

## Bell 212A/CCITT V.22 Modem Filters

### GENERAL DESCRIPTION

The XR-2126/2127/2128/2129 modem filters are monolithic CMOS switched capacitor filters designed for use in full duplex 1200 BPS modems. They meet all the filtering functions of the Bell 212A and CCITT V.22 modem specifications. They include the low band (centered at 1200 Hz) and high band (centered at 2400 Hz) filters with full channel compromise equalization and output smoothing filters for both bands.

For CCITT V.22 applications, a notch filter is included that can be selected for either 550 Hz or 1800 Hz and provide greater than 55 dB of rejection at these frequencies. Also included in these devices are two uncommitted operational amplifiers which can be used for input anti-aliasing filtering or for additional gain, and additional equalization for Worst Case Line (3002, C<sub>0</sub>) conditions.

The XR-2126 is pin and function compatible to the AMI S35212 while the XR-2127 is pin and function compatible to the AMI S35212A. The XR-2128 is an enhanced version of the XR-2126 and XR-2127. Like the S35212 and S35212A, the high band filter in the XR-2126, XR-2127 and XR-2128 can be scaled down by a factor of 6 so it can be used to monitor Call Progress tones in smart modems. And, like the S35212A, the XR-2127 and XR-2128 have analog loop back mode for testing the functions of the modem.

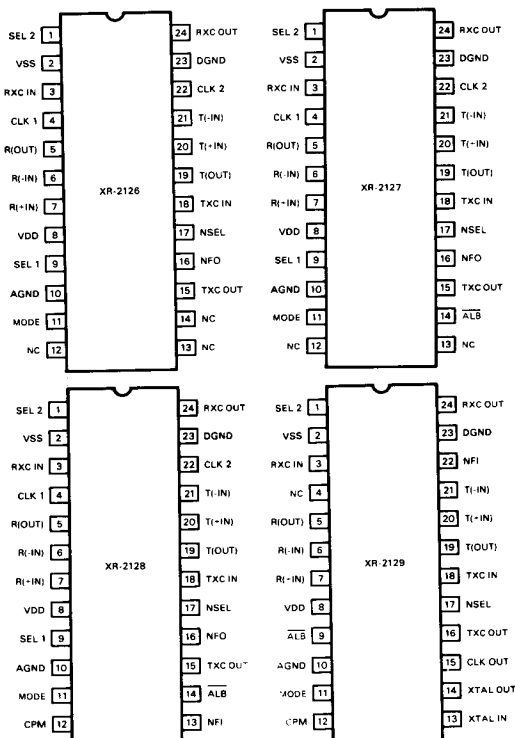
The XR-2128 contains two additional control pins, CPM (Pin 12) and NFI (Pin 13), that allow more accurate Call Progress Monitoring and easier V.22 implementation without the need for external multiplexers and smoothing filters. The CPM pin scales the low band filter by a factor of 2.5 for better centering over the Call Progress frequency range of 300 to 660 Hz, allowing the unscaled high band filter to be used for monitoring the modem answer tone.

The XR-2129 is an EXAR version of the 212A/V.22 modem filter. All the features of the XR-2126/2127/2128 except the clock frequencies are provided. The XR-2129 operates from a 1.8432 MHz crystal with an onboard clock oscillator. It also features a 1.8432 MHz buffered clock output and 10 dB of gain in the receive path. When used with the XR-2121 modulator, XR-2122 demodulator, and XR-2125 buffer, and a small amount of external circuitry, all the functions needed to realize the Bell 212A modem are in place.

### APPLICATIONS

Bell 212A Modem Filtering  
CCITT V.22 / V.22bis Modem Filtering  
Bell 103 Modem Filtering  
Other Modem Filter Applications

### FUNCTIONAL BLOCK DIAGRAMS



### FEATURES

Bell 212A/CCITT V.22 Compatible Transmit and Receive Filters with Full Channel Compromise Equalization  
Selectable V.22 Notch Filters Included (550 Hz/1800 Hz)  
Built-in Call Progress Mode/Enhanced Call Progress Mode  
Analog Loop Back Capability  
Phone Line Status Monitor Capability (Bypass Mode)  
Additional Equalization for Worst Case Line (3002, C<sub>0</sub>) Conditions  
On-chip Transmit and Receive Output Smoothing Filters  
Two Uncommitted Operational Amplifiers  
Choice of Clock Frequencies:  
153.6 KHz or 1.2288 MHz/2.4576 MHz on XR-2126, XR-2127, XR-2128  
1.8432 MHz Crystal with On-Chip Clock Oscillator on XR-2129  
TTL/CMOS Compatible Digital Inputs

# XR-2126/7/8/9

## ABSOLUTE MAXIMUM RATINGS

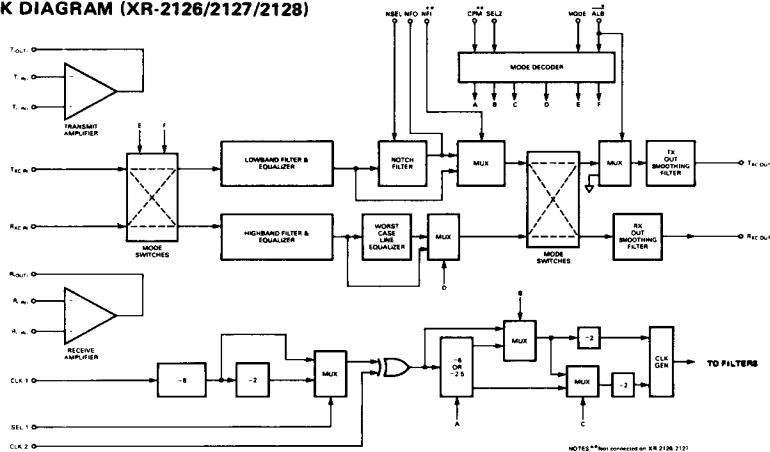
Power Supply	12V ( $\pm 6V$ )
Power Dissipation, Plastic	1.0W
Derate Above 25°C	5 mW/°C
Power Dissipation, Ceramic	1.3W
Derate Above 25°C	7 mW/°C
Operating Temperature	0°C to 70°C
Storage Temperature	-65°C to 150°C
Any Input Voltage	(VDD +0.5V) to (VSS -0.5V)

## ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2126CN	Ceramic	0°C to 70°C
XR-2126CP	Plastic	0°C to 70°C
XR-2127CN	Ceramic	0°C to 70°C
XR-2127CP	Plastic	0°C to 70°C
XR-2128CN	Ceramic	0°C to 70°C
XR-2128CP	Plastic	0°C to 70°C
XR-2129CN	Ceramic	0°C to 70°C
XR-2129CP	Plastic	0°C to 70°C

All devices are also available in Surface Mount Packages. Consult factory for complete information.

## BLOCK DIAGRAM (XR-2126/2127/2128)



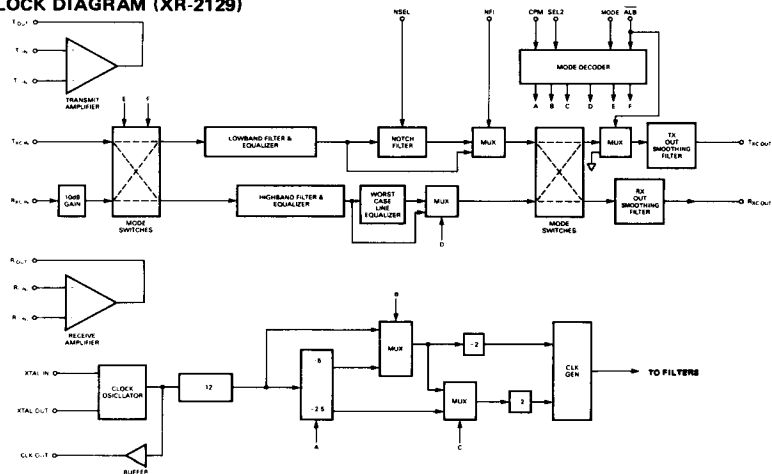
NOTES \*NFI not connected on XR-2126/2127

\*NFI not connected on XR-2128

Note: CLK 1, ALB, CLK 2 have internal pull-up to VDD

Note: SEL 2, SEL 1, MODE, CPM, NFI have internal pull-down to ground

## BLOCK DIAGRAM (XR-2129)



## DC ELECTRICAL CHARACTERISTICS

Test Conditions:  $T_A = 0^\circ\text{C to } 70^\circ\text{C}$ ,  $V_{DD} = +5\text{V} \pm 5\%$ ,  $V_{SS} = -5\text{V} \pm 5\%$ , unless otherwise specified.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
$I_{DD}$	Quiescent Current		15		mA	
$I_{SS}$	Quiescent Current		15		mA	
$V_{IH}$	High Level Input Voltage, Digital Signal Pins		2.5		V	Note 1
$V_{IL}$	Low Level Input Voltage, Digital Signal Pins		0.8		V	Note 2
$V_{OH}$	High Level Output Voltage	2.6			V	
$V_{OL}$	Low Level Output Voltage			0.5	V	

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## AC ELECTRICAL CHARACTERISTICS

Test Conditions:  $25^\circ\text{C}$ ,  $V_{DD} = +5\text{V}$ ,  $V_{SS} = -5\text{V}$ , unless specified otherwise.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
	Low Band Center Frequency	1190	1200	1210	Hz	
	High Band Center Frequency	2380	2400	2420	Hz	
	Adjacent Channel Rejection					
	Low Band	55	65		dB	
	High Band	55	75		dB	
	3 dB Bandwidth		950		Hz	
	Pass Band Gain at Center Frequency	-0.5		+0.5	dB	1200 Hz, 2400 Hz
	Crosstalk		65		dB	
	Dynamic Range		70		dB	
	Total Harmonic Distortion		0.3		%	
	Output Noise		1	2	mVrms	In Passband
	Stop Band Rejection					
	Low Band Filter		30		dB	At 500 Hz
			25		dB	At 1800 Hz
			75		dB	At 2400 Hz
			43		dB	At 4000 Hz
	High Band Filter		55		dB	At 500 Hz
			95		dB	At 1200 Hz
			25		dB	At 1800 Hz
			35		dB	At 4000 Hz
	NFI = High		65		dB	At 550 Hz, NSEL = Low
			65		dB	At 1800 Hz, NSEL = High
	Group Delay					
	Low Band Filter		5160		$\mu\text{sec}$	At 900 Hz
			5300		$\mu\text{sec}$	At 1200 Hz
			5360		$\mu\text{sec}$	At 1500 Hz
	High Band Filter		5370		$\mu\text{sec}$	At 2100 Hz
			5110		$\mu\text{sec}$	At 2400 Hz
			4900		$\mu\text{sec}$	At 2700 Hz
	Output Voltage Swing		8.0		Vp-p	

Note 1:  $V_{in} > V_{IH}$  is a logic 1.

Note 2:  $V_{in} < V_{IL}$  is a logic 0.

The following table lists EXAR filters and their pin compatible counterparts.

EXAR	Counterpart	
XR-2126	AMI	S35212
	Reticon	RM5632A
XR-2127	AMI	S35212A
	Sierra	SC11005
XR-2128	Sierra	SC11001
XR-2129	none	

## PIN DESCRIPTIONS

Pin	Name	Description/Function
1	SEL 2	Call Progress mode selection; SEL 2 logic 0 for normal operation, SEL 2 logic 1 scales down the high band filter by 6 for Call Progress Monitoring.
2	VSS	Negative supply voltage (typically -5V).
3	RXC IN	Receive signal input.
4	CLK 1	Clock input 1 on XR-2126/2127/2128; 2.4576 MHz with SEL 1 logic 1 or 1.2288 MHz with SEL 1 logic 0. TTL or CMOS compatible.
	NC	No connection on XR-2129.
5	R(OUT)	Receive uncommitted operational amplifier output.
6	R(-IN)	Inverting input of the receive uncommitted operation amplifier.
7	R(+IN)	Non-inverting input of the receive uncommitted operational amplifier.
8	VDD	Positive supply voltage (typically +5V).
9	SEL 1	Selects clock frequency into Pin 4 on XR-2126/2127/2128; logic 0 for 1.2288 MHz, logic 1 for 2.4576 MHz.
	ALB	Analog loop back on XR-2129; logic 1 for normal operation, logic 0 to internally loop back TXC OUT to RXC OUT with no signal (MUTE) on TXC OUT.
10	AGND	Analog ground.
11	MODE	Originate/Answer mode selection; logic 0 for Originate, logic 1 for Answer.
12	NC	No connection on XR-2126/2127.

	CPM	Enhanced Call Progress Mode selection on XR-2128 and XR-2129; CPM logic 0 for normal operation; CPM logic 1 scales down the low band filter by 2.5 for enhanced Call Progress Monitoring.
13	NC	No connection on XR-2126/2127.
	NFI	Notch filter insert pin on XR-2128; logic 0 for notch filter bypass (Bell 212A), logic 1 for inserting 550 Hz/1800 Hz notch (V.22).
	XTAL IN	XR-2129 only. On chip oscillator for input requiring 1.8432 MHz crystal connected across XTAL OUT and XTAL IN.
14	NC	No connection on XR-2126.
	ALB	Analog loop back on XR-2127 and XR-2128. Same as Pin 9 on XR-2129.
	XTAL OUT	XR-2129 only. Unbuffered oscillator output.
15	TXC OUT	Transmit output signal on XR-2126, XR-2127, XR-2128.
	CLK OUT	1.8432 MHz buffered clock output on XR-2129.
16	NFO	Buffered notch filter output on XR-2126, XR-2127, XR-2128
	TXC OUT	Transmit output signal on XR-2129. Same as Pin 15 on XR-2126/2127/2128.
17	NSEL	Notch filter selection; logic 0 for 550 Hz, logic 1 for 1800 Hz.
18	TXC IN	Transmit input signal.
19	T(OUT)	Transmit uncommitted operational amplifier output.
20	T(+IN)	Non-inverting input of the transmit uncommitted operation amplifier.
21	T(-IN)	Inverting input of the transmit uncommitted operational amplifier.
22	CLK 2	Clock input 2 on XR-2126/2127/2128. 153.6 KHz TTL or CMOS clock.
	NFI	Notch filter insert pin on XR-2129, same as Pin 13 on XR-2128.
23	DGND	Digital ground.
24	RXC OUT	Receive output signal.

## PRINCIPLES OF OPERATION

### Low Band Filter

The low band filter is a 20th order switched capacitor filter consisting of a 10th order bandpass filter centered at 1200 Hz and a 10th order allpass filter centered at 1200 Hz. The allpass filter is a delay equalizer that provides compensation for the pass band group delay variation in the low band filter and half of the compromise line characteristics. See Figure 1 for the group delay response and Figure 2 for amplitude response.

In the Originate mode, the low band is used in the transmit path and in the Answer mode, it is used in the receive path. When analog loop back is used in the Originate mode, the low band filter will be in the test loop. In Call Progress Monitoring mode with SEL 2 (Pin 1) at logic 1, and CPM (Pin 12) at logic 0, the center frequency of the filter will be shifted down by a factor of 6 to 250 Hz. If CPM (Pin 12) is logic 1, then the center frequency will be scaled down by 2.5 to 480 Hz. This allows the precision dial tone of 350 Hz/440 Hz to pass, as well as audible ringing at 440 Hz/480 Hz and the busy tone and the precision reorder tone of 480 Hz/620 Hz.

### High Band Filter

The high band filter is a 20th order switched capacitor filter consisting of a 10th order bandpass filter and a 10th order allpass filter centered at 2400 Hz. The allpass filter is a delay equalizer that provides compensation for the pass band group delay variation in the high band filter and half of the compromise line characteristics. See Figure 3 for the group delay response of the high band filter and Figure 2 for amplitude response.

In the Answer mode, the highband filter is used in the transmit path. In the Originate mode, it is used in the receive path.

When analog loop back is used in the Answer mode, the high band filter will be in the test loop. In Call Progress Monitoring mode with SEL 2 (Pin 1) at logic 1 and CPM (Pin 12) at logic 0, the center frequency will be scaled down by a factor of 6 to 400 Hz. If Pin 1 is at logic 0 or Pin 12 is at logic 1 this filter operates in the normal data mode.

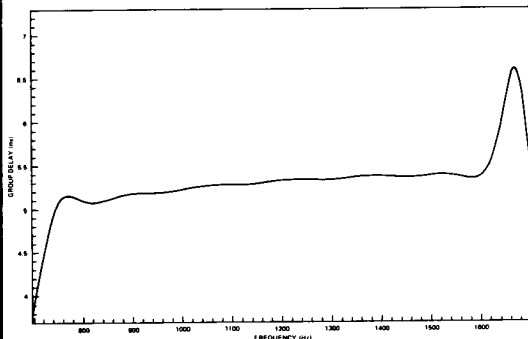


Figure 1. Low Band Group Delay Characteristics

In the XR-2129, a 10 dB gain is built into the receive filter path.

### Transmit and Receive Output Smoothing Filters

The transmit and receive output smoothing filters are 2nd order, active RC, low pass filters that reconstruct the time sampled output signals characteristic of switched capacitor filters.

### V.22 Notch Filter

The V.22 notch filter is a 4th order switched capacitor notch filter cascaded with the low band filter. The notch frequency of the filter is at 550 Hz when NSEL (Pin 17) is logic 0 and is shifted to 1800 Hz when NSEL is logic 1. In the XR-2128 and XR-2129, the notch filter is bypassed in the low band filter if NFI pin is logic 0. On the XR-2126/2127/2128, the notch filter output will always be available at Pin 16 (NFO). On the XR-2129, the NFO pin is not available; the notch filter will appear on Pin 24 (RXC OUT) if (NFI) is logic 1.

### Worst Case Line Equalizer

The worst case line equalizer is an optional fixed compromise (amplitude and delay) equalizer designed for worst case line conditions (3002, C<sub>0</sub>) in the high band receive mode. The equalizer is inserted in the high band receive path in operating modes 14 and 16 (see Table 1).

### Uncommitted Operational Amplifiers

Two uncommitted operational amplifiers are provided on all four versions of the modem filters. These are the transmit and receive amplifiers. They can be used as input anti-aliasing filters or as gain stages.

### Analog Loop Back Test

When  $\overline{ALB}$  (Pin 14) on XR-2127, XR-2128 and (Pin 9) on XR-2129 is logic 0, the modem transmit signal, TXC OUT (internally) is looped back to the modem through the RXC OUT pin with no signal present (MUTE) on TXC OUT (output pin). If the low band filter is to be tested, the MODE pin should be logic 0 and logic 1 if the highband filter is to be tested. The receive output smoothing filter will always be in the test loop regardless of the MODE level.

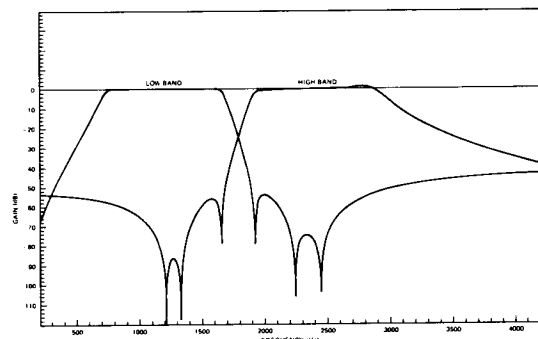


Figure 2. Low and High Band Amplitude Response

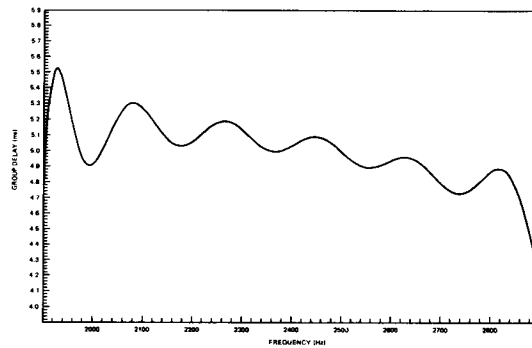


Figure 3. High Band Group Delay Characteristics

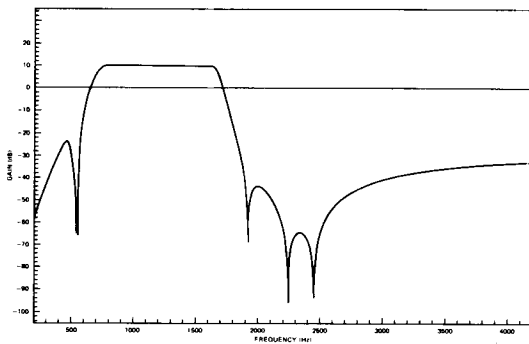


Figure 4A. XR-2129 with 500 Hz Notch

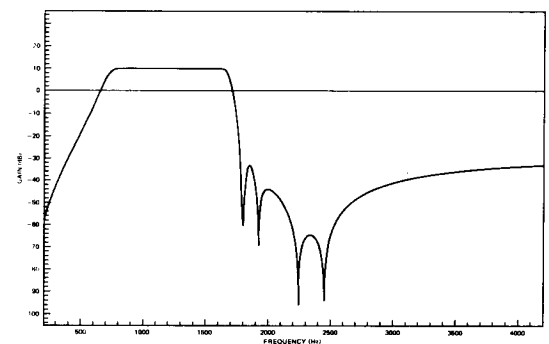


Figure 4B. XR-2129 with 1800 Hz Notch

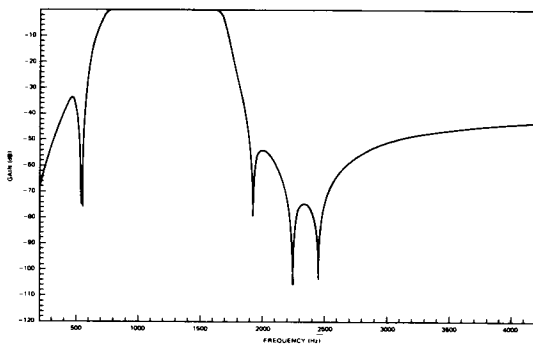


Figure 5A. XR-2126/2127/2128 with 500 Hz Notch

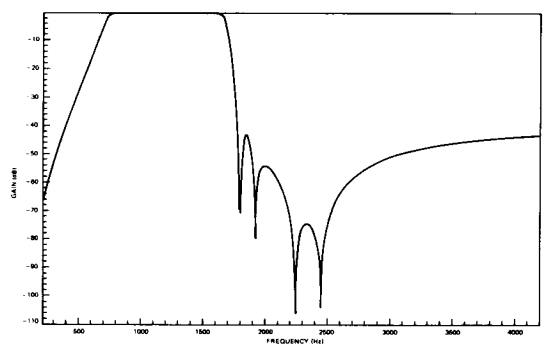


Figure 5B. XR-2126/2127/2128 with 1800 Hz Notch

## Originate/Answer Mode Selection

When MODE (Pin 11) is logic 0, the modem filter operates in the Originate mode, transmitting in the low band and receiving in the high band. If MODE is logic 1, the modem filter operates in the answer mode; transmitting in the high band and receiving in the low band.

## Transmit Squelch in Call Progress Mode

If CPM (Pin 12) is logic 1, the input of the transmit smoothing filter will be disconnected and shorted to ground, muting the transmitter. In the handshake sequence of the Bell 212A modem, this feature can be used to eliminate the transmit signal output.

## Phone Line Status Monitor

If the logic levels on the control pins are shown in operation 15 (Table 1), the low band and high band filters will be bypassed; TXC OUT will be connected to RXC IN and

RXC OUT will be connected to RXC IN. This feature can be used to monitor the status of the phone line. The output smoothing filters will always be in the TXC OUT and RXC OUT paths.

## Clock Selection (Note 1)

On the XR-2126/2127/2128, SEL 1 (Pin 9) is used to select the internal clock divider ( $\div 8/\div 16$ ) depending on the external clock frequency. SEL 1 is set at logic 0 for a 1.2288 MHz input clock and at logic 1 for a 2.4576 MHz clock on CLK 1 (Pin 4). A 153.6 KHz clock input is provided on CLK 2 (Pin 22). If used, CLK 1 (Pin 4) and SEL 1 (Pin 9) should be left open.

On the XR-2129, neither of these clock options are available. Instead, the device operates from an on chip clock oscillator which requires an external 1.8432 MHz crystal. Also available on the XR-2129, is a buffered 1.8432 MHz clock output on Pin 15.

**TABLE 1 OPERATING MODES**

OPERATION	CPM	SEL 2	ALB	MODE	NFI	NSEL	TXC IN	TXC OUT	RXC IN	RXC OUT
0	0	0	1	0	0	X	L	L	H	H
1	0	0	1	1	0	X	H	H	L	L
2	0	0	0	0	0	X	L	MUTE	—	L
3	0	0	0	1	0	X	H	MUTE	—	H
4	0	1	1	0	X	X	L/6	L/6	H/6	H/6
5	0	1	1	1	X	X	H/6	H/6	L/6	L/6
6	0	1	0	0	X	X	L/6	L/6	H/6	L/6
7	0	1	0	1	X	X	H/6	H/6	L/6	H/6
8	1	0	1	0	X	X	—	MUTE	H	H
9	1	X	1	1	X	X	—	MUTE	L/2.5	L/2.5
10	1	X	0	0	X	X	—	MUTE	L/2.5	L/2.5
11	1	0	0	1	X	X	H	MUTE	—	H
12	0	0	1	1	1	0	H	H	L	L+ 550 Hz Notch
13	0	0	1	1	1	1	H	H	L	L+ 1800 Hz Notch
14	0	0	1	0	1	0	L	L	H	H+ WCL EQ
15	0	0	1	0	1	1	—	TXC IN	—	RXC IN
16	0	0	0	1	1	X	H	MUTE	—	H+ WCL EQ
17	0	0	0	0	1	0	L	MUTE	—	L+ 550 Hz Notch
18	0	0	0	0	1	1	L	MUTE	—	L+ 1800 Hz Notch

**Note:** MUTE means no signal present on transmitter output.

L refers to low band filter with center frequency of 1200 Hz.

H refers to high band filter with center frequency of 2400 Hz.

— means no filter connection.

+ means connection to both filters.

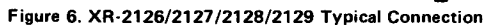
X means "don't care" condition.

N refers to Notch

Mode 15 is filter bypass mode where low band and high band filters are bypassed to monitor status of phone line.

WCL EQ is the Worst Case Line equalizer.

1. The first step is to identify the problem. This involves understanding the current situation and what needs to be achieved.





## DESCRIPTIONS OF INPUTS AND OUTPUTS

### VSS

VSS (pin 2) is the negative supply line to the IC. In most modern applications this will be  $-5\text{ V}$ .

### RXC IN

RXC IN (pin 3) is the filter input for the received signal. This signal may be taken directly from the secondary side of the DAA isolation transformer, or may pass through a gain/anti-aliasing stage.

### ROUT, R(−IN), R (+IN)

ROUT (pin 5), R(−IN) (pin 6), and R(+ IN) (pin 7) are respectively the output, inverting input, and non-inverting input of an additional onboard op amp. Figure 6 shows this op amp with gain setting resistors  $R_1$  and  $R_2$ . This amplifier may also be used in an anti-aliasing filter. The cut off frequency is chosen to be approximately  $\frac{1}{4}$  of the sampling frequency.

### VDD

VDD (pin 8) is the positive supply line to the IC. In most modern applications, this will be  $5\text{ V DC}$ .

### AGND

AGND (pin 10) is the analog ground line of the IC. It should be connected to all other analog circuitry in a system design.

### MODE

MODE (pin 11) sets the mode of operation for the filters. The filters consist of a high band filter with a center frequency at  $2400\text{ Hz}$  and a low band filter with a center frequency at  $1200\text{ Hz}$ . MODE is used to place the proper filter ( $2400\text{ Hz}$  or  $1200\text{ Hz}$  center frequency) in the proper signal path (transmit or receive). Answer mode (MODE logic 1), places the low band filter in the receive path and the high band filter is the transmit path. Originate mode (MODE logic 0) places the high band filter in the receive path and the low band filter in the transmit path.

### TXC OUT

TXC OUT (pin 15 for XR-2126/2127/2128 and pin 16 for XR-2129) provides the smoothed transmit signal output. This is typically taken through a  $1\text{ }\mu\text{F}$  capacitor and into the secondary of an isolation transformer which represents a  $1200\text{ }\Omega$  load.

### NSEL

NSEL (pin 17) is used to select one of two notch filters which are available for CCITT V.22 mode filtering. A logic 0 on NSEL selects the  $550\text{ Hz}$  filter while a logic 1 on NSEL selects the  $1800\text{ Hz}$  filter. Both notch filters are in the low band path and are used to attenuate the feed-through of the transmitted guard tone through the transformer and into the Answer modem's received carrier input to a level much lower than the received carrier. (See Figures 4 and 5.)

### TXC IN

TXC IN (pin 18) is the filter input for the transmitted signal.

This signal may be taken directly from TXC OUT (pin 4) of the XR-2121 Bell 212A Type Modulator.

### T(OUT), T(+ IN), T(−IN)

T(OUT) (pin 19), T(+ IN) (pin 20), and T(− IN) (pin 21) are respectively the output, non-inverting input, and inverting input of an additional onboard op amp. Figure 6 shows this op amp with gain setting resistors  $R_3$  and  $R_4$ . This op amp may also be used in an anti-aliasing filter. This cut off frequency is chosen to be approximately  $\frac{1}{4}$  of the sampling frequency.

### DGND

DGND (pin 23) is the digital ground line of the IC. It should be connected, single point, to all other digital circuitry in a system design.

### RXC OUT

RXC OUT (pin 24) provides the smoothed received signal output. This is typically taken through a  $1\text{ }\mu\text{F}$  capacitor to the AGC circuit and CD IN of the XR-2122 Bell 212A Demodulator.

## XR-2126

The XR-2126 has four features in addition to those common to the other members of this filter family. They are CLK 1, SEL 1, NFO, and CLK 2.

### CLK 1

CLK 1 (pin 4) is one of two clock inputs for the XR-2126. Either clock input may be used (CLK 1 or CLK 2). CLK 1 will accept either a  $2.4576\text{ MHz}$  input or a  $1.2288\text{ MHz}$  input, depending on the state (logic 1 or logic 0 respectively) of SEL 1.

### SEL 1

SEL 1 (pin 9) selects either the  $2.4576\text{ MHz}$  clock or the  $1.2288\text{ MHz}$  clock for input on pin 4, CLK 1.

### NFO

NFO (pin 16) is the notch filter output.

### CLK 2

CLK 2 (pin 22) takes a  $153.6\text{ KHz}$  TTL or CMOS clock input.

## XR-2127

The XR-2127 has five functions in addition to those common to the other members of this filter family. They are CLK 1, SEL 1, ALB, NFO, and CLK 2.

### CLK 1

CLK 1 (pin 4) is one of two clock inputs for the XR-2127. Either clock input may be used (CLK 1 or CLK 2). CLK 1 will accept either a 2.4576 MHz input or a 1.2288 MHz input, depending on the state (logic 1 or logic 0 respectively) of SEL 1.

### SEL 1

SEL 1 (pin 9) selects either the 2.4576 MHz clock or the 1.2288 MHz clock for input on pin 4, CLK 1.

### ALB

ALB (pin 14) selects the Analog Loop Back mode when logic 0. A logic 1 on ALB allows normal operation.

### NFO

NFO (pin 16) is the notch filter output.

### CLK 2

CLK 2 (pin 22) takes a 153.6 KHz TTL or CMOS clock input.

## XR-2128

The XR-2128 has seven functions in addition to those common to the other members of this filter family. They are CLK 1, SEL 1, CPM, NFI, ALB, NFO, CLK 2.

### CLK 1

CLK 1 (pin 4) is one of two clock inputs for the XR-2128. Either clock input may be used (CLK 1 or CLK 2). CLK 1 will accept either a 2.4576 MHz input or a 1.2288 MHz input, depending on the state (high or low respectively) of SEL 1.

### SEL 1

SEL 1 (pin 9) selects either the 2.4576 MHz clock or the 1.2288 MHz clock for input on pin 4, CLK 1.

### CPM

CPM (pin 12) selects normal low band filter operation and divides by 2.5 for Call Progress Monitoring use. Logic is TTL with a logic 0 for normal low band operation and a logic 1 for low band divided by 2.5 for enhanced Call Progress Monitoring.

### NFI

NFI (pin 13) selects the low band filter path. With NFI logic 1, the notch filter (550 Hz or 1800 Hz) selected by NSEL (pin 17) is inserted in the low band filter signal path. With NFI logic 0, the signal bypasses the notch filters.

### ALB

ALB (pin 14) selects the Analog Loop Back mode when logic 0. A high on ALB allows normal operation.

### NFO

NFO (pin 16) is the notch filter output.

### CLK 2

CLK 2 (pin 22) takes a 153.6 KHz TTL or CMOS clock.

## XR-2129

The XR-2129 is designed specifically for use with the XR-212AS chip set (XR-2125, XR-2121, and XR-2122 excluding the XR-2120). This part requires no division of the 1.8432 MHz clock oscillator frequency. A 1.8432 MHz crystal is connected between XTAL IN and XTAL OUT (pins 13 and 14 respectively). Figure 7 shows the XR-212AS chip set using the XR-2129 in place of the XR-2120 to complete the Bell 212A Modem Signal Processor.

The XR-2129 has six functions in addition to those common to the other members of this filter family. They are ALB, CPM, XTAL IN, XTAL OUT, CLK OUT, NFI.

### ALB

ALB (pin 9) selects the Analog Loop Back mode when logic 0. A logic 1 on ALB allows normal operation.

### CPM

CPM (pin 12) is used to select either normal low band operation ( $f_o = 1200$  Hz) or low band divided by 2.5 ( $f_o = 480$  Hz). Logic is TTL with a logic 0 for normal low band operation and a logic 1 for low band divided by 2.5 for Call Progress Monitoring.

### XTAL IN, XTAL OUT

XTAL IN (pin 13) and XTAL OUT (pin 14) are the oscillator nodes across which a 1.8432 MHz crystal must be connected for operation. This 1.8432 MHz crystal is the same frequency crystal required for operation of the XR-2121, XR-2122, and XR-2125. The buffered output from this onboard oscillator is available from CLK OUT (pin 15). XTAL OUT (pin 14) offers the unbuffered oscillator output.

### CLK OUT

CLK OUT (pin 15) provides the buffered output from the onboard oscillator. It can be used to drive other circuitry requiring a 1.8432 MHz clock.

### NFI

NFI (pin 22) selects the low band filter path. With NFI logic 1, the notch filter (550 Hz or 1800 Hz) selected by NSEL (pin 17), is inserted in the low band filter signal path. With NFI logic 0, the notch filters are bypassed by the signal.

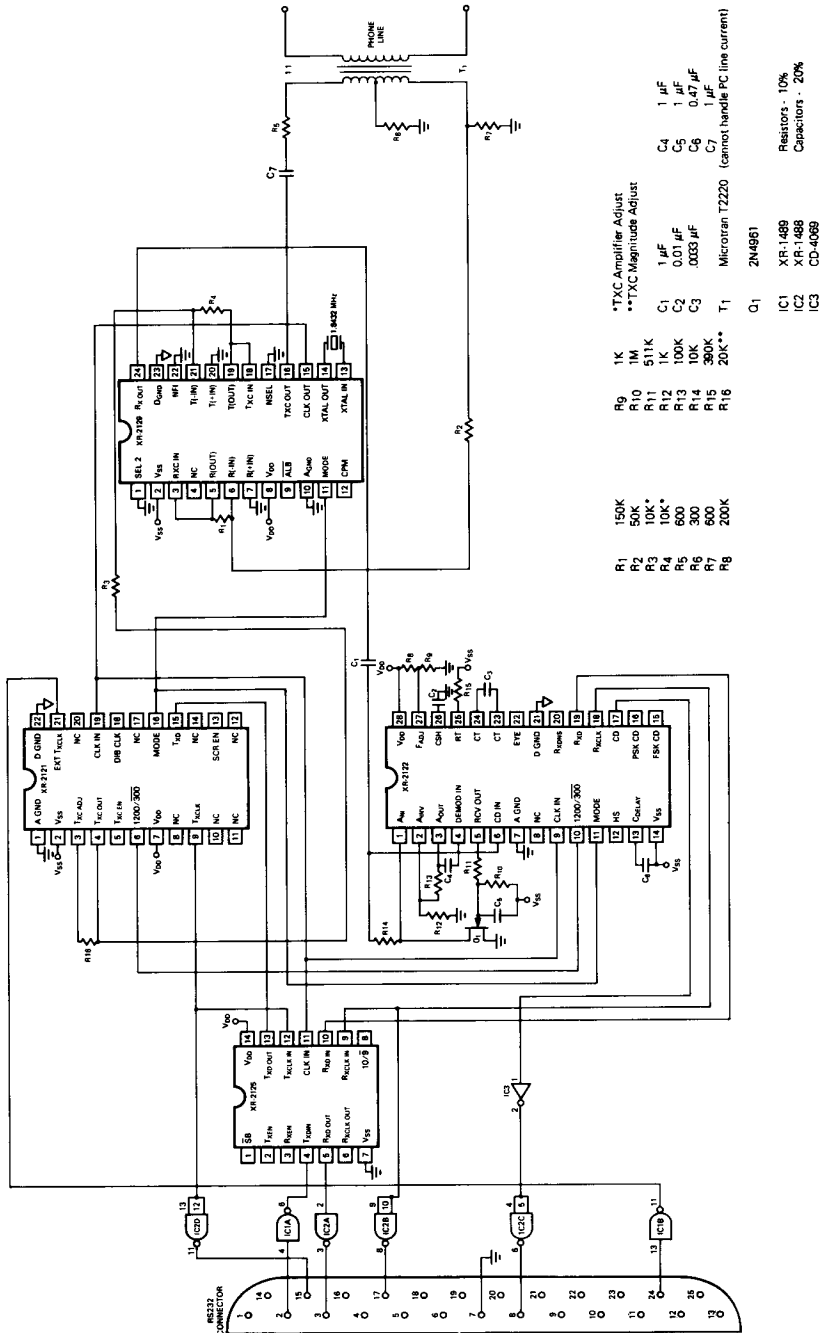


Figure 7. XR-212AS Bell 212A Modem Utilizing the XR-2129 Modem Filter