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-2400and 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 ±5 volt power supplies.

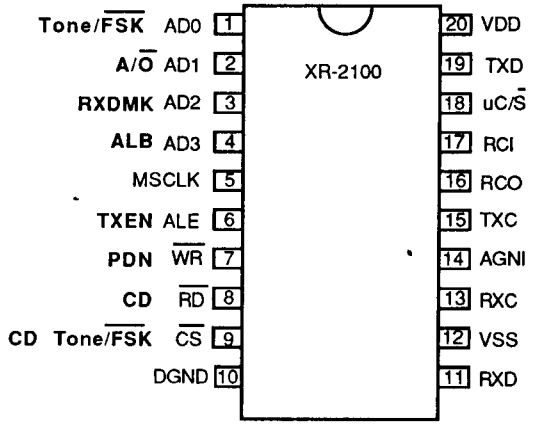
FEATURES

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
InputVoltage	VSS -0.3V to VDD +0.3V
DC Input Current	+10mA
Power Dissipation (Package Limitation)	
Plastic Dip	1W
Derate Above 25°C	
Plastc 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 umber	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.

ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
I_{DD}	Positive Supply Current		11		mA	
	Power Down Mode		7		mA	Guaranteed but not tested.
I_{SS}	Negative Supply Current		11		mA	
	Power Down Mode		7		mA	Guaranteed but not tested.
V_{IH}	High Level Input Voltage	2.0			V	
V_{IL}	Low Level Input Voltage			0.8	V	
I_{OH}	High Level Output Current			300	µA	V_{OH} = 2.4 V
I_{OL}	Low Level Output Current			2	mA	
I_I	Input Current			50	µA	V1 = 0 to V_{DD}
VO_{CAR}	Transmit Carrier Output	+6.5	7	8.2	dBm	FSK Carrier calling or
		+5.7	7	8.2		ANS Tone, calling tone
$V_{CAR\ RNG}$	Input Carrier Range	-43		-10	dBm	ANS, ORIG mode.
CD off		-49	-48	-47	dBm	FSK
CD on		-43	-43	-41	dBm	FSK
CD HYS	Carrier Detect Hysteresis	2	6	20	dB	FSK,
S/N	Signal-to-noise Ratio		7		dB	ANS/ORIG R_{XC} = -40 dBM T_{XC} = -10 dBM C0, C2, or B/B line conditions BER≤1/10-5
BIAS DIST	Bias Distortion		4		%	ORIG mode
			5		%	ANS mode
f_{AMARK}	Mark Frequency Answer		1650		Hz	
f_{ASPACE}	Space Frequency Answer		1850		Hz	
fo_{MARK}	Mark Frequency Originate		980		Hz	
foSPACE	Space Frequency Originate		1180		Hz	
fANS	Answer Tone Frequency		2100		Hz	

Carrier Frequencies fMSCLK - 11.0592 MHz

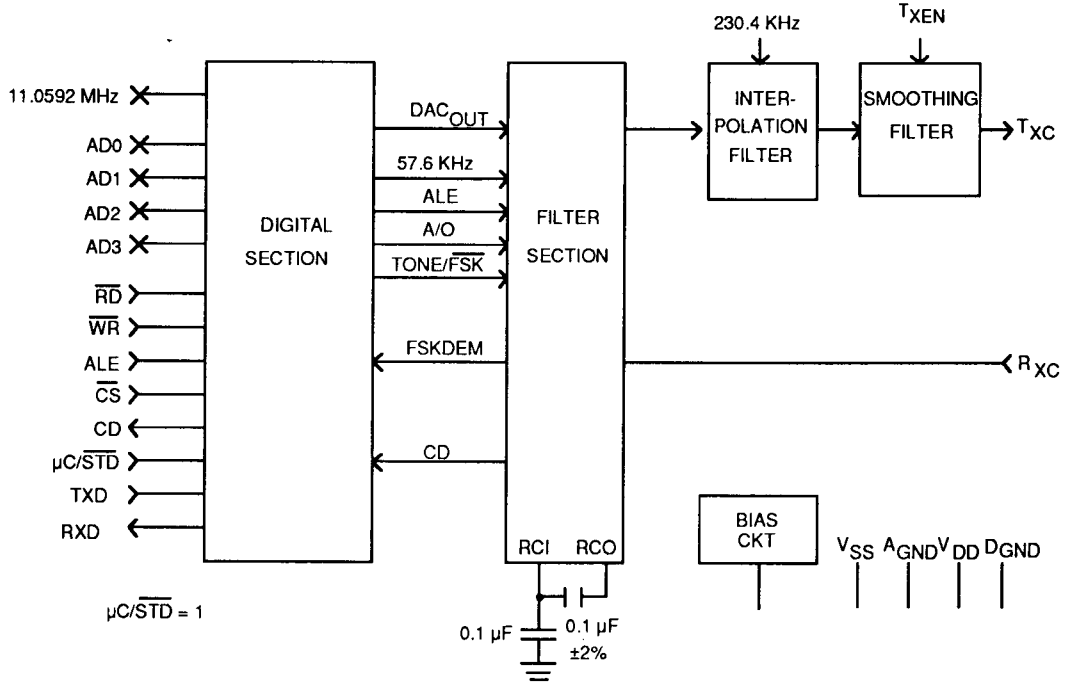
Desired (Hz)	Actual (Hz)	Error (Hz)
980	978.34	-1.66
1180	1181.54	+1.54
1650	1651.61	+1.61
1850	1850.60	+0.60
1300	1301.69	+1.69
2100	2104.11	+4.11

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

Table 2. CCITT V.21 Frequency Parameters

CCITT V.25 Answer
Tone: 2100 Hz



System Block Diagram For XR-2100

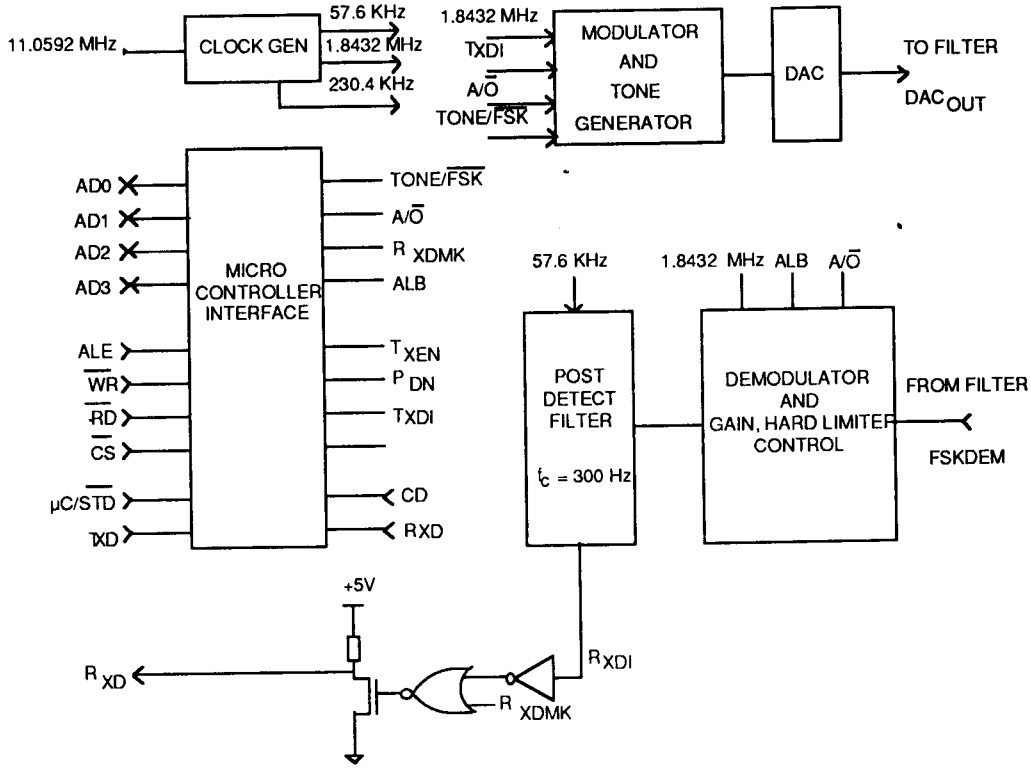


Figure 1. Digital Section Block Diagram For XR-2100

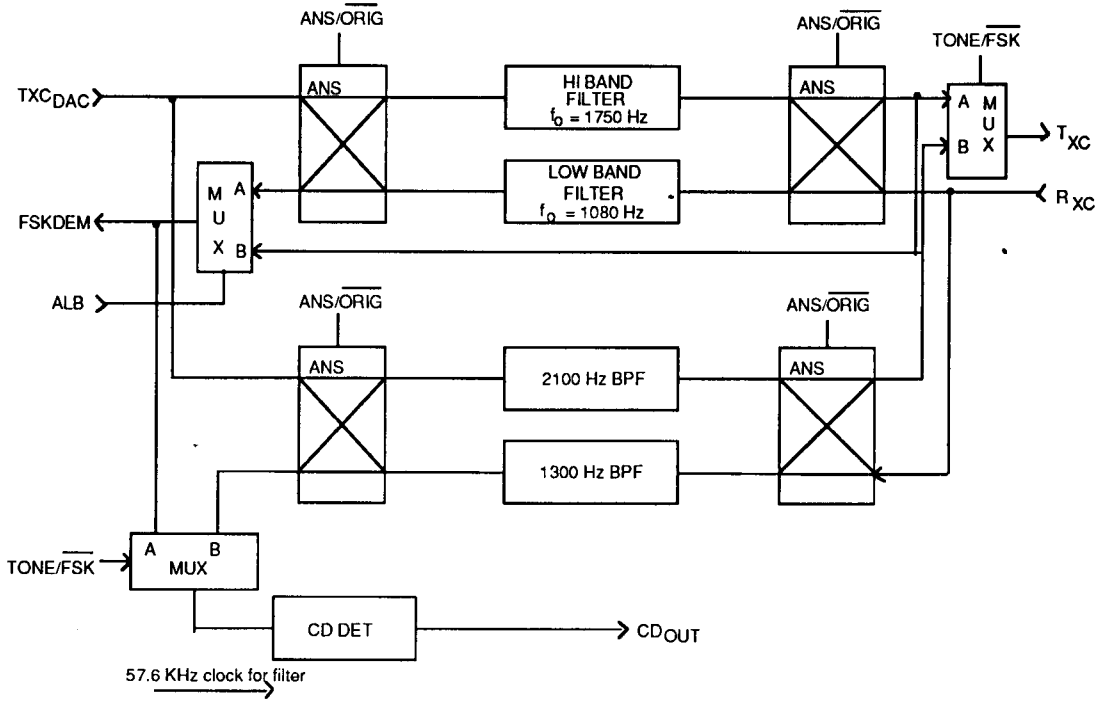


Figure 2. Block Diagram of XR-2100 Filter Section

PIN DESCRIPTIONS

Name	Pin #	I/O	Description
AD0 (Tone/$\overline{FSK}$)	1	I/O	Address/data bus bit 0 for µC. Select tone or FSK mode for stand-alone (Tone = 1, FSK = 0).
AD1 (A/$\overline{O}$)	2	I/O	Address/data bus bit 1 for µC. Mode select for stand-alone (ANS = 1, Orig = 0).
AD2 (RX_{DMK})	3	I/O	Address/data bus bit 2 for µC. R_{XD} control for stand-alone (R_{XD} clamped to mark = 1, R_{XD} from DEMOD = 0).
AD3 (ALB)	4	I/O	Address/data bus bit 3 for ALB control for stand-alone (ALB = 1, normal receive = 0).
MSCLK	5	I	Master clock input of 11.0592 MHz.
ALE (T_{XEN})	6	I	Address latch enable for µC. Transmit carrier control for stand-alone (1 = enable0 = disable).
$\overline{WR}$ (P_{DN})	7	I	Write enable 'or" for µC. Power down control for stand-alone (1 = power down, 0 = normal operation).
$\overline{RD}$ (CD)	8	I/O	Read enable 'not' for µC. Carrier detect status for stand-alone.
$\overline{CS}$ (CD Tone/$\overline{FSK}$) stand-	9	I	Chip select 'not' for µC. Energy output control alone. (1 = Tone Energy, 0 = FSK Energy)
DGND	10	I	Digital ground. This pin should be routed separate to the AGND to the power supply.
R_{XD}	11	O	Receive data output from the demodulator output (1 = mark, 0 = space).
V_{SS}	12	I	Negative power supply, -5V ±5%. A 0.1uF ceramic bypass capacitor should be placed near the device.
R_{XC}	13	I	Analog recieve carrier input.
AGND	14	I	Analog ground. This pin should be routed separate to the DGND to the power supply.
T_{XC}	15	O	Analog transmit carrier output.
R_{CO}	16	O	Receive filter output. Connected to the R_{CI} through a 0.1 µF capacitor.
R_{CI}	17	I	Demod input. Connected to R_{CO} through a 0.1 µF capacitor
µC/$\overline{STD}$	18	I	Control input for selecting µC or stand-alone interface. (1 = µC, 0 = stand-alone).
T_{XD}	19	I	Transmit data input (1 = mark, 0 = space).
V_{DD}	20	I	Positive power supply voltage, +5V±5%. A 0.1 µF bypass capacitor should be placed near this pin.

CONTROL REGISTERS
With µC/$\overline{STD}$ = 1 (µC interface selected)

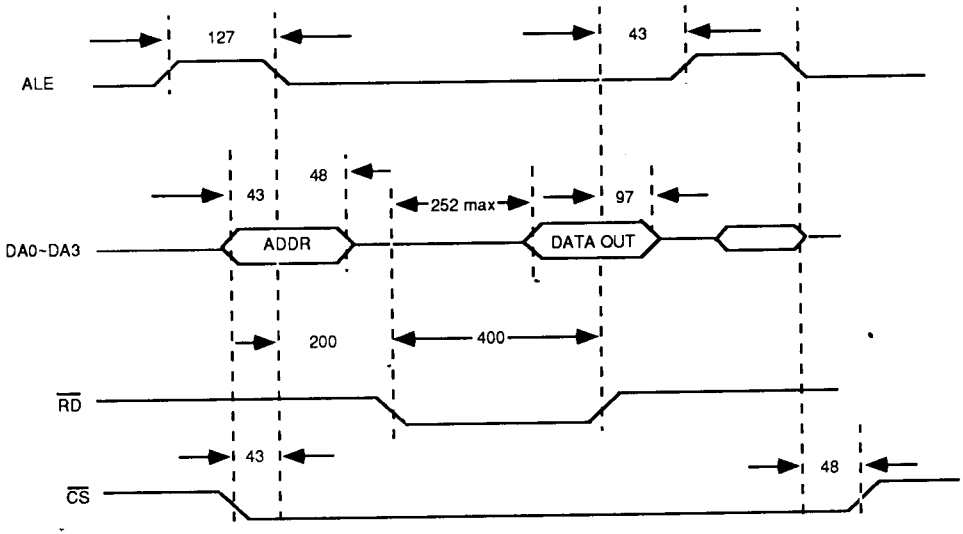
ADDRESS BITS				DATA BITS			
AD3	AD2	AD1	AD0	Bit 3	Bit 2	Bit 1	Bit 0
$\overline{WR}$ =0							
1	0	0	0	ALB	RXDMK	A/$\overline{O}$	Tone/$\overline{FSK}$
1	0	0	1	CD Tone/$\overline{FSK}$	-	PDN	TXEN
$\overline{RD}$ = 0							
1	0	0	0	-	-	CD	RXD

Table 3. µC Control Bit Assignments

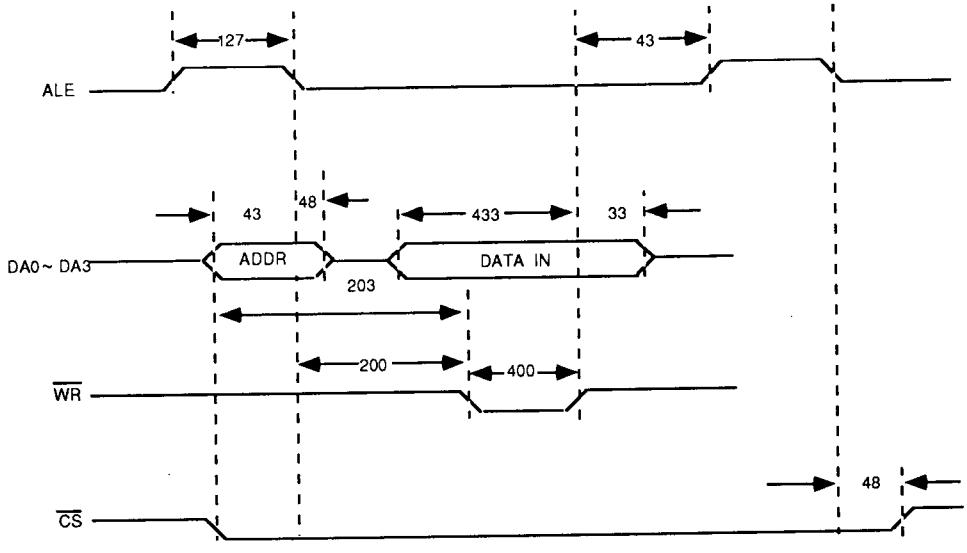
STAND-ALONE MODE SELECTIONS
With µC/$\overline{STD}$ = 0 (Stand-alone mode selected).

Mode	I/O State	Mode Descriptions
Tone/$\overline{FSK}$	1	Answer or calling tone, 2100 Hz for A/$\overline{O}$ = 1 and 1300 Hz for A/$\overline{O}$ = 0.
	0	FSK mode, 980 Hz/ 1180 HZ for mark/space in ORIG and 1650 Hz/ 1850 Hz for mark/space in ANS.
A/$\overline{O}$	1	Answer mode.
	0	Originate mode.
RXDMK	1	R_{XD} is clamped to mark.
	0	R_{XD} is demod output.
ALB	1	ALB

Mode	I/O State	Mode Descriptions
T_{XEN}	1	T_{XC} is enabled.
	0	T_{XC} is disabled.
P_{DN}	1	Power down mode
	0	Normal operation.
CD	1	CD is on.
	0	CD is off.
		CD depends on the mode selected, it can be: . Normal receive HI band: FSK Orig. . Normal receive LO band: FSK Ans. . Ans Tone Detect: Tone Orig. . Calling Tone Detect: Tone Ans.



Read Cycle



Write Cycle

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 µF ceramic capacitors close to the IC.

Figure 4 shows the XR-2100 used in a stand-alone configuration as selected by µC/$\overline{STD}$ = 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.

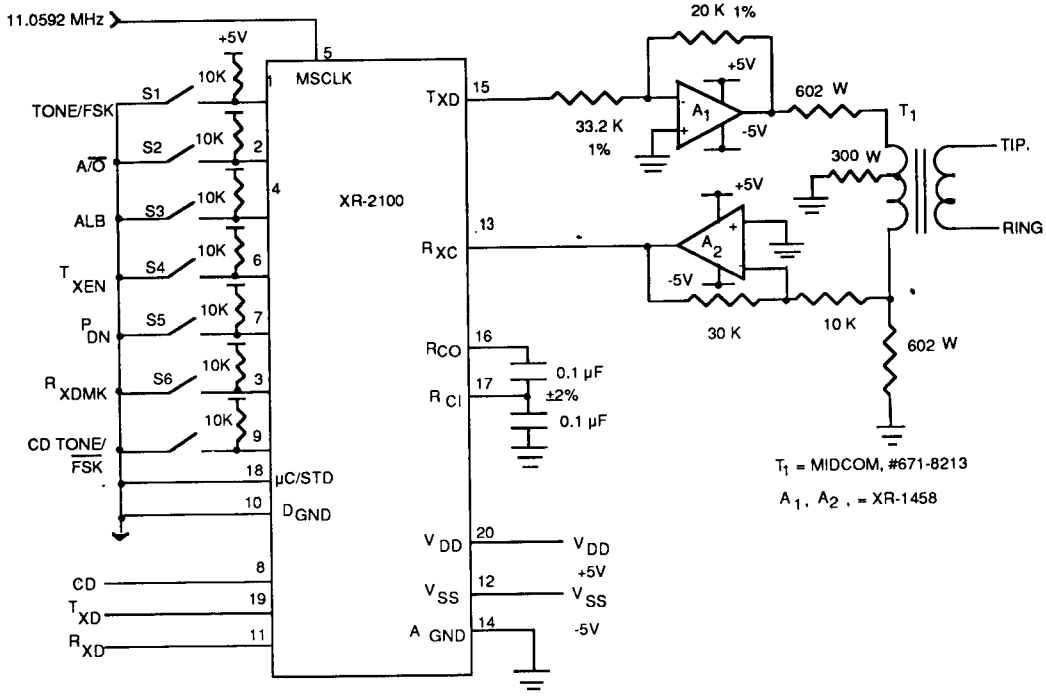


Figure 4. Standalone V.21 Modem With Serial Control