Maintenance Manual

Rockwell Modem

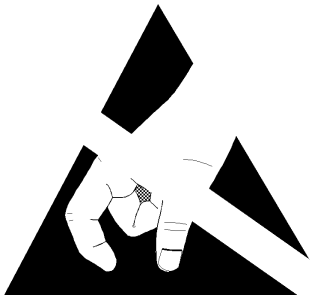
Model R96FT (19A705178)

U.S. Robotics Courier Modem

Model 2400 (19A149786P1)
Model V.32 (19A149786P2)

ERICSSON

TABLE OF CONTENTS



CAUTION

OBSERVE PRECAUTIONS FOR HANDLING

ELECTROSTATIC SENSITIVE DEVICES

1.0 SCOPE

This document describes how to test the Rockwell Modem (R96FT) to insure operation of the 9600 bps serial data transmission used in the Public Service Trunked System and Voice Guard® System.

Mechanical and Electrical specifications are also included mounting holes and overall dimensions are on Sh. 9 of this drawing.

2.0 DESCRIPTION

The Rockwell Modem (R96FT) is a purchased part from the Rockwell Corporation used in the GETC™ shelf. The Rockwell Modem is used to transmit and receive 9600 bps serial data to and from four-wire dedicated unconditioned telephone 1ines under control of the GETC shelf.

2.1 GETC SHELF

The GETC shelf (19D901868) is used to test the Rockwell Modem as part of the shelf assembly.

2.2 PHONE MODEM BOARD (ROCKWELL R96FT)

The Rockwell R96FT is a board level synchronous serial 9600 bit per second modem. The GETC logic board contains phone 1ine interface circuits (T1, T2 etc.) that couple the phone modem to the phone line.

2.3 TEST SOFTWARE

The GETC shelf is used as a test fixture for the test of the Rockwell Modem.

The GETC exercises the testing of the Rockwell Modem via the built in test software known as SIMON on the GETC.

3.0 SPECIFICATIONS

3.1 POWER SUPPLIES

13.8 volts nominal GETC power supply.
Refer to the GETC test specification (19A705179).

Modem Input Power	+5 Volts +/-5% < 700 Ma
	+12 Volts +/-5% < 20 Ma
	-12 Volts +1-5% < 80 Ma

3.2 DATA RATE

Data Rate	9600 +1 -1 Bit/Second
Input Level Range	- 43 dBm to 0 dBm
Output Level	0 dBm
Train Time	30 msec

3.3 APPLICABLE DRAWINGS

DRAWING NO.	DRAWING NAME
19D901868	GETC SHELF
19D901855	GETC LOGIC BOARD ASSEMBLY
19D901852	GETC LOGIC BOARD SCHEMATIC DIAGRAM

4.0 RECOMMENDED TEST EQUIPMENT

Refer to the GETC test specification (19A705179).

The test equipment necessary to set up the GETC for the Rockwell Modem test is listed blow. This setup is performed once on the specified GETC.

QTY	EQUIPMENT TYPE
1	6286A DC SUPPLY WITH CURRENT LIMIT (OR EQUIVALENT.)
1	OSCILLOSCOPE MEDIUM BANDWIDTH NON-STORAGE
1	FREQUENCY METER CAPABLE OF MEASURING l2 MHz
1	STANDARD TERMINAL
1	TRIPLETT AC VOLT OHMMETER MODEL 630-PL TYPE 5 or DVM
1	19D901868 GETC shelf
1	PROM with SIMON software (standard Application software)

The equipment necessary to test the Rockwell Modem is a GETC shelf (19D901868).

The GETC is used as a test fixture.

5.0 TEST PROCEDURES

5.1 PREPARATION FOR TEST

Refer to the GETC test specification for certain alignment procedures prior to testing of the Rockwell Modem. Set up terminal with 19.2 KBaud rate, odd parity, full duplex, and all upper case letters. Connect the terminal to the master communication link as follows:

SIGNAL	GETC LOGIC BOARD	TERMINAL (D-TYPE CONNECTOR)
TXD	J8-1	PIN 3
RXD	J8-2	PIN 2
GND	J8-3	PIN 7

SIMON is used to test the Rockwell Modem.

5.2 ROCKWELL MODEM TEST

The GETC shelf setup procedures to configure it as the test fixture for the Rockwell Modem follows. These procedures need to be implemented only once on the specified GETC shelf to be used as the Rockwell Modem test fixture.

1) Plug the Rockwell Modem into J3 on the GETC test fixture.

2) Install P11 between J11-1 and J11-2 on the GETC logic board.

3) Connect a jumper between J6-7 and J6-9 on the GETC.

4) Connect a jumper between J6-6 and J6-8 on the GETC.

5) Install a 680 ohm resistor (1/4 watt) between J6-8 and J6-9.

6) Adjust R1 to about half range on the GETC.

7) Adjust R2 to about half range on the GETC.

The procedures to test the Rockwell Modem follows:

l) Plug the Rockwell Modem into the test fixture.

2) Apply power (13.8 volts) to the GETC shelf and the SIMON welcome message is displayed on the terminal. The GETC is DTP switch configured for SIMON operation prior to power up. See 19A701179 for dip switch set-up.

3) Type "TIM 19" on the terminal to set the time delay from RTS to beginning of data to 250 milliseconds.

4) Execute the SIMON command "MDS 1" to select the phone modem for subsequent BER command.

5) Execute the SIMON command "BER DE-00=10". This command transmits data and simultaneously checks to see that data is being received. The terminal should respond with the following: Error Count = 0000 Receive Checksum = 00188123

   If the terminal does not respond with the above data, the Rockwell Modem has failed the test and needs to be returned to the vendor.

   The test continually runs, outputting data to the terminal in 10 second intervals.

6) After four consecutive test periods (10 seconds per test period) with data outputted to the terminal, the test can be terminated by pressing a CTRL Z or the ESC key on the terminal.

6.0 PART DRAWING

INTRODUCTION

The Rockwell R96FT is a synchronous serial 9600 bps modem designed for multipoint and networking applications. The R96FT allows full-duplex operation over 4-wire dedicated unconditioned lines. or half-duplex operation over the general switched telephone network.

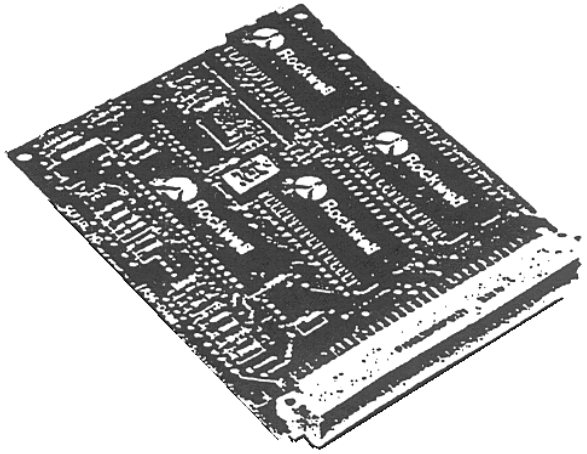
Proprietary fast train configurations provide training times of 23 ms for V.29FT/9600/7200/4800, 22 ms for V.27FT/4800. and 30 ms for V.27FT/2400. A 2400/4800 bps Gearshift configuration provides a training time of 10 ms. For applications requiring operation with international standards, fallback configurations compatible with CCITT recommendations V.29 and V.27 bis/ter are provided. A 300 bps FSK configuration, compatible with CCITT V.21 Channel 2, is also provided.

The small size and low power consumption of the R96FT offer the user flexibility in formulating a 9600 bps modem design customized for specific packaging and functional requirements.

This data sheet corresponds to assembly number TR96D400-061 and subsequent revisions.

FEATURES

- Proprietary Fast Train
- 2400/4800 bps Gearshift
- User Compatibility
  – CCITT V.29, V.27 bis/ter and V.21 Channel 2
- Train on Data
- Full-Duplex (4-Wire)
- Half-Duplex (2-Wire)
- Programmable Tone Generation
- Dynamic Range -43 dBm to 0 dBm
- Diagnostic Capability
- Equalization:
  – Automatic Adaptive
  – Compromise Cable (Selectable)
  – Compromise Link (Selectable)
- DTE Interface:
  – Microprocessor Bus
  – CCITT V.24 (RS-232-C Compatible)
- Loopbacks
  – Local Analog (V.54 Loop 3)
  – Remote Analog (Locally Activated)
  – Remote Digital (Locally ActivatedV.54 Loop 2)
- Small Size
  – 100 mm x 120 mm (4.0 in. x 4.8 in.)
- Low Power Consumption
  – 3 watts, typical
- Programmable Transmit Output Level
- TTL and CMOS Compatible



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PRINTS TO

GENERAL SPECIFICATIONS

POWER

Voltage	Tolerance	Current (Max.)
+5 Vdc +12 Vdc -12 Vdc	±5% ±5% ±5%	<700 mA <30 mA <80 mA
Note: All voltages must have ripple ≤0.1 volts peak-to-peak.		

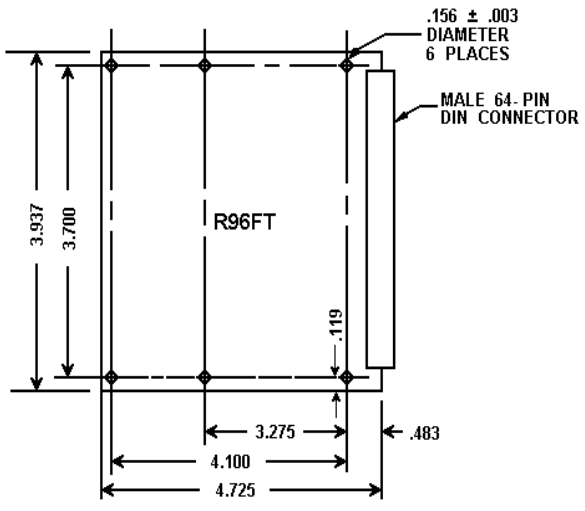
ENVIRONMENTAL

Parameter	Specification
Temperature Operating Storage	 0°C to + 60°C (32 to 140°F) -40°C to +80°C (-40 to 176°F) Stored in heat sealed antistatic bag and shipping container
Relative Humidity	Up to 90% noncondensing, or a wet bulb temperature up to 35°C, whichever is less.

MECHANICAL

Parameter	Specification
Board Structure	Single PC board with single right angle header with 64 pins. Burndy P196B32R00A00Z1 or equivalent mating connector.
Dimensions	Width - 3.94 in. (100 mm) Length - 4.72 in. (120 mm) Height - 0.4 in. (10.2 mm)
Weight	Less than 3.6 oz (100g)

Similar to Burndy
P196B22P00F00Z1



Inches	MM
.119	3
.156	4
.483	12
3.725	83
3.700	94
3.937	100
4.100	104
4.725	120

L30

PRINTS TO

TECHNICAL SPECIFICATIONS

Transmitter Carrier Frequencies

Function	Frequency (Hz ±0.01%)
V27 bis/ter Carrier	1800
V27FT Carrier	1800
2400/4800 bps Gearshift	1800
V29 Carrier	1700
V29FT Carrier	1700/1800*
V21 Channel 2:	
Mark	1650
Space	1650
*Selectable carrier frequency	

Tone Generation

Under control of the host processor. the R96FT can generate voice band tones up to 4800 Hz with a resolution of 0.15 Hz and an accuracy of 0.01%. Tones over 3000 Hz are attenuated.

Signaling And Data Rates

Parameter	Specification
Signaling Rate: Data Rate:	2400 baud 9600 bps 7200 bps 4800 bps
Signaling Rate: Data Rate:	1600 baud 4800 bps
Signaling Rate: Data Rate: Gearshift Data Rate:	1200 baud 2400 bps 2400/4800 bps
Signaling Rate: Data Rate:	300 baud 300 bps

Data Encoding

At 2400 baud. the data stream is encoded per CCITT V.29. At 9600 bps, the data stream is divided in groups of four-bits (quadbits) forming a 16-point structure. At 7200 bps, the data stream is divided into three bits (tribits) forming an 8-point structure. At 4800 bps. the data stream is divided into two bits (dibits) forming a 4-point structure.

At 1600 baud, the 4800 bps data stream is encoded into tribits per CCITT V.27 bis/ter.

At 1200 baud, the 2400 bps data stream encoded into dibits per CCITT V.27 bis/ter.

For the Gearshift configuration, the signaling rate is 1200 baud. The 2400 bps data stream is encoded into dibits forming a 4 point structure, and the 4800 bps data stream is encoded into quadbits forming a l6-point structure. The first 32 bauds of data are transmitted at 2400 bps and the remaining message is transmitted at 4800 bps.

At 300 baud, the 300 bps data stream is encoded per CCITT V.21 Channel 2 into a mark frequency of I650 Hz and a space frequency of 1850 Hz

Equalizers

The R96FT provides equalization functions that improve performance when operating over low quality lines.

Cable Equalizers - Selectable compromise cable equalizers in the receiver and transmitter are provided to optimize performance over different lengths of non-loaded cable of 0.4 mm diameter.

Link Equalizers - Selectable compromise link cable equalizers in the receiver optimize performance over channels exhibiting severe amplitude and delay distortion. Two standards are provided: U.S. survey long and Japanese 3-link.

Automatic Adaptive Equalizer - An automatic adaptive T equalizer is provided in the receiver circuit

Transmitted Data Spectrum

If the cable equalizer is no enabled the transmitter spectrum is shaped by the following raised cosine filter functions:

1. *1200 Baud.* Square root of 90 percent
2. *1600 Baud.* Square root of 50 percent
3. *2400 Baud.* Square root of 20 percent

The out-of-band transmitter power limitations meet those specified by Part 68 of the FCC's rules, and typically exceed the requirements of foreign telephone regulatory bodies.

L30

PRINTS TO

Scrambler/Descrambler

The R96FT incorporates a self-synchronizing scrambler/ descrambler. This facility is in accordance with either V.27 bis/ter or V.29 depending on the selected configuration.

The scrambler/descrambler facilities for Gearshift can be selected to be in accordance with either V.27 bis/ter or V.29. The scrambler/descrambler selection is made by writing the appropriate configuration codes into the transmitter and receiver.

Received Signal Frequency Tolerance

The receiver circuit of the R96FT can adapt to received frequency error of up to ±10 Hz with less than 0.2 dB degradation in BER performance.

During fast train polling, frequency offset must be less than ±2 Hz for successful training.

Receive Level

The receiver circuit of the modem satisfies all specific performance requirements for received line signal levels from 0 dBm to -43 dBm. The received line signal level is measured at the receiver analog input (RXA).

Receive Timing

The R96FT provides a data derived Receive Data Clock ($\overline{\text{RDCLK}}$) output in the form of a squarewave. The low-to-high transitions of this output coincide with the centers of received data bits. For the Gearshift configuration, the first 32 bauds of data are at 2400 bps followed by 4800 bps data for the remaining message. The timing recovery circuit is capable of racking a ±0.0l% frequency error in the transmit timing source. $\overline{\text{RDCLK}}$ duty cycle is 50.% ±1%.

Transmit Level

The transmitter output level is accurate to ±1.0 dB and is programmable from -l.0 dBm to -l5.0 dBm in 2dB steps.

Transmit Timing

The R96FT provides a Transmit Data Clock (TDCLK) output with the following characteristics:

1. *Frequency.* Selected data rate of 9600,7200.4800,2400 or 300 Hz (±0.01%). For the Gearshift configuration, TDCLK is a 2400 Hz clock for the first 32 bauds of data and a 4800 Hz clock for the remaining message.

2. *Duty Cycle*. 50% ±1%

Input data presented on TXD is sampled by the R96FT at the low-to-high transition of TDCLK. Data on TXD must be stable for at least one microsecond prior to the rising edge of TDCLK and remain stable for at least one microsecond after the rising edge of TDCLK.

External Transmit Clock

The transmitter Data clock (TDCLK) can be phase locked to a signal on input XTCLK. This input signal must equal the desired data rate ±0.01 with a duty cycle of 50% ±20%.

Train On Data

When train on data is enabled (by setting a bit in the interface memory), the modem monitors the EOM signal. If EOM indicates a loss of equalization (i.e., BER approximately 10^{-3} for 0.5 seconds) the modem attempts to retrain on the data stream. The time for retrain is typically 3 to 15 seconds.

Turn-On Sequence

A total of 20 selectable turn-on sequences can be generated as defined in the following table:

L30

PRINTS TO

No.	V.29 (bps)	V.27 bis/ter (bps)	Gearshift (bps)	$\overline{RTS}$-$\overline{CTS}$ Response Time (milliseconds)	Comments
1	FT/9600			23	
2	FT/7200			24	Proprietary
3	FT/4800			23	Fast Train
4		FT/4800		22	
5		FT/2400		30	
6	9600			253	
7	7200			253	
8	4800			253	
9				708	
10		4800 long		943	
11		2400 long		50	
12		4800 short		152	
13			2400 short	67	
14	9600			438	Preceded
15	7200			438	by Echo
16	4800			438	Protector
17		4800 long		913	Tone for
18		2400 long		1148	lines using
19		4800 short		255	echo
20		2400 short		272	suppressers

1. For short echo protector tone, subtract l55 ms from values of $\overline{RTS}$-$\overline{CTS}$ response time.
2. V.21 (300 bps FSK). $\overline{RTS}$-$\overline{CTS}$, response time is <35 ms.

Turn-Off Sequence

For V.27 bis/ter, V.27FT and 2400/4800 bps Gearshift configurations, the turn-off sequence consists of approximately 10 ms of remaining data and scrambled ones followed by a 20 ms period of no transmitted energy (V.27 bis/ter only). For V.29 and V.29FT, the turn-off sequence consists of approximately 8 ms of remaining data and scrambled ones.

Clamping

Received Data (RXD) is clamped to a constant mark (one) when the Received Line Signal Detector ($\overline{RLSD}$) is off.

Response Times Of Clear To Send ($\overline{CTS}$)

The time between the off-to-on transition of Request To Send ($\overline{RTS}$) and the off-to-on transition of Clear to Send ($\overline{CTS}$) is dictated by the length of the training sequence and the echo protector tone. if used. These times are given in the Turn-on Sequences table. If training is not enabled. $\overline{RTS}$/$\overline{CTS}$ delay is less than 2 baud times.

The time between the on-to-off transition of $\overline{RTS}$ and the on-to-off transition of $\overline{CTS}$ in the data state is a maximum of 2 baud times for all configurations.

Receive Line Signal Detector ($\overline{RLSD}$)

Response

For Fast Train and Gearshift configurations, the receiver enters the training state upon detecting a significant increase in the received signal power. If the received line signal power is greater than the selected threshold level at the end of the training state, the receiver enters the Data state and $\overline{RLSD}$ is activated. If the received line signal power is less than the selected threshold level at the end of the training state, the receiver returns to the idle state and $\overline{RLSD}$ is not activated.

Also, in Fast Train and Gearshift configurations, the receiver initiates the turn-off delay upon detecting a significant decrease in the received signal power. If the received signal power is less than the selected threshold at the end of the turn-off delay, the receiver enters the idle state and $\overline{RLSD}$ is deactivated. If the received signal power were greater than the selected threshold at the end of the turn-off delay, the receiver returns to the data state and $\overline{RLSD}$ is left active.

For CCITT configurations, the receiver enters the training detection state when the received line sign power crosses the selected threshold level. $\overline{RLSD}$ is activated at the end of the training sequence. For V.21 Channel, a separate received line signal detector ($\overline{FRLSD}$) is provided. $\overline{FRLSD}$ is activate when energy above -43 dB is present at the receiver's audio input (RXA). The $\overline{FRLSD}$ off-to-on response time is 15 ±1.5ms and the on-to-off response time is 25 ±1.5ms.

The $\overline{RLSD}$ on-to-off response times are:

Configuration	$\overline{RLSD}$ On-To-Off Response Time (ms)
V.29 Fast Train	6.5 ±1
V.27 Fast Train	8 ±1
Gearshift	6 ±1
V.29	30 ±9
V.27 bis/ter	10 ±5

$\overline{RLSD}$ response times are measured with a signal at least 3 dB above the actual $\overline{RLSD}$ on threshold or at least 5 dB below the actual $\overline{RLSD}$ off threshold.

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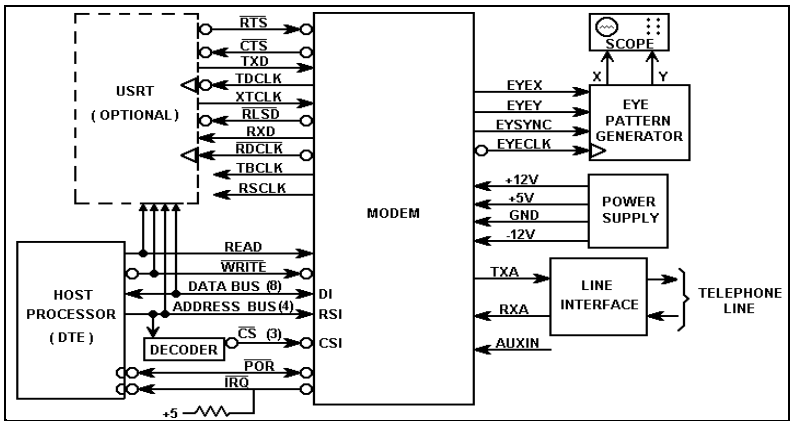
PRINTS TO



R96FT Functional Interconnect Diagram

Threshold Options

Four threshold options are provided:

1. Greater than -43 dBm ($\overline{\text{RLSD}}$ on)
   Less than -48 dBm ($\overline{\text{RLSD}}$ off)
2. Greater than -33 dBm ($\overline{\text{RLSD}}$ on)
   Less than -38 dBm ($\overline{\text{RLSD}}$ off)
3. Greater than -26 dBm ($\overline{\text{RLSD}}$ on)
   Less than -31 dBm ($\overline{\text{RLSD}}$ off)
4. Greater than -16 dBm($\overline{\text{RLSD}}$ on)
   Less than -21 dBm ($\overline{\text{RLSD}}$ off)

NOTE

Performance may be at a reduced level when the received signal is less than -43 dBm.

For CCITT configurations. a minimum hysteresis action of 2dB exists between the actual off-to-on and on-to-off transition levels. The threshold levels and hysteresis action are measured with unmodulated 2100 Hz tone applied to the receiver's audio signal input (RXA)

MODES OF OPERATION

The R96FT capable of being operated in either a serial or a parallel mode of operation.

Serial Mode

The serial mode uses standard V.24 (RS-232-C compatible) signals to transfer channel data. An optional USRT device (shown in the Functional Interconnect Diagram) illustrates this capability.

Parallel Mode

The R96FT has the capability of transferring channel Data (up to eight bits at a time) via the microprocessor bus.

Mode Selection

For the transmitter, a control bit determines whether the source of transmitted data is the V.24 interface (serial mode) or the parallel transmitter data register (parallel mode).The transmitter automatically defaults to three serial mode at power-on.

The receiver simultaneously outputs received data via the V.24 interface and he parallel receiver data register.

In either parallel or serial mode, the R96FT is configured by the host processor via the microprocessor bus.

INTERFACE CRITERIA

The modem interface comprises both hardware and software circuits. Hardware circuits are assigned to specific pins in a 64-pin DlN connector. Software circuits are assigned to specific bits in a 48-byte interface memory.

Hardware Circuits

Signal names and descriptions of the hardware circuits, including the microprocessor interface, are listed in the R96FT Hardware Circuits table. In the table, the column titled "Type" refers to designations found in the Hardware Circuit Characteristics. The microprocessor interface is designed to be directly compatible with an 8080 microprocessor. With the addition of a few external logic gates, it can be made compatible with 6500, 6800 or 68000 microprocessors.

L30

PRINTS TO

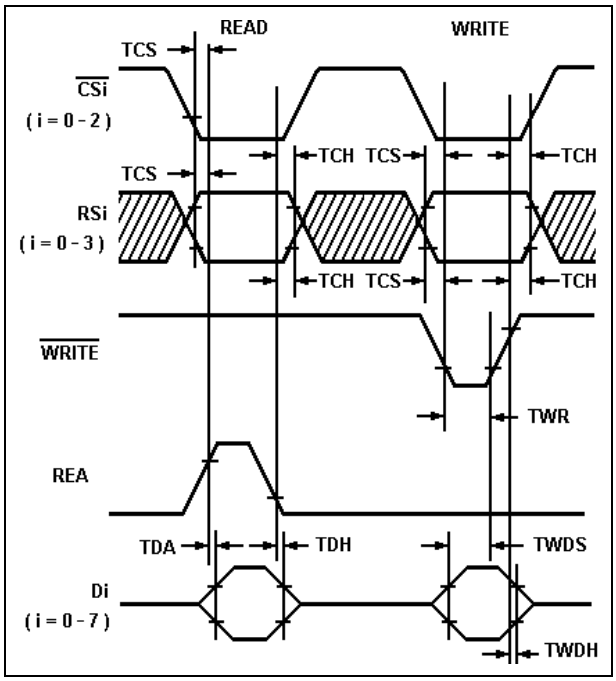
R96FT Hardware Circuits

Name	Type	Pin No.	Description
A. OVERHEAD:			
Ground (A)	AGND	31C, 32C	Analog Ground Return
Ground (D)	DGND	3C, 8C, 5A, 10A	Digital Ground Return
+5 volts	PWR	19C, 23C, 26C, 30C	+5 Vdc Supply
+12 volts	PWR	15A	+12 Vdc Supply
-12 volts	PWR	12A	-12 Vdc Supply
POR	I/OB	13C	Power-on-reset
B. MICROPROCESSOR INTERFACE:			
D7	I/OA	1C	Data Bus (8 Bits)
D6	I/OA	1A	
D5	I/OA	2C	
D4	I/OA	CA	
D3	I/OA	3A	
D2	I/OA	4C	
D1	I/OA	4A	
D0	I/OA	5C	
RS3	IA	6C	Register Select (4 Bits)
RS2	IA	6A	
RS1	IA	7C	
RS0	IA	7A	
$\overline{CS0}$	IA	10C	Chip Select - Transmitter Device
$\overline{CS1}$	IA	9C	Chip Select - Receiver Sample Rate Device
$\overline{CS2}$	IA	9A	Chip Select - Receiver Baud Rate Device
READ	IA	12C	Read Enable
WRITE	IA	11A	Write Enable
IRQ	OB	11C	Interrupt Request
C. V.24 INTERFACE:			
$\overline{RDCLK}$	OC	21A	Receive Data Clock
TDCLK	OC	23A	Transmit Data Clock
XTCLK	IB	22A	External Transmit Clock
$\overline{RTS}$	IB	25A	Request to Send
$\overline{CTS}$	OC	25C	Clear to Send
TXD	IB	24C	Transmitter Data
RXD	OC	22C	Receiver Data
RLSD	OC	24A	Received Line Signal Detector
D. ANCILLARY CIRCUITS:			
RBCLK	OC	26A	Receiver Baud Clock
TBCLK	OC	27C	Transmitter Baud Clock
FRXD	OD	16A	FSK Receiver Data (inverted data)
$\overline{FRLSD}$	OD	17C	FSK Received Line Signal Detector
E. ANALOG SIGNALS:			
TXA	AA	31A	Transmitter Analog Output
RXA	AB	32A	Receiver Analog Input
AUXIN	AC	30A	Auxiliary Analog Input
F. DIAGNOSTIC:			
EYEX	OC	15C	Eye Pattern Data - X Axis
EYEY	OC	14A	Eye Pattern Data - Y Axis
EYECLK	OA	14C	Eye Pattern Data
EYESYNC	OA	13A	Eye Pattern Synchronizing Signal

Eye Pattern Generation

The four hardware diagnostic circuits, identified in the following table, allow the user to generate and display an eye pattern. Circuits EYEX and EYEY serially present eye pattern data for the horizontal and vertical display inputs respectively. The 8 bit data words are shifted out most Significant bit first, clocked by the rising edge of the $\overline{EYECLK}$ output. The EYESYNC output is provided for word synchronization. The falling edge of EYESYNC may be used to transfer the 8-bit word from the shift register to a holding register. Digital to analog conversion can then be performed for driving the X and Y inputs of an oscilloscope.

Microprocessor Timing



Microprocessor Interface Timing Diagram

Critical Timing Requirements

Characteristic	Symbol	Min	Max.	Units
$\overline{CSi}$, RSi setup time prior to Read or $\overline{Write}$	TCS	30	—	nsec
Data access time after Read	TDA	—	140	nsec
Data hold time after Read	TDH	10	50	nsec
$\overline{CSi}$, RSi hold time after Read or $\overline{Write}$	TCH	10	—	nsec
Write data setup time	TWDS	75	—	nsec
Write data hold time	TWDH	10	—	nsec
Write strobe pulse width	TWR	75	—	nsec

L30

PRINTS TO

Digital Interface Characteristics

Digital Interface Characteristics

Symbol	Parameter	Units	Input/Output Type IA	IB	IC	OA	OB	OC	OD	I/O A	I/O B
V_{IH}	Input Voltage, High	V	2.0 Min.	2.0 Min.	2.0 Min.					2.0 Min.	5.25 Max. 2.0 Min.
V_{IL}	Input Voltage, Low	V	0.8 Max.	0.8 Max.	0.8 Max.					0.8 Max.	0.8 Max.
V_{OH}	Output Voltage, High	V				2.4 Min. [1]			2.2 Min.[6]	2.4 Min. [1]	2.4 Min.[3]
V_{OL}	Output Voltage, Low	V				0.4 Max. [2]	0.4 Max. [2]	0.4 Max. [2]	0.6 Max.[7]	0.4 Max. [2]	0.4 Max.[5]
I_{IN}	Input Current, Leakage	µA	±2.5 Max.							±2.5 Max.[4]	
I_{OH}	Output Current, High	mA				-0.1 Max.					
I_{OL}	Output Current, Low	mA				1.6 Max.	1.6 Max.	1.6 Max.			
I_L	Output, Current, Leakage	µA					±10 Max.				
I_{PU}	Pull-up Current (Short Circuit)	µA		-240 Max. -10 Min.	-240 Max. -10 Min.			-240 Max. -10 Min.			-260 Max. -100 Min.
C_L	Capacitive Load	pF	5	5	20					10	40
C_D	Capacitive Drive	pF				100	100	100		100	100
	Circuit type		TTL	TTL w/Pull-up	TTL w/Pull-up	TTL	Open-Drain	Open-Drain w/Pull-up	TTL	3-State Transceiver	Open-Drain w/Pull-up

Notes
1. I Load = -100 µA
2. I Load = 1.6 mA
3. I Load = -40 µA
4. V_{IN} = 0.4 to 2.4 Vdc, V_{CC} = 5.25 Vdc
5. I Load = 0.36 mA
6. I Load = -400 µA
7. I Load = 2.0 mA

Analog Interface Characteristics

Analog Interface Characteristics

Name	Type	Characteristics
TXA	AA	The transmitter output impedance is 604 ohms ±1%.
RXA	AB	The receiver input impedance is 60K ohms ±23%.
AUXIN	AC	The auxiliary analog input allows access to the transmitter for the purpose of interacting with user provided equipment. Because this is a sampled data input, any signal above 4800 Hz will cause aliasing errors. The input impedance is 1K ohms, and the gain to transmitter output is TLVL setting +0.6 dB -l.4 dB. If unused, this input must be grounded near the modem connector. If used, it must be driven from a low impedance source.

Software Circuits

The R96FT comprises three signal processor chips. Each of these chips contains 16 registers to which an external (host) microprocessor has access. Although these registers are within the modem, they may be addressed as part of the processor's memory space. The host may read data out of or write data into these registers. The registers are referred to as interface memory. Registers in chip 1 update at half the modem sample rate (4800 bps). Registers in chip 0 and 2 update at the selected baud rate.

When information in these registers is being discussed, the format Y:Z:Q is used. The chip is specified by Y(0-2), the register by Z(0-F), and the bit by Q(0-7, 0 = LSB).

Status Control Bits

The operation of the F96FT is affected by a number of software control inputs These inputs are written into registers within the interface memory via the host microprocessor bus. Modem operation is monitored by various software flags that are read from interface memory via the host microprocessor bus. All status and control bits are defined in the Interface Memory table. Bits, designated by a dash (—) are reserved for modem use only and must not be changed by the host.

RAM Data Access

The R96FT provides the user with access to much of the data stored in the modem's memories. This data is useful for performing certain diagnostic functions

Two RAM access registers in chip 2 allow user access to RAM locations via the X word registers (2:2 and 2:2) and the Y word register (2:1 and 2:0). The access code stored in RAM ACCESS X (2:5) selects the source of data for RAM DATA XM and RAM DATA XL (2:3 and 2:2). Similarly, the access code stored in RAM ACCESS Y (2:4) selects the source of data for RAM DATA Y and RAM DATA YL(2:1 and 2:0).

L30

PRINTS TO

Reading of diagnostic RAM data is performed by storing the necessary access codes in 2:5 and 2:4, reading 2:0 to reset the associated data available bit (2:E:0), then waiting for the data available bit to return to a one. Data is now valid and may be read from 2:3 through 2:0.

An additional diagnostic is supplied by the sample rate processor (chip 1). Registers 1:2 and 1:3 supply a 16 bit AGC Gain Word. These two diagnostic data registers are updated at the sample rate during the data state and may be read by the host processor asynchronously.

RAM Access Codes

The RAM access codes defined in the following table allow the host processor to read diagnostic information within the modem.

Baud Rate Processor (Chip 2) RAM Access Codes

No.	Function	X Access	Y Access	Register
1	Equalizer Input	C0	40	0,1,2,3
2	Equalizer Tap Coefficients	81-A0	01-20	0,1,2,3
3	Unrotated Equalizer Output	E1	61	0,1,2,3
4	Rotated Equalizer Output	E2	62	0,1,2,3
5	Decision Points (Ideal Data Points)	E8	68	0,1,2,3
6	Error Vector	E5	65	0,1,2,3
7	Rotation Angle	A7	Not Used	2,3
8	Frequency Correction	A5	Not Used	2,3
9	Eye Quality Monitor (EQM)	AC	Not Used	2,3

Receiver Interface Memory Chip 1 ($\overline{CS1}$)

Register \ Bit	7	6	5	4	3	2	1	0
F	—	—	—	—	—	—	—	—
E	RIA	—	—	—	RSB	RIE	—	RDA
D	—	—	—	—	—	—	—	—
C	—	—	—	—	—	—	—	—
B	—	—	—	—	—	—	—	—
A	—	—	—	—	—	—	—	—
9	—	$\overline{FED}$	—	—	—	$\overline{CDET}$	—	—
8	—	—	—	—	$\overline{P2DET}$	—	—	—
7	RTH		DDIS	—	—	RCF	RDIS	—
6	TOD	RECEIVER CONFIGURATION						
5	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—
3	AGC GAIN WORD (MSB)							
2	AGC GAIN WORD (LSB)							
1	—	—	—	—	—	—	—	—
0	RECEIVER DATA							
Register / Bit	7	6	5	4	3	2	1	0

NOTE: (—) indicates reserved for modem use only.

Transmitter Interface Memory Chip 0 ($\overline{CS0}$)

Register \ Bit	7	6	5	4	3	2	1	0
F	—	—	—	—	—	—	—	—
E	TIA	—	—	—	TSB	TIE	—	TBA
D	—	—	—	—	—	—	—	—
C	—	—	—	—	—	—	—	—
B	—	—	—	—	—	—	—	—
A	—	—	—	—	—	—	—	—
9	FSKT	ASCR	—	—	TCF	DDEE	—	—
8	—	—	—	—	—	—	—	—
7	RTS	TTDIS	SDIS	MHLD	EPT	TPDM	XCEN	SEPT
6	TRANSMITTER CONFIGURATION							
5	—	—	CEQ		LAEN	LDEN	A3L	D3L
4	L3ACT	L4ACT	L4HG	TLVL			L2ACT	LCEN
3	FREQM							
2	FREQL							
1	—	—	—	—	—	—	—	—
0	TRANSMITTER DATA							
Register / Bit	7	6	5	4	3	2	1	0

NOTE: (—) indicates reserved for modem use only.

Receiver Interface Memory Chip 2 ($\overline{CS2}$)

Register \ Bit	7	6	5	4	3	2	1	0
F	—	—	—	—	—	—	—	—
E	RBIA	—	—	—	—	RBIE	—	RBDA
D	—	—	—	—	—	—	—	—
C	—	—	—	—	—	—	—	—
B	—	—	—	—	—	—	—	—
A	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—
5	RAM ACCESS X							
4	RAM ACCESS Y							
3	RAM DATA XM							
2	RAM DATA XL							
1	RAM DATA YM							
0	RAM DATA YL							
Register / Bit	7	6	5	4	3	2	1	0

NOTE: (—) indicates reserved for modem use only.

L30

PRINTS TO

R96FT Interface Memory Definitions

Mnemonic	Name	Memory Location	Description
ASCR	Append Scrambled Ones	0:9:6	When control bit ASCR is a one, one baud of scrambled marks is included in the V.29 FT and V.27 FT training sequences The RTS-CTS delay is thus extended by one baud per when ASCR is a one.
A3L	Amplitude 3-Link Select	0:5:1	See LAEN.
$\overline{\text{CDET}}$	Carrier Detector	1:9:2	When zero, status bit $\overline{\text{CDET}}$ indicates that passband energy is being detected, and that a training sequence is not in process. $\overline{\text{CDET}}$ goes to a zero at the start of the data state, and returns to a one at the end of the received signal. $\overline{\text{CDET}}$ activates up to 1 baud time before $\overline{\text{RLSD}}$ and deactivates within 2 baud times after $\overline{\text{RLSD}}$.
CEQ	Cable Equalizer	0:5:(4,5)	The CEQ Control field simultaneously controls amplitude compromise equalizers in both the transmit and receive paths. The following table lists the possible cable equalizer selection codes: CEQ — Cable Length (0.4 mm diameter) 0 — 0.0 1 — 1.8 km 2 — 3.6 km 3 — 7.2 km
DDEE	Digital Delay Equalizer Enable	0:9:2	When control bit DDEE is a one, a fourth order digital delay equalizer is inserted in the transmit path.
DDIS	Descramble Disable	1:7:5	When control bit DDIS is a one, the receiver descrambler circuit is removed from the data path.
D3L	Delay 3-Link Select	0:5:0	See LDEN.
EPT	Echo Protector Tone	0:7:3	When control bit EPT is a one, an unmodulated carrier is transmitted for 185 ms (optionally 30 ms) followed by 20 ms of no transmitted energy at the start of transmission. This option is available in the V.27 and V.29 configurations, although it is not specified in the CCITT V.29 Recommendation.
$\overline{\text{FED}}$	Fast Energy Detector	1:9:6	When status bit $\overline{\text{FED}}$ is a zero, it indicates that energy above the receiver threshold is present in the passband
(None)	FREQL/FREQM	0:2:0-7 0:3:0-7	The host processor conveys tone generation data to the transmitter by writing a 16-bit data word to the FREQL and FREQM registers in the interface memory space, as shown below: *FREQM Register (0:3)* **Bit:** 7 6 5 4 3 2 1 0 **Data Word:** 2^{15} 2^{14} 2^{13} 2^{12} 2^{11} 2^{10} 2^{9} 2^{8} *FREQL Register (0:2)* **Bit:** 7 6 5 4 3 2 1 0 **Data Word:** 2^{7} 2^{6} 2^{5} 2^{4} 2^{3} 2^{2} 2^{1} 2^{0} The frequency number (N) determines the frequency (F) as follows: F = (0.146486) (N) Hz ±0.01% Hexadecimal frequency numbers (FREQL, FREQM) for commonly generated tones are given below: Frequency (Hz) — FREQM — FREQL 462 — 0C — 52 1100 — 1D — 55 1650 — 2C — 00 1850 — 31 — 55 2100 — 38 — 00
FSKT	FSK Transmitter Configuration	0:9:7	The V.21 Channel 2 (300 bps synchronous FSK) transmitter configuration is selected by setting the FSKT control bit to a one (see TSB). While set to a one, this control bit overrides the configuration selected by the control code in register 0:6. The FSK data may be transmitted in parallel mode or in serial mode (see TPDM).

L30

PRINTS TO

R96FT Interface Memory Definitions (Continued)

Mnemonic	Name	Memory Location	Description
LAEN	Link Amplitude Equalizer Enable	0:5:3	The link amplitude equalizer enable and select bits control an amplitude compromise equalizer in the receive path according to the following table: LAEN A3L Curve Matched 0 X No Equalizer 1 0 U.S. Survey Long 1 1 Japanese 3-Link
LCEN	Loop Clock Enable	0:4:0	When control bit LCEN is a one, the transmitter clock tracks the receiver clock.
LDEN	Link Delay Equalizer Enable	0:5:2	The link delay equalizer enable and select bits control a delay compromise equalizer in the receiver path according to the following table: LDEN D3L Curve Matched 0 X No Equalizer 1 0 U.S. Survey Long 1 1 Japanese 3-Link
L2ACT	Remote Digital Loopback Activate	0:4:1	When control bit L2ACT is a one, the receiver digital output is connected to the transmitter digital input in accordance with CCITT Recommendation V.54 loop 2.
L3ACT	Local Analog Loop-back Activate	0:4:7	When control bit L3ACT is a one, the transmitter analog output is coupled to the receiver analog input through an attenuator in accordance with CCITT Recommendation V.54 loop 3.
L4ACT	Remote Analog Loopback Activate	0:4:6	When control bit L4ACT is a one, the receiver analog input is connected to the transmitter analog output through a variable gain amplifier in a manner similar to CCITT Recommendation V.54 loop 4.
L4HG	Loop 4 High Gain	0:4:5	When control bit L4HG is a one, the loop 4 variable gain amplifier is set for +16 dB, and when at zero the gain is zero dB.
MHLD	Mark Hold	0:7:4	When control bit MHLD is a one, the transmitter input data stream is forced to all marks (ones).
$\overline{\text{P2DET}}$	Period 2 Detector	1:8:3	When status bit $\overline{\text{P2DET}}$ is a zero, it indicates that a period 2 sequence has been detected. This bit sets to a one at the start of the period N sequences. This bit is only significant for CCITT V.29 and V.27 bis/ter configurations.
(None)	RAM Access X	2:5:0-7	Contains the RAM access code used in reading chip 2 RAM locations via word X (2:3 and 2:2)
(None)	RAM Access Y	2:5:0-7	Contains the RAM access code used in reading chip 2 RAM locations via word Y (2:3 and 2:2)
(None)	RAM Data XL	2:2:0-7	Least significant byte of 16-bit word X used in reading RAM locations in chip 2.
(None)	RAM Data XM	2:3:0-7	Most significant byte of 16-bit word X used in reading RAM locations in chip 2.
(None)	RAM Data YL	2:0:0-7	Least significant byte of 16-bit word Y used in reading RAM locations in chip 2.
(None)	RAM Data YM	2:1:0-7	Most significant byte of 16-bit word Y used in reading RAM locations in chip 2.
RBDA	Receiver Baud Data Available	2:E:0	Status bit RBDA goes to a one when the receiver writes data into register 2:0. The bit goes to a zero when the host processor reads data from register 2:0.
RBIA	Receiver Baud Interrupt Active	2:E:7	This status bit is a one whenever the receiver baud rate device is driving $\overline{\text{IRQ}}$ low.
RBIE	Receiver Baud Interrupt Enable	2:E:2	When the host processor writes a one in the RBIE control bit, the $\overline{\text{IRQ}}$ line of the hardware interface is driven to zero when status bit RBDA is a one.
RCR	Receiver Carrier Frequency	1:7:2	Control bit RCF selects the demodulator carrier frequency for V.29FT configurations as follows: RCF Demodulator Carrier Frequency 0 1700 Hz 1 1800 Hz

L30

PRINTS TO

R96FT Interface Memory Definitions (Continued)

Mnemonic	Name	Memory Location	Description
(None)	Receiver Configuration	1:6:0-6	The host processor configures the receiver by writing a control code into the receiver configuration field in the interface memory space (see RSB). **Note:** The receiver must be disabled prior to changing configurations. See RDIS. *Receiver Configuration Control Codes* Control codes for the modem receiver configuration are:
(None)	Receiver Data	1:0:0-7	The host processor obtains channel data from the receiver in the parallel data mode by reading a data byte from the receiver data register. The data is divided on baud boundaries as is the transmitter data.
RDA	Receiver Data Available	1:E:0	Status bit RDA goes to a one when the receiver writes data to register 1:0. RDA goes to a zero when the host processor reads data from register 1:0.
RDIS	Receiver Disable	1:7:1	When control bit RDIS is a one, the receiver is disabled, $\overline{\text{RLSD}}$ is turned off and RXD is clamped to all marks. This bit can be used to squelch the receiver during half duplex transmissions over two wires. This bit must be set to a one prior to changing the receiver configuration.
RIA	Receiver Interrupt Active	1:E:7	This status bit is a one whenever the receiver sample rate device is driving $\overline{\text{IRQ}}$ to zero.
RIE	Receiver Interrupt Enable	1:E:2	When the host processor writes a one in the RIE control bit, the $\overline{\text{IRQ}}$ line of the hardware interface is driven to zero when status bit RDA is a one.
RSB	Receiver Setup Bit	1:E:3	When the host processor changes the receiver configuration or the RTH field, the host processor must write a one in the RSB control bit. RSB goes to zero when the changes become effective
RTH	Receiver Threshold Field	1:7:6,7	The receiver energy detector threshold is set by the RTH field according to the following codes (see RSB):
RTS	Request-to-Send	0:7:7	When control bit RTS goes to a one, the modem begins a transmit sequence. It continues to transmit until RTS is reset to zero, and the turn-off sequence has been completed. This input bit parallels the operation of the hardware RTS control input. These inputs are OR'ed by the modem.

Configuration		
V.29	**V.27 bis/ter**	**Configuration Code (Hex)**
FT/9600		1C
FT/7200		1A
FT/4800		19
	FT/4800	0A
	FT/2400	09
9600		14
7200		12
4800		11
	4800 long	22
	2400 long	21
	4800 short	02
	2400 short	01
2400/4800 bps Gearshift/V.29 descrambler		61[1]
2400/4800 bps Gearshift/V.27 bis/ter descrambler		41[1]
V.21 Channel 2		See Note 2

1. The Receiver Configuration code automatically changes from a hex 61 (or hex 41) to a hex 64 (or hex 44) when the receiver transitions from the 2400 bps data state to the 4800 bps data state.
2. The FSK receiver is active at all times. Two ancillary hardware circuits, $\overline{\text{FRLSD}}$ and $\overline{\text{FRXD}}$, are supplied for FSK message reception. $\overline{\text{FRLSD}}$ is described under the Received Line Signal Detector section. $\overline{\text{FRXD}}$ provides inverted FSK received data. Timing extraction must be performed on the $\overline{\text{FRXD}}$ signal externally as no FSK receiver data clock is provided by the R96FT.

RTH	RLSD On	RLSD Off
0	≥ 43 dBm	≥ 48 dBm
1	≥ 33 dBm	≥ 38 dBm
2	≥ 26 dBm	≥ 31 dBm
3	≥ 16 dBm	≥ 21 dBm

L30

PRINTS TO

R96FT Interface Memory Definitions (Continued)

Mnemonic	Name	Memory Location	Description
SDIS	Scrambler Disable	0:7:5	When control bit SDIS is a one, the transmitter scrambler circuit is removed from the data path.
SEPT	Short Echo Protector Tone	0:7:0	When control bit SEPT is a one, the echo protector disable tone is 30 ms long rather than 185 ms (See TSB)
TBA	Transmitter Buffer Available	0:E:0	This status bit resets to zero when the host processor writes data to transmitter data register 0:0. When the transmitter empties register 0:0, this bit sets to a one.
TCF	Transmitter Carrier Frequency	0:9:3	Control bit TCF selects the modulator carrier frequency for V.29FT configurations as follows: TCF — Modular Carrier Frequency 0 — 1700 Hz 1 — 1800 Hz
TIA	Transmitter Interrupt Active	0:E:7	This status bit is a one whenever the transmitter is driving $\overline{IRQ}$ to a zero.
TIE	Transmitter Interrupt Enable	0:E:2	When the host processor writes a one in control bit TIE, the $\overline{IRQ}$ line of the hardware interface is driven to zero when status bit TBA is at a one.
TLVL	Transmitter Level Field	0:4:2-4	The transmitter analog output level is determined by eight TLVL codes, as follows: TLVL — Transmitter Analog Output 0 — -1 dBm ± 1 dB 1 — -3 dBm ± 1 dB 2 — -5 dBm ± 1 dB 3 — -7 dBm ± 1 dB 4 — -9 dBm ± 1 dB 5 — -11 dBm ± 1 dB 6 — -13 dBm ± 1 dB 7 — -15 dBm ± 1 dB *Each step above is a 2 dB change ±0.2 dB.
TOD	Train-On-Data	1:6:7	When control bit TOD is a one, it enables the train-on-data algorithm to converge the equalizer if the signal quality degrades sufficiently. When TOD is a one, the modem still recognizes a training sequence and enters the force train state. A BER of approximately 10^{-3} for 0.5 seconds initiates train-on-data.
TPDM	Transmitter Parallel Data Mode	0:7:2	When control bit TPDM is a one, the transmitter accepts data for transmission form the transmitter data register (0:0) rather than the serial hardware data input.
(None)	Transmitter Configuration	0:6:0-7	The host processor configures the transmitter by writing a control byte into the transmitter configuration register in its interface memory space. (See TSB) Transmitter Configuration Control Codes Control codes for the modem transmitter configurations are:

Configuration		
V.29	V.27 bis/ter	Configuration Code (Hex)
FT/9600		1C
FT/7200		1A
FT/4800		19
	FT/4800	0A
	FT/2400	09
9600		14
7200		12
4800		11
	4800 long	22
	2400 long	21
	4800 short	02
	2400 short	01
2400/4800 bps Gearshift/V.29 descrambler		61[1]
2400/4800 bps Gearshift/V.27 bis/ter descrambler		41[1]
V.21 Channel 2		See FSKT
Tone transmit		80

L30

PRINTS TO

R96FT Interface Memory Definitions (Continued)

Mnemonic	Name	Memory Location	Description
(None)	Transmitter Data	0:0:0-7	The host processor conveys output data to the transmitter in the parallel mode by writing a data byte to the transmitter data register. The data is divided on baud boundaries, as follows: Note: Data is transmitted bit zero first.
TSB	Transmitter Setup	0:E:3	When the host processor changes the transmitter configuration, the SEPT bit or the FSKT bit, the host must write a one in this control bit. TSB goes to a zero when the change becomes effective. Worst case setup time is 2 baud + turnoff sequence + training (if applicable).
TTDIS	Transmitter Train Disable	0:7:6	When control bit TTDIS is a one, the transmitter does not generate a training sequence at the start of transmission. With training disabled, RTS/CTS delay is less than two baud times.
XCEN	External Clock Enable	0:7:1	When control bit XCEN is a one, the transmitter timing is established by the external clock supplied at the hardware input XTCLK, pin 22A.

Configuration	Bits 7	6	5	4	3	2	1	0
V.29 9600 bps	Baud 1				Baud 0			
V.29 7200 bps	Not Used		Baud 1			Baud 0		
V.29 4800 bps	Baud 3		Baud 2		Baud 1		Baud 0	
V.27 4800 bps	Not Used		Baud 1			Baud 0		
V.27 2400 bps	Baud 3		Baud 2		Baud 1		Baud 0	
2400 bps Gearshift	Baud 3		Baud 2		Baud 1		Baud 0	
4800 bps Gearshift	Baud 1				Baud 0			

POWER-ON INITIALIZATION

When power is applied to the R96FT, a period of 50 to 350 ms is required for power supply settling. The power-on-reset signal ($\overline{POR}$) remains low during this period. Approximately 10 ms after the low to high transition of $\overline{POR}$, the modem is ready to be configured, and $\overline{RTS}$ may be activated. If the 5 Vdc power supply drops below 3.5 Vdc for more than 30 msec, the POR cycle is generated.

At POR time the modem defaults to the following configuration: fast train, V.29, 9600 bps, no echo protector tone, 1700 Hz carrier frequency, scrambled ones segment disabled, serial data mode, internal clock, cable equalizers disabled, transmitter digital delay equalizer disabled, transmitter output level set to -1 dBm ± 1 dB, interrupts disabled, receiver threshold set to -43 dBm, and train-on-data enabled.

$\overline{POR}$ can be connected to a user supplied power-on-reset signal in a wire-or configuration. A low active pulse of 3 µsec or more applied to the $\overline{POR}$ pin causes the modem to reset. The modem is ready to be configured 10 msec after $\overline{POR}$ is removed.

PERFORMANCE

Whether functioning in V.27, V.29 or the proprietary fast train configurations, the R96FT provides the user with high performance.

Polling Success

In the 9600 bps fast train configuration the modem approaches a 98% success rate over unconditioned 3002 lines for a signal-to-noise ratio of 26 dB, with a received signal level of -20 dBm.

Bit Error Rates

The Bit Error Rate (BER) performance of the modem is specified for a test configuration conforming to that specified in CCITT Recommendation V.56. Bit error rates are measured at a received line signal level of -20 dBm as illustrated.

Phase Jitter

At 2400 bps, the modem exhibits a bit error rate of 10^{-6} or less with a signal-to-noise ratio of 12.5 dB in the presence

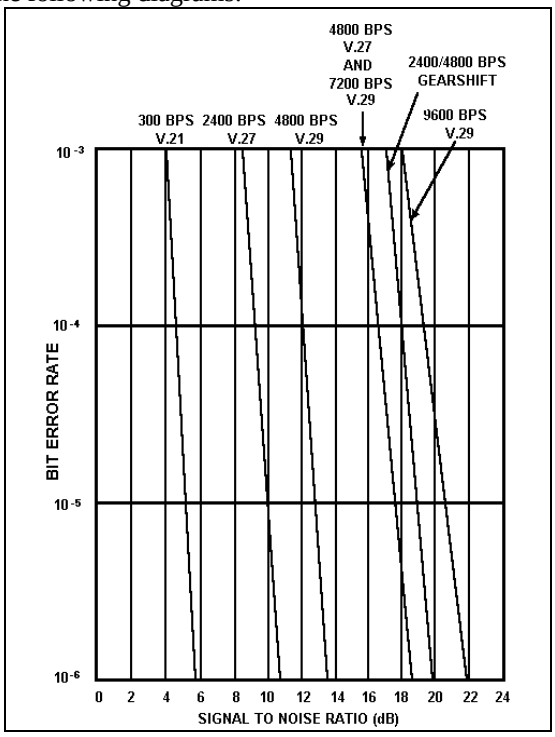
L30

of 15° peak-to-peak phase jitter at 150 Hz, or with a signal-to-noise ratio of 15 dB in the presence of 30° peak-to-peak phase jitter at 120 Hz (scrambler inserted).

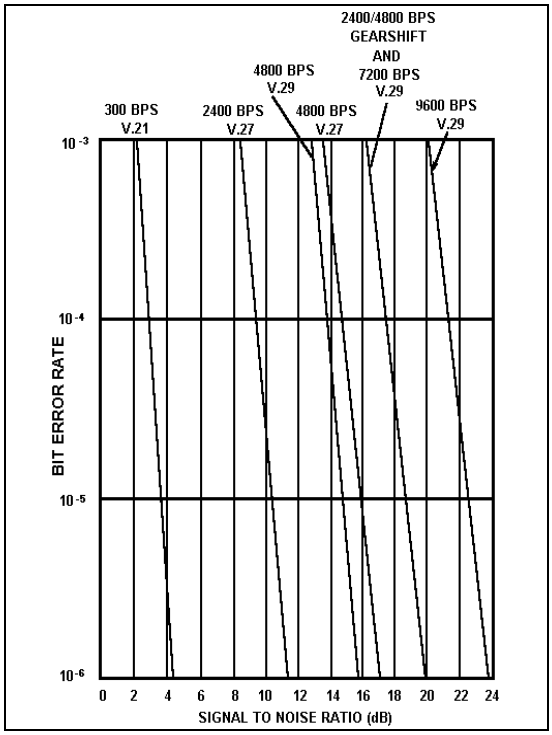
At 4800 bps (V.27 bis/ter), the modem exhibits a bit error rate of 10^{-6} or less with a signal-to-noise ratio of 19 dB in the presence of 15° peak-to-peak phase jitter at 60 Hz.

At 9600 bps, the modem exhibits a bit error rate of 10^{-6} or less with a signal-to-noise ratio of 23 dB in the presence of 10° peak-to-peak phase jitter at 60 Hz. The modem exhibits a bit error rate of 10^{-5} or less with a signal-to-noise ration of 23 dB in the presence of 20° peak-to-peak phase jitter at 30 Hz.

An example of the BER performance capabilities is given in the following diagrams:

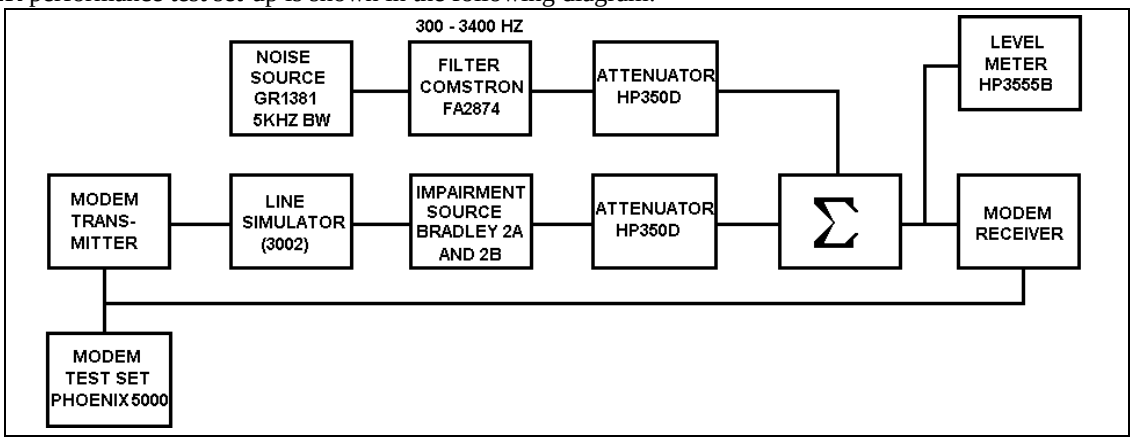


Typical BER Performace
Back-to-Back, -20 dBm Receive Signal Level



Typical BER Performace
3002 Unconditioned Line, -20 dBm Receive Signal Level

The BER performance test set-up is shown in the following diagram:



L30

PRINTS TO

INTRODUCTION

The R96FAX, R96DP, R48DP, AND R96FT modems include integrated analog devices using switched capacitor filters to perform the functions of receiver input bandpass filtering, transmitter output lowpass filtering, and compromise equalization. Differences in performance result form half-duplex (HDX) or full-duplex (FDX) versions of the integrated analog device.

R96 FILTERS

The following tables illustrate the response of the receiver input bandpass and transmitter output low pass filters without compromise equalization.

A. Receiver Input Bandpass Filter

Parameter	Value
Test signal range	0 dBm to -45 dBm
Passband	400 Hz - 3000 Hz
Passband ripple	0.5 dB max.
Loss below 60 Hz	40 dB min.
Loss above 6000 Hz	40 dB min.
Passband gain	0.0 dB ± 1.0 dB
Delay distortion 400 Hz - 1800 Hz	Less than 1000 usec
Delay distortion 1800 Hz - 3000 Hz	Less than 150 usec

B. Transmitter Output Lowpass Filter

Parameter	Value
Test signal	0 dBm to -16 dBm
Passband	400 Hz - 3000 Hz
Passband Gain	-1 dB ± 1 dB
Passband ripple	0.5 dB max.
Loss at 3600 Hz	5.5 dB min.
Loss at 7800 Hz	32 dB min.
Loss at 11400 Hz	33.5 dB min.
Loss at 12000 Hz	41 dB min.
Loss above 17400 Hz	45 dB min.
Delay distortion 400 Hz - 3000 Hz	Less than 300 usec

The following tables illustrate the change in filter response caused by enabling each of the compromise equalizers independently.

A. Receiver

1. Link Amplitude Equalizer HDX and FDX.

Frequency	Gain dB Relative to 1700 Hz	
Hz	US Long	Japanese 3 Link
1000	-0.27	-0.13
1400	-0.16	-0.08
2000	+0.33	+0.16
2400	+1.54	+0.73
2800	+5.98	+2.61
3000	+8.65	+3.43

2. Link Delay Equalizer FDX Only.

Frequency	Delay Microseconds Relative to 1700 Hz	
Hz	US Long	Japanese 3 Link
800	-498.1	-653.1
1200	-188.3	-398.5
1600	-15.1	-30.0
1700	+0.0	+0.0
2000	-39.8	+11.7
2400	-423.1	-117.1
2800	-672.4	-546.3

3. Cable amplitude HDX and FDX.

a. Code 1

Frequency	Gain dB Relative to 1700 Hz	
Hz	HDX	FDX
700	-0.99	-0.94
1500	-0.20	-0.24
2000	+0.15	+0.31
3000	+1.43	+1.49

b. CODE 2

Frequency Hz	Gain dB Relative to 1700 Hz	
	HDX	FDX
700	-2.39	-2.67
1500	-0.65	-0.74
2000	+0.87	+1.02
3000	+3.06	+3.17

c. CODE 3

Frequency Hz	Gain dB Relative to 1700 Hz	
	HDX	FDX
700	-3.93	-3.98
1500	-1.22	-1.20
2000	+1.90	+1.81
3000	+4.58	+4.38

B. Transmitter

1. Link Amplitude Equalizer HDX Only.

Frequency Hz	Gain dB Relative to 1700 Hz	
	US Long	Japanese 3 Link
1000	-0.27	-0.13
1400	-0.16	-0.08
2000	+0.33	+0.16
2400	+1.54	+0.73
2800	+5.98	+2.61
3000	+8.65	+3.43

2. Cable Amplitude HDX and FDX.

a. CODE 1

Frequency Hz	Gain dB Relative to 1700 Hz
700	-0.99
1500	-0.20
2000	+0.15
3000	+1.43

b. CODE 2

Frequency Hz	Gain dB Relative to 1700 Hz
700	-2.39
1500	-0.65
2000	+0.87
3000	+3.06

c. CODE 3

Frequency Hz	Gain dB Relative to 1700 Hz
700	-3.93
1500	-1.22
2000	+1.90
3000	+4.58

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Rev.	Description	Date	Approved By
0	First Release issued by: E. Gaddy	16 Oct 89	J.S.H.
1	Rec - ADD PT 3, 4 & 5	5 May 91	Jim Eldin
1A	Rec - ADD PT 6 - 14	20 Dec 94	Rene Gomez

SECTION 1 MODEMS NAMES & PART NUMBERS

PART NUMBER, NAME AND DESCRIPTION

P1: **Courier 2400** - 2400 baud modem

P2: **Courier V.32** - 9600 2-wire audio modem

P3: (1) **Courier V32** 9600 baud modem.
(1) 220 V **Euro Adapter** Pt No. 15-332 (installed)
Note -
Same as P2 except for 220 v operation
Vendor USRobotics

P4: **USRobotics Rackmount 32 Chassis** Pt No. 0111
Comes with 1 power supply and no (zero) modem modules
Rack accepts P5 modem modules

P5: **USRobotics Rackmount V.32 bis Modem Module** Pt NO. 0072
Represents single (qty 1) modem module to be installed in P4 rack

P6: **ZYXEL Desktop Modem U-1496+**
Note.-
For 2-wire or 4-wire (leased line) applications

P7: **ZyXEL Desktop Modem U-1496+**
Note.-
For 2-wire or 4-wire (leased line) applications
Same as P6, except for 220V operation
Purchasing must specify 220V when ordering (same model number)

P8: **ZyXEL 16 Modem Rack RS-1602**
Note.-
For 2-wire or 4-wire (leased line) applications
Recommend to use P9, P10 and P11 with this part

P9: ZyXEL Redundant Power Supply RDS-PS

Note.-

For use with P8
One for each P8

P10: ZyXEL RS Modular Jack Interface

Note.-

For use with P8
One for each P8

P11: ZyXEL Centronics (Telco) Interface

Note.-

For use with P8
One for each P8

P12: ZyXEL 16 Modem Rack RS-1602 220V

Note.-

For 2-wire or 4-wire (leased line) applications
Recommend to use P9, P10 and P11 with this part
Same as P8, except for 220V operation
Purchasing must specify 220V when ordering (same model number)

P13: ZyXEL Rackmount Modem U1496R+

Note.-

For 2-wire or 4-wire (leased line) applications
Rackmodem for use with P8
Up to 16 modems P13 for each P8 (Modem Rack)

P14: ZyXEL Rackmount Modem U1496R+

Note.-

Same as P13, except for 220V operation
Purchasing must specify 220V when ordering (same model number)

SECTION 2 US ROBOTICS V.32. CONFIGURATION INFORMATION

Preliminary Information

The following document will cover the programming procedures for the U.S. Robotics Courier V.32 modem when used for the named applications below:

- Dialup System Manager to Site Controller Connection
  Both Modems
- Dedicated Line System Manager to Site Controller Connection
  Site Controller Modem
  System Manager Modem
- Dialup System Manager Terminal Connection
  System Manager Modem
  Remote Terminal Modem

U.S. Robotics Courier V.32 Modem Configuration Guide

Dialup System Manager to Site Controller Connection:

Both modems are configured as follows:

1) Set modem DIP switches (located on back of modem) as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	D	U	U	U	D	D	D	D

2) Attach a terminal or PC to the modem using a straight-through (modem) cable. This may be a full ribbon cable or a DEC BC22E. Set the terminal to 9600 baud, 8-bit, no parity ONLY. Failure to do so will cause unreliable behavior from the modem once it is installed.

3) Apply power to the modem. You should be able to type the two letters "AT" followed by a carriage return and receive an "OK" response. If the modem does not respond, check the cable and steps 1-2 above.

4) Type the following commands in the order shown, following each with a carriage return:

ATS15=32	(treat DELETE as BACKSPACE)
ATS13 =1	(reset on falling DTR)
AT&M0	(no error control)
AT&K0	(no data compression)
AT&B1	(fixed DTE rate)
AT&N6	(fixed link rate, 9600 baud)
ATT	(default to tone dialing)
ATX6	(fast dial, extended responses)
AT&W	(save in NRAM)

5) Power off the modem and set the DIP switches as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	U	U	U	D	U	U	D	D	D	U

U.S. Robotics Courier V.32 Modem Configuration Guide

Dedicated Line System Manager to Site Controller Connection:

Site Controller modem:

1) Set modem DIP switches (located on back of modem) as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	D	U	D	U	D	D	D	D

2) Attach a terminal or PC to the modem using a straight-through (modem) cable. This may be a full ribbon cable or a DEC BC22E. Set the terminal to 9600 baud, 8-bit, no parity ONLY. Failure to do so will cause unreliable behavior from the modem once it is installed.

3) Apply power to the modem. You should be able to type the two letters "AT" followed by a carriage return and receive an "OK" response. If the modem does not respond, check the cable and steps 1-2 above.

4) Type the following commands in the order shown, following each with a carriage return:

ATS15=32	(treat DELETE as BACKSPACE)
ATS7=255	(no carrier detect timeout)
AT&M0	(no error control)
AT&K0	(no data compression)
AT&B1	(fixed DTE rate)
AT&N6	(fixed link rate, 9600 baud)
AT&L1	(leased line mode)
AT&S2	(CTS follows DCD)
AT&W	(save in NRAM)

5) Power off the modem and set the DIP switches as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	U	D	D	U	D	U	D	U

U.S. Robotics Courier V.32 Modem Configuration Guide

Dedicated Line System Manager to Site Controller Connection:

System Manager modem:

1) Set modem DIP switches (located on back of modem) as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	D	U	U	U	D	D	D	D

2) Attach a terminal or PC to the modem using a straight-through (modem) cable. This may be a full ribbon cable or a DEC BC22E. Set the terminal to 9600 baud, 8-bit, no parity ONLY. Failure to do so will cause unreliable behavior from the modem once it is installed.

3) Apply power to the modem. You should be able to type the two letters "AT" followed by a carriage return and receive an "OK" response. If the modem does not respond, check the cable and steps 1-2 above.

4) Type the following commands in the order shown, following each with a carriage return:

ATS15=32	(treat DELETE as BACKSPACE)
ATS7=255	(no carrier detect timeout)
ATS13=1	(reset on falling DTR)
AT&M0	(no error control)
AT&K0	(no data compression)
AT&B1	(fixed DTE rate)
AT&N6	(fixed link rate, 9600 baud)
AT&L1	(leased line mode)
AT&S2	(CTS follows DCD)
AT&W	(save in NRAM)

5) Power off the modem and set the DIP switches as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	U	D	U	U	D	U	D	U

NOTE: If the modems lose sync for a long enough time, the System Manager modem will go on-hook and stop trying to re-sync. To force it to re-sync, power if off and back on.

U.S. Robotics Courier V.32 Modem Configuration Guide

Dialup System Manager Terminal Connection:

System Manager Modem:

1) Set modem DIP switches (located on back of modem) as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	D	U	U	U	D	D	D	D

2) Attach a terminal or PC to the modem using a straight-through (modem) cable. This may be a full ribbon cable or a DEC BC22E. Set the terminal to 9600 baud, 8-bit, no parity ONLY. Failure to do so will cause unreliable behavior from the modem once it is installed.

3) Apply power to the modem. You should be able to type the two letters "AT" followed by a carriage return and receive an "OK" response. If the modem does not respond, check the cable and steps 1-2 above.

4) Type the following commands in the order shown, following each with a carriage return:

ATS15=32	(treat DELETE as BACKSPACE)
ATS13=1	(reset on falling DTR)
AT&H2	(XON/XOFF flow control on transmit)
AT&B1	(fixed DTE rate)
ATT	(default to tone dialing)
ATX6	(fast dial, extended responses)
AT&W	(save in NRAM)

5) Power off the modem and set the DIP switches as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	U	U	D	U	U	U	D	D	D	U

NOTE: Modem port should be set for 9600 baud, remote, no autobaud.

U.S. Robotics Courier V.32 Modem Configuration Guide

Dialup System Manager Terminal Connection:

Remote Terminal Modem:

1) Set modem DIP switches (located on back of modem) as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	D	U	U	U	D	D	D	D

2) Attach a terminal or PC to the modem using a straight-through (modem) cable. This may be a full ribbon cable or a DEC BC22E. Set the terminal to 9600 baud, 8-bit, no parity ONLY. Failure to do so will cause unreliable behavior from the modem once it is installed.

3) Apply power to the modem. You should be able to type the two letters "AT" followed by a carriage return and receive an "OK" response. If the modem does not respond, check the cable and steps 1-2 above.

4) Type the following commands in the order shown, following each with a carriage return:

ATS15=32	(treat DELETE as BACKSPACE)
AT&H2	(XON/XOFF flow control on transmit)
AT&B1	(fixed DTE rate)
ATT	(default to tone dialing)
ATX6	(fast dial, extended responses)
AT&W	(save in NRAM)

5) Power off the modem and set the DIP switches as shown:

DUAL	1	2	3	4	5	6	7	8	9	10
U	D	U	D	U	U	U	D	D	D	U

NOTE: Terminal should be set for 9600 baud, data leads only (no modem control), XON/XOFF recognition (default for all DEC VT1xx/VT2xx/VT3xx terminals).

SECTION 3 ZyXEL MODEM CONFIGURATION INFORMATION

Preliminary Information

The following document will cover the programming procedures for the ZyXEL U-1496+ modem when used for the named applications below:

- Site Controller 4 Wire Leased Parameters (to system manager)
- Site Controller 2 Wire Dialup Parameters (to system manager)
- System Manager 4 Wire Leased Parameters (to site)
- System Manager 2 Wire Dialup Parameters (to site)
- System Manager 4 Wire Leased Parameters (to remote terminal)
- System Manager 2 Wire Dialup Parameters (to remote terminal)
- C3 Maestro Console 4 Wire Leased Parameters (to IMC)
- IMC 4 Wire Leased Parameters (to C3 Maestro Console)

It is recommended that the installer become familiar with the modem being installed by reading the modem manual. All configurations are based upon the modem being initially reset to the factory default.

Site Controller 4 Wire Leased Parameters (to system manager)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 4 wire, leased configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTR RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DATA ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE RATE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT
LLINE TX POWER	0 DBM (-15 if line loss is 0)
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ANSWER
LINE TYPE	4W LEASED

Error Control

CONTROL LEVEL	NONE
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

Only those registers which are to be changed will be listed. The remaining are left as default.

S23 = 00	Numeric X0 result codes with no command echo
S35 = 22	Disable abort during handshaking
S38 = 08	Assert CD before initiating CONNECT result

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

Site Controller 2 Wire Dialup Parameters (to system manager)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 2 wire, dialup configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTE RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2 + RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODES	DISABLED
DTE ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT
LLINE TX POWER	0 DBM
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ANSWER
LINE TYPE	DIAL UP

Error Control

CONTROL LEVEL	NONE
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

Only those registers which are to be changed will be listed. The remaining are left as default.

S01 = 01	Answer on first ring
S23 = 80	No result codes with no command echo
S35 = 22	Disable abort during handshaking

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

System Manager 4 Wire Leased Parameters (to site)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 4 wire, leased configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTE RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST

DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DTE ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT
LLINE TX POWER	0 DBM (-15 if line loss is 0)
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ORIGINATE
LINE TYPE	4W LEASED

Error Control

CONTROL LEVEL	NONE
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

Only those registers which are to be changed will be listed. The remaining are left as default.

S23 = 00	Numeric X0 result codes with no command echo
S35 = 22	Disable abort during handshaking
S38 = 08	CD on before issuing CONNECT result

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

System Manager 2 Wire Dialup Parameters (to site)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 2 wire, dialup configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTE RATE OPTION	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DTE ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT
LLINE TX POWER	0 DBM
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ORIGINATE
LINE TYPE	DIAL UP

Error Control

CONTROL LEVEL	NONE
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

Only those registers which are to be changed will be listed. The remaining are left as default.

S01 = 01	Answer on first ring
S23 = 00	Numeric X0 result codes with no command echo
S35 = 22	Disable abort during handshaking
S38 = 08	CD on before issuing CONNECT result

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

System Manager 4 Wire Leased Parameters (to remote terminal)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 4 wire, leased configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTR RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DATA ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE RATE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT

LLINE TX POWER	0 DBM (-15 if line loss is 0)
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ANSWER
LINE TYPE	4W LEASED

Error Control

CONTROL LEVEL	V.42 + V.42bis
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

Only those registers which are to be changed will be listed. The remaining are left as default.

S23 = 00	Numeric X0 result codes with no command echo
S35 = 22	Disable abort during handshaking
S38 = 08	Assert CD before initiating CONNECT result

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

System Manager 2 Wire Dialup Parameters (to remote terminal)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 2 wire, dialup configuration (see the menu flow chart if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTE RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DTE ASYNC RATE	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT

LLINE TX POWER	0 DBM
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ORIGINATE
LINE TYPE	DIAL UP

Error Control

CONTROL LEVEL	V.42 + V.42bis
FLOW CONTROL	LOCAL XON/XOFF
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

Only those registers which are to be changed will be listed. The remaining are left as default.

S01 = 01 Answer on first ring

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

C3 Maestro Console 4 Wire Leased Parameters (to IMC)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 4 wire, leased configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTR RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DATA ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE RATE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE

RDL REQUEST	GRANT
LLINE TX POWER	0 DBM (-15 if line loss is 0)
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ORIGINATE
LINE TYPE	4W LEASED

Error Control

CONTROL LEVEL	NONE
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

All registers are left as default.

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

IMC 4 Wire Leased Parameters (to C3 Maestro Console)

The ZyXEL U-1496 modem is either desk or rack style. Also, front panel buttons allow programming to be performed without the use of a terminal.

Reset the modem to factory defaults.

From here on, the configuration steps are in point form. Press the MENU, ENTER, ⇒ or ⇐ buttons to get the following 4 wire, leased configuration (see the menu flow chart in the modem manual if required).

Terminal Options

DATA FORMAT	ASYNC
CHARACTER LENGTH	10
COMMAND SET	AT
DTR RATE OPTIONS	FIXED AT DTE RATE
DTR OPTIONS	108.2+RST
DCD OPTIONS	TRACKS CARRIER
RTS OPTIONS	IGNORED
DSR OPTIONS	DATA SET READY
COMMAND ECHO	DISABLED
RESULT CODE	DISABLED
DATA ASYNC SPEED	9600

Modem Options

LINK OPTIONS	MULTIAUTO
QUALITY ACTION	ADAPTIVE RATE
DEFAULT DIAL	PH0
DIAL BACKUP	DISABLED
GUARD TONE	NONE
RDL REQUEST	GRANT

LLINE TX POWER	0 DBM (-15 if line loss is 0)
PHONE JACK	SINGLE RJ11,
MAKE/BREAK RATIO	39%/61%
SECONDARY CHANNEL	DISABLED
SYNC CLOCK	INTERNAL
AUTO HANDSHAKE	ANSWER
LINE TYPE	4W LEASED

Error Control

CONTROL LEVEL	NONE
FLOW CONTROL	DISABLED
NEGOTIA FALLBACK	STAYS ON-LINE
BREAK HANDLING	EXPEDITED

Audio Options

SPEAKER CONTROL	ON UNTIL CONNECT
SPEAKER VOLUME	7
RING VOLUME	7

S Registers

All registers are left as default.

Configuration Save

Save this configuration in PROFILE 0 under SAVE TO = PROFILE 0. Then set RESET = PROFILE 0 to recall from profile 0 whenever the modem is powered up or reset via DTR.

SECTION 4 ZyXEL WORLDWIDE PTT APPROVALS AND OTHER SPECIFICATIONS

COUNTRY	MODEL #
AUSTRALIA	E
CANADA	ALL MODELS
CROATIA	S+,E+,E,R+
DENMARK	ALL MODELS
FINLAND	S+,E+,E,B+,B
GERMANY	SG+,EG+.EG
HOLLAND	E+
HONG KONG	All Models
HUNGARY	E+,E
INDIA	S+,E+
INDONESIA	S
IRELAND	S+
ISRAEL	S+,E
JAPAN	E+, Rack Series
JORDAN	S+
MALAYSIA	S+,E+,R
MOROCCO	S+,E,B,R
NEW ZEALAND	S+,E+,E,B+,B
POLAND	S+,E
RUSSIA	S+,E+,E
SAUDI ARABIA	S+
SINGAPORE	All Models
SLOVAK	All Models
SOUTH AFRICA	S+,E+,E,R+,R
SWEDEN	S+,E+,E,R+
SWITZERLAND	All Models
THAILAND	S+
TURKEY	S+,E,B
UNITED STATES	All Models
YUGOSLAVIA	S+,E+,E

S+, S = U1496+

R+,R = U1496R+

Temperature:

- Safe Operating Range of 0 C to 70 C
- Safe Storage Range of 0 C to 70 C

Humidity:

- Safe Operating Level of 85% at 45 C

19A149786

CONT ON SHEET A2 SH NO. A1

REV NO.	TITLE
CONT ON SHEET SH NO.	MODEMS FIRST MADE FOR PST SYSTEM

F. C. F. O. 19A149786

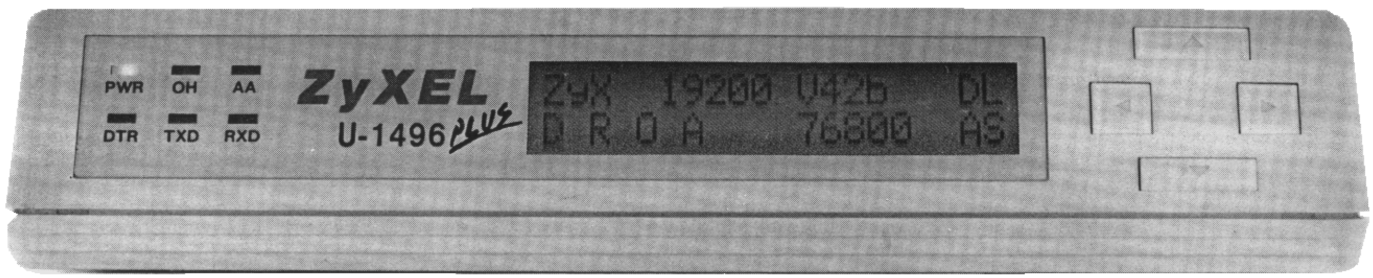
REVISIONS

ZyXEL U-1496 PLUS

ZyXEL 19.2Kbps Ultra High Speed

14.4Kbps Data + 14.4Kbps Fax

Advanced CELP Voice Capability



- ZyXEL's 19.2Kbps. Ultra High Speed
- V.32bis, V.32, V.22bis, V.22/BELL 212A, V.21/BELL 103
- 76.8Kbps Maximum Data Throughput
- V.33, V.29, V.27ter
- 2/4 Wire Leased Line with Dial Backup
- Auto Dial-up Mode Speed Detection
- On-Screen Line Condition Monitoring
- V.42bis and MNP®5 Data Compression
- V.42 and MNP® 4/3 Error Correction
- Line Probing
- Friendly Menu Control
- Remote Configuration
- Caller ID and Distinctive Ring
- Advanced Digitized Voice Capability
- V.25bis and Enhanced AT Command Set
- V.17-14.4Kbps, EIA Class 2, G3 Fax, S&R
- Full Duplex, async./sync. operation
- Call-Back Security and Password Protection
- Automatic Speed Fall-back and Fall-forward

ZyXEL Offers The V.Fast Advantage

After the V.Fast standard is finalized, you will be able to upgrade your ZyXEL modem to V.Fast. This will be a trade-in offer, requiring users to send in their modems for an upgrade. Offer valid in USA and Canada only.

L61

PRINTS TO

MADE BY E. Gaddy 19 Dec. 1994	APPROVALS Rene Gomez 20 Dec. 94	ERICSSON	19A149786
ISSUED E. G. 20 Dec. 1994			CONT ON SHEET A2 SH NO. A1

ZyXEL U-1496 PLUS

FEATURES

- ZyXEL's 19.2Kbps, ultra high speed, modem/fax
- Fully compatible with CCITT V.32bis, V.32, V.22bis, V.22/BELL 212A, and V.21/BELL 103, V.23, V.33, V.29 and V.27ter.
- Speed range: 19.2Kbpps, 16.8Kbps, 14.4Kbps, 12Kbps, 9.6Kbps, 7.2Kbps, 4.8Kbps, 2.4Kbps, 1.2Kbps and 300bps
- On-line automatic speed fall-back and fall-forward with fast rate renegotiation.
- V.42bis data compression with up to76.8Kbps throughput
- Caller ID decoding and Distinctive ring detection
- Remote configuration with modem reset
- Call-back security and password protection
- 14.4Kbps G3 FAX send and receive
- EIA Class II Fax Command Set
- Automatic Data/Fax call detection
- Digitized voice capability with speech compression
- Offers the ability to upgrade by FIRMWARE
- Automatic dial back-up for leased lines
- Line probing

FAX ATTRIBUTES

- V.17-14.4Kbps G3 Fax, send and receive
- V.29 G3 Fax up to 9.6Kbps
- V.27ter G3 Fax up to 4.8Kbps
- ZyXEL Fax AT commands
- EIA Class 2 Fax commands

VOICE ATTRIBUTES

- ADPCM Voice Digitization at 28.8Kbps and 19.2 Kbps
- Simultaneaous DTMF Detection
- Voice AT Command Set
- Advanced Voice Digitization (CELP)

ZyXEL's New VoiceFax Software Now available for only $50

- DOS version supports up to 1000 data/fax/voice mailboxes
- Windows and Mac versions support up to 1000 fax/voice mailboxes
- Automatic attendant system
- Forward voice/fax calls*
- Call transfer and fax on demand*
- Remotely retrieve fax and voice messages
- Security code protection

*DOS Version Only

TECHNICAL SPECIFICATIONS

- Data Mode: Asynchronous or synchronous
- Asynchronous data format: 8, 9, 10 or 11-bit character
- Operation Modes: Auto-dial/answer and Manual originate/answer
- DTE Interface: EIA-232D/V.24 up to 76.8Kbps
- Error Control: MNP® 4/3 and V.42
- Data Compression: MNP5 and V.42bis
- Flow Control: Software XON/XOFF or hardware CTS/RTS
- Command Set: Extended AT and V.25bis command set.
- Line Status Monitoring: Signal-to-noise ratio, Receive signal level, Frequency offset, Phase jitter, Retrain log and Carrier loss log
- Diagnostic Modes: Modem full self test, Analog loopback (with self test), Remote digital loopback (with self test), Digital loopback
- Configuration Settings: Software or LCD menu programmable (with non-volatile memory storage, 4 user profiles)
- LED Status Indicator: PWR, AA, OH, DTR, TXD, RXD
- Line Interface: RJ11 and RJ45 2/4 wire dial-up or leased line
- Dialing Type: Tone/Pulse dialing
- Call Progress Monitoring: Dial tone, busy and ring back detection
- Audio Monitor: Programmable volume control

HARDWARE & SOFTWARE COMPATIBILITY

ZyXEL U-1496 Plus is compatible with DOS, Windows®, Macintosh® and OS/2® environments and are fully compatible on IBM®, PC's/compatibles, terminals with RS232, Macintosh®, NeXT®, Amiga® computers and a wide range of connectivity systems, and a host of popular communications and fax software packages.

COMPATIBILITY & SPEED

Operation Mode	Bit Rate (+/-0.01%) bps	Baud Rate (+/-0.01%) bps	Modulation
ZyXEL 19.2	19200	Proprietary	Proprietary
ZyXEL 16.8	16800	Proprietary	Proprietary
V.33	14000	2400	128-TCM
V.33	12000	2400	64-TCM
V.32bis	14400	2400	128-TCM
V.32bis	12000	2400	64-TCM
V.32bis	7200	2400	16-TCM
V.32	9600	2400	32-TCM
V.32	9600 uncoded	2400	16-QAM
V.32	4800	2400	4-DPSK
V.29	9600	2400	16-QAM
V.29	7200	2400	8-QAM
V.29	4800	2400	4-DPSK
V.27ter	4800	1600	8-PSK
V.27ter	2400	1200	4-DPSK
V.22bis	2400	600	16-QAM
V.22/BELL 212A	1200	600	4-DPSK
V.21 BELL 103	300	300	FSK
V.23	1200/75	1200/75	FSK
G3 FAX	According to V.17, V.29 and V.27ter		

Dimensions: 10.5" X 8.75" X 1.75"
US FCC & Canadian DOC approved
All trademarks are property of their respective owners.
Specifications are subject to change without notice.

5 Year parts & labor warranty

BOARDWATCH MAGAZINE
November 1992
ZyXEL U-1496
ZyXEL U-1496E

Winter 1992
ZyXEL U-1496
Awarded 5 NeXTWORLD Cubes

PC Computing HARDWARE 200 TOP RATED
June 1993
ZyXEL U-1496E

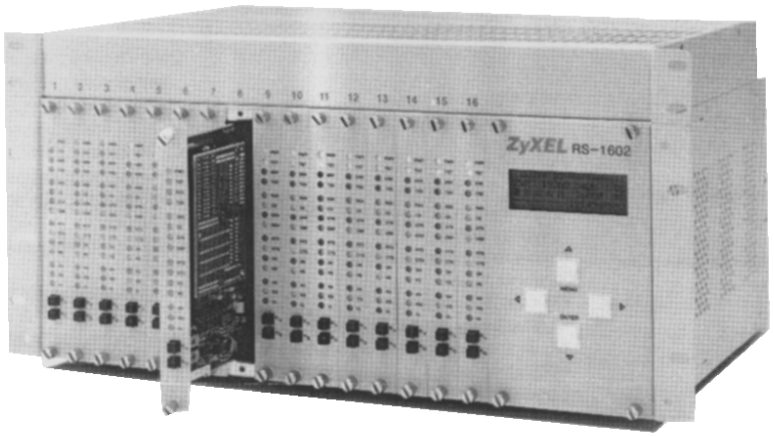
PC MAGAZINE EDITORS' CHOICE
June 29, 1993
ZyXEL U-1496 Plus

PC PROFESSIONELL EMPFEHLUNG DER REDAKTION
February 1993
ZyXEL U-1496E Plus

PC PROFESSIONELL EMPFEHLUNG DER REDAKTION
November 1992
ZyXEL U-1496E

ZyXEL
The Intelligent Modem
4920 E. La Palma Ave, Anaheim, CA 92807
Tel.: 714-693-0808 Fax: 714-693-8811 BBS:714-693-07622

ZyXEL RS-1602 with the U-1496R



2 Year Limited Warranty

It's 16 to 1, and with ZyXEL's Rackmount System, the Odds of Reliable Communication are in Your Favor!

New Options for ZyXEL's Rackmount System!

RS Centronics® Interface
Can ZyXEL make it any easier? Absolutely! The Centronics Interface from ZyXEL provides four connector cable outlets for your phone lines. Each outlet is conveniently designated for telephone sets, dial-up, and leased lines.

RS Modular Jack Interface
Stop splitting wires and fumbling with that little screwdriver to connect your modems to your rack. With ZyXEL's New Modular Interface, it's as easy as plugging in the telephone's RJ-45 or RJ-11 phone cords to the back panel of your rack. The Modular Jack Interface comes with a Centronics Interface.

With ZyXEL's RS-1602 Rackmount System, you can control up to sixteen U-1496R modem cards from one central location. And with the high speed and reliability of ZyXEL's award-winning modems, the payoff is maximized with faster and higher connection rates. If you want to increase your odds, the optional Network Management System (NMS) lets you control up to 4096 U-1496R modem cards from a single PC.

ZyXEL U-1496R
The U-1496R is a rack-mountable version of the standalone U-1496 Plus 19.2Kbps ultra high speed modem/fax with voice. The U-1496R supports a wide range of ITU-T (formerly CCITT) standards including V.32 and V.32bis, and is compatible with virtually all low and high speed modems available on the market today.

The U-1496R supports asynchronous and synchronous operations on 2/4-wire leased or dial-up lines. Implementing both V.42bis and MNP®5 data compression protocols, the U-1496R's asynchronous, error-free communications throughput can reach as high as 76.8Kbps.

G3 Fax send and receive capabilities are built-in with the Class 2 Fax Command Set, including the ITU-T V.17-14.4Kbps fax transmission standard.

The U-1496R is the perfect network solution to centralize your high speed modem requirements. Fifteen LED status lights on every card's front panel give a complete monitoring of its operation.

ZyXEL Rack Chassis - RS-1602
Standard features of the RS-1602 include: a single power supply, a 20x4 LCD display menu control panel and four directional keys. The settings of all 16 modem cards can be viewed, changed and saved through the control panel. Dialing, going on/off hook, and performing tests can also be done from the rack's panel.

Network Management System
ZyXEL's NMS is an optional, Windows-based software that lets you manage up to 4096 remote and/or local ZyXEL U-1496Rs from one computer screen! The rack's control card stores each modem card's settings and will automatically configure any newly replaced card to those correct settings.

ZyXEL U-1496R

TECHNICAL SPECIFICATIONS

Compatibility and Speed
- V.33, V.32bis, V.32, V.29, V.27ter, V.22bis, V.22/Bell 212A, and V.21/Bell 103

LED Status Indicators
- PWR, TST, ERR, TXD, RXD, CD, DTR, DSR, RTS, CTS, OH, HS, AA, SQ, and LL

Manual Switches
- Voice/Data Toggle and Answer/Originate Mode Setting

Transmit Level
- -9 or -10 dBm permissive for dial-up line
- 0 to -27 dBm for leased line

Dialing Type
- Tone or Pulse

Intelligent Features
- Hot Swap Capability
- Call Progress Monitoring
- Line Status Monitoring
- Signal-to-Noise Ratio
- Receive Signal Level
- Frequency Offset
- Phase Jitter
- Retrain and Carrier Loss Logs

Receive Sensitivity
- -43 dBm

Asynchronous Data Format
- 8, 9, 10, or 11-bit character

Operation Modes
- Auto-Dial/Answer
- Manual Originate/Answer

Error Control
- MNP 4/3 & V.42

Data Compression
- MNP 5 & V.42bis

Flow Control
- XON/XOFF or RTS/CTS

Configuration Settings
- Software or central panel LCD menu programmable
- Non-volatile memory storage

Diagnostic Modes
- Modem full self-test
- Analog loopback (with self-test)
- Remote digital loopback (with self-test)
- Digital loopback

Command Set
- Extended AT Command Set, V.25bis

Fax Features
- G3 Fax send and receive
- V.17 - 14.4Kbps transmission rate
- EIA Class 2 Fax Command Set

DTE Interface
- EIA-232D/V.24
- Speed: 300bps to 76.8Kbps

Features

- ZyXEL's 19.2Kbps, ultra high speed modem/fax
- On-line automatic fall-back/ fall-forward with fast rate renegotiation
- V.42bis data compression with up to 76.8Kbps throughput
- Caller ID and Distinctive Ring
- Remote configuration
- Call-Back Security and Password Protection
- V.17 - 14.4Kbps G3 Fax send and receive
- EIA Class 2 Fax Command Set
- Automatic Data/Fax call detection
- Digitized Voice capability with Speech Compression
- Automatic dial back-up for leased lines
- Line probing techniques
- Upgradable by firmware

Width: 19 in. (483 mm)
Height: 7 in. (178 mm)
Depth: 12 in. (305 mm)
Weight: Rack Chassis: 27 lbs. Modem Card: 1.5 lbs.
US FCC & Canadian DOC approved.

Specifications are subject to change without notice.

ZyXEL RS-1602

TECHNICAL SPECIFICATIONS

Capacity
- 1 to 16 U-1496R modem cards

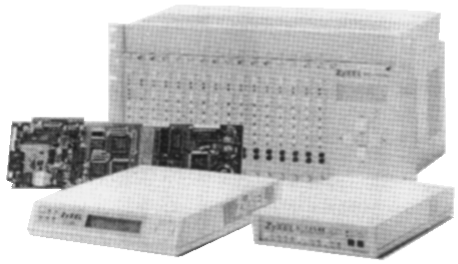
Central Front Panel Control
- 20x4 character LCD display
- 4 key menu control
- Operation Control
- Line condition monitoring
- Configuration setting and parameter checking

Rear Panel
- 16 DB25s connectors for DTE connection
- 16 8-pole terminal blocks for 2/4-wire leased line, dial-up line, and phone connections
- Two RJ-11 interface jacks on rear panel

Power Supply
- 50/60 Hz, 150 Watts
- AC 110VAC or 220VAC input (+/- 15%)
- Redundant Power Supply (Optional)

OPTIONAL

Network Management System
- Runs in the Windows 3.x environment
- Remote configuration/testing
- Controls and monitors individual modems
- Collects system statistics
- Generates reports



ZyXEL's entire line of award-winning modems - the intelligent choice for high-speed, reliable data transmission. From ZyXEL's Rackmount System to its new portable, ZyXEL modems provide a total communications solution. They are compatible with DOS®, Windows®, Mac®, UNIX® and OS/2® environments. ZyXEL has a new rackmount that is an ideal, low cost solution for SysOps - **the RS-1602E, with U-1496RE and U-1496RE*plus* modem cards.**

ZyXEL
The Intelligent Modem
4920 E. La Palma Ave. Anaheim, CA 92807
Tel: 714-693-0808 Fax: 714-693-0705 BBS: 714-693-0762

L61

PRINTS TO