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SSI 73D2417
MNP5 Datacom/FAX Modem Device Set

Preliminary Data

T-75-33-90 December 1991

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DESCRIPTION

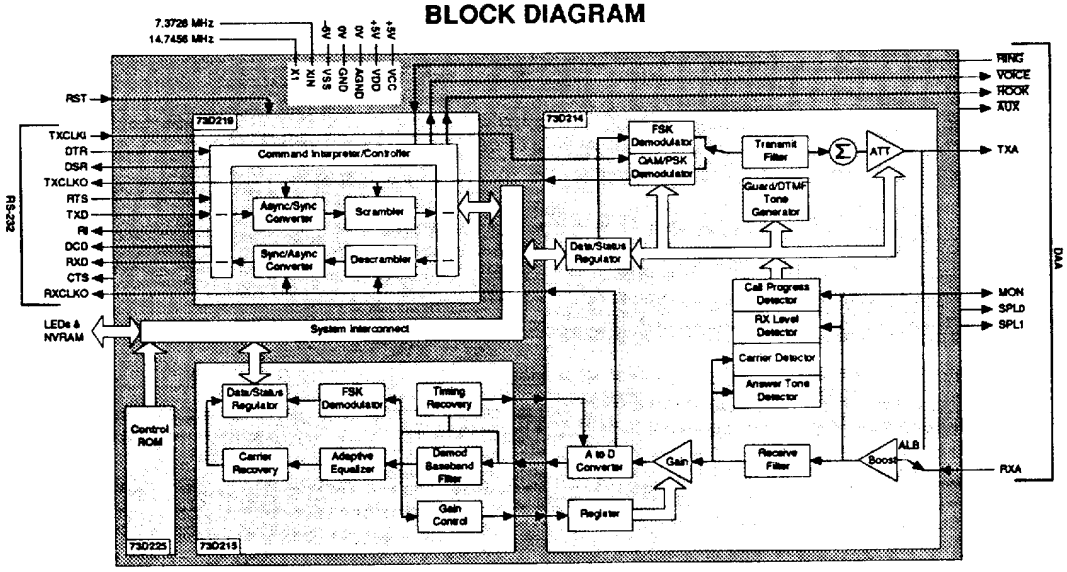
The SSI 73D2417 is a 4-chip CMOS device set that combines 2400 bit/s smart modem functions, including MNP 5, with FAX transmit capability. The 73D2417 includes operating modes compatible with V.22bis, V.22, V.21, and Bell 212A/103 communications standards. The 73D2417 also complies with V.27 ter FAX standards for transmit only FAX operation at 4800 and 2400 bit/s. All user interface and modem protocol is included in the 73D2417 to provide a turnkey modem/FAX design. In datacom mode, the 73D2417 command interpreter provides an AT command set compatible with industry standard software. MNP 5 capability can also be used during data communication to provide error free data transfer and compression, increasing the effective data throughput. In FAX mode, the 73D2417 provides a send only FAX function, operating at speeds of 4800 or 2400 bit/s, that can transmit to conventional FAX machines. The 73D2417 includes a subset of the industry standard AT user interface commands as defined by EIA/TIA, and is compatible

(continued)

FEATURES

- **2400 bit/s data communication, MNP5, and FAX capability combined in one product**
- **Multimode V.22bis/V.22/V.21, and Bell 212A/103 data com**
- **Microcom Networking Protocol (MNP) level 4 and 5 error control and data compression**
- **V.27ter FAX transmit capability at 4800/2400 bit/s rates for text, ASCII, or graphic files**
- **Standard 2400 bit/s AT and TIA/EIA Class 2 (FAX AT) command sets and features for software compatibility**
- **Supports external NVRAM for nonvolatile storage of user setup configurations**
- **Compact DIP or PLCC packages for surface mount designs**

BLOCK DIAGRAM



CAUTION: Use handling procedures necessary for a static sensitive component.

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DESCRIPTION (Continued)

with existing terminal software. The SSI 73D2417 is designed to provide an economical, high performance solution for applications needing both datacom and FAX capability. Its high level of performance and integrated features make it ideal for use in personal computer, portable terminal, and laptop FAX applications which communicate using the dialup telephone network.

OPERATION

The SSI 73D2417 is a complete datacom/FAX capable "smart" modem with MNP5 functions included in four CMOS ICs. The device set forms the basis for a high performance stand alone modem/FAX product with self contained AT command interpreter and features, RS232 or UART interface lines, and expansion for NVRAM for storage of default parameters.

MNP5 error control and data compression is included in datacom modes, and an EIA/TIA industry standard AT user interface is provided in FAX mode for compatibility with conventional software.

The SSI 73D2417 provides the QAM, PSK and FSK modulator/demodulator functions, call progress and handshake tone monitors, test modes and a tone generator capable of producing DTMF, answer and CCITT guard tones. This device supports the V.22bis, V.22, V.21 and Bell 212A/103 operating modes, both synchronous and asynchronous. The SSI 73D2417 is designed to provide functions needed for an intelligent modem and includes auto-dial/auto-answer, handshake with auto-fallback, and selectable pulse or DTMF dialing sequences to simplify these designs.

The SSI 73D2417 consists of four devices. The SSI 73M214 is an analog processor that performs the filtering, timing adjustment, level detection and modulation functions. The SSI 73D215 is the receiver digital signal processor. The SSI 73D219 is a command processor that provides supervisory control and command interpretation. A SSI 73D225 ROM provides storage for internal control software.

QAM MODULATOR/DEMODULATOR

The SSI 73D2417 scrambles and encodes the 2400 bit/s incoming data into quad bits represented by 16 possible signal points as specified by CCITT recommendation V.22bis. The modulator transmits this encoded data using either a 1200 Hz (originate mode) or 2400 Hz (answer mode) carrier. The demodulator recovers a data clock from the incoming signal and reverses this procedure. Adaptive equalization corrects for different line conditions by automatically changing filter parameters to compensate for line characteristics.

PSK MODULATOR/DEMODULATOR

In PSK mode the SSI 73D2417 modulates the 1200 bit/s incoming data using a subset of the QAM signal points as specified by CCITT recommendation V.22bis, V.22 and Bell 212A. For FAX operation, the modulator conforms to V.27 ter signal point locations. The PSK demodulator is similar to the QAM demodulator.

FSK MODULATOR/DEMODULATOR

The FSK transmitter frequency modulates the analog output signal using two discrete frequencies to represent the binary data. The Bell 103 standard frequencies of 1270 and 1070 Hz (originate mark & space) and 2225 and 2025 Hz (answer mark & space) or the V.21 standard frequencies of 980 and 1180 Hz (originate mark and space) and 1650 and 1850 Hz (answer mark and space) are used when this mode is selected. Demodulation involves detecting the receive frequencies and decoding them into the appropriate binary value. The speed rate may be any up to 300 bit/s.

PASSBAND FILTERS AND EQUALIZERS

A bandsplit filter is included to shape the amplitude and phase response of the transmit signal to a square root of 75% raised cosine and provide rejection of out-of-band signals in the receive channel.

ASYNCHRONOUS MODES

The asynchronous mode is used for communication between asynchronous terminals which may vary the data rate from +1.5% to -2.3% from the nominal 1200 or 2400 value. When transmitting in this mode the serial data on the TXD input is passed through a rate converter which inserts or deletes stop bits in the serial bit stream in order to output a signal whose data rate is accurate to 0.01%. The signal is routed to a data scrambler (following the CCITT V.22bis algorithm) and

into the modulator. The SSI 73D2417 recognizes a break signal and handles it in accordance with BELL 212A specifications. Received data is processed in a similar fashion except that the rate converter now acts to reinsert any deleted stop bits. An incoming break signal will be passed through without incorrectly inserting a stop bit.

SYNCHRONOUS MODES

Synchronous operation is possible with the PSK or QAM mode at 1200 or 2400 bit/s. Operation is similar to that of the asynchronous mode except that data must be synchronized to a provided clock and no variation in data transfer rate is allowable. Serial input data appearing at TXD must be valid on the falling edge of TXCLK. Receive data at the RXD output is clocked out on the rising edge of RXCLK. The async/synch converter is bypassed when synchronous mode is selected.

AUTOMATIC HANDSHAKE

The SSI 73D2417 will automatically perform a complete handshake as defined by the V.22bis, V.22 and Bell 212A/103 standards to connect with a remote modem. The SSI 73D2417 automatically determines the speed and operating mode and adjusts its operation to correspond to that of an answering modem when originating a call.

TEST MODES

The SSI 73D2417 allows use of Analog Loopback, Digital Loopback and Remote Digital Loopback test modes. Full test mode capability allows testing of the modem and interface functions from the local terminal using the analog loopback command, or remotely using the RDL command. The digital loopback command must be entered at the remote modem.

ADAPTIVE EQUALIZATION WITH AUTO-RETRAIN

The SSI 73D2417 uses adaptive equalization which automatically compensates for varying line characteristics by adjusting taps on a multi-tap FIR filter. Optimum performance is obtained with this technique over a wide range of line conditions. When the line quality deteriorates to a specified level the SSI 73D2417 can automatically initiate a retrain of the equalizer to re-establish data communications without the need to go through a complete handshake sequence.

AT COMMAND INTERPRETER

The SSI 73D2417 includes an AT command interpreter which is compatible with the Hayes 2400 Smartmodem™ command set. Functions and features included with intelligent modems are provided by the SSI 73D2417 command interpreter.

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NON-VOLATILE MEMORY

The SSI 73D2417 supports connection to an external non-volatile memory (i.e., 93C46) to store a dial string and the current AT command configuration.

MICROCOM NETWORKING PROTOCOL

Error control features of the Microcom Networking Protocol (MNP) Level 4 and data compression Level 5 are available through AT commands. Throughput increases of up to 20% are available with MNP4 and 200% with MNP5. In either case, data passed is error-free.

FAX TRANSMIT CAPABILITY

The 73D219 Controller, when operating in FAX mode, sends data to a digital-to-analog converter, the output of which is converted from a current to a voltage and filtered to emulate the output of a V.27 FAX modulator. This, in conjunction with the 300 bit/s capability of the basic modem, provides the hardware necessary to communicate with a FAX machine at 2400 or 4800 bit/s. Firmware necessary to dial a FAX call, determine the capabilities of the remote receiver and pass the FAX traffic is included.

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SPEED/PROTOCOL COMPATIBILITY GUIDE

Calling a:			73D2417 Originating as:				
			Bell		CCITT		
			300	1200	300	1200	2400
Bell	300	(103)	300	300	-	-	300
	1200	(212)	300	1200	-	1200	1200
	2400[1]	(224)	300	1200	-	1200	2400
CCITT	300	(V.21)	-	-	300	-	-
	1200	(V.22)	300	1200	-	1200	1200
	2400	(V.22bis)	300	1200	-	1200	2400

Called from a:			73D2417 Answering as:				
			Bell		CCITT		
			300	1200	300	1200	2400
Bell	300	(103)	300	300	-	-	300
	1200	(212)	300	1200	-	1200	1200
	2400	(224)	300	1200	-	1200	2400
CCITT	300	(V.21)	-	-	300	-	-
	1200	(V.22)	300	1200	-	1200	1200
	2400	(V.22bis)	300	1200	-	1200	2400

[1] Bell 2400 is the same as V.22bis using a 2225 Hz answer tone without unscrambled marks.

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HARDWARE INTERFACE

DEVICE SET INTERCONNECT

LABEL	I/O*	PIN CONNECTION					DESCRIPTION
		73M214	73D215	73D218	73D221 DIP	73D221 SMT	
VPP	I		1		1	2	+5V
INT	I		17				+5V
$\overline{EA}$	I			31			+5V
EXADCC	I	19					GND
$\overline{DACK}$	I		2				+5V
CLK	S	16	15				7.3728 MHz
$\overline{RXINT}$	S		5	13			Rx Interrupt
$\overline{TXINT}$	S	21		12			Tx Interrupt
RST	S		16	1			
FSK	S		4	7			
$\overline{RD}$	S	3	25	17	22	25	
$\overline{WR}$	S	4	24	16			
D0	I/O	5	6	39	11	13	Data Bus 0
D1	I/O	6	7	38	12	14	Data Bus 1
D2	I/O	7	8	37	13	15	Data Bus 2
D3	I/O	8	9	36	15	18	Data Bus 3
D4	I/O		10	35	16	19	Data Bus 4
D5	I/O		11	34	17	20	Data Bus 5
D6	I/O		12	33	18	21	Data Bus 6
D7	I/O		13	32	19	22	Data Bus 7
SIN	S	10	22				
SOUT	S	11	21				
SIRQ	S	9	23				
SCK	S	13	18				
$\overline{SEN}$	S	12	19,20				
A0	S				10	11	Address Bus 0
A1	S				9	10	Address Bus 1
A2	S				8	9	Address Bus 2
A3	S				7	8	Address Bus 3
A4	S				6	7	Address Bus 4
A5	S				5	6	Address Bus 5
A6	S				4	5	Address Bus 6
A7	S				3	4	Address Bus 7
A8 (AH0)	S		27	21	25	29	Address Bus 8

* "S" refers to System Interconnect

HARDWARE INTERFACE (Continued)

DEVICE SET INTERCONNECT

LABEL	I/O	PIN CONNECTION					DESCRIPTION
		73M214	73D215	73D218	73D221 DIP	73D221 SMT	
A9 (AH1)	S				24	28	Address Bus 9
A10 (AH2)	S				21	24	Address Bus 10
A11 (AH3)	S				23	27	Address Bus 11
A12 (AH4)	S				2	3	Address Bus 12
A13 (AH5)	S				26	30	Address Bus 13
A14 (AH6)	S				27	31	Address Bus 14
A15 (AH7)	S						Address Bus 15
$\overline{CE}$	I				20	23	0V
ALE	S	1		30			
DSP/$\overline{CS}$	S		26				
$\overline{PSEN}$	S			29	22		Program Store Enable
$\overline{CE}$					20		GND

NVRAM INTERFACE

NVRCE	I			14			NVRAM CE (active high)
TXD	I/O			10			NVRAM DI/DO
RXD	I			11			NVRAM SK

POWER SUPPLIES AND CLOCKS

LABEL	I/O	PIN CONNECTION					DESCRIPTION
		73M214	73D215	73D218	73D225 DIP	73D225 SMT	
VDD	I			40			Positive supply (analog +5V)
VCC	I	28	28		28		Positive supply (digital +5V)
VSS	I	14					Negative supply (analog -5V)
AGND	I	26					Analog ground
GND	I	15	14	20	14	16	Digital ground
X1	I			19			XTAL input 14.7456 MHz
X2	O			18			XTAL output 14.7456 MHz
XIN	I	18					Clock input 7.3728 MHz
RST	I			9			Reset (10 µF & 8.2 kΩ)
Vpp			1				+5V

HARDWARE INTERFACE (Continued)

DAA INTERFACE

LABEL	I/O	PIN CONNECTION					DESCRIPTION
		73M214	73D215	73D218	73D225 DIP	73D225 SMT	
RXA	I	27					Receive analog from DAA
TXA	O	20					Transmit analog to DAA
MON	O	25					Audio monitor
$\overline{HOOK}$	O			8			Off hook relay control

RS-232/V.24 INTERFACE

$\overline{RI}$	O			3			Ring indicator output
TXD	I			10			Digital data from terminal
RXD	O			11			Digital receive data
DCD	O			2			Data carrier detect
DSR	O						Data set ready
TXCLK1	I	22					External Tx sync clock input
RXCLK	O	24		15			Receive clock ouptut
TXCLK	O	23		15			Transmit clock output
CTS	O			5			Clear to send
RTS	I			1			Request to send
DTR	I			4			Indicates DTE available

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AT COMMAND SUMMARY*

Command	Description
AT	command prefix – precedes command line
<CR>	carriage return character – terminates command line
A	go into answer mode; attempt to go to on-line state
A/	re-execute previous command line; not preceded by AT nor followed by <CR>
B0	select CCITT V.22 standard for 1200 bit/s communication
B1	***select Bell 212A standard for 1200 bit/s communication***
D	dial number that follows; attempt to go to on-line state, originate mode
	dial modifiers:
T	tone dial
P	pulse dial
W	Wait for dial tone
,	delay processing of next character
@	wait for quit answer
!	hookflash
;	return to command state after dialing
R	reverse mode (to call an originate - only modem)
S=n	dial a telephone number stored with the & Zn=xxx command
E0	disable character echo in command state
E1	***enable character echo in command state***
H0	go on hook (hang up)
H1	go off hook; operate auxiliary relay
I0	request product indentification code
I1	perform checksum on firmware ROM; return checksum
I2	perform checksum on firmware ROM; returns OK or ERROR result codes
L0 or L1	low speaker volume
L2	***medium speaker volume***
L3	high speaker volume
M0	speaker off
M1	***speaker on until carrier detected***
M2	speaker always on
M3	speaker on until carrier detected, except during dialing
O0	go to on-line state
O1	go to on-line state and initiate equalizer retrain at 2400 bit/s
Q0	***modem returns result codes***
Q1	modem does not return result codes
Sr	set pointer to register "r"
Sr=n	set register "r" to value "n"
Sr?	display value stored in register "r"
V0	display result codes in numeric form
V1	***display result codes in verbose form (as words)***
X0	enable features represented by result codes 0-4
X1	enable features represented by result codes 0-5, 10-12
X2	enable features represented by result codes 0-6, 10-12
X3	enable features represented by result codes 0-5, 7, 10-12
X4	***enable features represented by result codes 0-7, 10-12***
Y0	***disable long space disconnect***
Y1	enable long space disconnect
Z0	reset modem
&C0	***assume data carrier always present***
&C1	track presence of data carrier
&D0	***ignore DTR signal***
&D1	assume command state when an on-to-off transition of DTR occurs
&D2	hang up and assume command state when an on-to-off transition of DTR occurs
&D3	reset when an on-to-off transition of DTR occurs
&F	recall factory settings as active configuration
&G0	***no guard tone***
&G1	550 Hz guard tone
&G2	1800 Hz guard tone
&J0	***RJ-11/RJ-41S/RJ-45S telco jack***
&J1	RJ-12/RJ-13 telco jack
&M0	***asynchronous mode***
&M1	synchronous mode 1
&M2	synchronous mode 2
&M3	synchronous mode 3
&P0	select 39% / 61% make / break ratio (United States)
&P1	select 33% / 67% make / break ratio (United Kingdom / Hong Kong)
&R0	CTS is always ON
&R1	CTS is always ON
&S0	DSR is always ON
&S1	DSR is always ON
&T0	terminate test in progress
&T1	initiate local analog loopback
&T3	initiate local digital loopback
&T4	***grant request from remote modem for RDL***
&T5	deny request from remote modem for RDL
&T6	initiate remote digital loopback
&T7	initiate remote digital loopback with self test
&T8	initiate local analog loopback with self test
&V	view active configuration, user profiles, and stored numbers
&W0	save storable parameters of active configuration
&W1	store current active configuration as profile as stored profile #1
&X0	***modem provides transmit clock signal***
&X1	data terminal provides transmit clock signal
&X2	receive carrier provides transmit clock signal
&Y0	select stored profile #0 as the default user profile
&Y1	select stored profile #1 as the default user profile
&Zn=x	store phone number "x" in location "n" (0-3)

Note: ***Italicized*** parameters indicate default settings. If a parameter (0, 1, etc.) is not specified, the modem assumes the 0 parameter.

* Hayes Standard AT Command Set as implemented in Hayes Smartmodem 2400™.

If the NovRAM has not been initialized it may be necessary to Power down/Power up and type *AT&F&W<cr>* to properly initialize modem state.

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MNP COMMANDS

Command	Description
%An	**Where n is a decimal integer between 0 and 127 indicating an ASCII character (default = 0, the auto-reliable fallback character is disabled).**
\An	**Maximum block size**
	\A0 Sets the MNP block size to 64 characters
	\A1 Sets the MNP block size to 128 characters
	\A2 Sets the MNP block size to 192 characters
	\A3 Sets the MNP block size to 256 characters
%Cn	**Compression control**
	%C0 Disable data compression during MNP 5 Reliable Link connection
	%C1 Enable data compression during MNP Class 5 Reliable Link connection
\Gn	**Modem port flow control**
	\G0 Disable modem port flow control
	\G1 Enable modem port flow control
\Jn	**Rate adjust**
	\J0 Disable speed adjust at serial port
	\J1 Enable speed adjust to match serial port
\Kn	**Break control**
	\K0 Do not send a break to the remote system
	\K1 Empty data buffers and immediately send a break to the remote system
	\K2 Immediately send a break to the remote terminal or computer
	\K3 Send a break to the remote modem in sequence with data
\Nn	**Operating mode**
	\N0 Set Normal mode
	\N1 Set Direct mode
	\N2 Set Reliable mode
	\N3 Set Auto-Reliable mode
	\N4 Set V.42 (LAP-M) mode
\O	**Originate mode**
\Qn	**Flow control**
	\Q0 Disable flow control
	\Q1 Enable XON/XOFF flow control
	\Q2 Enable hardware (RTS/CTS) flow control
	\Q3 Enable bidirectional hardware flow control
	\Q4 Enable unidirectional software flow control
	\Q5 For unidirectional hardware flow control, keep CTS OFF until connection is established
	\Q6 Keep CTS off until connection for bidirectional hardware flow control is established
\Tn	**Inactivity timer**
	\T0 Disables timer
	\Tn Any number between 0 and 90 specifies minutes. Default is 0, no timeout
\U	**Accept a reliable Link request, independent of whether or not the modem originated or answered the call**
\Vn	**Result code form**
	\V0 Disable extended MNP and V.42 result codes
	\V1 Enable extended MNP and V.42 result codes
\Xn	**XON/XOFF pass through**
	\X0 Disable XON/XOFF pass through, but still process
	\X1 Enable XON/XOFF pass through and process
\Y	**Switch to Reliable mode**
\Z	**Switch to Normal mode**

TRANSMIT FAX COMMANDS

Command	Description
+Bn	**Speed Control**
	B/B0 Reserved
	B1 Reserved
	B2 Reserved for V.23
	B3 Reserved for V.23
	B4 Fax transmission speed of 2400 bps
	B5 Fax transmission speed of 4800 bps
	B6 Fax transmission speed of 7200 bps
	B7 Fax transmission speed of 9600 bps
+En	**Received frame display format selection**
	E/E0 Disable display of received HDLC frames
	E1 Display frame in binary format
	E2 Display frame in 2 digit ASCII Hex format
+Fn	**Mode control**
	F/F0 Return to normal modem mode (300 to 2400 bps data rate)
	F1 Enter Fax mode (19,200 bps data rate)
+Kn	**DTE flow control**
	K/K0 Disable flow control
	K3 Enabale CTS flow control
	K4 Enable XON/XOFF flow control
+Pn	**Number of pages to be transmitted (n = 1 to 255)**
+Rn	**Resolution control**
	R/R0 Send document with normal resolution
	R1 Send document with fine resolution
+Tn	**Test modes**
	T/T0 End test mode
	T1 Enter test mode 1. This mode is used to dial a remote Fax machine and automatically send a message stored in EPROM.

All extednded commands have a + prefix after the AT. Extended commands have only one alpha character followed by a numeric value in the range of 0 to 255; the value 0 may be omitted. Once FAX mode is entered, commands are accepted at a fixed rate of 19200 bit/s and FAX mode will remain active until one of the following occurs:

1. The host software issues a +F command to return to modem command mode.
2. A call disconnect frame is received.
3. The host software issues an abort by dropping DTR.

The &D2 command must be issued for a DTR controlled abort. FAX mode assumes XON/XOFF or CTS flow control in data mode.

TABLE 1: Result Codes

Xn	VERBOSE/TERSE RESULT CODES
X0	OK/0, CONNECT/1, RING/2, NO CARRIER/3, ERROR/4
X1	All functions of X0 + CONNECT (RATE)/1 = 300, 5 = 1200, 10 = 2400
X2	All functions of X1 + NO DIAL TONE/6
X3	All functions of X1 + BUSY/7
X4	All functions of X3 + NO DIAL TONE/6, NO ANSWER/8

TABLE 2: S Registers Supported

NUMBER	FUNCTION	UNITS	DEFAULT
S0[1]	Answer on ring	No. of rings on which to answer	000[2]
S1[3]	Ring counter	No. of rings accumulated	000
S2	Escape code	ASCII CHR Decimal 0-127	043
S3	Carriage return	ASCII CHR Decimal 0-127	013
S4[4]	Line feed	ASCII CHR Decimal 0-127	010
S5	Back space	ASCII CHR	008
S6	Wait for dial tone	Seconds	002
S7[5]	Wait for carrier	Seconds	030
S8	Pause time	Seconds	002
S9	Carrier valid	100 milliseconds (0.1 sec)	006
S10[6]	Carrier drop out	100 milliseconds (0.1 sec)	014
S11	DTMF tone duration	1 millisecond (0.001 sec)	070
S12	Escape guard time	20 milliseconds (0.05 sec)	050
S13	Unused		N/A
*S14[1]	Bit mapped register	Decimal 0-255	170
S15	Unused		N/A
S16	Test register	Decimal #	000
S17	SSi Special test register - not used	Decimal 0-255	096
S18	Test timer	Decimal 0-255	000
S19	Unused		N/A
S20	Unused		N/A
*S21[1]	Bitmapped register	Decimal 0-255	000
*S22[1]	Bitmapped register	Decimal 0-255	118
*S23[1]	Bitmapped register	Decimal 0-255	007
S24	Unused		N/A

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TABLE 2: S Registers Supported (continued)

NUMBER	FUNCTION	UNITS	DEFAULT
S25[1]	DTR delay	10 milliseconds (0.01 sec)	005
S26[1,7]	CTS delay	10 milliseconds (0.01 sec)	001
*S27[1]	Bitmapped register	Decimal 0-255	064
S37[8]	Desired Modem Line Speed	Decimal 0-3	000

* The bitmapped register functions are equivalent to normal "AT" command modem registers. They are not needed for evaluation of the 73D2407 capabilities.

Asynchronous character formats supported:
[Number of data bits, parity (even/odd/none), number of stop bits]

1200/2400 bit/s: 7N2, 7E1, 7O1, 8N1 300 bit/s: 7N2, 7E1, 7O1, 8N1, 8E1, 8O1

[1] Stored in NVRAM with &W command
[2] Modem will not answer until value is changed to 1 or greater
[3] Cleared if no rings occur over any eight second interval
[4] Values greater than 127 will disable escape code detection
[5] Has no effect if leased line is selected
[6] Setting to 255 causes the modem to ignore carrier detect
[7] Pertains to synchronous operation only
[8] 0 - connects at speed of last AT
1 - connects at 300 bit/s
2 - connects at 1200 bit/s
3 - connects at 2400 bit/s

RECOMMENDED OPERATING CONDITIONS

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
T_A, Ambient Temperature		0		70	°C
V_{CC} & V_{DD}, Supply Voltage	73M214, 73D215, 73D219, 73D225	4.75		5.25	V
V_{SS}, Supply Voltage	73M214	–4.25		–5.25	V
V_{DD}, V_{SS} Bypass Capacitors		10+0.1			µF
CLK Load Capacitance				25	pF
Digital Load Capacitance				50	pF
TXA, MON Loading				See Note	
Input Clock Frequency (X1)			14.7456		MHz
Input Clock Variation (X1, XIN)	XIN must be X1 ÷ 2	–0.01		0.01	%

Note: 10 kΩ in parallel with 50 pF

INPUT CLOCK TIMING (See Figure 1.)

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
TCLCX		20			ns
TCLCX2		54		82	ns
TCHCX		20			ns
TCHCX2		54		82	ns
TR, TF				15	ns
TCHCH		0		20	ns

INTERFACE TIMING

LED Write Timing (See Figure 2.)

TWLWH	$\overline{WR}$ pulse width		307			ns
TAVWL	Address valid to $\overline{WR}$ low		141			ns
TQVWH	Data valid to $\overline{WR}$ high		370			ns
TQVWX	Data valid to $\overline{WR}$ transition		27			ns
TWHDX	Data hold after $\overline{WR}$		86			ns

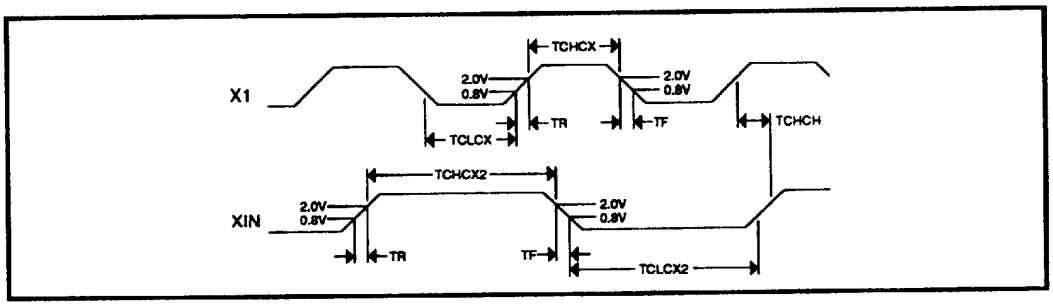

FIGURE 1: Input Clock Timing

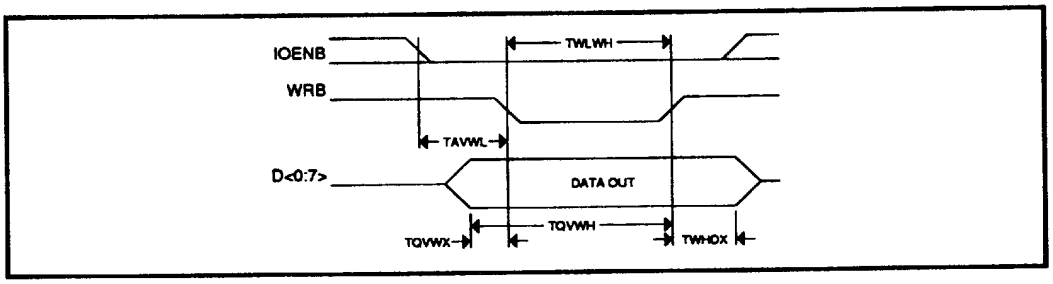

FIGURE 2: LED Write Timing

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DC ELECTRICAL CHARACTERISTICS

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNITS
I_{DD}	Supply Current				130	mA
I_{SS}					25	mA
VIL	Input Low Voltage		0		0.8	V
VOH	Input High Voltage		2.0		VDD	V
I_{IH}	Input High Current	Except $\overline{CS}$ which has a pulldown of 20 kΩ			10	µA
I_{IL}	Input Low Current	Except TXCLKI, EXADCC which have pullups of 20 kΩ			-20	µA
	Digital Input Capacitance				10	pF
V_{OH}	Output High Voltage	Iout = -.4 mA	2.4			V
V_{OL}	Output Low Voltage	Iout = 1.6 mA			0.4	V
RXA	Input Resistance		100			kΩ
RXA	Input Capacitance				25	pF

TRANSMITTER SPECIFICATIONS

TRANSMITTER POWER

Values given are mearsured at the line connection point and assume that the DAA shown in our application literature is used with a 600Ω load.

TRANSMITTER POWER	CONDITIONS	MIN	NOM	MAX	UNITS
QAM/DPSK Transmitter Power	With or without CCITT tones	–9.8		–8.2	dBm
CCITT Guard Tone	550	–14.8		–12.8	dBm
	1800	–16.0		–14.0	dBm
FSK Transmitter Power	103/V.21	–10.0		–8.0	dBm
Answer Tone Power		–10.0		–8.0	dBm
DTMF Transmitter Power	High band tones	–7.0		–5.0	dBm
	Low band tones	–9.0		–7.0	dBm
	Twist	–3.0		–1.0	dB

TRANSMITTER FREQUENCY
(All tones are digitally derived from the clock input and have the input clock frequency tolerance.)

TRANSMITTER FREQUENCY		CONDITIONS		MIN	NOM	MAX	UNITS
QAM/DPSK Carrier Frequencies		Originate			1200.0		Hz
		Answer			2400.0		Hz
FSK Tone Frequencies							
103	Originate	Space	1070		1066.7		Hz
		Mark	1270		1269.4		Hz
	Answer	Space	2025		2021.1		Hz
		Mark	2225		2226.1		Hz
V.21	Originate	Space	1180		1181.6		Hz
		Mark	980		978.3		Hz
	Answer	Space	1850		1850.0		Hz
		Mark	1650		1651.6		Hz
Special Tone Frequencies							
Answer Tone			2100		2104.1		Hz
CCITT Guard Tones			550		556.5		Hz
			1800		1786.0		Hz
DTMF Dialing Tone Frequencies							
Low Group		Columns	697		698.2		Hz
			770		771.9		Hz
			852		853.3		Hz
			941		942.3		Hz
High Group		Rows	1209		1209.5		Hz
			1336		1335.7		Hz
			1477		1476.9		Hz
			1663		1634.0		Hz

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TRANSMITTER DISTORTION

TRANSMITTER DISTORTION	CONDITIONS	MIN	NOM	MAX	UNITS
QAM/DPSK Carrier Suppresion	Measured at TXA	35			dB
CCITT Guard Tone Distortion	800-1600 Hz band			–60	dB
	0-10 kHz band			–45	dB
Answer Tone Distortion	800-1600 Hz band			–60	dB
	0-10 kHz band			–40	dB
FSK Output Bias Distortion	Transmit dotting 300 bit/s	–6		6	%
FSK Opposite Band Distortion				–60	dB
DTMF Tone Distortion	700-2900 Hz band			–29	dB

RECEIVER SPECIFICATIONS

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
Carrier VCO					
Capture Range	Carrier offset	–10		10	Hz
Carrier Phase Jitter	50-65 Hz			30	Degrees
Data Clock Recovery Capture Range	From system clock + 24576 (600 Hz symbol clock)	-.025		+.025	%
Data Delay Time	RXA to RXD	30		75	ms
Retrain Request Threshold	If enabled	10^{-3}		10^{-2}	BER
Carrier Detect					
Threshold		–48		–43	dBm
Hysteresis		2			dB
Answer Tone Detect	2100/2225 Hz				
Threshold		–48		–43	dBm
Hysteresis		2			dB
Call Progress Detect	350-650 Hz dual tone				
Threshold		–40		–30	dBm
Hysteresis		2			dB

PERFORMANCE DATA

(This performance data was taken using an AEA tester and a Silicon Systems evaluation modem.)

BER PERFORMANCE

(–20dBm receive level 10^{-5} BER)

PARAMETER	MINIMUM SNR REQUIRED
2400 Bit/s Originate	16.5 dB SNR
2400 Bit/s Answer	16.0 dB SNR
1200 Bit/s Originate	9.0 dB SNR
1200 Bit/s Answer	8.0 dB SNR
0-300 Bit/s Originate	9.0 dB SNR
0-300 Bit/s Answer	7.5 dB SNR

DYNAMIC RANGE

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
2400 Bit/s Originate	10^{-5} BER @ 17dB SNR	–45		0	dBm
2400 Bit/s Answer	10^{-5} BER @ 17dB SNR	–45		0	dBm
1200 Bit/s Originate	10^{-5} BER @ 12dB SNR	–45		0	dBm
1200 Bit/s Answer	10^{-5} BER @ 12dB SNR	–45		0	dBm
0-300 Bit/s Originate	10^{-5} BER @ 12dB SNR	–45		0	dBm
0-300 Bit/s Answer	10^{-5} BER @ 12dB SNR	–45		0	dBm

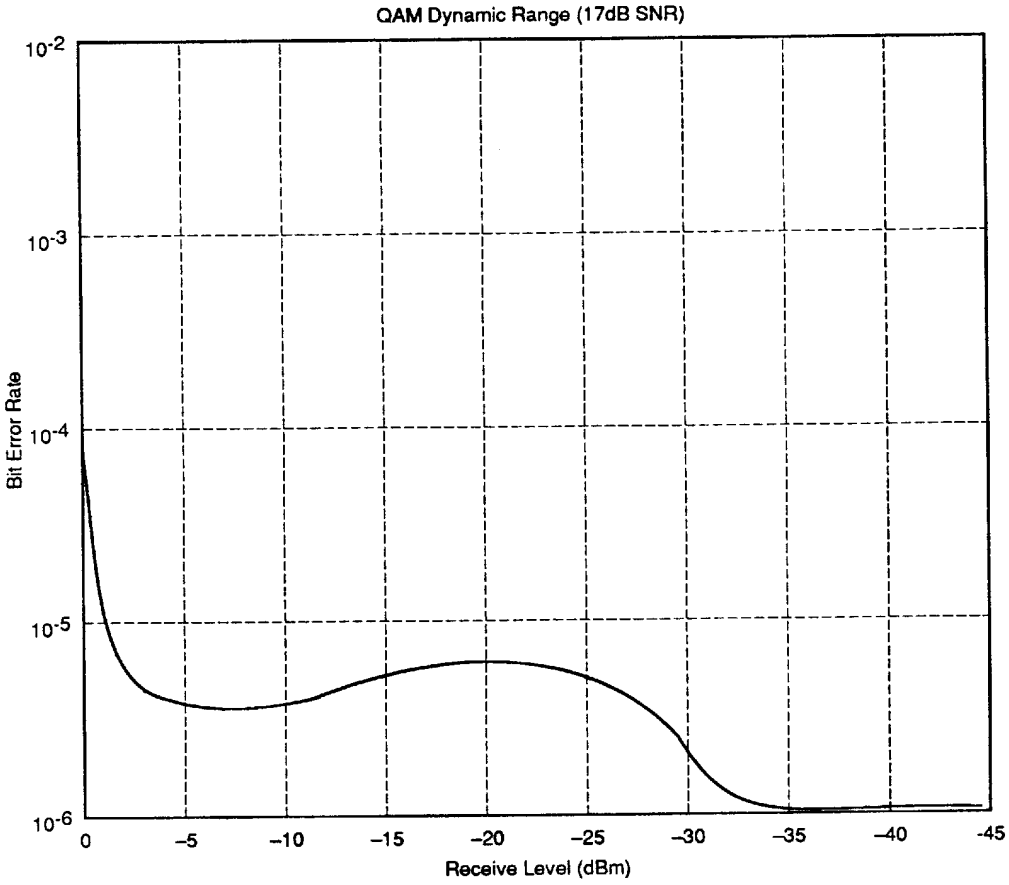

FIGURE 4: QAM Dynamic Range

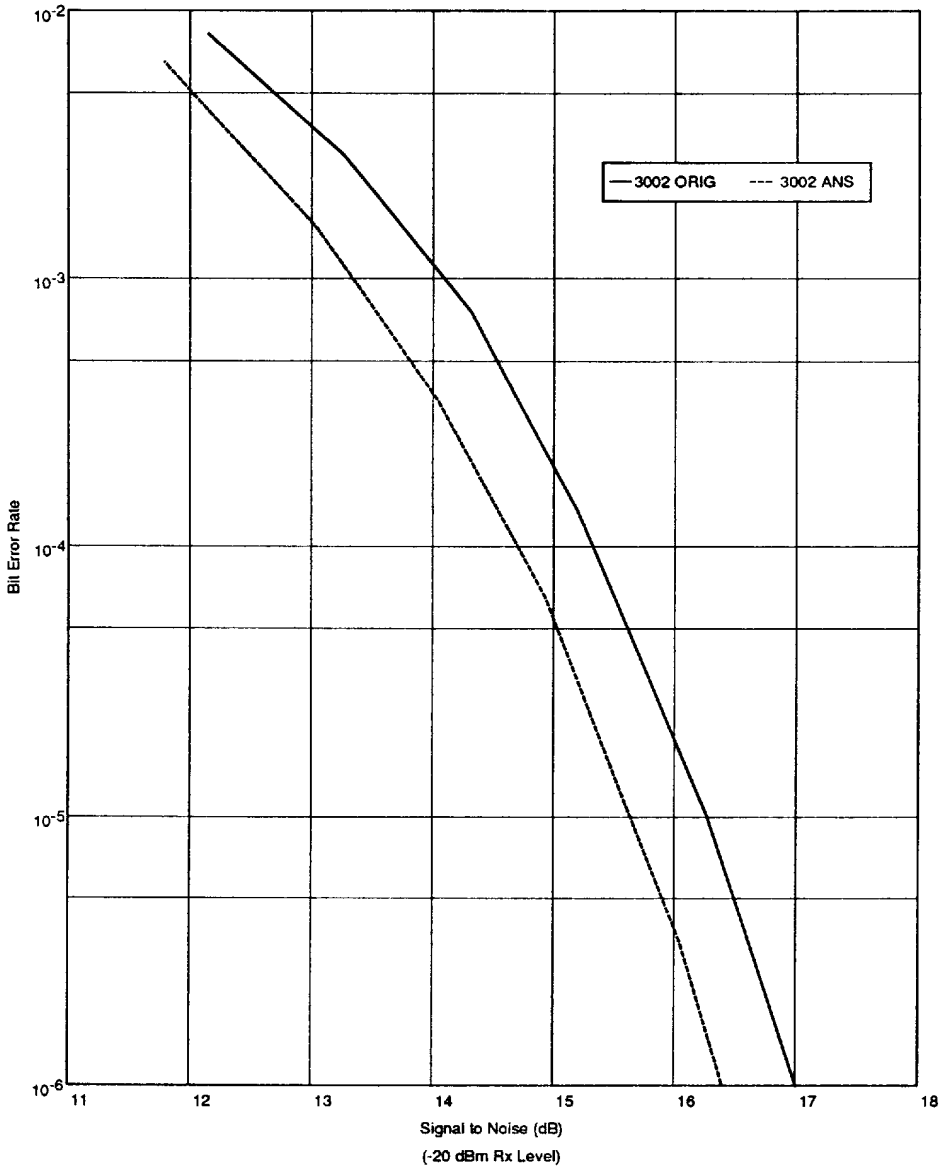

FIGURE 5: BER vs. SNR

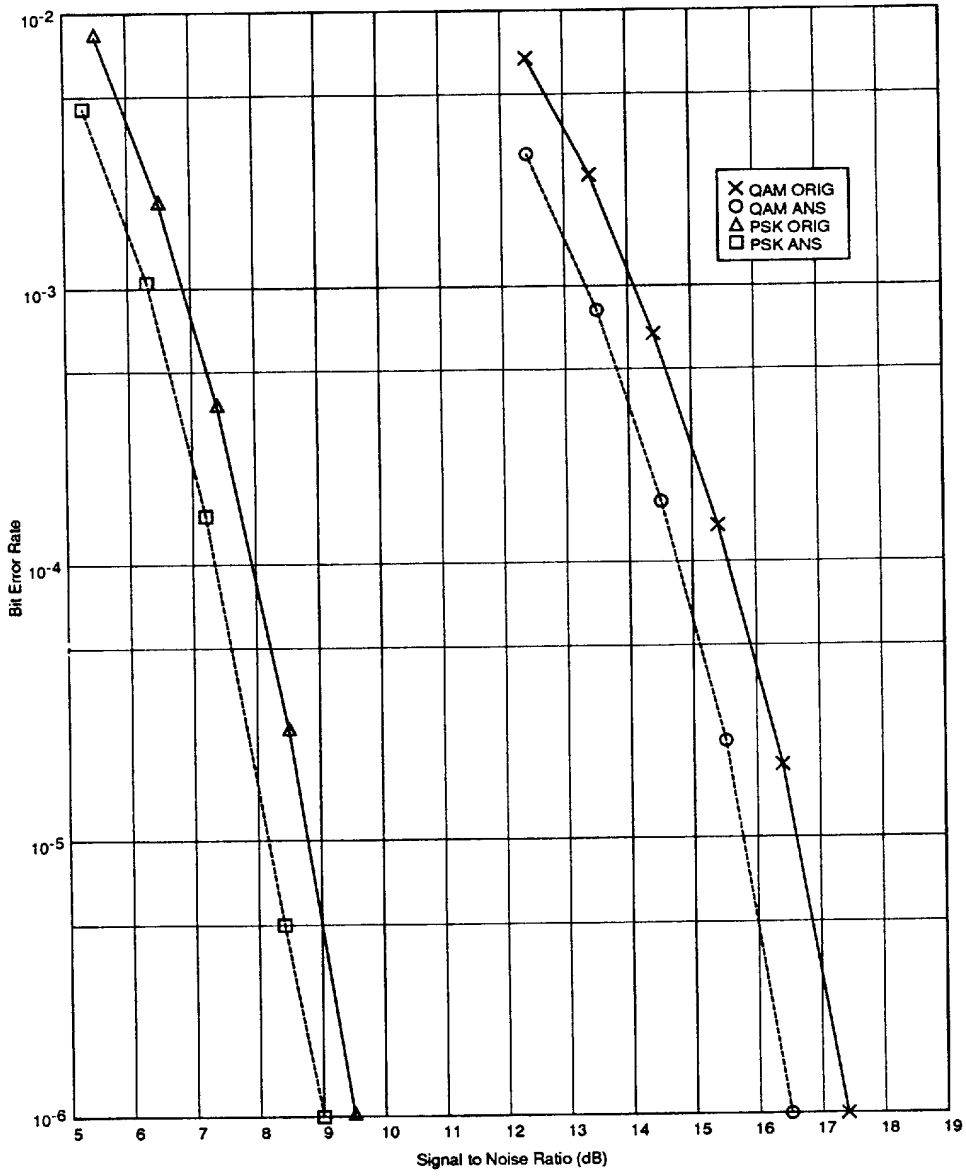

FIGURE 6: QAM and PSK BER vs. SNR with -20dBm Receive Level

SSI 73D2417
MNP5 Datacom/FAX
Modem Device Set

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APPLICATIONS INFORMATION

The SSI 73D2417 includes features and commands that are needed to design a full featured "smart" modem with industry standard AT commands and functions, including MNP5.

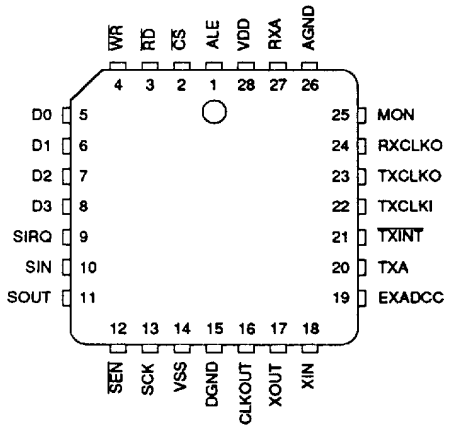
Control software needed for modem management, AT user interface, and FAX transmit mode is included within the device set. A complete basic modem requires the addition of an RS232 or UART interface, an appropriate telephone line interface, and circuitry for clock generation and address decode logic. Optional features that are provided for in the SSI 73D2417 and that may be included in a full featured modem design include: Nonvolatile memory for storage of setup parameters, a speaker and amplifier for audible monitoring of call activity, and LEDs for display of modem status.

The FAX transmit mode additionally requires a low cost D/A converter and band shaping filter to provide a V.27ter conformant transmit waveform. For data communication modes, the SSI 73D2417 employs an AT command set user interface that is compatible with existing modem products and software. With this interface, the user can directly control a modem using simple AT commands. As an option, communications software programs such as Smartcom™ may be used to provide a menu driven interface and additional features that make the modem easier to use.

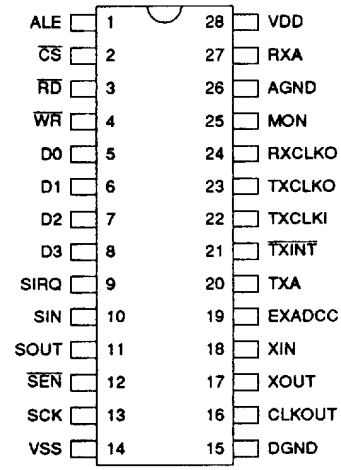
A FAX operating sequence is similar to, but more complex than that required for data communication, as the FAX operation adds an additional format conversion step which must be implemented by external communications software. A compatible communications software package, in conjunction with the SSI 73D2417 will provide full transmit FAX capability. Sources for datacom software that currently support this standard are listed below:

1. Bit FAX available from Bit Software
   (408) 263-2197
2. QuickLink II FAX available from
   Smith Micro Software
   (714) 964-0412

PACKAGE PIN DESIGNATIONS (Top View)



SSI 73M214
28-Pin PLCC



SSI 73M214
28-Pin DIP

SSI 73D2417
MNP5 Datacom/FAX
Modem Device Set

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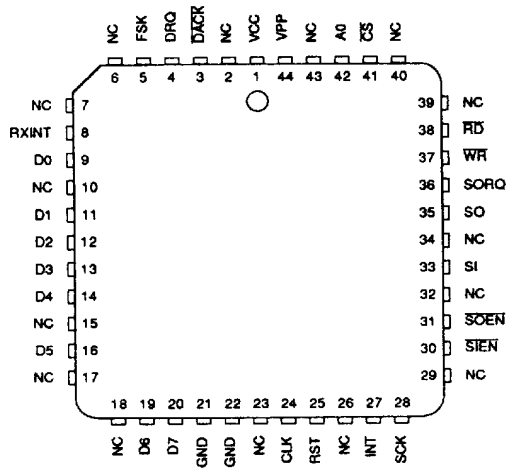
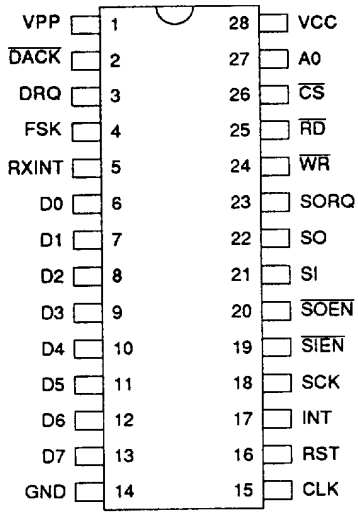
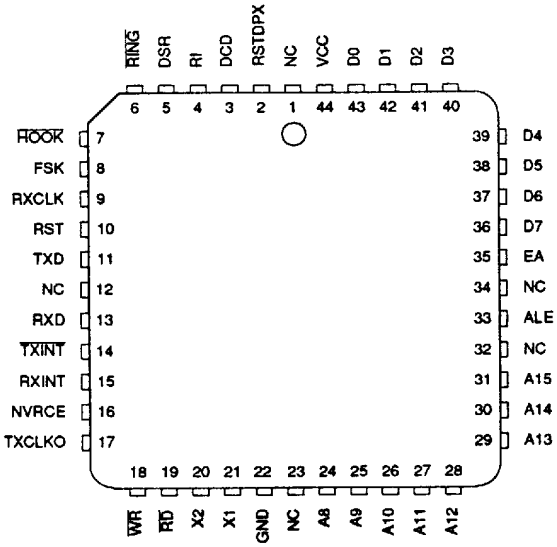
PACKAGE PIN DESIGNATIONS (Top View)



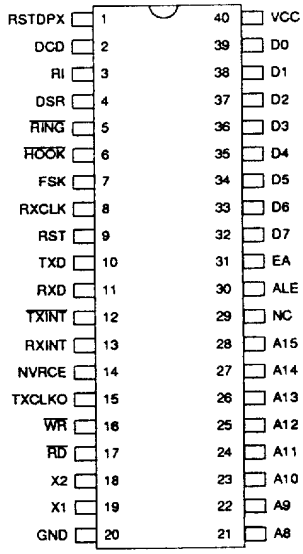
SSI 73D215
44-Pin PLCC



SSI 73D215
28-Pin DIP



SSI 73D219
44-Pin PLCC



SSI 73D219
40-Pin DIP

SSI 73D2417
MNP5 Datacom/FAX
Modem Device Set

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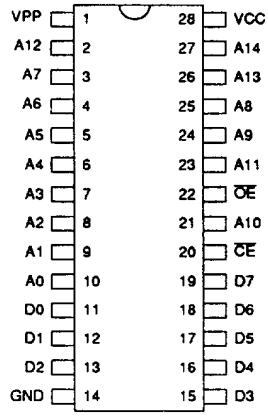
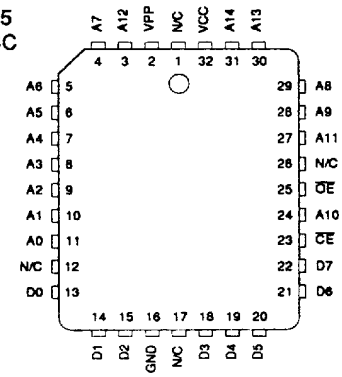
SSI 73D225
28-Pin DIP



SSI 73D225
32-Pin PLCC



ORDERING INFORMATION

PART DESCRIPTION	ORDER NO.	PKG. MARK
SSI 73D2417 Dual-In-Line Package	73D2417-CP	
28-pin Plastic DIP		73M214-IP
28-pin Plastic DIP		73D215-CP
40-pin Plastic DIP		73D219-CP
28-pin Plastic DIP		73D225-CP
SSI 73D2417 Surface Mount Package	73D2417-CH	
28-pin Plastic Leaded Chip Carrier		73M214-IH
44-pin Plastic Leaded Chip Carrier		73D215-CH
44-pin Plastic Leaded Chip Carrier		73D219-CH
32-pin Plastic Leaded Chip Carrier		73D225-CP

Preliminary Data: Indicates a product not completely released to production. The specifications are based on preliminary evaluations and are not guaranteed. Small quantities are available, and Silicon Systems should be consulted for current information.

Silicon Systems, Inc., 14351 Myford Road, Tustin, CA 92680 (714) 731-7110, FAX (714) 573-6914