EXAR

XR-2942

T-75-33-90

XR-2942 Fax/Data Microcontroller

GENERAL DESCRIPTION

The XR-2942 is a dedicated microcontroller that provides command control for the XR-2900 Fax/Data modem chip set. The XR-2942 provides control for CCITT recommended V.42 error detection, including LAPM and MNP 2-4 protocols, with MNP class 5 data compression included for greater compatibility. Also supported is the CLASS 2 (EIA PN2388) standard 'AT+F' extended command set.

The system architecture of the XR-2942 allows the actual command sets for the 'AT', 'AT+F', MNP, and LAPM to reside external to the XR-2942, allowing ease of customization. Exar provides these command sets to use as is, or the designer can modify to the requirements of the design.

The XR-2942 operates from a single +5 volt power supply, offering low power consumption through CMOS technology.

FEATURES*

Group 3 Send/Receive Fax
Compatibility with Available Applications Software
Error Free Data Transfer:
DATA Mode
- LAPM
- MNP 2-4

Increased Data Throughput by MNP 5 Data Compression
- 4800 BPS Throughput

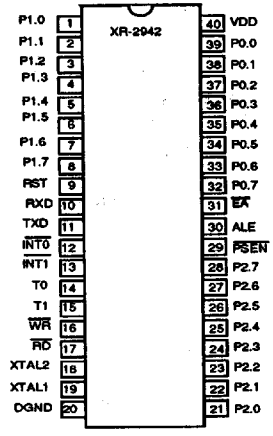
'AT' Command Control
EIA 2388 (CL2) Standard Commands ('AT + F')
- Easily Modified, Exar Supplied Commands
- 'AT'/'AT+F'/MNP/V.42

Possible Chip Upgrade to V.42bis (XR-2943)
*(Apply when used with XR-2900 Fax/Data modem chip set)

APPLICATIONS

Error Free Fax/Data Modem Applications
Stand-Alone Fax/Data Modems
Smart Modems
Laptop Modems (Send and Receive Fax or Data)
Networked Fax Machines

PIN ASSIGNMENT



(For other pin assignments, refer to the end of this datasheet)

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ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2942CP	40 Pin Plastic Dip	0°C to 70°C
XR-2942CJ	44 Pin PLCC	0°C to 70°C
XR-2942CQ	44 Pin QFP	0°C to 70°C

ABSOLUTE MAXIMUM RATINGS

Power Supply	-0.3V to + 7V
Input Voltage	-0.7V to (VDD +0.3V)
DC Input Current (any input)	±10mA
Power Dissipation **(Package Limitation)**	1W
Derate above 25°C	11 mW/°C
Storage Temperature Range	-65°C to +150°C

SYSTEM DESCRIPTION

The XR-2942, when coupled to the XR-2900 Fax/Data modem chip set, allows the implementation of a Group 3 fax/2400 BPS V.22bis modem. With MNP/V.42 operation included for data mode, error-free operation is provided.

The XR-2942 is just one in the family of controller options for the XR-2900 Fax/Data modem chip set, including:

FUNCTION	CONTROLLER
'AT' and 'AT+F'	8031
'AT'/'AT+F'/V.42/MNP 5	XR-2942
'AT'/'AT+F'/V.42/V.42bis/MNP 5	XR-2943

ELECTRICAL CHARACTERISTICS

Test Conditions: $T_A = 25°C$, $V_{DD} = 5V \pm 10\%$, $F_{CLK} = 11.0592MHz \pm 0.05\%$, unless otherwise specified.

SYMBOL	PARAMETERS	MIN	TYP	MAX	UNITS	CONDITIONS
V_{DD}	Power Supply Voltage	4.5	5	5.5	V	
I_{DD}	Power Supply Current		18	22	mA	
V_{IH}	Input High Voltage	1.8			V	(Except XTAL1 and RST)
V_{IH}	Input High Voltage	3.5			V	XTAL 1 and RST
V_{OH}	Output High Voltage	2.4			V	Ports 1,2,3 $I_{OH} = -60\mu A$
V_{OH}	Output High Voltage	2.4			V	Port 0 (External Bus Mode) ALE, PSEN $I_{OH} = -400\ \mu A$
V_{OL}	Output Low Voltage			0.45	V	Ports 1,2,3, $I_{OL} = 1.6$ mA
V_{OL}	Output Low Voltage			0.45	V	Port 0, ALE, PSEN $I_{OL} = 3.2$ mA
I_{IH}	Input High Current (Leakage)			±10	µA	$0.45V \leq V_I \leq V_{DD}$
I_{IL}	Input Low Current			-50	µA	$V_I = 0.45V$

SYSTEM OPERATION

A typical application utilizing the XR-2942 to support the XR-2900 Fax/Data chip set, is shown in Figure 1. The XR-2900 provides the complete modem data pump function for:

CCITT	V.29	9600, 7200 BPS and 4800BPS
	V.27ter	4800 and 2400 BPS
	V.22bis	2400 BPS
	V.22	1200 BPS
	*V.23(mode 2)	1200/75 BPS
	V.21(Ch 2)	300 BPS
Bell	212A	1200 BPS
	103	300 BPS

* Supported by the XR-2321

Command control is supported by the XR-2942 for:

MNP 2-4	Microcom Error Correction
MNP 5	Microcom Data Compression
LAPM	CCITT Recommended V.42 Error Correction
'AT'	Industry Standard 'AT'
'AT+F'	EIA2388 (CL2) Fax Commands

Although the XR-2942 does provide complete command control, the actual commands for the various modes reside in an external EPROM - 27256, 32k Byte. With this architecture and an Exar supplied command set, maximum flexibility is offered. The command set can be used as is, or customer tailored to a particular design.

The unique architecture utilized by the XR-2900 and command controller allow the **same** hardware (Printed Circuit Board (PCB)) to support several different types of Fax/Data modems. By changing available pin-to-pin compatible microcontrollers, the Fax/Data modem types listed in Table 1 are all possible with the same printed circuit board. As mode types are changed by the µC, EPROM supported command sets and SRAM size change and/or elimination are also required. In each case Exar provides complete production worthy command sets which may be used as is, or easily modified to meet specific application requirements. To aid in software modifications, Tables 2, 3 and 4 list the XR-2942 memory mapping, indicating customer usable regions.

External memory modifications requiring µC (XR-2942) support will need entry/re-entry point information. This point is important as the XR-2942 contains program memory with Exar proprietary V.42/MNP5 / Auto Fax / Data Select functions not accessible externally (fusible link protected) or available to Exar customers. The Auto Fax/Data select is in external EPROM, however source code is not provided for this routine.

2400 BPS Data Mode	Microcontroller Part Number	External Memory Requirements (Bytes)	
		EPROM	SRAM
'AT'	8031 (Generic ROMLESS µP)	32K	8k / 32k
'AT' / MNP5/V.42	XR-2942	32K	8K / 32K
'AT'/MNP5/V.42/ V.42bis	XR-2943	32K	32K

Table 1. 2900 BPS Modem Options / µC, EPROM, RAM Requirements

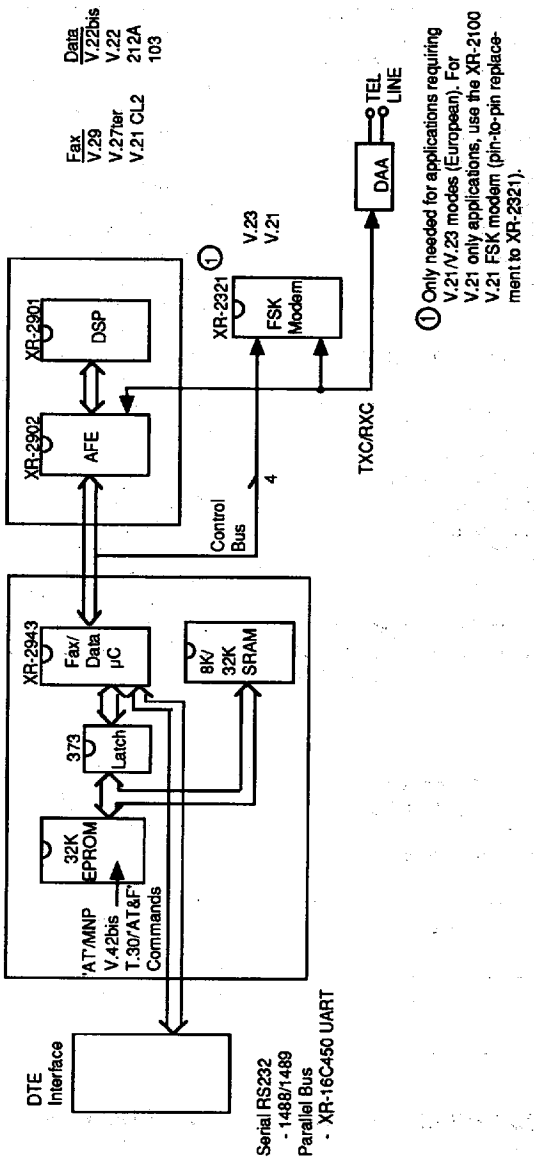

Figure 1. Fax/Data Modem with V.42bis/MNP5 (Data Mode) Block Diagram

ENTRY POINTS AND MEMORY MAPPING

Status / Mode Setting Memory Locations

Status	Location	Description
SPD_FLG	20 H.7	Speed Conversion Enable Flag.
BK_PRE	51 H	Break Prescaler Timer
BK_TMR	52 H	Break Timer (Only in Normal Mode)
MRCVP2	803BH	Disconnect to Check Auto-Reliable Fallback Mode.
PASS_B	9D14H	Escape Code Checking Byte in Speed Conversion Mode.
SPEED	9D15H	Speed Indicator For All Modes. 0-19200 BPS 1 - 9600 BPS 2 - 4800 BPS 3- 2400 BPS 4 - 1200 BPS 5 - 300 BPS
Z_BUF	9D16H	Auto Reliable Fallback Character.
BACK_RAM	9D1AH	Starting Address for Command Buffer Back-up.
OPT_P	9D50H	Output Port Selection Option (F0FF H to 40FFH). This Parameter is Initialized Immediately After Power On and constantly monitored by MNP Module.
MNP_S	9E22H	Reliable Link Indicator
RETRAN	24H.0	RETRANSMISSION

Function Call Locations - V.42bis/V.42/ MNP 5 Program Entry Points

Function	Location	Description
SCTINT_1	0006H	Interrupt 0 Jump-In Point.
SCRINT_1	0016H	Interrupt 1 Jump-In Point.
SPINT_1	0026H	Serial Port Interrupt Jump-In Point.
MSG_CP	0030H	Exar Copyright Message.
P_ECRAM_1		0060H After Escape MNP Re-Entry Point.
MSG_CPY	0063H	Exar Copyright Calling Subroutine.
MNP_IN	0066H	MNP Program Immediate Re-Entry Point for modifying MNP Program.
SPD_INM	0069H	Speed Conversion Program Jump-In Point.
INI_SPDM	006CH	Speed Conversion Initialization Routine.
V21_IN_1	006FH	300 BPS Speed Conversion Timer Set-Up.
EC_MAIN	0080H	Calling Main MNP Program. This is the only location which will initiate the MNP program.

XR-2942Re-Entry Points

Function	Location	Description
PWR_ONS	C000H	Power On
OUT_SCT	C003H	Interrupt 0
OUT_T0	C006H	Timer 0
OUT_SCR	C009H	Interrupt 1
OUT_T1	C00CH	Timer 1
OUT_SP	C00FH	Serial Port Interrupt
OUT_T2	C012H	Timer 2
MNP_OUT	C015H	MNP Program Intermediate Point
CHK070S	C01BH	MNP 'ESC' Jump Out Point
DISCONNECT S		C01EH MNP Disconnect
ON_LOOPS	C021H	Auto-Reliable Fallback Point.
SPD_OUTS	C024H	Speed Conversion Jump Out Point.
V21_INS	C027H	Call Speed Conversion ASM for 300 BPS.
SPD_TXD	C02AH	Put TXDATA to Modem Chip.
SPD_RXD	C02DH	Get RXDATA From Modem Chip.
I_TXSYNTT	C030H	GET TX CRC-CCITT CALCULATION ROUTINE
I_RXSYNTT	C033H	GET RX CRC-16 CALCULATION ROUTINE
I_TXASYN16		C036H GET TX CRC-16 CALCULATION ROUTINE
I_RXASYN16		C039H GET RX CRC-16 CALCULATION ROUTINE
I_SNDREL	C03CH	GET SENDING RESULT CODE SUBROUTINE
I_MNPINIT	C03FH	MNP PARAMETER INITIALIZATION ROUTINE
I_V42INIT	C042H	V42 PARAMETER INITIALIZATION ROUTINE
I_SETURMNP		C045H UART SETTING ROUTINE

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RAM Locations

The stack in the 'AT' program starts from 0C0H on page 1 and occupies 64 bytes of space. Internal RAM on page 0 has 23 bytes and page 1, 64 bytes of free indicator space.

The external RAM data memory is as follows:

1) Error Control	8000H-8FFFH
2) Data Compression Buffer	9000H-93FFH
3) FAX/Remote Access	9400H-95FFH
4) Available for use	9600H-97FFH
5) V.42	9800H-98FFH
6) Break Buffer	9A00H-9AFFH
7) DTE TX Buffer	9B00H-9BFFH
8) DTE RX Buffer	9C00H-9CFFH
9) Misc. Registers	9D00H-9DFFH
10) MNP RAM Backup Buffer	9E00H-9EFFH
11) 'AT' RAM Backup Buffer	9F00H-9FFFH
12) BTLZ Compression Dictionary	C000H-FFFFH

Note: Before jumping into the MNP program the control code will backup the entire 256 bytes of AT RAM into external RAM. In addition, before jumping out of the MNP program it will backup the entire 256 bytes of MNP RAM into external RAM.

The Miscellaneous register function list is provided below. The option code control allows the firmware engineer to change the factory defaults in source code, then reassemble.

OPTION	LOCATION	PARAMETER	COMMAND	DESCRIPTION
Opt_0	9D09H	0	\N0	Non-MNP
		1	\N2	Reliable Mode
		2*	\N3	Auto _reliable Mode
Opt_1	9D0AH	0	\Q1	Normal XON/XOFF
		1		Not Used
		5*	\Q2	Unidirectional RTS/CTS
		3	\X1	Xon/Xoff Pass Through
		4	\Q4	Xon/Xoff Send Only
		2	\Q3	Bidirectional RTS/CTS
		6	\Q0	Disable Flow Control
Opt_2	9D0BH (BIT0)	0		Disable Speed Conversion
		1		Enable Speed Conversion
Opt_2	9D0BH (BIT1)	0	\J0	Disable Serial port rate adjust
		1*	\J1	Enable Serial port rate adjust
Opt_2	9D0BH (BIT2)	0*	\G0	Disable modem port flow control
		1	\G1	Enable modem port flow control to XON/XOFF (for normal mode only)
Opt_2	9D0BH (BIT3)	0*	-P0	Parity bit for checking XON/XOFF
		1	-P1	Ignore parity bit checking for XON/XOFF
Opt_2	9D0BH (BIT4)	0*		Not Used
		1		
Opt_2	9D0BH (BIT5)	0*		Not Used
		1		
Opt_2	9D0BH (BIT6)	0*	\M0	V.42 Mode
		1	\M1	MNP Mode
Opt_2	9D0BH (BIT7)	0	%C0	Disable Data Compression
		1*	%C1	Enable Data Compression

OPTION	LOCATION	PARAMETER	COMMAND	DESCRIPTION
Opt_3	9D0CH	0	\A0	Block size to transmit, 64bytes
		1	\A1	128 bytes
		2	\A2	192 bytes
		3*	\A3	256 bytes
Opt_4	9D0DH	0-9	\Bn	Xmit break during normal mode
		3*		at data mode, n=100ms
Opt_5	9D0EH	1	\K1	Expedited, Destructive
		2	\K3	Expedited, Non-destructive
		3*	\K5	Non-expedited, Non-destructive
Opt_6	9D12	(81H)	\0	Originate Reliable Link
Opt_6	9D12H	(82H)	\U	Accept Reliable
Opt_6	9D12H	(80H)	\Y	Switch to Reliable Link
Opt_7	9D13	1		For 300 BPS connect indicator
	(BIT0)	0		For other speed
Opt_8	9D0FH	0	\V0	Standard Result code form
	(BIT1,0)	1*	\V1	Result code for MNP
		2	\V2	
		3	\V3	
Opt_8	9D0FH	0*	\C0	No set for Auto-reliable buffer
	(BIT3,2)	1	\C1	Set Auto-reliable buffer
		2	\C2	Set fall back character
Opt_8	9D0FH	0	\L0	MNP Stream mode
	(BIT4)	1*	\L1	MNP Block mode
Opt_8	9D0FH	0	\Q0-\Q4	
	(BIT5)	1*	\Q5,\Q6	For \Q5, \Q6 turnoff CTS
Opt_8	9D0FH	0*		
	(BIT6)	1		V.42 only negotiation
Opt_8	9D0FH	0*		
	(BIT7)	1		Eliminate ODP for V.42
Opt_9	9D10H	0*	%An	Auto-reliable fallback
		N		character
Opt_A	9D11H	0*	\Tn	Inactivity Timer
		N		
Opt_B	9D51H	0*	%Dn	**Default**
	(BIT4)	1		Clear RX Buffer after disconnect

Interrupt Vectors

The XR-2942 brings out all interrupt vectors to the external program. This allows easy customer modification of service routines to suit a particular application. The interrupt vectors of the XR-2942 are as follows:

```
        ORG     0
        LJMP    PWR_ONS; Jump to Power On
                         Set Up Routine
        ORG     3H
EXT_INTO:               ; Interrupt 0 for SCT
        LJMP    OUT_SCT
SCTINT1:
        LJMP    SCTINT
        ORG     0BH
T_INTO:                 ;Timer 0 Interrupt
        LJMP    OUT_T0
        ORG     13H
EXT_INT1:               ;Interrupt 1 for SCR
        LJMP    OUT_SCR
SCRINT_1:
        LJMP    SCRINT
        ORG     1BH
T_INT1:                 ;Timer 1 Interrupt
        LJMP    OUT_T1
        ORG     23H
INT_SER:                ;Serial Port Interrupt
        LJMP    OUT_SP
SPINT_1:
        LJMP    SPINT
        ORG     2BH
T_INT2:                 ;Timer 2 Interrupt
        LJMP    OUT_T2
```

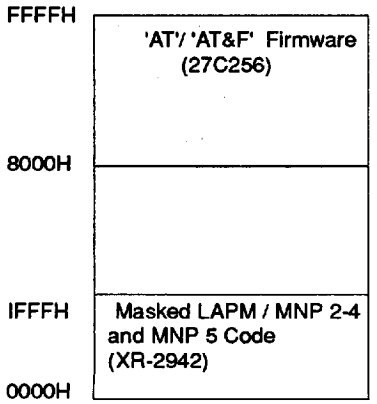
XR-2942 PROGRAM/DATA MEMORY MAPS

Tables 2, 3 and 4 show the ROM and RAM memory maps for XR-2942. It should be noted that without the use of separate CS(chip select) of the XR-2902 and the XR-2321, there would be an overlap of address locations.

As it is indicated in Table 2, 32K bytes of EPROM is assigned to 'AT' command firmware. This section of the ROM is located between 8000H and FFFFH.

LAPM, MNP2-4 and MNP5 code is masked in the microcontroller (XR-2942), and resides in the 8K bytes of memory, between address locations 0000H and 1FFFH.

Table 3 shows the RAM map, in which the space between 0000H and 002CH address locations is used for modem chip address. Table 4 shows the modem chip (XR-2902) address assignment. Included is addressing for the XR-2321 and XR-2100. These chips are optional to the system design, but may be added where V.21 or V.23/V.21 standards are required. The XR-2321 provides both V.23 and V.21 FSK data standards, while the XR-2100 provides only V.21. See XR-2321 or XR-2100 datasheets for details.



Note: 27C256 = 32K Byte EPROM

Table 2. XR-2942 ROM Map

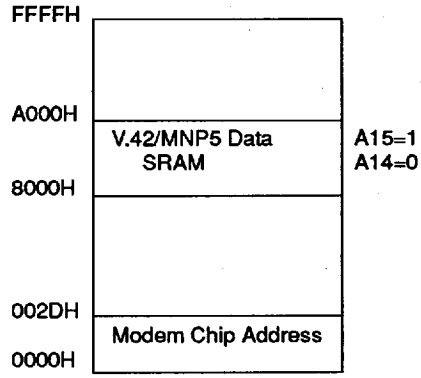


Table 3. XR-2942 RAM Map

MODEM CHIP	RAM ADDRESS	$\overline{CS}$
XR-2902	0000H - 001FH	A15=0 and A5=0
XR-2321	0028H - 002CH	A5=1 and A15=0
XR-2100	0028H - 0029H	A5=1 and A15 =0

Table 4. Modem Chip Address

Also RAM space between 8000H and 9FFFH is assigned for V.42 and MNP5 data or fax data. RAM locations between A000H and FFFFH, as well as RAM locations between 002FH and 7FFFH are available for I/O ports such as LED, EIA, etc.

V.42 / MNP OPERATION

The XR-2942 when coupled with the XR-2900 Fax/Data modem chip set allows the implementation of a group 3 fax and an **error-free, increased throughput** 2400 BPS data modem. To gain an understanding of V.42/MNP 5 modes for data operation, the following basic information has been included. A basic understanding of error correction techniques, flow control, speed buffering, and data compression will allow the designer to better understand a V.42/MNP5 modems capabilities and how to best utilize them. One excellent reference is "Data Compression", by Gilbert Held. The publisher is Wiley.

V.42 is a **CCITT** recommended error correction protocol which allows asynchronous DTE's (Data Terminal Equipment) to communicate error-free with other such equipped modems.

The actual error detection protocol used in V.42 is an **HDLC** (High-level Data Link Control) based protocol called LAPM, for **Link Access Procedure for Modems.** For additional detailed information beyond the following basic description, refer to the CCITT Recommendations, Series V, 'Data Communication Over the Telephone Network'. The latest version is known as the **'Blue Book'** (Blue Covers) or Series, dated 1988 (Melbourne), a recent update from the **'Red Book'.**

V.42 Basic Operation/Features

- **HDLC**-based error correction protocol-LAPM
- Asynchronous (Async or 'start/stop') DTE Communication - error free
- Actual line transmission is synchronous (sync)- no start or stop bits (stripped from data), however initial handshake, subsequent to modem handshake is asynchronous
- Error Detection
  - Data sent in 'frames' or blocks with a nominal size (default) of 128 Octets (Octet - 8 bit) data frames
  - Start/Stop bit elimination from data creates an actual data throughput improvement, roughly 120% of nominal. 2400 BPS becomes about 2900 BPS
  - Encoded information added to data frame for receiver to 'decode' and determine if the block was error free. 16-bit cyclic redundancy (CRC) methods are used for data encoded information to (1) indicate correct data and (2) recognize imperfect data frame
  - Retransmission (automatic) of determined imperfect frames to ensure perfect data is received

V.42 operation is found to be virtually identical (specifically to variable parameters) to that of MNP reliable or normal modes of operation. For this reason the MNP command set is also used for V.42 variables control.

MNP® OPERATION

MNP, or Microcom Networking Protocol was developed by Microcom, Inc., a modem manufacturer. Since conception, it has been in a constant state of update/improvement. For this reason 'classes' of operation emerged to signify each major update or improvement.

Relative to the V.22bis or 2400 BPS modems, up to class or level 5 has become the 'standard'. MNP is not used with the FAX modes of operation, as mentioned before HDLC framing techniques are used.

MNP CLASSES

(Throughput data is based on **2400 BPS** line speed).

Class 1 A half duplex protocol and not included in many new designs. Throughput was about 70% or 1690 BPS. The XR-2942 does not support this class.

Class 2 Asynchronous operation with byte orient ed data formatting. Throughput is rough ly 84% of nominal or about 2000 BPS.

Class 3 Conversion to synchronous, bit oriented data handling is transmitted in blocks consisting of 1 to 64 characters. Throughput is about 108% or 2600 BPS.

Class 4 Basic characters are the same as Class 3, but block size is dynamic, up to 256 Bytes, (flexible size is based on data transmission quality). Throughput is 120% or 2900 BPS.

Class 5 Includes Class 3 and 4 with data com pression techniques added. The com pression effectiveness is dependent on the type of data, but typical throughput enhancements of up to 200% or 4800BPS.

ERROR CORRECTION

Modem users have come to expect sophisticated circuitry like automatic adaptive equalization for varying phone characteristics and retrain modes for ensuring continued optimal performance. These techniques dramatically improve performance characteristics which is quantified by BER vs S/N measurements, the probability of errors when the modem signal is in the presence of noise.

The previously mentioned techniques are aimed at improving the modem data pump through analog (or digitally synthesized) circuitry. Techniques are becoming popular for not only improving, but virtually eliminating data errors through protocols implemented in the modems command microcontroller (µC). Prior to these 'hardware' based schemes, error correction provided in the applications software was available, such as X-MODEM or Kermit for asynchronous file transfer. In mainframe environments, SDLC or HDLC schemes were used.

Software based error correction schemes do however have their disadvantages. One important one being reduced data throughput. The throughput performance varies, but all schemes reduce data transfer below its nominal rate. Typical values of 31% are common, equating to only about 600 BPS for a 2400 BPS connection.

The hardware based error correction protocols supported by the XR-2942 for data mode are those as specified by the **CCITT LAPM,** and **MNP.** These schemes convert asynchronous data to be transmitted to a synchronous format (start and stop bits are stripped) for a packet-oriented protocol. Throughput values again vary, however typical values of 108% for the lower MNP Class 3 and 120% for MNP Class 4 or LAPM. These equate to roughly 2600 - 2900 BPS for 2400 BPS modems.

Actual error correction is based on adding information to the block-oriented data, through a 16-bit CRC (Cyclic Redundancy Check) calculation. The receiving side calculates CRC values for each block and if found to be incorrect, a retransmission of that block will be requested.

Typical frame sizes for LAPM are 128 Octets (8-bit start/stop bit stripped characters).

DATA COMPRESSION

The CCITT recommendation for V.42 only specifies error correction modes, as provided by LAPM and MNP 2-4. Modem controller protocols have advanced to the point where in addition to providing error-free data transfer, they can also offer other significant enhancements. One very significant enhancement is the addition of data compression operation. Simply put, this technique substantially enhances the data throughput of the modem.

This data compression scheme, MNP 5, although not specifically part of the V.42 recommendation, has been included in the XR-2942 to serve only as a further enhancement to the XR-2942 based modems.

MNP Class 5 is the protocol for **data compression.** It is by far the most accepted protocol for this function. CCITT recommendations are adding a data compression mode to V.42, called **V.42bis.** The upcoming **XR-2943** will support the future CCITT recommended **BTLZ** data compression.

MNP 5 data compression offers the XR-2900 Fax/Data modem chip set roughly 100% increase in throughput (in data mode), or 200% of nominal. This translates to a maximum modem throughput of 2400 BPS x 2 = 4800 BPS for a text file.

MNP 5 techniques utilize a scheme which abbreviates redundant data characters for a much higher transmission efficiency or throughput increase. Because of its dependency on redundant characters, the amount of improvement will vary. Typical improvement values are in the range of 75 to 125%, or 4200 to 5400 BPS for a 2400 BPS modem link.

FLOW CONTROL

As previously outlined, a method for regulating the flow of data to be transmitted is necessary when DTE data rates exceed line rates. Figure 2 illustrates a basic modem connection and helps illustrate where flow controls fit in.
Flow control can be under **hardware** or **software** control.

HARDWARE FLOW CONTROL

Hardware Flow Control allows the modem to lower or raise its CTS (Clear to Send) line to the DTE. This provides an ON/OFF control of data flow from DTE to modem. If the modem data buffer becomes full it lowers the CTS line to stop transmit data flow to allow the modem to "catch-up".

SOFTWARE FLOW CONTROL

An alternative to hardware flow control is control by software, known as **Xon/Xoff**. This is accomplished by special characters inserted into the data stream to start and stop data flow. **Control Q (^Q)** is used to start or restart data flow and **Control S (^S)** to stop data flow.

Three different variations of Xon/Xoff control modes are:

- Send Only
- Normal
- Passthrough

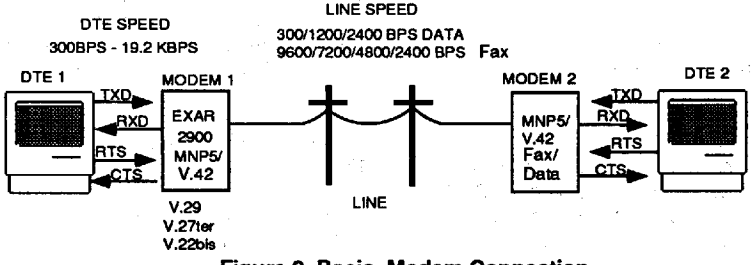


Figure 2. Basic Modem Connection

XR-2942 V.42/MNP FUNCTIONS AND COMMANDS

The XR-2942 with external EPROM provides control for the following major functions:

FUNCTION	DESCRIPTION
• 'AT' Command Control	Provides 'AT' Command Set Control
• 'AT+F' Commands	Provides control of the FAX functions
• MNP Level 2-4	Provides error correction for 100% perfect data transfer.
• MNP Level 5	Allows roughly a 100% increase (4800 BPS for V.22bis mode) in data throughput, through data compression techniques.
• V.42 (LAPM)	100% perfect data transfer
• Speed Conversion	Maintain up to 19,200 BPS DTE (terminal) speed for 300 BPS to 9600 BPS line speeds, both for LAPM/MNP and non-error correcting connections.

Application Software Interface

The firmware of the XR-2942 (combined masked and supporting code) supports the working document of the Telecommunication Industry Association for Fax/Data modems, assigned the EIA part number 2388. The level of support is service Class 2, which places most of the CCITT T.30 command functions in the modem (XR-2901, XR-2902 and XR-2942). Figure 3 indicates the approximate division between modem (DCE) and PC (DTE).

The command section of the XR-2942 data sheet defines the commands, responses and functions of the firmware supplied with the XR-2942. It is possible to send those commands to the XR-2900 system by hand, visually monitor the responses and send or receive data of the proper format. However, to use the XR-2900 modem system effectively, it is best to use an application software package that automatically monitors the response strings and acts accordingly.

In general the application software would be required to perform:

- ASCII to Bitmap Conversion
- PCX to Bitmap Conversion
- TIFF to Bitmap Conversion
- PICT to Bitmap Conversion

In an imbedded system, such as a text editor, the above list could be reduced to include only the ASCII to Bitmap conversion. Because ASCII is encoded, information as to the font, italics, bold, underline, and other word processor options is lost. It is expected that either the communication packages will start recognizing some Word processor options, or an integration of word processors and communication software such as seen today. The second step is to perform:

•BITMAP to 1 Dimensional Coding or
•BITMAP to 2 Dimensional Coding
as per the CCITT T.4 specification.

Figure 4 shows the process of taking text and encoding it 1 dimensionally using the CCITT T.4 Huffman codes. The entire line must total 1728 picture elements or pels. The application software will need to convert from files set up for 640 pels per line to one containing 1728 or more.

In the Vertical dimension, either 98 dpi (dots per inch) or 1968 dpi would be selected. This would determine the number of scan lines needed per page as well as determine the quality of the reproduced image. Two dimensional Huffman encoding is supported. Both of these modes would need to be enabled by using the VR (vertical resolution) and DF (data format) subparameter of the +FDIS command.

AUTO Fax/Data Negotiate: The XR-2942 supports the EIA PN 2388 Class 2 standard and auto Fax/Data negotiation. Figure 5 shows the flow for this process to proceed. The entire process requires less than 4 seconds permitting it to be compatible with fax machines and data modems available today.

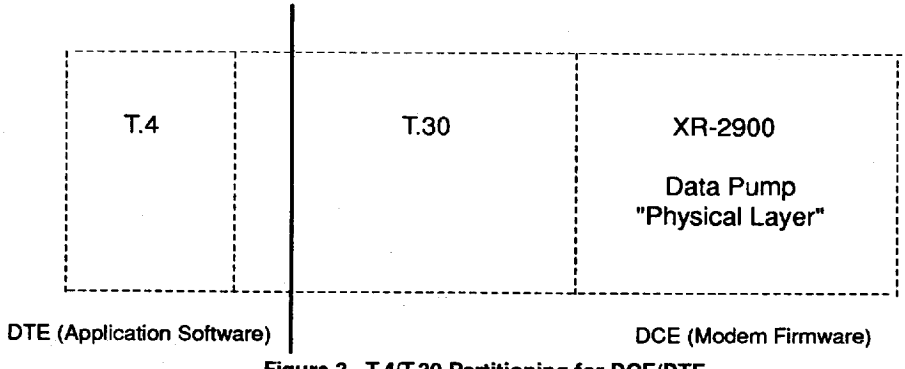


Figure 3. T.4/T.30 Partitioning for DCE/DTE

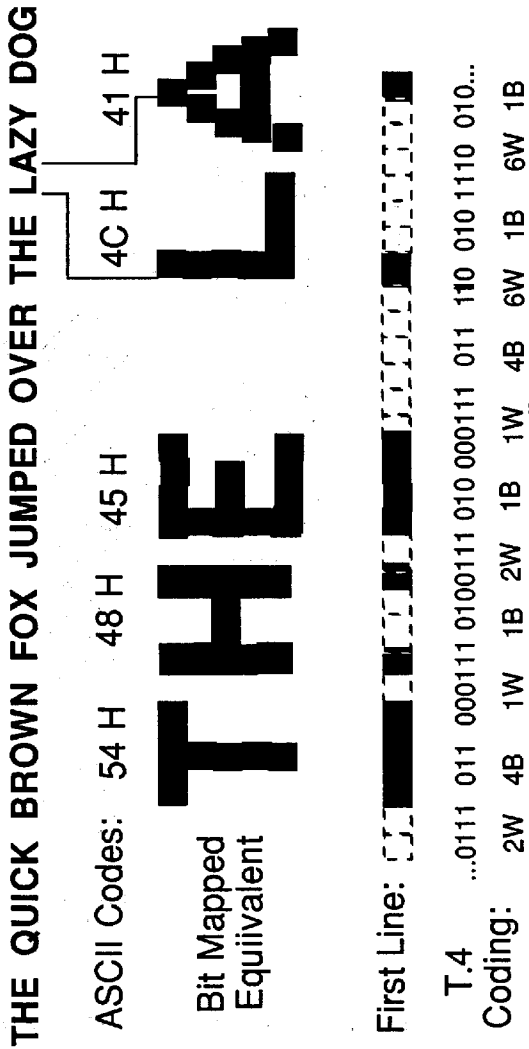


Figure 4. T.4 Encoding

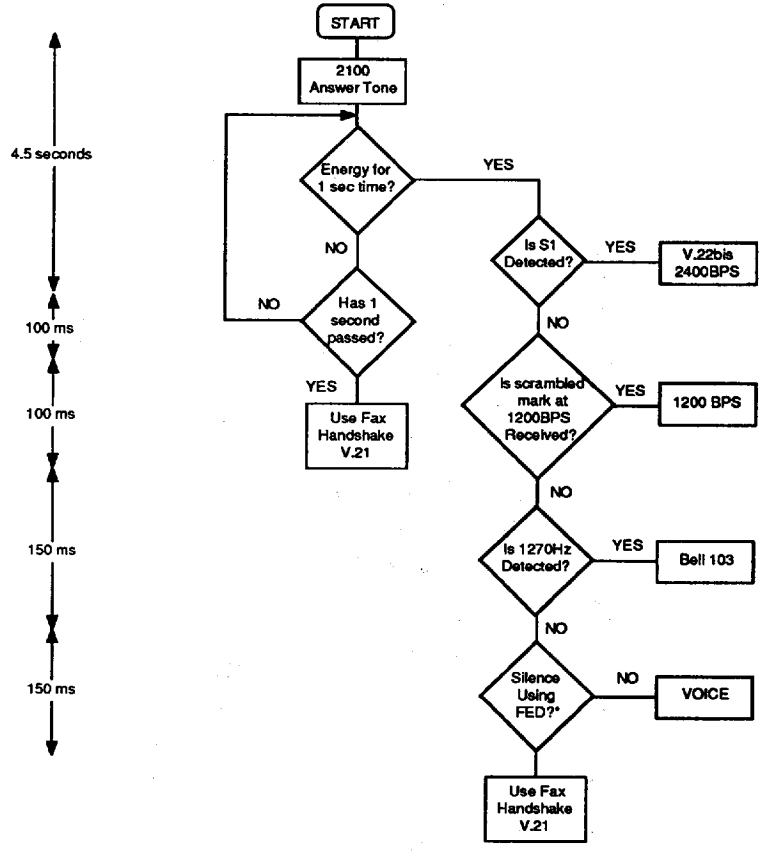


Figure 5. Auto Fax/Data Negotiation For Answer Mode

T.30 Description

The CCITT T.30 specification was intended to standardize the signaling between two fax machines. This permits any group 3 fax card or machine to communicate with another also meeting the standard.

The T.30 specification defines the fax transmission and reception process into five steps or phases:

Phase A: Call Establishment
Phase B: Negotiation of data rate, and capabilities of both machines
Phase C: Message (Page) Transmission
Phase D: Post Message (Page) Transmission; confirm send; possibly more pages
Phase E: Call Release (Hang up)

Figure 6 provides a general flow chart of the process.

Phase A of the CCITT T.30 specification establishes that a fax modem is answering the line and not a data modem. The uniqueness of this handshake allows the ability to add the feature of switching between fax and data modes with the XR-2900 Fax/Data modem chip set. In addition, the optional identification of the called and calling unit takes place using CCITT V.21 modulation and demodulation. The data is framed (synchronous) to ensure reliable communication at this point, even on an extremely poor phone line. By taking this extra step the CCITT has provided a means to negotiate (during Phase B) the data rate to a lower rate, as required. This can be utilized by the application software developer to add a security mode: if the correct response is not provided, the session can be ended at this point.

Phase B is the exchange of information as to capabilities of the two fax modems, again using V.21 channel 2 synchronous transmission and reception. Information such as scanning speed, number of dimensions of Huffman encoding, and grey scale encoding is sent at this time.

Phase B also includes the phasing and training process for the fax modem data pump. The calling (originating) modem transmits a bi-phase signal at the proper baud rate for the transmission (2400 symbols/second for 9600 BPS) to allow the called (answering) modem to adjust for group delay distortion as well as gain loss of the line. If not successful, a failure to train (FTT) is sent from the called modem to the calling modem at 300 BPS using the framing described above. The calling modem tries at the next lower speed. Once this process is successful, the called modem confirms that it is programmed to receive.

The sending of the page or information occurs during **Phase C** at the maximum negotiated data rate (9600 BPS for the XR-2900).

Phase D is the confirmation of the end of message and of receiving the page. This usually indicates that the page has been received properly. At this time the optional multiple pages signal can be sent. If another page is to be sent or received, phase C is repeated.

Phase E disconnects the phone line (on hook).

The XR-2942 supports automatic call establishment, for it is felt that the manual process is not practical in a Fax/Data product where interaction between the host computer (to perform the file conversion and T.4 encoding) and the modem is needed. However this does not preclude a manual to automatic process, using an external dialer and starting the application program to send the fax (off hook immediate and wait for **Phase A** to begin).

The process is similar when receiving a call. However, with the Exar proprietary Fax/Data auto select, the modem will determine during phase A whether a fax machine/card or data modem is calling. Details for this is provided in this datasheet.

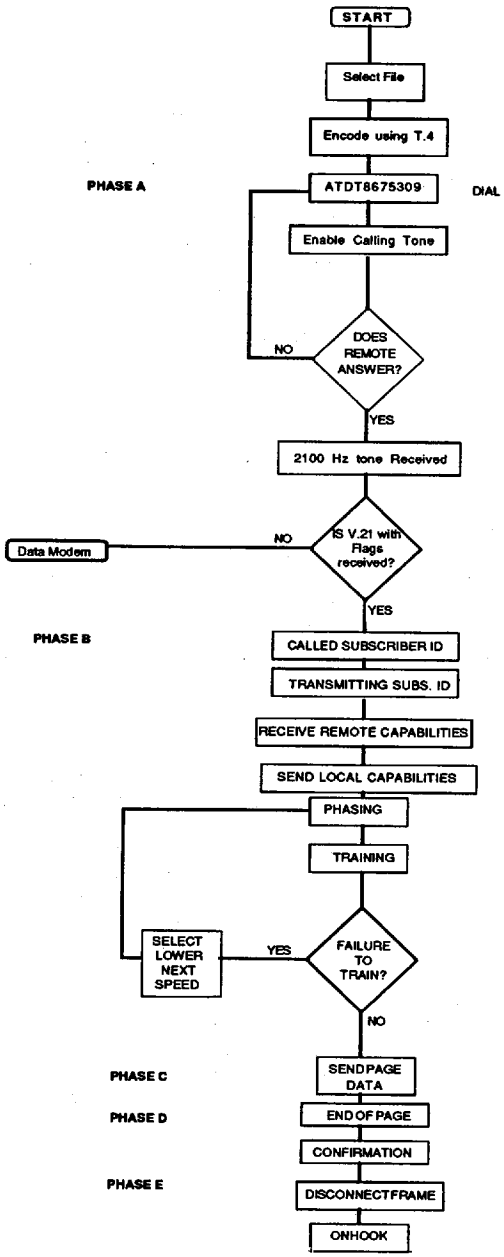


Figure 6. CCITT T.30 Process Sequence (Transmit a Single Page)

PROTOCOL NEGOTIATION

The XR-2942, for data mode, supports error correcting or reliable modes of operation for not only LAPM, but also MNP2-4 type protocols. Also, although data compression operation is not specified by CCITT V.42 specifications, it has been included through MNP 5 for increased compatibility. Because of these multiple protocols supported, the XR-2942 offers two protocol negotiation modes:

1) **AT\M0** Default Mode
   This command selects an automatic protocol negotiation mode. **First LAPM** negotiation will be attempted. If not possible, MNP2-4,5 operation will be negotiated. The highest possible class of MNP operation will be negotiated (depending upon setting on %C command). If the remote modem does not support error correction, normal 2400 BPS (or1200/300 BPS) operation will be supported.

2) **AT\M1**
   This command will **disable LAPM** operation. Here only MNP 2-5 and non-error correcting modes of operation will be supported.

The following is a command set summary for the XR-2942. Provided are:

Data Mode
1) Basic Connection/Dialing Commands
2) Dialing Modifiers
3) Standard Hayes 'AT' Command Set
4) 'S' Register Descriptions/Functions. These registers are used for controlling the value or function of various 'AT' commands.
5) MNP/LAPM Commands. The entire list represents the MNP command set. Most of the MNP commands also apply to LAPM, with the exceptions indicated.

Fax Mode
6) Extended 'AT + F' Commands per EIA PN 2388 (Class 2) operation
7) Fax responses

COMMAND	DESCRIPTION / RANGE - SIZE
A/	Execute previous command, without striking <CR> key
AT	Attention
ATA	Answer Immediate
ATB0	CCITT V.22 mode
ATB1	Bell 212A mode **DEFAULT**
ATB2	V.23 mode
ATD	Dial Command
ATDP	Dial Using pulse dial
ATDT	Dial Using DTMF tone dial **DEFAULT**
The following 8 modifiers will dial using the previously used technique (pulse or tone), or the T or P command can be added after the D (dial) command. 0-9 A B C D * #	
ATDW	Wait for Dial Tone for Period Set by S7 Register
ATD@	Quiet Answer: Wait for 5 Seconds of Silence Before Dialing
ATD!	Hookflash: Commonly Used PBX Systems
ATDR	Reverse Answer Mode
ATDS=n	Dial Stored Number when n= 0-3
ATD/	Wait 0.125 Seconds
ATD;	Return to Command Mode After Dialing
ATD,	Pause for Time Set by S8 Register
ATE0	Command Echo Disabled
ATE1	Command Mode Echo Enabled **DEFAULT**
ATH0	Go On Hook (Open Relay)
ATH1	Go Off Hook (Close Relay)
ATI0	Identification Code
ATI1	Identification Code
ATI2	"OK" Response if Checksum Verifies
ATI3	EXAR EPROM Revision Date
ATL0	Lowest Volume Setting
ATL1	Same as ATL0
ATL2	Medium Volume Setting **DEFAULT**
ATL3	Maximum Volume
ATM0	Speaker Always Off
ATM1	Speaker On Until Carrier Is Detected **DEFAULT**
ATM2	Speaker Always On
ATM3	DTMF Tones are not Heard, but Speaker is on Until Carrier Detected
ATO	Originate Immediate or Return to Data Mode
ATO1	Request a Retrain When in V.22bis Mode
ATQ0	Provide Result Codes **DEFAULT**
ATQ1	Disable Result Code
ATSn?	Provide S Register Value
ATSn=	Set S Register Value
ATV0	Terse (and Verbose) Responses, affected by \Vn

NUMERIC	DESCRIPTION / RANGE - SIZE	
		\V1
0	OK	Command Executed
1	CONNECT	Connection at 0 to 300 BPs
2	RING	Ring Signal Detected
3	NO CARRIER	Carrier Signal not Detected
4	ERROR	Error
5	CONNECT 1200	Connection at 1200 BPS
6	NO DIALTONE	No DialTone Detected
7	BUSY	Busy Signal Detected
8	NO ANSWER	No Silence Detected
10	CONNECT 2400	Connection at 2400 BPS
11	CONNECT 4800	Connection at 4800 BPS
12	CONNECT 9600	Connection at 9600 BPS
14	CONNECT 19200	Connection at 19200 BPS
		\V1
22	CONNECT 1200/REL 4	MNP Class 4 Link
22	CONNECT 1200/REL 5	MNP Class 5 Link
23	CONNECT 2400/REL 4	MNP Class 4 Link
23	CONNECT 2400/REL 5	MNP Class 5 Link
22	CONNECT 1200/V.42	V.42 Link
23	CONNECT 2400/V.42	V.42 Link

COMMAND	DESCRIPTION / RANGE - SIZE
ATV1	Verbose Response **DEFAULT**. See ATV0 for Responses
ATX0	Enable Result Codes 0-4
ATX1	Enable Result Codes 0-5, 10
ATX2	Enable Result Codes 0-6, 10
ATX3	Enables Result Codes 0-5 and 7 and 10
ATX4	Enables Result Codes 0-10 **DEFAULT**
ATY0	Disable Long Space Disconnect **DEFAULT**
ATY1	Enable Long Space Disconnect
ATZ0	Software Reset, Restore S Register from profile location 0 in NVRAM
ATZ1	Restore S Registers From Profile Location 1 in NVRAM
AT&C0	EIA Carrier Line Always Forced on **DEFAULT**
AT&C1	EIA Carrier Line Follows Data Carrier
AT&D0	DTR Always on **DEFAULT**
AT&D1	Modem Goes to Command Mode When DTR Goes Off
AT&D2	Modem Goes on HOOK and Returns to Command Mode When DTR Goes Off
AT&D3	Modem Initializes When DTR Goes Off
AT&F	Fetch S Registers From EPROM for Factory Default
AT&G0	No Guard Tone **DEFAULT**
AT&G1	550 Hz Guard Tone Enabled
AT&G2	1800 Hz Guard Tone Enabled
AT&J0	RJ-11 Select **DEFAULT**
AT&K0	Flow Control Disabled
AT&K1	No Function
AT&K2	No Function
AT&K3	RTS/CTS Flow Control **Default**
AT&K4	Xon/Xoff Flow Control
AT&K5	Xon/Xoff Pass Through
AT&L0	Switched Line Select **DEFAULT**
AT&L1	Leased Line Select
AT&M0	Asynchronous Mode **DEFAULT**
AT&M1	Synchronous Mode With Asynchronous Dial
AT&M2	Synchronous Mode and Dial the Stored Number Immediately
AT&M3	Synchronous Mode With DTR Controlling Data/Talk
AT&P0	US Make/Break Ratio For Pulse Dialing **DEFAULT**
AT&P1	UK Make/Break Ratio For Pulse Dialing
AT&Q0	Direct mode (same as Hayes)
AT&Q1	Same as &M1
AT&Q2	Same as &M2
AT&Q3	Same as &M3
AT&Q5	Error Control Mode
AT&Q6	Normal Mode
AT&R0	Clear To Send (CTS) Follows RTS **DEFAULT**
AT&R1	CTS Always On
AT&S0	Data Set Ready (DSR) Always on **DEFAULT**
AT&S1	DSR Normal
AT&T0	Terminate Test in Progress **DEFAULT**
AT&T1	Initiate Local Analog Loopback For Time Set by Register S18
AT&T2	Not Defined
AT&T3	Initiate Digital Loopback for Time Set by Register

COMMAND	DESCRIPTION / RANGE - SIZE
AT&T4	(Not Supported)
AT&T5	Disable Remote Digital Loopback (RDLB) Response
AT&T6	Initiate RDLB
AT&T7	Initiate RDLB with Self Test
AT&T8	Initiate ALB with Self Test (for Direct / Normal Mode only)
AT&W0	Write User Profile 0 into NVRAM
AT&W1	Write User Profile 1 into NVRAM
AT&X0	Modem Provides Transmit Clock
AT&X1	DTE Supplies Transmit Clock (Not Supported)
AT&X2	Slave Clock Mode (Not Supported)
AT&Y0	Power Up Recall User Profile 0
AT&Y1	Power Up Recall User Profile 1
AT&V	List Configuration both Active and Stored
AT&Z m=An	Store Telephone Number into NVRAM (XL93C46) where: *m* is the number location (0-3) *A* is *P* or *T* (pulse or Tone) *n* is the telephone number

COMMAND	LAPM Yes/No	DESCRIPTION/RANGE - SIZE	FUNCTION
AT \ N0	Y	Normal	
AT \ N1	Y	Direct	
AT \ N2	Y	MNP 2-5/Reliable	
AT \ N3	N	MNP 2-5/Auto Reliable	
AT \ N4	Y	V.42 Mode	
AT \ N5	Y	V.42 Mode Auto Reliable	
AT \ N6	Y	V.42 / MNP 2-5 Reliable	
AT \ N7*	Y	V.42 / MNP 2-5 Auto Reliable	
AT \ A0	N	64 Characters	Transmit Block Size
AT \ A1	N	128 Characters	
AT \ A2	N	192 Characters	
AT \ A3*	N	256 Characters	
AT%An	Y	n = 0-127 ASCII	Auto-Reliable Fallback Character
AT \ L0*	N	Stream Link	Block MNP Link
AT \ L1	N	Block Link \L1 = \L0	(Stream Mode)
AT \ O	N	Initiate Reliable Link After Escape Command Independent of Modem Initial mode (ANS or ORG)	Originate Reliable Link
AT \ U	N	Accept Reliable Link after Escape Command request from Initiator of Link	Accept Reliable Link
AT \ Y	N	Establish Reliable Link after Connecting in Normal Mode	Switch to Reliable Mode
AT \ Z	N	Switch to Normal Mode After Establishing a Reliable Link	Switch to Normal Mode
AT % C0	Y	Compression Disabled	Compression On/Off Control
AT % C1*	Y	Compression Enabled	
AT \ V0	Y	Standard Non-MNP Result Codes	Result Code Form
AT \ V1*	Y	Modified MNP Result Codes (As Listed Below)	
AT \ Bn	Y	N = 0 - 9 (100ms Increments) Used in Normal Mode Default = 3, Error Control Mode Always 300ms	Transmit Break for Normal Data Mode
AT \ C0*	Y	Does not buffer Data Default	Set Auto-Reliable Buffer Break Control
AT \ C1	Y	Buffers All Data on Answering Modem until 200 Characters (Non-Sync) are Returned	
AT \ C2	Y	Does Not Buffer Data on Answering Modem, according to % An to fall back	
AT \ K1	Y.	"Destructive" signaling regardless of its sequence in data sent and received; data in process at time is destroyed	Break Control for Reliable Data Mode
AT \ K3	Y	"Expedited" signaling regardless of its sequence in data sent and received; data integrity maintained	

COMMAND	LAPM Yes/No	DESCRIPTION / RANGE - SIZE	FUNCTION
AT \ K5*	Y	"In sequence" signaling as data is sent and received; data integrity maintained ahead of and after break	
AT \ K0,2,4	-	Not Supported (Will be equal to AT \ K5 if selected)	
AT \ Tn	Y	N = 0-90 min N* = 0 (disable)	Inactivity Timer
%D0*	Y	Hang up without clearing buffer	
%D1	Y	Clear the receive buffer before hang up	
AT \ I	-	Not Functional	Interface Protocol
AT \ J0*	Y	BPS Rate Adjust Disabled	Speed Conversion Control Disable
AT \ J1	Y	BPS Rate Adjust Enabled Adjustment	Modem Port Rate
AT \ S	Y	List Profiles	
AT \ G0*	Y	Disables Modem Port Flow Control	Set Modem Port
AT \ G1	Y	Sets Modem Port Flow Control to Xon / Xoff	Flow Control
AT \ X0*	Y	Does Not Pass Xon / Xoff to Remote Modem	Xon / Xoff Pass Through Control
AT \ X1	Y	Passes Xon / Xoff to Remote Modem	
AT \ Q0	Y	Disable Flow Control	Serial Port Flow Control
AT \ Q1	Y	Bidirectional Xon / Xoff Enabled	
AT \ Q2*	Y	Unidirectional Hardware Control by CTS	
AT \ Q3	Y	Bidirectional Hardware Control by RTS / CTS	
AT \ Q4	Y	Unidirectional Xon /Xoff Send Only	
AT \ Q5		Keep CTS off until connect unidirectional hardware flow control	
AT \ Q6		Keep CTS off until connect for bidirectional hardware flow control	
AT % U	Y	Not Functional	Clear Serial Port Speed Serial Port
AT - P0*	Y	Ignores Parity for Special Characters	Check Parity
AT - P1	Y	Processes Special Characters Only if they have Correct Parity	

Note: ** Denotes Default Condition*

See Command AT \ V1 Above

STANDARD RESULT CODES\V0			MODIFIED RESULT CODES \V1	
Verbose	Numeric		Verbose	Numeric
CONNECT	1			
CONNECT 1200	5		CONNECt 1200 / REL 4 or 5	22
CONNECT 2400	10		CONNECT 2400 / REL 4 or 5	23
CONNECT 4800	11			
CONNECT 9600	12		CONNECT 1200/V.42	22
CONNECT 19200	14		CONNECT 2400/V.42	23

S	REGISTER FUNCTION
S0	Number of Rings to Answer: **Default** = 0 (no answer)(stored)
S1	Ring Count: Stores Number of Rings: Resets After Every Call
S2	Escape Code Character: **Default** = 043 (ASCII for "+")
S3	Carriage return Character: **Default** = 013
S4	Line Feed Character: **Default** = 010
S5	Back Space Character: **Default** = 008
S6	Wait for Dial Tone: **Default** = 002 (seconds) (minimum setting)
S7	Wait for Carrier After Dial: **Default** = 030 (seconds)
S8	Duration of Delay for Comma: **Default** = 002 (seconds)
S9	Carrier Detect Response Time: **Default** = 0.6 (seconds)
S10	Loss of Carrier Response Time **Default** = 1.4 (seconds)
S11	Touch Tone Duration: **Default** = 095 (milliseconds)
S12	Escape Code Guard Time: **Default** = 1 (second)
S13	Reserved
S14	Bit Mapped Register: Stored in NVRAM (XL93C46) Bit 0 Reserved Bit 1 Echo Bit 2 Result Codes Bit 3 Numeric Result Codes Bit 4 Always 0 Bit 5 Tone/Pulse Dialing Bit 6 Reserved Bit 7 Answer/Originate
S15	Reserved
S16	Test Register Bit 0 ALB Bit 1 Reserved Bit 2 Local Digital Loopback Bit 3 Remote Digital Loopback (Not Supported) Bit 4 Initiate Remote Test Bit 5 Initiate Remote Test With Self Test Bit 6 Analog Loopback With Self Test Bit 7 Reserved
S17	Reserved
S18	Test Time Stored in NVRAM (XL93C46) Default = 000 (seconds)
S19	Reserved
S20	Reserved
S21	Bit Mapped Register Stored in NVRAM (XL93C46) READ ONLY Bit 0 0 = RJ11 Jack Bit 1 Not Used Bit 2 CTS RTS Function Bit 3 DTR Function Bit 4 DTR Function Bit 4 / Bit 3 / Function 0 / 0 / DTR Always True Default 0 / 1 / DTR Off, Forces Command State 1 / 0 / DTR Off, Forces Modem Offline 1 / 1 / Modem Initializes With DTR OFF (ATZ)

REGISTER NUMBER	REGISTER FUNCTION
S22	Bit 5 EIA Carrier Status Bit 6 Bit 7 Guard Tone Select Bit 7 / Bit 6 / Function 0 / 0 / No Guard Tone Default 0 / 1 / 550 Hz Guard Tone 1 / 0 / 1800 Hz Guard Tone 1 / 1 / Reserved Option Bit - Mapped Register Bit 0 Determines Speaker Volume Bit 1 Bit 1 / Bit 0 / Speaker Volume 0 / 0 / Low 0 / 1 / Low 1 / 0 / Medium Default 1 / 1 / High Bit 2 Determines the Speaker Status Bit 3 Bit 3 / Bit 2 / Speaker Status 0 / 0 / Always Off 0 / 1 / On Until Carrier is Detected Default 1 / 0 / Always On 1 / 1 / As '01', Except Off for Dialing Bit 4, 5 and 6 Determine Response Messages Bit 6 / Bit 5 / Bit 4 / Message 0 / 0 / 0 / Basic Message Set 1 / 0 / 0 / Extended with Connect 1200 and Connect 2400 1 / 0 / 1 / Extended with 'No Dial Tone' 1 / 1 / 0 / Extended with 'Busy' 1 / 1 / 1 / Extended with All Messages Default Bit 7 Determines Off Hook/On Hook (Make/Break) Ratio for Pulse Dialing Bit 7 / Ratio 0 / 39/61 (USA and Canada) Default 1 / 33/67 (Uk and Hong Kong)
S23	Option Bit Mapped Register (LSB) Bit 0 Not Supported Bit 3 / Bit 2 / Bit 1 0 / 0 / 0 / 300 0 / 0 / 1 / Not Used 0 / 1 / 0 / 1200 0 / 1 / 1 / 2400 1 / 0 / 0 / 4800 1 / 0 / 1 / 9600 1 / 1 / 0 / 19200 1 / 1 / 1 / 38400(reserved) Bit 4 Determines the Parity for Transmitting and Receiving Data

REGISTER NUMBER	REGISTER FUNCTION
	Bit 5 Bit 5 Bit4 Parity 0 0 Even Default 0 1 Space/None 1 0 Odd 1 1 Mark Bit 6 Determines Guard Tone Frequency Bit 7 (Used in European Applications) Bit 7 Bit 6 Guard Tone (Hz) 0 0 Disabled Default 0 1 550 1 0 1800 1 1 Reserved
S24	Not Used
S25	Delay to DTR (Stored in NVRAM) Default = 005 (seconds)
S26	RTS to CTS Delay (Synchronous Mode Only) Default = 1 (milliseconds)
S27	Bit Mapped Register STORED IN NVRAM Bit 0 Bit 1 Transmission Mode Bit 1 Bit 0 Function 0 0 Asynchronous Mode Default 0 1 Synchronous Mode 1 1 0 Synchronous Mode 2 1 1 Synchronous Mode 3 Bit 2 Reserved Bit 3 Reserved Bit 4 Bit 5 Transmission Mode Bit 5 Bit 4 Function 0 0 Internal Modem Clock Used Default 0 1 DTE Supplied Clock 1 0 Slave Clock Mode 1 1 Same as 00 Bit 6 CCITT or Bell Handshaking Standard 0 CCITT 1 Bell (including CCITT V.22bis) Default Bit 7 Reserved
S28-35	Reserved
S36	Negotiate Failure Fallback (Affected by %C and \N) Bits 0 Hang Up 1 Attempt a standard asynchronous connection (&Q0) 3 Attempt an asynchronous connection using automatic speed buffering (&Q6) 4 Attempt a V.42 Alternative Protocol connection (MNP compatible); if negotiation fails, attempt a standard asynchronous connection 5 Attempt a V.42 Alternative Protocol connection (MNP compatible); if negotiation fails attempt a standard asynchronous connection
S37	Not Supported

REGISTER NUMBER	REGISTER FUNCTION
S38	Not Supported
S39	Reserved
S40	Not Supported
S41	Not Supported
S43-45	Reserved
S46	Protocol Selection: Bits 136 LAPM only (V.42)
S47	Not Supported
S48	Feature Negotiation Action 0 Negotiation disabled; presume the remote modem is configured for and has the capabilities necessary for the connection selected with S46 3 Negotiation enabled, but originating modem remains silent during detection phase. For connections with MNP modems; defeats connection sequence with other V.42 modems 7 Negotiation enabled 128 Negotiation disabled; forces fallback options specified in S36 to be taken immediately
S82	Break Handling: Affected by \K commands 3 "Expedited" signaling regardless of its sequence in data sent and received; data integrity maintained 7 "Destructive" signaling regardless of its sequence in data sent and received; data in process at time is destroyed 128 "In sequence" signaling as data is sent and received; data integrity maintained ahead of and after break
S86	Not Supported

Special Notes regarding the use of S registers above S27 and AT/n Commands.

1. Changes of S register values above S27 will effect the profile display for AT/n Commands. AT/n Commands however, do not modify the setting of S registers.

2. It is intended that a user or application software package will use only one method (S register \ n Commands) to effect the error control functions. Use of a combination could result in unpredictable behavior.

"AT + F" COMMANDS

The following are the list of commands supported by the XR-2900. They follow the Aug. 20, 1990 EIA standard PN-2388 (class 2).

All of the commands listed can be used in a string length of up to 40 characters, always preceeded by "AT". For example, "AT&D2E1V0+FCLASS=2<CR>" is a valid command sequence. A semicolon(;) must be used to separate =F commands.

COMMAND	DESCRIPTION	RESPONSE	COMMENTS
+FCLASS =*n*	Establish Class	OK	*n* integer values are 0 or 2 0 for Data mode 2 for FAX mode
+FCLASS=?		0,2	Provides service Class list
+FCLASS?	Service Class Setting	0 or 2	Indicates latest setting
	Default Fax Parameters	OK	Each number's location in the
+FDCC=VR, BR, WD, LN, DF, ER, FT, ST	DCE Capability		string represents the function listed below:
+FDCS=VR, BR, WD, LN, DF, ER, FT, ST	Current Session Parameters	OK	
+FDIS=VR, BR, WD, LN, DF, ER, FT, ST	Parameters for Session	OK	VR Vertical Resolution *0 for 98 dpi (dots/inch) 1 for 196 dpi BR DCE Bit Rate (modulation) 0 = 2400 BPS V.27ter 1 = 4800 BPS V.27 ter 2 = 7200 BPS V.29 *3 = 9600 BPS V.29 WD Page Width *0 = 1728 PIXELS IN 215 mm 1 = 2048 pixels in 255 mm 2 = 2432 pixels in 303 mm 3 = 1216 pixels in 151 mm 4 = 864 pixels in 107 mm LN Page Length *0 = A4, 297 mm 1 = B4, 364 mm 2 = unlimited DF Data Format *0 = 1. D Modified Huffman 1 = Not Supported 2 = Not Supported ER ErrorFree Mode *0 = Disable 1 = Not Supported

COMMAND	DESCRIPTION	RESPONSE	COMMENTS
			FT Binary File Transfer *0 = Disable 1 = Not Supported ST Scan Time 5 = 20 ms
+FLID = "Local ID"	Local FAX ID String	OK	20 character alpha numeric string for identification 0-9 space, +, ASCI 32-127
+FCR = 0	Capability to Receive	OK	DCE will not receive, but will answer and handshake
+FCR = 1		OK	
+FCQ = 0,1	Copy Quality	OK	n = 2 , Not Supported
+FBUG = 0, 1	Debug Mode: HDLC Frame	OK	
FMINSP = 0, 1, 2, 3	Minimum Transmit Speed	OK	0: 2400, 1: 4800, 2: 7200, 3: 9600
+FBOR = 0	Bit Order (DCE to DTE)	OK	MSB First
+FBOR = 1		OK	LSB First
+FDR	Begin Phase C Reception	CONNECT	Beginning of file is noted by DC2(12H) character
+FAA = 0	Auto Answer Mode	OK	FAX only communication
+FAA = 1		OK	Auto Fax/Data determination
+FDT =	Begin Sending Page	CONNECT	Marks beginning of Phase C data
+FHPS=0, 1	Handshake Protocol	OK	0: OK 1: Error
+FET=0,2	End of page	OK	1: Not Supported Indicates additional pages if any 0 for another page no parameter changes

RESPONSES from XR-2900 FIRMWARE:

The following lists valid responses to be expected from the XR-2942 firmware. The standardization of these responses allows the Application software to verify that a particular mode has been entered and monitoring of the fax transmission or reception process is easier.

RESPONSE	DESCRIPTION	COMMENTS
+FCON	FAX connection	Occurs after V.21 flags received
+FCSI:	Called Station ID	Report ID being Received (originate)
+FTSI:	Transmit Station ID	
+FDIS:	Session Negotiation Parameters	Uses format shown in Commands Section
+FDCS:	Report of DCS Frame Information	The Format is the same as +FDIS command
+FET:0, 2	Post Page Message Response	0: Another Page coming same document 1: Not Supported 2: No more pages or documents
+FPTS: 1, 2		1: Message Confirmation 2: Bad quality
+FHNG: 0	Call terminated status	Normal and proper connections

APPLICATIONS INFORMATION

The XR-2942 is shown in a typical "stand-alone" application in the modem schematic. The XR-2942 provides the command controller function for the XR-2900 Fax/Data modem chip set. For data operation the modem operates error-free through LAPM or MNP 2-4 modes and can offer increased throughput with MNP 5. The XR-2321 device included adds CCITT V.21 and V.23 FSK modes, it is optional and can be eliminated for designs not requiring these modes.

Detailed information for the XR-2900 is available in XR-2900 Fax/Data modem chip set datasheet.

Layout Hints

In order for the XR-2942 to provide optimal support for best performance of the modem, some design hints/rules should be followed.

- Locate the XR-2902 AFE near the DAA section
  - provide for a short transmit / receive carrier input path, away from any digital control lines.
- Maintain separate analog and digital grounds/ power lines back to the power supply.
- Bypass (capacitor decouple) the XR-2901, XR-2902, XR-2942 and op amp power supplies with both 0.01µF ceramic and 0.47µF tantalum capacitors near their actual pins. Ensure analog/digital supplies are bypassed to their respective ground.
- Crystal - parallel resonant type. Typical loading capacitors are 18pF.

SYSTEM PERFORMANCE

Performance for an error-correcting modem (data mode) has two major areas.

1) DATA PUMP PERFORMANCE
With error-detection capabilities turned off, the integrity of the data pump to pass data in the presence of impairments. Most often the major specification measured here is the probability of data errors with the receive carrier impaired by noise, or BER (bit error rate) vs S/N (Signal-to-Noise ratio).

Figure 8 shows BER vs S/N for the circuit in Figure 12, as measured with the test set-up in Figure 9.

2) ERROR CONTROLLER PERFORMANCE
The XR-2942, when in LAPM or MNP modes provides the control and detection required to yield perfect data transfer (Data Modem mode).

Beyond error correction, throughput, or data transfer rate, is another important parameter to the modems overall performance.

LAPM and MNP 2-4 Modes are not specifically provided for increased throughput. However an additional benefit of their error-detecting schemes is roughly a 20% increase in throughput. Using the 'Quick Brown Fox....' pattern, both LAPM and MNP 4 modes yielded better than a 20% throughput increase. V.22bis mode was used for this test, with an actual throughput of better than 2900 BPS measured.

MNP 5 Data Compression included in the XR-2942 allows roughly a 100% throughput increase over the modems nominal data rate. As previously discussed, the throughput performance of MNP 5 varies with different types of data. Figure 10 shows data for various data patterns. Figure 11 illustrates the test set-up used for measuring the circuit of Figure 12.

Fax S/N performance is shown in the XR-2900 performance/ compatibility summary bulletin.

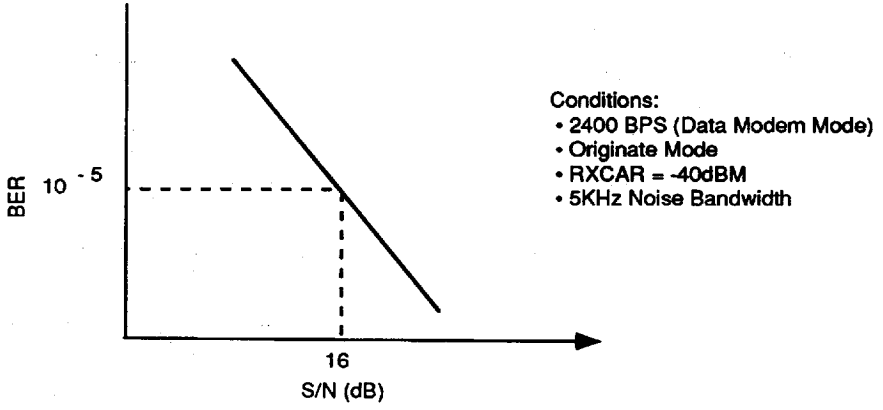


Figure 8. 2400 BPS Data Mode BER vs S/N (Non-Error Correcting)

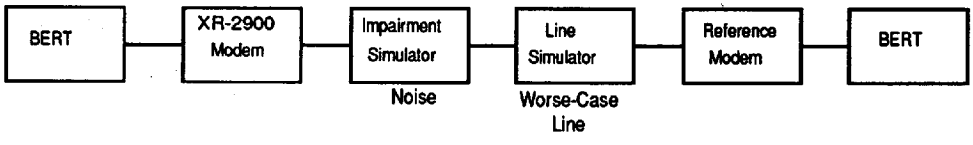


Figure 9. Data Quality Test Set-up

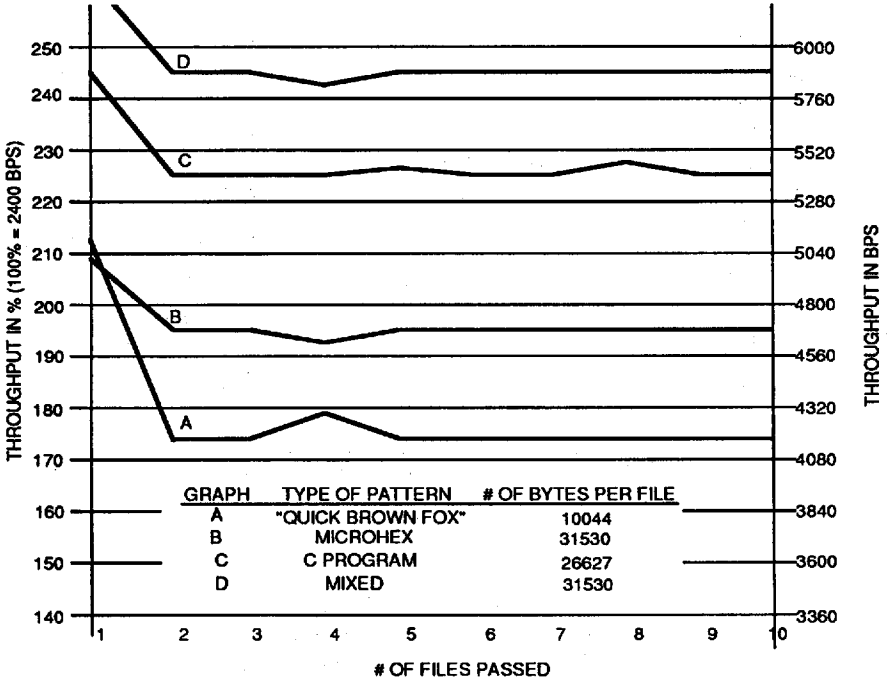
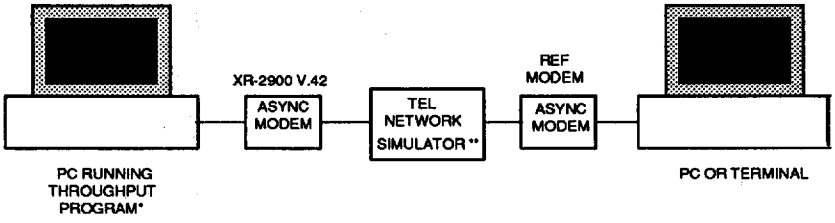


Figure 10. Effective Data Throughput



* APT (asynchronous Performance Tester), also contains data or files to be used during measurement. Productof Concord Data Systems.
** Simulates line impairment and attenuation conditions.

Figure 11. MNP5 Throughput Measurement Test (Data Mode)

XR-2942

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