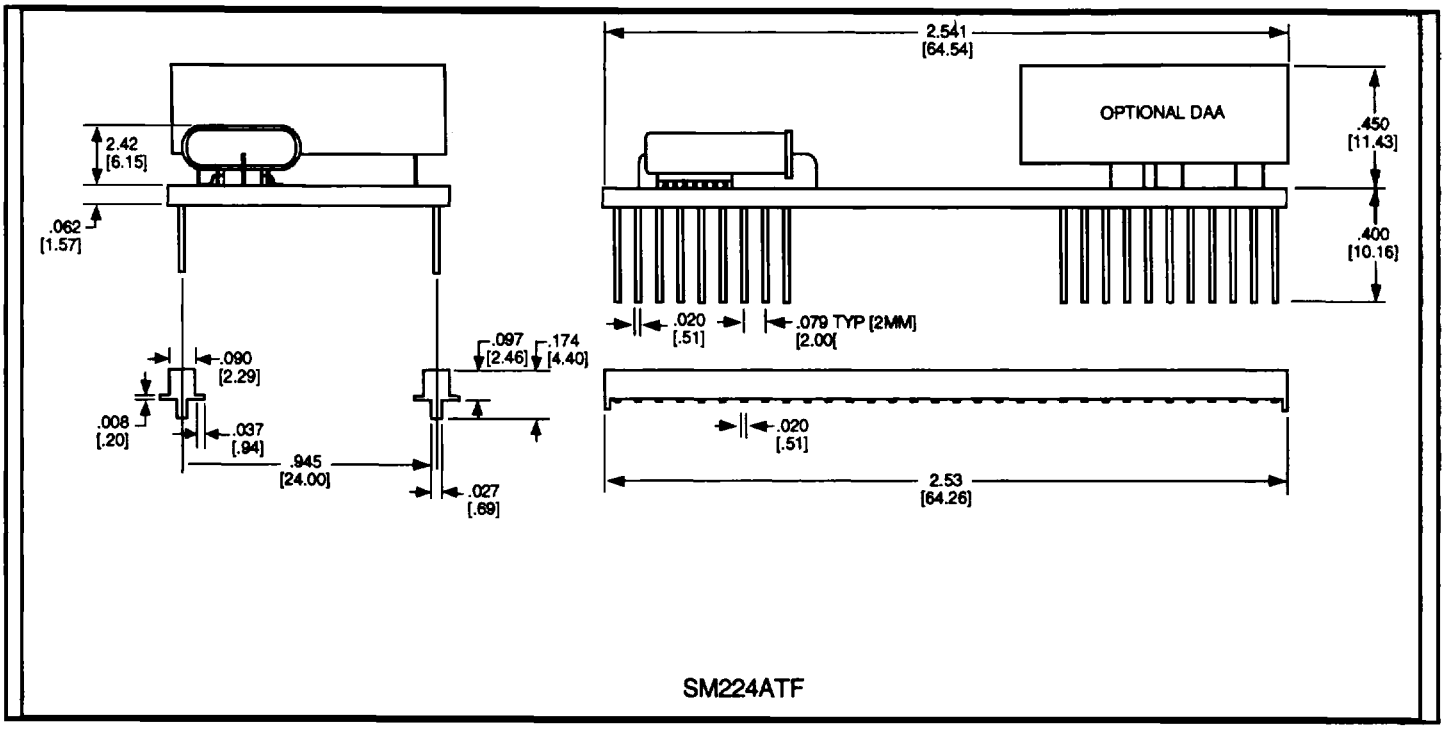

Figure 5 SM224ATF/SM224ATL Physical Dimensions

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