

## V.21 Modem

### GENERAL DESCRIPTION

The XR-2100 is designed to provide the CCITT V.21 modem function. Complete circuitry is included for this 300 BPS FSK full duplex operation.

The XR-2100 can be used as a stand-alone modem under control of a standard microcontroller such as the 8031. Bus structured control interfaces have been implemented for direct microcontroller connection. The XR-2100 may also be programmed for serial control.

The XR-2100 can also be used to provide V.21 operation for other higher speed Exar modem chips such as the XR-2400 and XR-2900 chip sets for V.29/V.27ter/V.22 bis/V.22/212A applications. The XR-2100 ties directly to the same control bus and line interface circuitry as the XR-2400 chip set.

The XR-2100 is constructed in silicon gate CMOS technology for low power operation. Available in a 20 pin dip (0.3" width) and PLCC package, the XR-2100 operates from  $\pm 5$  volt power supplies.

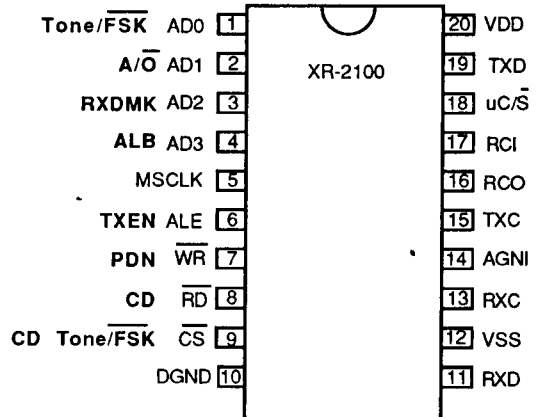
### FEATURES

- CCITT V.21 operation
- 300 BPS FSK, full duplex
- Universal microcontroller or serial interface
- Direct connection to:
  - XR-2900/XR-2400, V.29/V.27ter/V.22bis/V.22/212A
- Low power CMOS (100 mW TYP)
- Analog loopback
- Generator and detector for answer and calling tones
- Power down mode

### ABSOLUTE MAXIMUM RATINGS

Power Supply		
VDD	-0.3 to 7V	
VSS	0.3 to -7V	
Input Voltage	VSS -0.3V to VDD +0.3V	
DC Input Current	+10mA	
Power Dissipation (Package Limitation)		
Plastic Dip		1W
Derate Above 25°C		
Plastic Dip		5mW/°C
Storage Temperature Range	-65°C to +150°C	

### PIN ASSIGNMENT



**Bold type indicates uC/STD = 0**

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

### ORDERING INFORMATION

Part number	Package	Operating Temperature
XR-2100CP	Plastic	0°C to 70°C
XR-2100CJ	PLCC	0°C to 70°C

### APPLICATIONS

- Stand-alone V.21 Modem
- V.21 Mode for 1200/2400 BPS Systems
- Internal Type Modem

### SYSTEM DESCRIPTION

The XR-2100, when connected to a microcontroller and line interface circuit, forms a complete CCITT V.21 300 BPS modem. Utilizing a universal bus interface, the XR-2100 can be used as a stand-alone modem or for providing the V.21 to existing modem chip sets such as the XR-2400 and XR-2900 modems.

# XR-2100

## ELECTRICAL CHARACTERISTICS

Test Conditions:  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 5V \pm 5\%$ ,  $V_{SS} = -5V \pm 5\%$ ,  $MS_{CLK} = 11.0592\text{ MHz} \pm 0.05\%$  unless otherwise specified.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
$I_{DD}$	Positive Supply Current		11		mA	Guaranteed but not tested.
	Power Down Mode		7		mA	
$I_{SS}$	Negative Supply Current		11		mA	Guaranteed but not tested.
	Power Down Mode		7		mA	
$V_{IH}$	High Level Input Voltage	2.0			V	$V_{OH} = 2.4\text{ V}$  $V_I = 0\text{ to }V_{DD}$
$V_{IL}$	Low Level Input Voltage			0.8	V	
$I_{OH}$	High Level Output Current			300	$\mu\text{A}$	
$I_{OL}$	Low Level Output Current			2	mA	
$I_I$	Input Current			50	$\mu\text{A}$	
$V_{OCAR}$	Transmit Carrier Output	+6.5	7	8.2	dBm	FSK Carrier calling or ANS Tone, calling tone
$V_{CAR\text{ RING}}$	Input Carrier Range	+5.7	7	8.2	dBm	
CD off CD on CD HYS	Carrier Detect Hysteresis	-49	-48	-47	dBm	FSK
		-43	-43	-41	dBm	FSK
		2	6	20	dB	FSK,
S/N	Signal-to-noise Ratio		7		dB	ANS/ORIG $R_{XC} = -40\text{ dBM}$ $T_{XC} = -10\text{ dBM}$ C0, C2, or B/B line conditions $BER \leq 1/10\text{-}5$ ORIG mode ANS mode
BIAS DIST	Bias Distortion		4 5		% %	
$f_{AMARK}$	Mark Frequency Answer		1650		Hz	
$f_{ASPACE}$	Space Frequency Answer		1850		Hz	
$f_{oMARK}$	Mark Frequency Originate		980		Hz	
$f_{oSPACE}$	Space Frequency Originate		1180		Hz	
$f_{ANS}$	Answer Tone Frequency		2100		Hz	

Carrier Frequencies fMSCLK - 11.0592 MHz

Desired (Hz)	Actual (Hz)	Error (Hz)
980	978.34	-1.66
1180	1181.54	+1.54
1650	1651.61	+1.61
1850	1850.60	+0.60
1300	1301.69	+1.69
2100	2104.11	+4.11

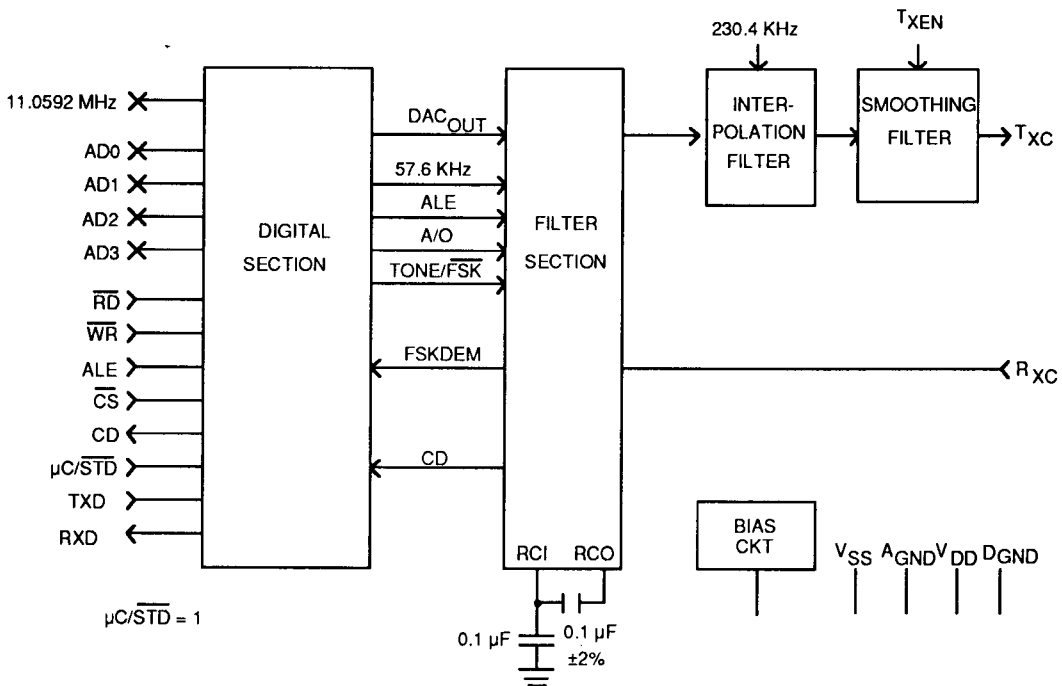
**Table 1. Frequency Accuracy**

Mode	Transmit Frequency (Hz)		Receive Frequency (Hz)	
	Mark	Space	Mark	Space
Originate	980	1180	1650	1850
Answer	1650	1850	980	1180

3

**Table 2. CCITT V.21 Frequency Parameters**

CCITT V.25 Answer  
Tone: 2100 Hz



**System Block Diagram For XR-2100**

# XR-2100

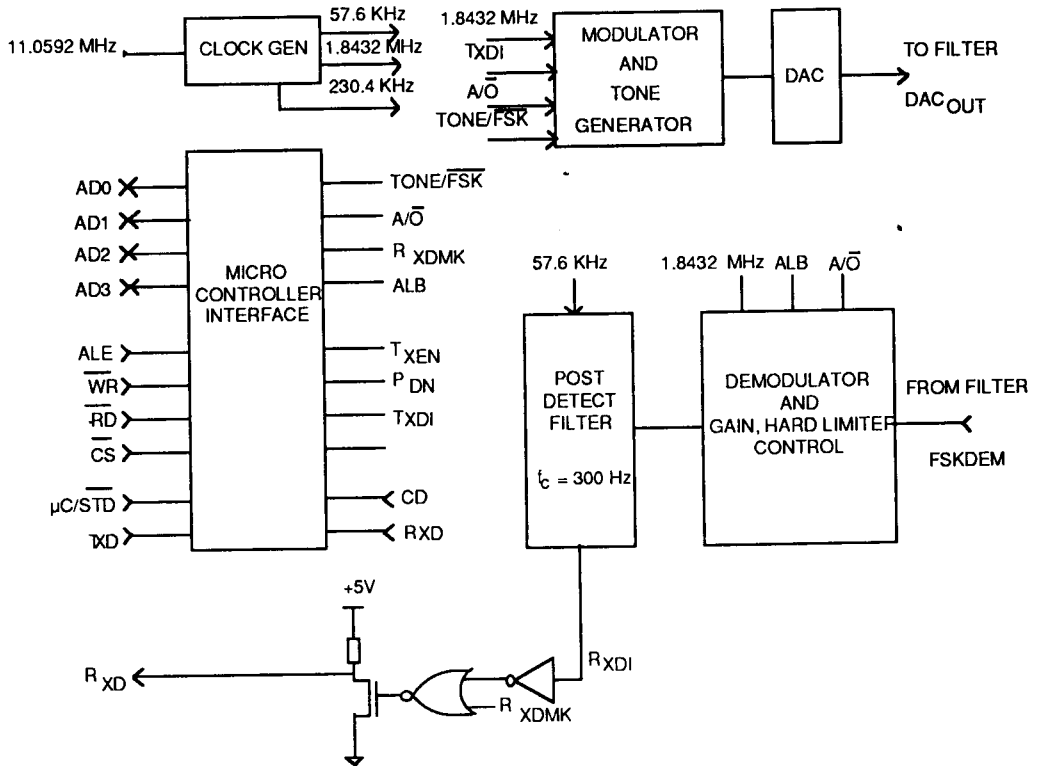
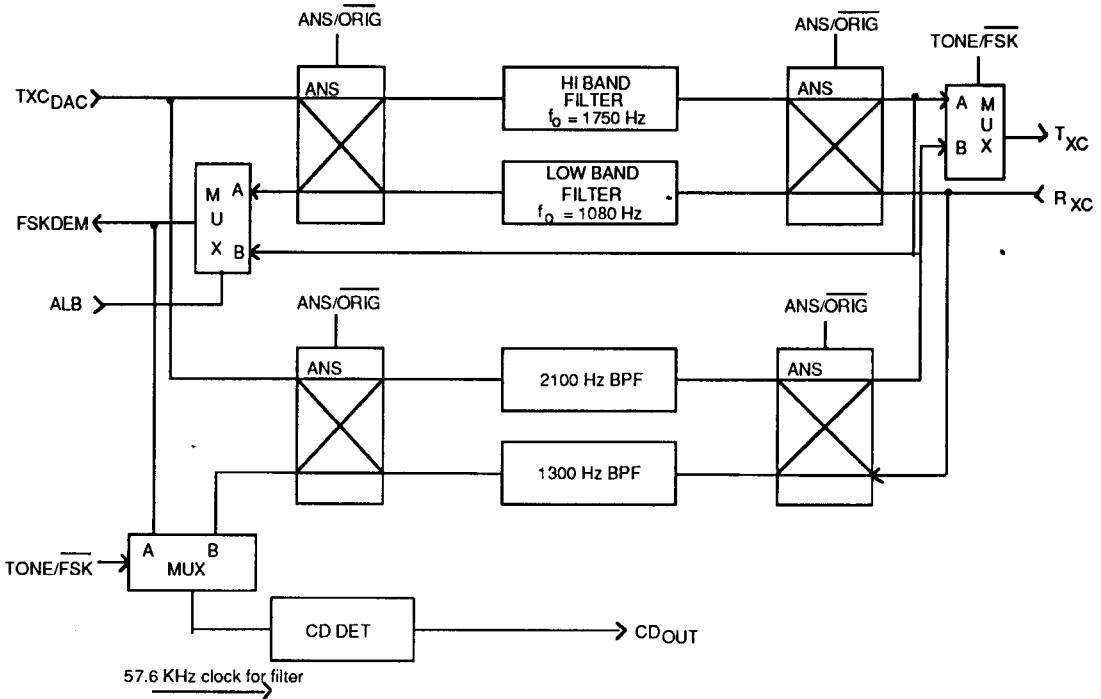


Figure 1. Digital Section Block Diagram For XR-2100



3

Figure 2. Block Diagram of XR-2100 Filter Section

# XR-2100

## PIN DESCRIPTIONS

Name	Pin #	I/O	Description	Name	Pin #	I/O	Description
AD0 (Tone/ $\overline{\text{FSK}}$ )	1	I/O	Address/data bus bit 0 for $\mu\text{C}$ . Select tone or FSK mode for stand-alone (Tone = 1, FSK = 0).	DGND	10	I	Digital ground. This pin should be routed separate to the AGND to the power supply.
AD1 ( $\overline{\text{A/O}}$ )	2	I/O	Address/data bus bit 1 for $\mu\text{C}$ . Mode select for stand-alone (ANS = 1, Orig = 0).	R <sub>X</sub> D	11	O	Receive data output from the demodulator output (1 = mark, 0 = space).
AD2 (R <sub>X</sub> DMK)	3	I/O	Address/data bus bit 2 for $\mu\text{C}$ . R <sub>X</sub> D control for stand-alone (R <sub>X</sub> D clamped to mark = 1, R <sub>X</sub> D from DEMOD = 0).	V <sub>SS</sub>	12	I	Negative power supply, -5V $\pm$ 5%. A 0.1 $\mu\text{F}$ ceramic bypass capacitor should be placed near the device.
AD3 (ALB)	4	I/O	Address/data bus bit 3 for ALB control for stand-alone (ALB = 1, normal receive = 0).	R <sub>X</sub> C	13	I	Analog receive carrier input.
MSCLK	5	I	Master clock input of 11.0592 MHz.	AGND	14	I	Analog ground. This pin should be routed separate to the DGND to the power supply.
ALE (T <sub>X</sub> EN)	6	I	Address latch enable for $\mu\text{C}$ . Transmit carrier control for stand-alone (1 = enable, 0 = disable).	T <sub>X</sub> C	15	O	Analog transmit carrier output.
$\overline{\text{WR}}$ (P <sub>DN</sub> )	7	I	Write enable 'or' for $\mu\text{C}$ . Power down control for stand-alone (1 = power down, 0 = normal operation).	R <sub>CO</sub>	16	O	Receive filter output. Connected to the R <sub>CI</sub> through a 0.1 $\mu\text{F}$ capacitor.
$\overline{\text{RD}}$ (CD)	8	I/O	Read enable 'not' for $\mu\text{C}$ . Carrier detect status for stand-alone.	R <sub>CI</sub>	17	I	Demod input. Connected to R <sub>CO</sub> through a 0.1 $\mu\text{F}$ capacitor.
$\overline{\text{CS}}$ (CD Tone/ $\overline{\text{FSK}}$ ) stand-	9	I	Chip select 'not' for $\mu\text{C}$ . Energy output control alone. (1 = Tone Energy, 0 = FSK Energy)	$\mu\text{C}/\overline{\text{STD}}$	18	I	Control input for selecting $\mu\text{C}$ or stand-alone interface. (1 = $\mu\text{C}$ , 0 = stand-alone).
				T <sub>X</sub> D	19	I	Transmit data input (1 = mark, 0 = space).
				V <sub>DD</sub>	20	I	Positive power supply voltage, +5V $\pm$ 5%. A 0.1 $\mu\text{F}$ bypass capacitor should be placed near this pin.

## CONTROL REGISTERS

With  $\mu\text{C}/\overline{\text{STD}} = 1$  ( $\mu\text{C}$  interface selected)

ADDRESS BITS				DATA BITS			
AD3	AD2	AD1	AD0	Bit 3	Bit 2	Bit 1	Bit 0
$\overline{\text{WR}} = 0$							
1	0	0	0	ALB	RXDMK	$\overline{\text{A/O}}$	Tone/ $\overline{\text{FSK}}$
1	0	0	1	CD Tone/ $\overline{\text{FSK}}$	-	PDN	TXEN
$\overline{\text{RD}} = 0$							
1	0	0	0	-	-	CD	RXD

Table 3.  $\mu\text{C}$  Control Bit Assignments

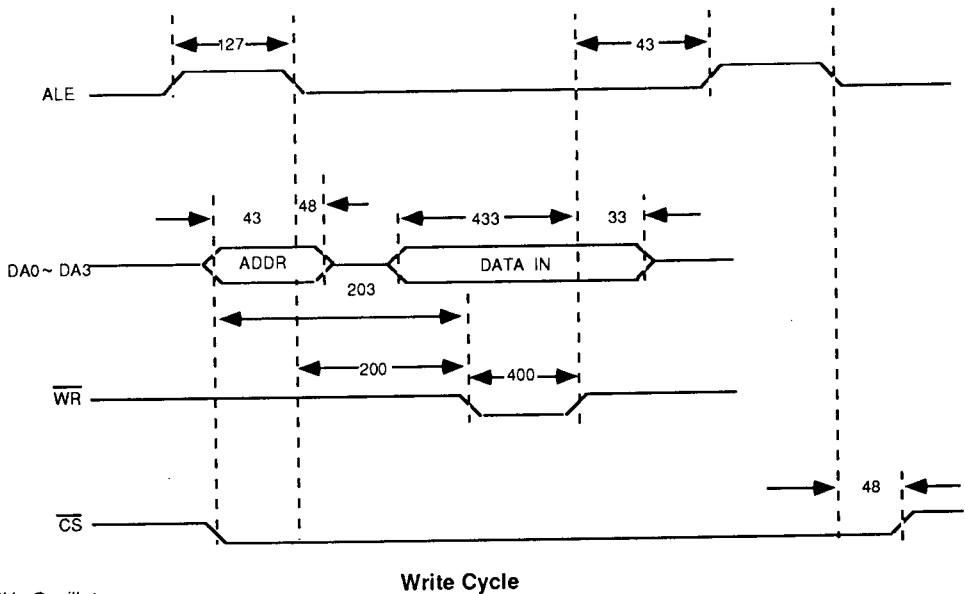
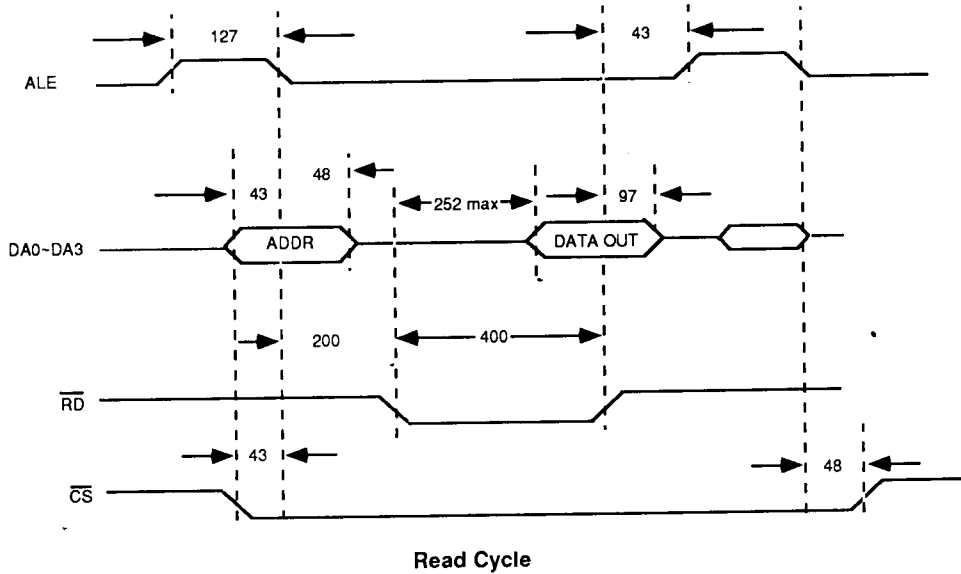
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## STAND-ALONE MODE SELECTIONS

With  $\mu\text{C}/\overline{\text{STD}} = 0$  (Stand-alone mode selected).

Mode	I/O State	Mode Descriptions	Mode	I/O State	Mode Descriptions
$\overline{\text{Tone/FSK}}$	1	Answer or calling tone, 2100 Hz for $\overline{\text{A/O}} = 1$ and 1300 Hz for $\overline{\text{A/O}} = 0$ .	TXEN	1	TXC is enabled.
	0	FSK mode, 980 Hz/1180 Hz for mark/space in ORIG and 1650 Hz/1850 Hz for mark/space in ANS.		0	TXC is disabled.
$\overline{\text{A/O}}$	1	Answer mode.	PDN	1	Power down mode
	0	Originate mode.		0	Normal operation.
RXDMK	1	RXD is clamped to mark.	CD	1	CD is on.
	0	RXD is demod output.		0	CD is off.
ALB	1	ALB	CD depends on the mode selected, it can be: <ul style="list-style-type: none"> <li>. Normal receive HI band: FSK Orig.</li> <li>. Normal receive LO band: FSK Ans.</li> <li>. Ans Tone Detect: Tone Orig.</li> <li>. Calling Tone Detect: Tone Ans.</li> </ul>		

# XR-2100



Note: 12 MHz Oscillator  
 All units in nanoseconds (minimum),  
 unless otherwise specified.

**Figure 3. Read/Write Timing Waveforms for XR-2100 Using 8031/51 Controller**



## APPLICATIONS INFORMATION

Figures 4 and 5 illustrate the XR-2100 used in various applications. In each, several precautions should be followed in order to ensure optimum performance.

- 1) Analog (AGND) and digital (DGND) grounds should be routed separately to the power supply. They should be single point connected at the supply. This will minimize higher digital currents from interfering with more sensitive analog sections.
- 2) The power supply pins should be bypassed with 0.1  $\mu$ F ceramic capacitors close to the IC.

Figure 4 shows the XR-2100 used in a stand-alone configuration as selected by  $\mu$ C/STD = 0. The various modes of operation are selected by switches S1-S7.

The XR-2100 is shown in the XR-2400 schematic to provide the V.21 operation for a V.22 bis (2400BPS) modem. Here the XR-2401/XR-2402 chips support V.22 bis, V.22 and Bell 212A modes. The control for both the XR-2100 and XR-2401/XR-2402 come from the XR-2403B microcontroller. User-specified firmware can be added to drive the XR-2100.

Should your future application require combined V.21 and V.23 communications, the design shown in Figure 5 can be easily retrofitted with the pin-compatible XR-2321. By a simple drop-in replacement and one jumper modification, the resulting solution will support all four CCITT Standards (V.22bis, V.22, V.23 and V.21) providing "Quad" modem capabilities.

