INSTRUCTION BOOK FOR MODEL 4380A-232

RS-232-C BUS COMPATIBLE INTERFACE UNIT

FOR USE WITH BIRD RF POWER ANALYST® WATTMETERS

Electronic Corporation

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SAFETY PRECAUTIONS

The following are general safety precautions that are not necessarily related to any specific part or procedure and do not necessarily appear elsewhere in this publication.

Keep away from live circuits.

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect a RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

The following will appear in the text of this publication and is shown here for emphasis.

CAUTION

The 4380A-232 contains MOS integrated circuits which may be damaged by static electricity. Open the housing only when sure that there are no static producing materials such as carpeting or styrofoam where the work is to be done. Work on a conductive, grounded work surface touching it frequently to discharge static from your body. If a part is to be stored or shipped, wrap it in conductive packaging materials designed for static sensitive circuitry.

WARNING

If removal of cover becomes necessary, unplug device. The potential of electrical shock exists.

CAUTION

The Model 4380A-232 complies with FCC regulations as a class A computing device under Part 15.J of the FCC rules. To maintain this compliance it is required to only use external cables supplied by Bird Electronic Corporation.

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INTRODUCTION

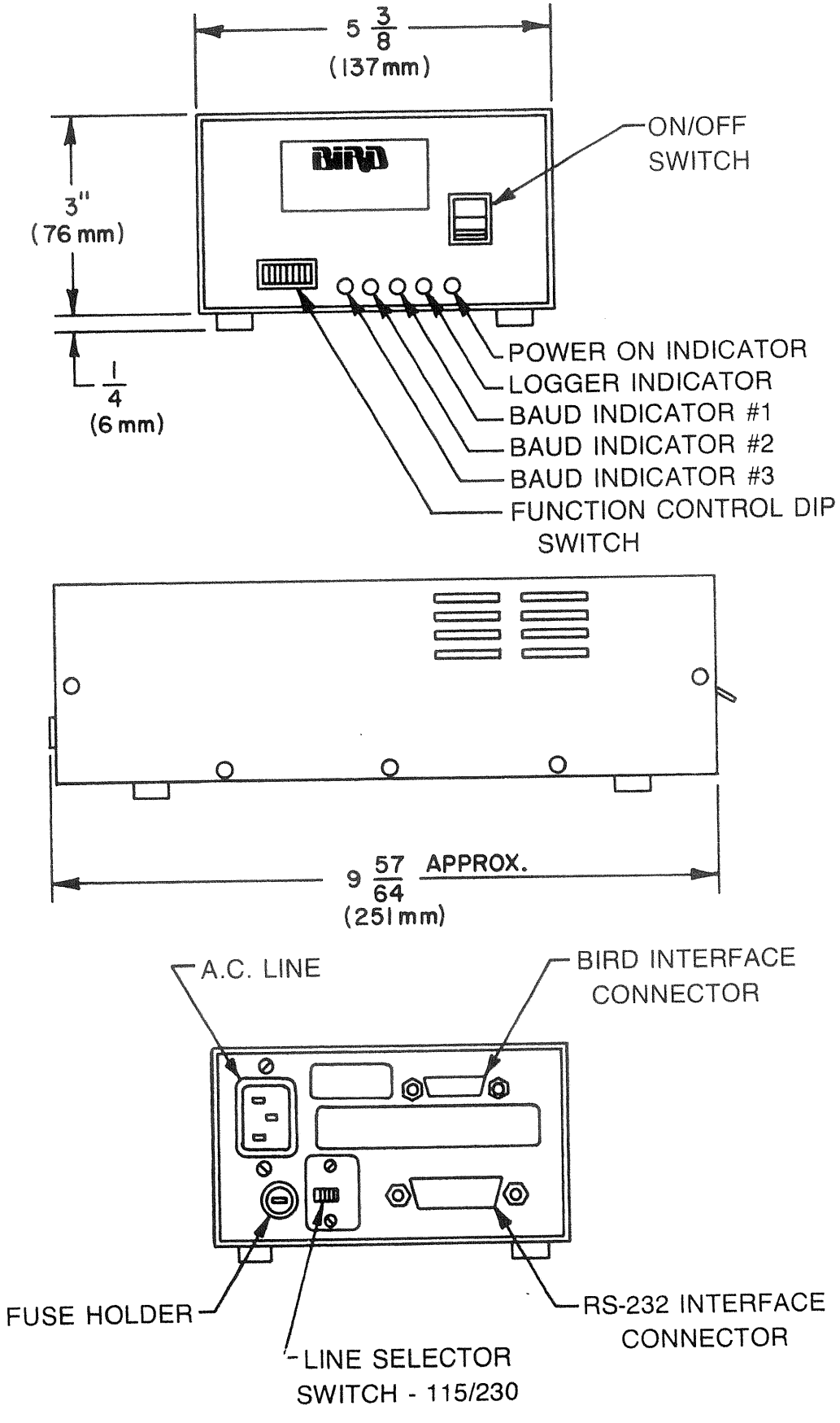
PREFACE

This publication refers to Bird power analysts as 4380 Series Wattmeters. This term includes the following wattmeters; 4381, 4382, 4383 and 4391 portable wattmeters 4385, 4386, 4387 and 4388 rack mount wattmeters. To be used with Model 4380A-232, the above wattmeters must be equipped with the 832 option.

SCOPE

The purpose of this manual is to provide the operator with an understanding of the Model 4380A-232 and its operation. It is not the intent of this manual to familiarize the operator with the EIA RS232C Standard and its detailed protocol. It is therefore recommended the operator be familiar with the EIA RS232C Standard (or CCITT V.24) before configuring this instrument with the bus.

Figure I-1. 4380A-232 Outline



SHORT FORM COMMAND SUMMARY

Measurement	FC	Forward Carrier Wave
	FP	Forward Peak Envelope Power
	FD	Forward Decibels
	RC	Reflected Carrier Wave
	RP	Reflected Peak Envelope Power
	RD	Reflected Decibels
	SW	Standing Wave Ratio
	AM	Percent of Modulation
	RL	Return Loss
	MN	Minimum Value
	MX	Maximum Value
	AD	Delta Function
Logger	LGxx HyyM	Logger Every xx Hours yy Minutes
Terminators	YT	Two Terminators (CR) (LF)
	YO	One Terminator (CR)
	YN	No Terminator
Prefixes	PY	Prefixes Yes
	PN	No Prefixes
Triggers	T0	Continuous on ENT
	T1	One Shot on ENT
	T3	One Shot on TRG
	T5	One Shot on Measurement Command
Initialize	INT	Place in Default State
Command Trigger	TRG	Take a reading in T3 mode
Software Handshake	XO	Enable software handshake
	XF	Disable software handshake
Enter Data	ENT	Send a Reading to the RS232 Computer
Baud Select	B1	Set Baud to 110
	B2	Set Baud to 300
	B3	Set Baud to 600
	B4	Set Baud to 1200
	B5	Set Baud to 2400
	B6	Set Baud to 4800
	B7	Set Baud to 9600
Status	U0	Send Back Current Machine State
	U1	Send Back Error Conditions
	U2	Send Back Last Reading
	U3	Send Back Revision Levels
Self-Test	J0	Run Self-Test
Veritable Store	Wxxxxxx	Place xxxxxx in-Ram

DESCRIPTIONS

The purpose of the Model 4380A-232 Interface is to provide the 4380A Series of Wattmeters access to the EIA RS232C Serial Communication Interface Bus. The RS232 provides the capability for the 4380A Series Wattmeter to be commanded and read remotely via a RS232 Computer or appropriate command source.

The Model 4380A-232 is a device which meets all requirements of the EIA RS232C (CCITT V.24) standard.

The Model 4380A-232 interface unit is contained within an aluminum enclosure. It's front and rear panel are recessed to avoid accidental damage to panel mounted hardware. Communication cable interconnections and main line power are provided via the rear panel. The front panel contains a power switch to apply main line power to unit, and eight position dip switch to configure operational conditions and five leads to indicate instrument status.

Controls

ON/OFF Switch . . . Applies ac line power to 4380A-232

Dip Switch . . . . . Selects baud rate, parity, stop bit, and data bit conditions

Power Select . . . . . Selects 115/230 Vac*
* Model 4380A-232 is shipped with line select in 115V position. To select 230V position remove (2) #2-56 pan hd. screws. This allows removal of line select plate. Push switch button to the right (230V position). Now reverse line select plate and reinstall to lock in voltage section.

Indicators

POWER. . . . . Indicates 5 volts supplied

B1 . . . . . .

B2 . . . . . The number 1-7 which indicates the baud rate of the 4380A-232.

B4 . . . . . .

LOG . . . . . When flashing indicates Logger Function is enabled

SPECIFICATIONS FOR MODEL 4380A-232

Physical

Dimensions	Width 5.375 inches (137mm) Height 3.25 inches (82mm) Length 10.50 inches (9.89mm)
Weight	2 lbs 10 oz. (1.2kg)
Connectors	Bird Interface - AMP-205205-1 or 2 RS232 Interface - AMP-747303-2
Power	115/230 VAC + 10% 47-63Hz Fuse 1/4 AMP slow blow
Temperature	Operating Temp. Range: 0°C to 50°C Storage Temp. Range: −40°C to 100°C
Output	3-1/2 digit ASCII Format
Logic Levels	Meets all EIA std. RS232C specifications
Modes of Operation	Switch and Bus selectable
Talk Always	Allows the Wattmeter to output its keyboard initiated measurements to the bus, this information can then be accepted by any RS232 device.
Addressable	Allows the 4380A-232 to be commanded via an RS232 interface controller.
Logger	A bus-selected operation that allows measurements to be made repeatedly at time intervals chosen by the operator.

232C BUS INTERFACE SUBSET IMPLEMENTATION

On the rear of the Model 4380A-232 is a 25 pin connector with pin assignments, physical parameters, and electrical specifications which meet the RS232C standard. This connector provides the proper signal path to implement the RS232C interface.

The following is a list of the pin assignments:

Contact Number	EIA RS232C Designation	Circuit
1	Protection Gnd	AA
2	Transmit Data	BA
3	Receive Data	BB
4	Request to Send	CA
5	Clear to Send	CB
6	Data Set Ready	CC
7	Signal Gnd	AB
8	Receive Signal DET	CF
9	Reserved	——
10	Reserved	——
11	Unassigned	——
12	Secondary Receive Signal	SCF
13	Secondary Clear to Send	SCB
14	Secondary Transmit Data	SBA
15	Transmission Signal Element	DB
16	Secondary Receive Data	SBB
17	Receive Signal Element	DP
18	Unassigned	——
19	Secondary Request to Send	SCA
20	Data Terminal Ready	CD
21	Signal Quality	CG
22	Ring Indicator	CE
23	Data Signal Rate Selector	CH/CI
24	Transmit Signal Element	DA
25	Unassigned	——

BIRD INTERFACE

On the rear of the Model 4380A-232 is a 15 pin connector which is for interfacing the 4380A series Wattmeter to the Model 4380A-232. The connector provides a signal path which tells the Wattmeter to make a measurement, read back the measured value, and provide a ground reference to the Wattmeter. The following is the list of pin assignments and their functions:

Pin	Signal	Function
1	Ground	Shielding
2		Not Used
3	Row 3	Row 3 of Keyboard
4	Row 2	Row 2 of Keyboard
5	Row 1	Row 1 of Keyboard
6	Col 4	Fourth column of Keyboard
7	Col 3	Third column of Keyboard
8	Col 2	Second column of Keyboard
9	Col 1	First column of Keyboard
10	Dec Point	Decimal point location
11	BCD 8	Most significant digit
12	BCD 4	
13	BCD 2	
14	BCD 1	Least significant digit
15	Ground	Signal

SECTION I - GETTING STARTED

1-1. QUICK UP AND RUNNING GUIDE

1-2. The paragraphs below will take you through a step-by-step procedure to get your Model 4380A-232 on the bus as quickly as possible and program basic operating modes. Refer to Section VI - RS232C (Serial I/O) Introduction for detailed information on EIA RS232C operation and programming.

1-3. Step 1: Connect Your Model 4380A-232 to the Controller

1-4. With power off, connect the Model 4380A-232 to the RS232C interface of the controller using a standard interface cable. Some controllers include an integral cable, while others require a separate cable. See Paragraph 1-21 for more detail.

1-5. Step 2: Connect Your 4380A-232 to the Desired Bird Wattmeter

1-6. With power off, connect the 4380A-232 to a Bird 4380 Series Wattmeter using the supplied shielded 15 pin cable. Be sure to secure the cable screws at both ends.

1-7. Step 3: Select the Baud Rate, Parity, Word Length, Stop Bits

1-8. The data rates and format must be selected in the Model 4380A-232 to correspond to the rates and formats selected in the RS232C interface controller. The Baud Rates, Parity, Word Length and Stop Bits must match each other, or you will not be able to program instruments operating modes and obtain data over the interface. Also select CMD position since we desire data only upon command over the interface.

1-9. The parameters of your Model 4380A-232 are factory set;

2400 Baud	2 stop bits	CMD data mode
No parity	8 data bits	

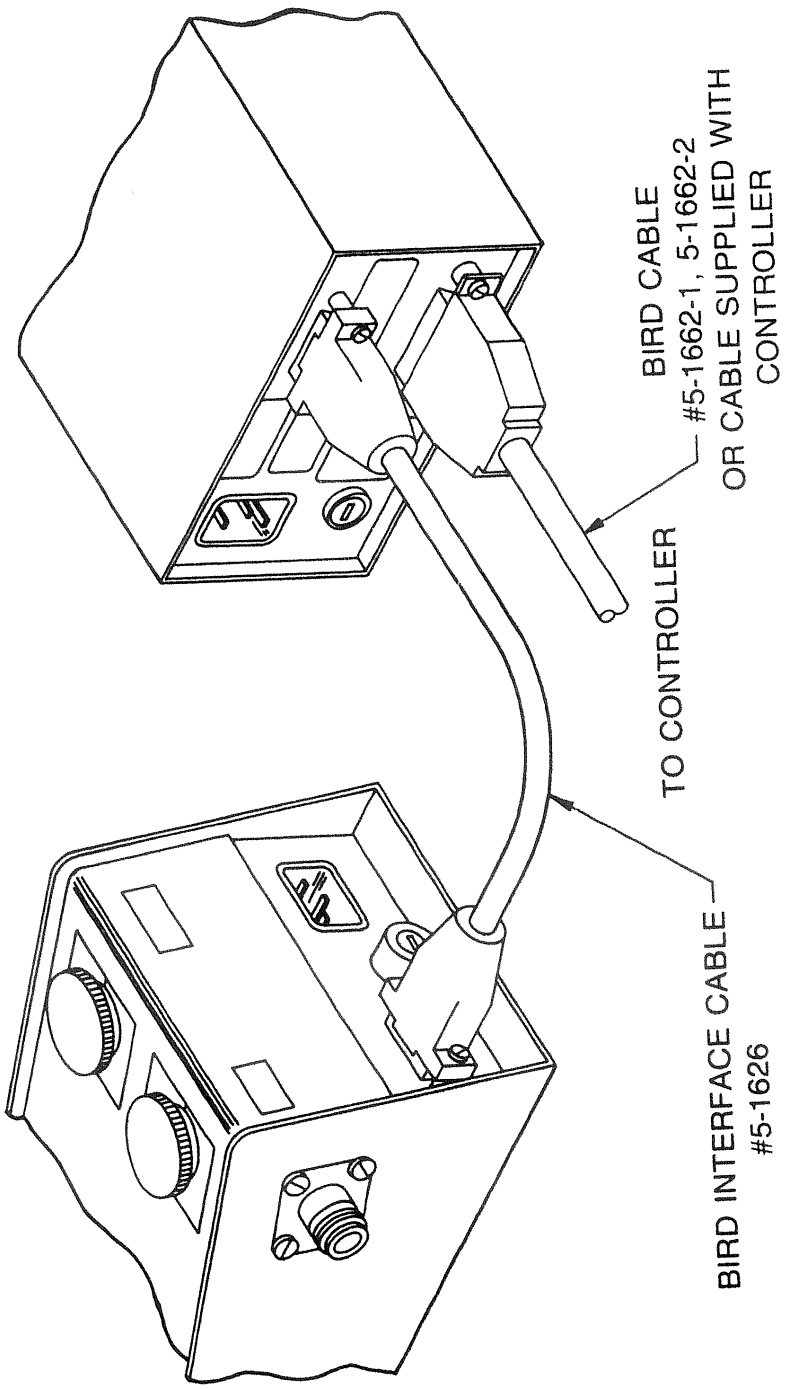
as shown below:

STP	CMD	WL	PAR	B4	B2	B1	
	X	X	XX		X		ON = 0
X				X		X	OFF = 1
	TA						
STOP BITS		WORD LENGTH	PARITY		BAUD		

1-10. Step 4: Write Your Program

1-11. Even the most basic operations will require that you write a simple program to send commands and read back data from the instrument. The Programming examples below allow such operations. The program will allow you to type in command strings to program the instrument and display data on the computer CRT.

Figure 1-1. Hook-up of External Cables to 4380A-232 Interface Unit and 4380 Series Wattmeter (4391 Shown).



1-12. IBM PC Programming Example - Use the sample program below to send programming commands to the Model 4380A-232 and display the data string on the computer CRT. This program converts the IBM into a CRT terminal.

PROGRAM	COMMENTS
50 SCREEN 0,0:CLS	Set screen and clear it.
60 PRINT "BIRD RS232 TEST IN PROGRESS, DEPRESS <CNTRL> <BREAK> TO STOP"	
70 PRINT	
80 FALSE = 0: TRUE = NOT FALSE	Define flags.
90 XOFF$ = CHR$(19) :XON$ = CHR$(17)	Define Xon/Xoff.
100 OPEN "COM1:2400,N,8,2,RS,CS" AS #1	File #1 is COM.
110 OPEN"SCRN:" FOR OUTPUT AS #2	File #2 is DISPLAY.
120 LOCATE ,,1	Cursor to top.
130 FULL = FALSE:ON ERROR GOTO 240	Start with Xon flag = OK.
140 B$ = INKEY$:IF B$ < > "" THEN PRINT #1,B$;:PRINT B$;	If not a null send to COM.
150 IF EOF (1) THEN 140	Wait for a char to be typed.
160 IF LOC(1) > 128 THEN FULL = TRUE : PRINT #1,XOFF$;	
170 A$ = INPUT$(LOC(1),#1)	Get char which came in.
180 LFP = 0	Strip line feed's.
190 LFP = INSTR(LFP + 1,A$,CHR$(10))	
200 IF LFP > 0 THEN MID$(A$,LFP,1) = " " :GOTO 190	
210 PRINT #2,A$;: IF LOC (1) > 0 THEN 160	Display incoming char's.
220 IF FULL THEN FULL = FALSE: PRINT #1,XON$;	Room now avail allow in char.
230 GOTO 140	
240 PRINT"ERROR NO.";ERR : RESUME	

1-13. Step 5: Turn the Power On.

1-14. Step 6: Program Model 4380A-232 Operating Modes.

1-15. You can program instrument operating modes by sending the appropriate command, which is made up of ASCII letters and numbers. The Introduction summarizes the 4380A-232 commands.

1-16. A number of commands can be grouped together in one string, if desired. See Section III - Device-Dependent Command Programming.

1-17. If you are using the programming examples from Step 4 above, simply type in the command string.

EXAMPLE: FC to select Forward Carrier Wave.

1-18. Step 7: Get Readings from the Model 4380A-232

EXAMPLE: ENT to read the data from the Model 4380A-232.

1-19. Usually, you will want to obtain one or more readings from the Model 4380A-232. In the example program above, a single reading is requested and displayed after each ENT command. In other cases, you may wish to program the instrument configuration at the beginning of your program, and then obtain a whole series of measurements.

1-20. The basic reading string that the Model 4380A-232 sends over the bus is in ASCII characters of the form:

NFC 1.234

where: N indicates a normal reading (O would indicate an overflow, U would indicate underflow) FC shows the Forward Carrier Wave measurement function is selected and 1.234 is the mantissa of the reading data. That is all that's required to get the unit working in your application.

1-21. DETAILED INTERFACE CONNECTIONS

1-22. The Model 4380A-232 is intended to be connected to the RS232C interface through a cable equipped with standard DB25 connectors. If a separate cable is required, it may be purchased from Bird Electronic Corporation in one of two lengths, (P/N 5-1662-1, 5 foot or P/N 5-1662-2, 10 foot) Two screws are located on each connector to ensure that connections remain secure.

1-23. Connect the Model 4380A-232 to the RS232 interface as follows:

a. Line up the cable connector with the connector located on the rear panel of the instrument. The connector is designed so that it will fit only one way.

b. Tighten the screws securely, but do not overtighten them.

1-24. The Model 4380A-232 uses the following RS232C lines:

Pin No.	Signal Name	Source	Function
1	PG(AA)	None	Chassis Ground
2	TD(BA)	4380A-232	Transmit Data
3	RD(BB)	Input Device	Received Data
4	RTS(CA)	4380A-232	(Output) Driven true after power up.
5	CTS(CB)	Input Device	(Input) Driven by input device. When true it enables 4380A-232 to transmit. When false it disables transmission.
6	DSR(CC)	4380A-232	Held true by 4380A-232 hardware.
7	SG(AB)	None	Return path for data and control signals.
8	DCD(CF)	4380A-232	Held true by 4380A-232 hardware.
20	DTR(CD)	4380A-232	(Output) Driven true after power up.

1-25. **CONNECTING 4380A-232 TO DCE**

1-26. When connecting the Model 4380A-232 to DCE (Data Communications Equipment), a standard RS-232C cable (Bird P/Ns 5-1662-1 or 5-1662-2) is all that is required.

1-27. **CONNECTING 4380A-232 TO DTE**

1-28. When connecting the Model 4380A-232 to another DTE (Data Terminal Equipment) it will be necessary to place an in-line null modem between the 4380A-232 and the other DTE. This null modem acts functionally as a DCE to perform necessary interconnection of signal paths.

1-29. Since different DTE's require implementation of a variety of RS-232 lines, it will be necessary for the operator to consult DTE's operations manual for lines required by unit.

1-30. The operator will then configure a null modem or can purchase from Bird Electronic Corporation an in-line null modem (P/N 4380-250) which can be hard wired as required.

1-31. Connect the RS-232 cable to the controller as follows:

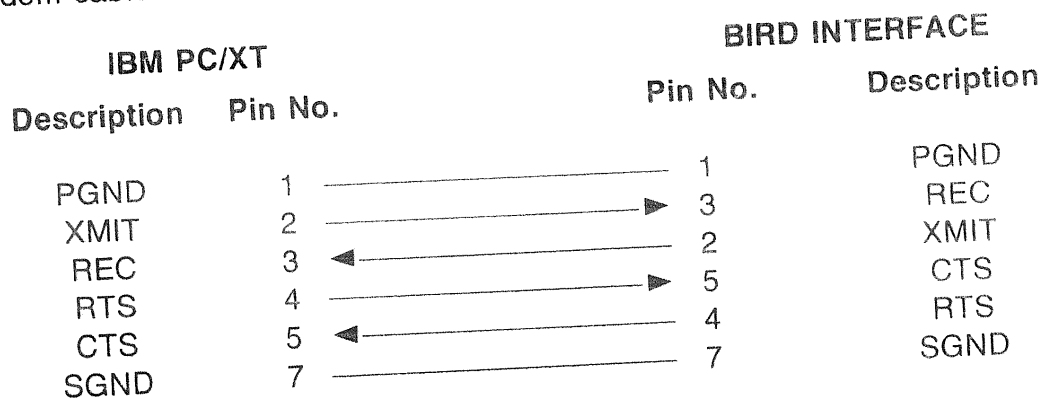
a. Most controllers are equipped with a DB25 style connector, but a few may require a different type of connecting cable. Consult the instruction manual of your controller for the proper connecting method.

b. Locate the serial port of the controller. Line up the cable connector with the serial port connector.

c. Tighten the screws securely if applicable, but do not overtighten them.

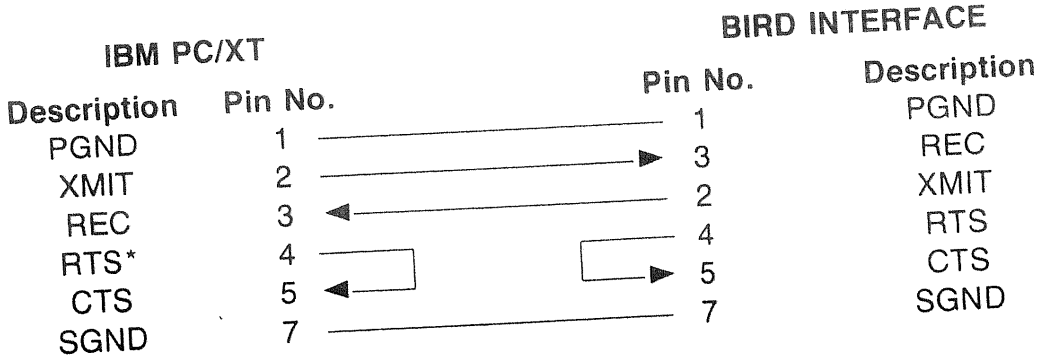
Note - The RS-232 interface cable length is limited to a maximum of 50 feet. Failure to observe this limit may result in erratic operation.

1-32. In order to connect to a computer it must be connected through a "null" modem cable. The wiring is shown below for an IBM PC (configured as DTE).



1-33. The Model 4380A-232 will set RTS active (> +3V) upon power turn on. The 4380A-232 will not transmit unless pin 5 (CTS) is active (> +3V); since the CTS hardware handshake is always enabled. If you wish to defeat the hardware handshake configure the cable below.

Note - The hardware handshake is independent from the Xon/Xoff software handshake.



*The line from 4 to 5 is not required in the IBM since you can program the response to the CTS line.

1-34. SWITCH SETTINGS

1-35. The eight (8) position dip switch on the front panel needs to be set up properly for the Model 4380A-232 to operate. The switch is shown below:

STP	CMD	WL	PAR	B4	B2	B1	ON OFF
1	2	3	4 5	6	7	8	

a. Baud (switches 6, 7, 8) are BCD weighted switches

SW6	SW7	SW8	
ON	ON	ON	B0 = AUTO Baud
ON	ON	OFF	B1 = 110
ON	OFF	ON	B2 = 300
ON	OFF	OFF	B3 = 600
OFF	ON	ON	B4 = 1200
OFF	ON	OFF	B5 = 2400
OFF	OFF	ON	B6 = 4800
OFF	OFF	OFF	B7 = 9600

b. Parity (switches 4, 5)

SW4	SW5	
ON	ON	= No Parity
ON	OFF	= Odd Parity
OFF	ON	= Even Parity
OFF	OFF	= Mark Parity

c. Word length (SW3)

SW3	
ON	= 8 data bits
OFF	= 7 data bits

d. Command Mode (SW2)

SW2	
ON	= need "ENT" command to get a reading
OFF	= result from a trigger automatically gives a reading (also used when a switch is hit to give a reading)

e. Stop bits (SW1)

SW1	
ON	= 1 stop bit
OFF	= 2 stop bits

1-36. HOW TO USE AUTO BAUD

1-37. If you have selected SW6, SW7, SW8 all on (i.e., auto baud) you need to follow the procedures shown below. Auto baud allows the user to have the Model 4380A-232 determine the correct Baud rate for use. (Note - Parity, Word Length and Stop Bits are not determined automatically, and need to be correct on switches.)

1-38. AUTO BAUD PROCEDURE

1. Turn SW6, SW7 and SW8 all on.
2. Turn Power on the Model 4380A-232 on.
3. Send to the Model 4380A-232 via the RS232C a character "U".
4. Wait 1 second
5. If Baud Leds light, rate has been determined, else send a second "U". Wait 1 second.
6. Baud Leds should light with correct rate shown.
7. End of procedure.

Note - If after 30 seconds the model 4380A-232 cannot absolutely determine a baud rate it will chose a rate, based on the information it has at the 30 second time period.

1-39. STATUS INDICATORS

1-40. The LED indicators show the present status of the instrument. The LOG indicator shows the status of the internal data logger. Each of these indicators is briefly described below.

LOG - This indicator shows when the logger mode is enabled by flashing at a 1/2 second rate.

B1, B2, B4 - These indicators will be on to show the Model 4380A-232 Baud rate selected. (The rate can be selected over the interface or through the front panel.)

RATE	B4	B2	B1
110			X
300		X	
600		X	X
1200	X		
2400	X		X
4800	X	X	
9600	X	X	X

X = LED ON

SECTION II - GENERAL RS232C COMMAND PROGRAMMING

2-1. GENERAL

2-2. This section contains information on programming the Model 4380A-232 with the Bird 4380 Series Wattmeter.

2-3. General interface commands are those commands which control the Model 4380A-232 on the interface bus.

2-4. INT (INITIALIZE)

2-5. The "INT" command may be used to clear the Model 4380A-232 and return the unit to the factory default conditions. Table 2-1 lists factory default conditions for the instrument after it receives an "INT".

Table 2-1. Default Conditions.

FC	= Forward Carrier Wave
LGOOHOOM	= Logger Off
YT	= Two Terminators (CR) (LF)
PY	= Prefixes Yes
T1	= Trigger One Shot being addressed on "ENT"
X0	= Enable XON/XOFF software flow control

2-6. IBM PC/XT Programming Example - Using a front panel button on the 4380 Series Wattmeter alters the instrument configuration from the Power Up state to another state (i.e. RC). Now enter the following program.

```
10    Open "COM1:2400,N,8,2,RS,CS" as #1
20    Print #1, "INT";
```

When the above program is executed the instrument returns to default conditions (the Forward Carrier Wave).

If "INT" is linked with any other command within a string, it must be separated from that command by entering a space between them.

```
Print #1, "INT FD";
```

2-7. ENT (ENTER COMMAND)

2-8. The "ENT" command may be used to instruct a Model 4380A-232 reading be sent back to the RS232C computer on the Receive data line. The unit needs to have had a trigger prior to the "ENT" command, so that a valid reading exists or will exist shortly in the output communications buffer of the Model 4380A-232.

2-9. IBM PC/XT Programming Example - Enter the following program:

```
10      Open "COM1:2400,N,8,2,RS,CS" as #1
20      Print #1, "T1FC" (this if power on default mode for trigger)
30      Print #1, "ENT"
40      If LOC (1)<9 then 40
50      A$ = Input$ (LOC(1),#1)
60      Print A$
70      End
```

2-10. In the above, line 10 initializes the COM 1 communication port on the IBM. Line 20 sets the trigger mode to T1 (this line is not necessary if you are in default conditions). Line 30 tells the Model 4380A-232 to send a reading and Line 50 reads it.

2-11. If this request/response type programming method is not desirable, place the CMD dip switch on the front panel in the CMD OFF (Talk Always) position then (cycle power). Remove Line 30 from the program. Now the Model 4380A-232 will always send a reading when the program is run (no "ENT" command need be given).

2-12. **TRG (TRIGGER)**

2-13. The "TRG" command may be used to initiate a Model 4380A-232 measurement if the instrument is placed in the appropriate trigger mode T3 (see Section III - Device-Dependent Command Programming). Once triggered, the instrument will perform the measurement sequence in accordance with previously selected parameters. (Place the CMD switch in the ON position and cycle power on the 4380A-232 for the example below:)

2-14. IBM PC/XT Programming Example - Enter the following program:

```
10      Open "COM1:2400, N,8,2,RS,CS" as #1
20      Print #1, "T3";
30      Print #1, "TRG ENT";
40      If LOC (1)<9 then 40
50      A$ = INPUT$ (LOC(1),#1)
60      Print A$
```

2-15. In the above Line 10-20 get the instrument into the wait for "TRG" trigger state. Line 30 does the actual triggering. Run the program to display the reading.

Again Note - With the CMD switch in the CMD OFF (Talk Always) position the "ENT" command need not be given to get a reading.

2-16. BN (BAUD SELECT)

2-17. The "Bn" (where n is an ASCII 1-7) may be used to instruct the Model 4380A-232 to change its baud rate. Once the unit recognized a valid "Bn" command the baud rate is immediately changed and the sending RS232 should also now be at that rate if it wishes to program the Model 4380A-232. The valid Bn commands are given below. The numbers 1-7 correspond to the switch settings of B1, B2, B4 on the front panel.

Baud	B1	=	110 Baud
	B2	=	300 Baud
	B3	=	600 Baud
	B4	=	1200 Baud
	B5	=	2400 Baud
	B6	=	4800 Baud
	B7	=	9600 Baud

Note - The "Bn" command will supersede the Baud switch settings on the Model 4380A-232 front panel.

2-18. IBM PC/XT Programming Example - Enter the following program:

```
10      Open "COM1:2400,N,8,2,RS,CS" as #1
20      Print #1, "B6";
30      Close #1
40      Open "COM1:4800,N,8,2,RS,CS" as #1
50      Print #1, "FP";
```

2-19. In the above Line 20 set the Baud rate to 4800 baud. Line 40 now initializes the IBM communications port to the new 4800 baud to agree with the change. Line 50 merely programs the Model 4380A-232 to FP to show it's at the new Baud rate.

Note - B0 has no operation in the programming mode setting. B0 programming will produce an IDDCO in the "U1" error status byte (see Section III - Device-Dependent Command Programming).

2-20. To do next section cycle power to return the Model 4380A-232 to 2400 Baud (or do it with Bn command).

2-21. XON/XOFF (XMISSION FLOW CONTROL)

2-22. The "Xn" (where n = ASCII "O" or "F") command may be used to enable XON/XOFF software flow control. On an RS232C interface the computer or the Model 4380A-232 may send data to the other device faster than it can be processed. XON(Hex 11) and XOFF(Hex 13) are characters which are embedded in the command strings to the over zealous talker to control the rate of information it's sending. There are two cases of interest (1) data from the 4380A-232 to the computer and (2) from the computer to the 4380A-232.

a. CASE 1 - (4380A-232 - Computer) - This is the case in which the "Xn" enable/disable works. If this mode is enabled ("XO" sent to the 4380A-232) when the Model 4380A-232 recognizes an XOFF (Hex 13 char) it stops transmission of data until it sees an XON (Hex 11 char); at which time it resumes character transmission.

b. CASE 2 - (Computer - 4380A-232) - There is no enable/disable control for this Case. The Model 4380A-232 has a 128 character circular input buffer to handle incoming characters at a very fast rate. This high speed buffer should prevent the need for XON/XOFF control in the case 2 mode. However, if the condition should arise that the input buffer becomes 87% full an XOFF (Hex 13 char) will be sent to the sending computer. This would tell the sending computer to stop sending characters to the Model 4380A-232. Once the input buffer has space in it again an XON (Hex 11 char) will be sent to the sending computer to tell it to resume sending characters.

Note - The hardware CTS/RTS flow control is always enabled to do the same function as the "Xn" above in Case 1.

c. The valid "Xn" commands are given below. Upon power up, on after a "INT" command, the instrument will be in the "XO" mode.

Table 2-2. XON/XOFF Control Commands (Case 1).

XO	=	Enable XON/XOFF for Case 1 conditions
XF	=	Disable XON/XOFF for Case 1 conditions

2-23. IBM PC/XT Programming Example - Use program in Section I, paragraph 1-12. Enter that program.

a. An XON (Hex 11 char) can be sent on the IBM PC/XT by issuing <CNTRL>Q.

b. An XOFF (Hex 13 char) can be sent by issuing <CNTRL>S.

c. Now issue XOFF (<CNTRL>S) and then type FC ENT notice nothing came back from the 4380A-232. Now issue XON (<CNTRL>Q) and the reading appears.

SECTION III - DEVICE-DEPENDENT COMMAND PROGRAMMING

3-1. GENERAL

3-2. RS232 Device-Dependent commands are the most important commands associated with the instrument because they control all of the 4380A-232 operating modes.

a. Command Syntax

1. Each 4380A-232 command is made up of an ASCII letter followed by an ASCII Integer number of 0 to 9 or an ASCII letter followed by other ASCII letters. ASCII letters can be upper or lower case.

2. Some valid examples are:

FC or fc
T2 or t2

3. If an invalid command is sent as a command string the instrument will place an error condition into the status (u) byte and the offending command will not be executed. Commands will continue not executing until the 4380A-232 recognizes another valid command. At that time it will execute the valid command.

4. The two invalid errors are IDDC and IDDCO. IDDC indicates that the command received was invalid (Invalid Device-Dependent Command). For example: V2. The IDDCO indicates that the command option received was invalid (Invalid Device Dependent Command Option).

For example: FQ.

b. Command String Structure

1. A number of device dependent commands can be issued in one string as long as like command functions are not repeated.

Print #1, "PNFCFPT3TRG"

2. This string when issued sets up the model 4380A-232 to no prefixes, forward peak, one-shot on "trg" and triggers the unit to take a measurement.

3. As a command string is entered, the model 4380A-232 will store different types of commands in separate locations. Each location is capable of storing one command. Multiple like commands will only write over each other leaving the last entered command the one to be performed on.

c. Device-Dependent Command Summary

Device-dependent commands that control the Model 4380A-232 are summarized in Table 3-1 below:

Table 3-1. Device-Dependent Commands.

Measurement	FC	Forward Carrier Wave
	FP	Forward Peak Envelope Power
	FD	Forward Decibels
	RC	Reflected Carrier Wave
	RP	Reflected Peak Envelope Power
	RD	Reflected Decibels
	SW	Standing Wave Ratio
	AM	Percent of Modulation
	RL	Return Loss
	MN	Minimum Value
	MX	Maximum Value
	AD	Delta Function
Logger	LGxx HyyM	Take Measurement Every xxH yyM
Terminators	YT	Two Terminators (CR) (LF)
	YO	One Terminator (CR)
	YN	No Terminator
Prefixes	PY	Yes, Send Proper Prefix
	PN	No, Do Not Send Prefix
Triggers	T0	Continuous on ENT
	T1	One Shot on ENT
	T3	One Shot on TR6
	T5	One Shot on Measurement Command
Status	U0	Send Back Current Machine State
	U1	Send Back Error Conditions
	U2	Send Back Last Reading
	U3	Send Back Revision Levels
Self-Test	J0	Run Self-Test and Report Results in SRQ
Writable Store	WXXXXXX	Receive 6 Bytes for Internal Storage

3-3. PROGRAMMING EXAMPLES

3-4. Throughout the following paragraphs, programming examples show how to send the various commands using a typical RS232C controller: the IBM PC/XT computer. The program will also work on most IBM compatibles. Note that all these examples assume that the instrument's set up as in Section I - Getting Started (2400 Baud, no parity, 2 stop bits, 8 data bits).

3-5. General IBM PC/XT Programming Example - Device-dependent commands may be sent from the IBM PC/XT with the following statements. Statement 10 sets up the IBM for the proper parameters on communications Port #1 using file #1. Statement 20 sends the command to the 4380A-232.

```
 5       INPUT A$
10       OPEN "COM1:2400,N,8,2,RS,CS" as #1
20       PRINT #1,A$;
```

3-6. MEASUREMENT FUNCTION

3-7. The measurement function allows you to select the type of measurement to be performed by the 4380 Series Wattmeter mated to the 4380A-232. The measurement function acts just like a key press on the 4380 Series Wattmeter in the manual mode. Consult the 4380 Series Wattmeter manual for detailed function operation.

3-8. It should be noted that based on the function selected a delay of 1 second or 15 seconds will be initiated on a function change (thus, for one shot triggers 15 second delays may be encountered). These delays will allow the analog front end to settle. The following table will show delays which can be encountered:

Table 3-2. Delays.

The functions on the Model 4380 Series Wattmeters fall into two major groups - Group 1 and Group 2. Group 2 has three subgroups.

GROUP 1	GROUP 2		
DELTA	Sub1	Sub2	Sub3
MINIMUM			
MAXIMUM	FWD CW	RFL CW	%MODULATION
SWR	FWD PEP	RFL PEP	
RTN LSS	FWD DBM	RFL DBM	

A long delay will be defined as 15 seconds. A short delay will be defined as 1 second.

Changes in command are marked by ——► with it's appropriate delay above it.

Group 2 —Short►— Group 1

SubX —Short►— SubX ; Subgroup to same Subgroup

SubX —Long►— SubY ; Subgroup to different Subgroup

SubX —Short►— Group 1 —Short►— SubX ; Return to same Subgroup after fast command

SubX —Short►— Group 1 —Long►— SubY ; Return to different Subgroup after fast command

3-9. Upon power up or after an "INT" command the 4380A-232 will be in the FC mode (forward carrier wave).

3-10. The List of Measurement Functions is given below:

Measurement		
	FC	Forward Carrier Wave
	FP	Forward Peak Envelope Power
	FD	Forward Decibels
	RC	Reflected Carrier Wave
	RP	Reflected Peak Envelope Power
	RD	Reflected Decibels
	SW	Standing Wave Ratio
	AM	Percent of Modulation
	RL	Return Loss
	MN	Minimum Value
	MX	Maximum Value
	AD	Delta Function

3-11. IBM Programming Example - Type in the following lines to program the instrument to select the Forward Decibels measurement. When the program is run the instrument goes to the Forward Decibels Function.

```
10      OPEN "COMM1:2400,N,2,8,RS,CS" as #1
20      PRINT #1, "FD";
30      END
```

3-12. LOGGER FUNCTION (LG)

3-13. The Logger Function (LG) command allows data to be taken at predetermined intervals by the 4380A-232. The value must be read out before the next interval or the data will be overwritten (only 1 value saved).

3-14. The LG function allows the user to specify the interval in hours and minutes (1 minute is the smallest interval and 19 hours 59 minutes is the maximum interval).

3-15. The format for the LG command is given below:

LGXXHYYM

XX = hours 01-19
YY = minutes 01-59

Note - XX = 00 and YY = 00 have special significance. It turns the logger off (disables it).

3-16. When the LG function is enabled (i.e., XX and YY different from 00). The Logger LED will blink at a 1/2 second rate to indicate that the Logger function is enabled.

3-17. Upon power up, or after an "INT" command, the 4380A-232 will be in the LG00H00M mode (Logger disabled).

3-18. IBM Programming Example - To enable the Logger function type in the following statements:

```
10      OPEN "COM1:2400,N,8,2,RS,CS" as #1
20      PRINT #1, "LG00H02M";
30      END
```

Note - that the Logger function is enabled on 2 minute intervals when the program above is executed.

3-19. TERMINATOR (Y)

3-20. The terminator that marks the end of the instrument's data string or status words can be programmed by sending the Y command followed by an appropriate ASCII character. The default terminator sequence in the commonly-used carriage return, line feed (CR) (LF) sequence (CR = DEC 13; LF = DEC 10). The terminator will assume this default value upon power up, or after the instrument receives a "INT" command (default is YT).

YT = Two terminators, append on message output a (CR) and a (LF)
YO = One terminator, append on message output a (CR)
YN = No terminator, append no terminator on the output message.

NOTES:

a. Many controllers use the default terminator sequence to end their input sequences. Modifying the terminator may cause the input sequence to hang unless a different terminating method is used.

b. The terminator sequence is sent only at the end of the complete transmission sequence regardless of the data format.

3-21. IBM PC/XT Programming Example - Use the program given in Section I, paragraph 1-2. Proceed as follows:

a. Run the program
b. Type YN on the computer
c. Type ENT on the computer

The terminator sequence will be suppressed when the second statement above is executed. The absence of a terminator can be verified by no (LF) (CR) after the data is read.

To return the instrument to its default conditions, type in the following:

INT

3-22. **PREFIXES (P)**

3-23. The P command gives control over the format of the data that is transmitted by the 4380A-232 over the RS232C interface.

3-24. The Prefix command has two options shown below:

PY - (Prefix yes) append message with prefix
PN - (Prefix no) append no prefix on the message

3-25. Upon power up, or after an "INT" command, the 4380A-232 will be in the PY mode (append prefix).

The list of prefixes used which correspond to the measurement function selected are given as:

FC	SW
FP	AM
FD	RL
RC	MN
RP	MX
RD	AD

U = underflow (when underflow indicated given value sent will be .0000)
O = overflow (when overflow indicated value sent will be 9999.)
N = normal on scale reading
BRD = numeric for BIRD Electronics

Data formats for the P mode are given in Table 3-3.

Table 3-3. Data Format (P) Mode Examples.

a. Normal forward carrier wave with Prefixes on:

N	F	C	0		.	1	2	3	(CR)	(LF)

b. Overflowed forward carrier wave with Prefixes on:

O	F	C		9	9	9	9	.	(CR)	(LF)

c. Underflowed forward carrier wave with Prefixes on:

U	F	C		.	0	0	0	0	(CR)	(LF)

3-26. OBTAINING DATA

3-27. Before the instrument will transmit its data string, it must be properly addressed to talk by the controller. The basic controller sequence for requesting data is as follows:

Send the "ENT" command.

3-28. Generally, data is placed into a string or numeric variable as the bytes are received. For example, a typical sequence for the IBM PC/XT computer is:

```
10      If LOC (1)<9 then 10
20      A$ = INPUT$ (LOC (1), #1)
```

In this instance the complete reading string is placed in the A$ variable.

3-29. IBM PC/XT Programming Example - Use the following program to obtain and display an instrument data string.

```
10          OPEN "COM1:2400,N,8,2,RS,CS" AS #1
20          PRINT #1, "PYENT"
30          If LOC (1)<9 then 30
40          A$ = INPUT$ (LOC (1),#1)
50          PRINT A$
60          END
```

3-30. In this program, the computer communications Port is initialized (line 10). The instrument is placed in the ENT format, (line 20), and data is then requested (line 40) and displayed (line 50). Note that data with prefix, is displayed because the instrument is in the PY mode.

3-31. TRIGGER MODE (T)

3-32. The trigger mode command programs the type of trigger stimulus to be used to initiate a measurement. Triggering may be done in two basic ways: single or continuous. In a single trigger mode, a trigger stimulus initiates a single measurement sequence, while in a continuous mode, the instrument will continuously repeat the measurement sequence once triggered (much like a Digital Multimeter in bench mode); at its own internal trigger rate (approximately 1 rdg/second). A number of different methods can be used to trigger the instrument, as summarized below:

Triggers	T0	Continuous on ENT
	T1	One Shot on ENT
	T3	One Shot on TRG
	T5	One Shot on Measurement command

3-33. Upon power up, or after a "INT" command, the instrument will be in the T1, one shot measurement function mode.

3-34. Talk (T0 and T1): The measurement will be triggered when "ENT" is received over the interface (unless the front panel dip switch is in the TA position).

3-35. TRG(T3): The "TRG" command provides the trigger in this mode.

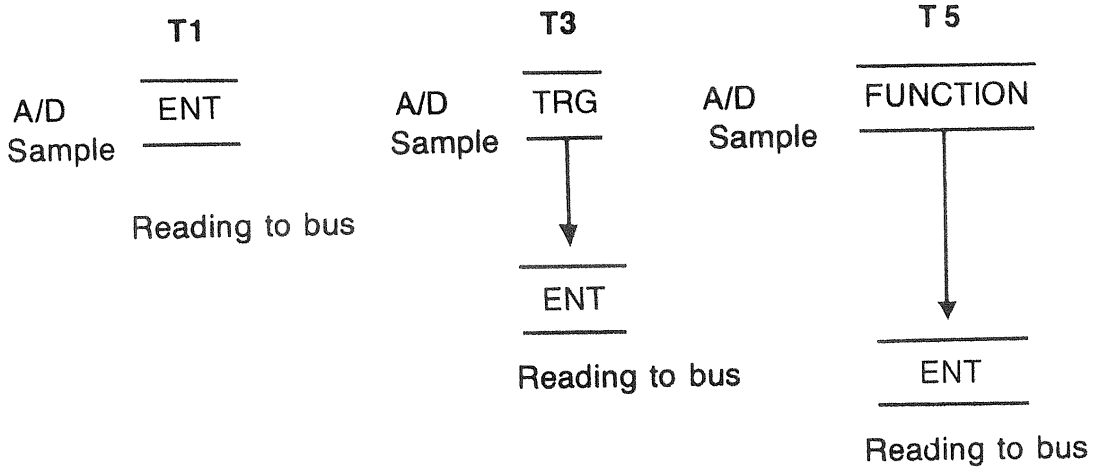
3-36. Measurement Function (T5): The measurement function triggers the instrument.

3-37. IBM PC/XT Programming Example - Place the instrument in the single, "ENT" (T1) trigger mode with the following statements. When the statements below are executed,the instrument will perform a single measurement sequence.

```
10      OPEN "COM1:2400,N,8,2,RS,CS" as #1
20      PRINT #1, "T1ENT";
30      If LOC (1)<9 then 30
40      A$ = INPUT$(LOC(1),#1)
50      Print A$
60      END
```

3-38. DESCRIPTION OF TRIGGERS

3-39. One shot triggers will be used most of the time. The three types can be viewed in time as follows:



3-40. Trigger T1 holds the interface while waiting for a reading - could be 1 to 15 seconds. If you want better bus throughput use T3 or T5. Function trigger (T5) needs a function given in the programming string (i.e., "FC"). If in T5 and no function is given the 4380A-232 will wait until you supply one. If you do not supply one and ask for a reading over the interface you will hold the interface.

3-41. Continuous triggers can be used to speed up certain interface transfers (15 seconds - 1 second) since the internal readings are being computed at the internal rate. This will be noticeable in column function changes (i.e., "FC" - "RC") if you change the function and then do some other bus action.

3-42. ADDITIONAL TRIGGERING NOTES

3-43. Fastest reading rate is 1 rdg/second, slowest is 1 rdg every 15 seconds (function column changes).

3-44. "ENT" may be given before or after trigger, the reading will be given after the trigger.

Notes:

a. If was in continuous and you program continuous again 4380A-232 will give next valid reading to the interface. (It's waiting for next continuous conversion from the previous continuous mode.)

b. If was in one-shot and you program continuous the 4380A-232 will initiate a reading and make it available to the interface and perform continuous reading.

3-45. When performing a cont. trigger in a one-shot trigger mode (T3 or T5) it will be necessary to separately the trigger command and "ENT".

```
10      OPEN "COM1:2400,N,8,2,RS,CS" as #1
20      PRINT #1, "T3FD";
30      PRINT #1, "TRG";
40      PRINT #1, "ENT";
50      If LOC (1)<9 then 30
60      A$ = INPUT$(LOC(1),#1)
70      Print A$
80      GOTO 30
90      END
```

3-46. **STATUS (U)**

3-47. The status command allows access to information concerning instrument operating modes that are controlled by other device-dependent commands such as T (trigger). Additional options of the status command allow access of unit data and error conditions.

3-48. The status command has four options, as summarized below. These command options are discussed in the following paragraphs.

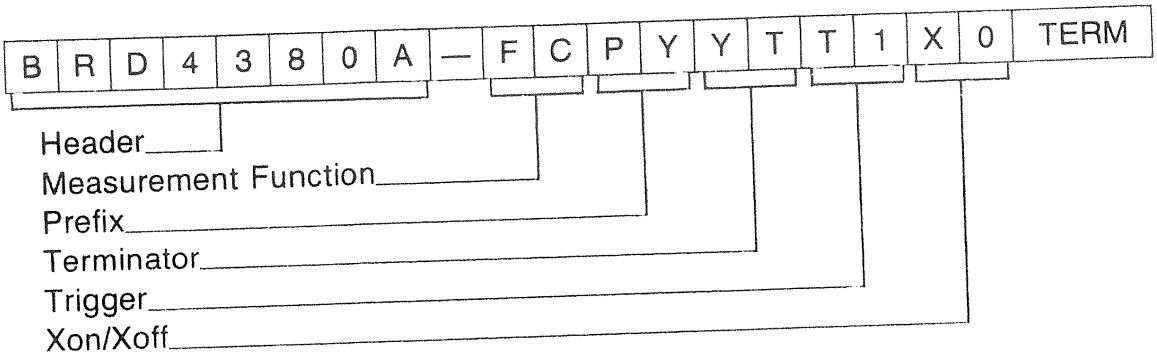
Status	U0	Send back current machine state
	U1	Send back error conditions
	U2	Send back last reading
	U3	Send back revision levels

3-49. **MACHINE STATUS (U0)**

3-50. When the command sequence U0 is transmitted to the Model 4380A-232, the instrument will send its machine status word the next time it is addressed to talk instead of its normal data string. The status word will be transmitted only once each time the U0 command is given. To make sure that correct status is transmitted, this status word should be requested as soon as possible after the command is sent.

3-51. The format of the U0 machine status word is shown in Table 3-4. The default values in the status word (upon power up or after an "INT" command) are also shown in the figure.

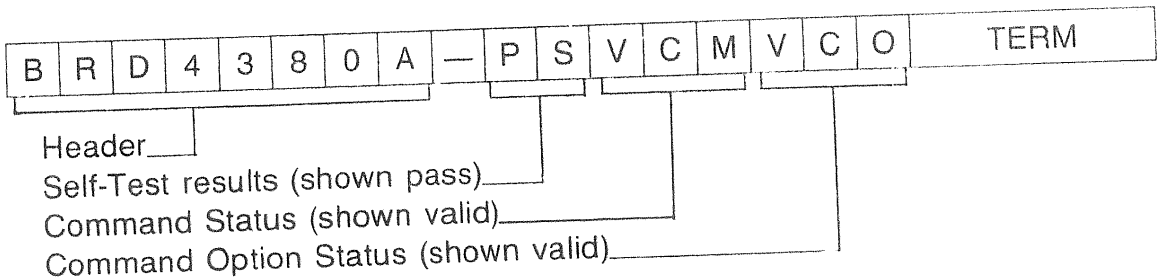
Table 3-4. Machine Status Word.



3-52. ERROR STATUS (U1)

3-53. The U1 command allows access to Model 4380A-232 error conditions in a similar manner. Once the sequence U1 is sent, the instrument will transmit the error conditions with the format shown in Table 3-5 the next time it is addressed to talk in the normal manner. The error condition word will be transmitted only once each time the U1 command is given. Note that the error word is actually a string of ASCII characters.

Table 3-5. Error Status Word.



3-54. The various characters in the error condition word are described as follows:

PS - (Self-test pass) occurs when a self-test has been commanded via the "J" command and the test was okay.

FL - (Self-test fail) occurs when a self-test has been commanded via the "J" command and the test has failed.

ICM - (Invalid command) occurs when an illegal device-dependent command (IDDC) such as V2 is received (V is illegal).

VCM - (Valid command) occurs when no illegal device-dependent command is received.

ICO - (Invalid command option) occurs when an illegal device-dependent command option (IDDCO) such as T6 is received (6 is illegal).

VCO - (Valid command option) occurs when no illegal device-dependent command option has been received.

All messages above will revert to their non-error conditions after the reading of the U1 work.

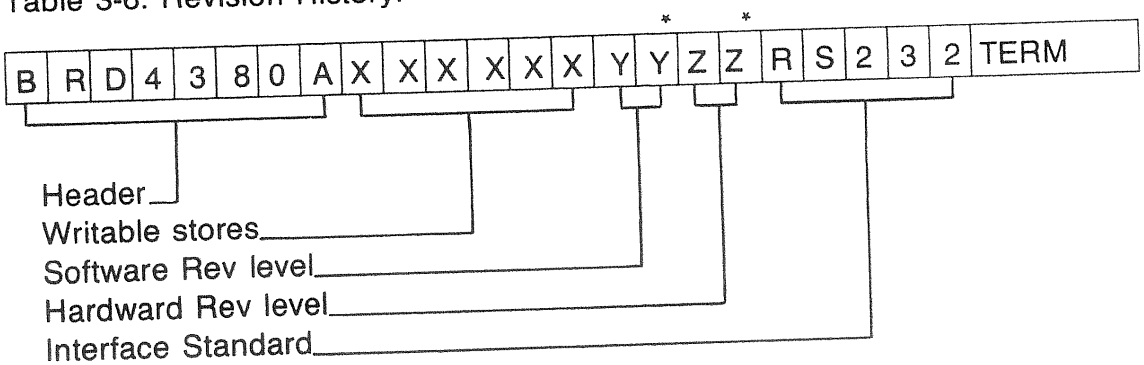
3-55. LAST READING (U2)

3-56. In a similar manner the U2 command allows access to the previous message (or reading) sent back on the interface. Note that if the previous message was the result of a "U" (status) request; it will be repeated. The format for the U2 command depends on what the last interface message (or reading) happened to be.

3-57. REVISION HISTORY (U3)

3-58. In a similar manner the U3 command allows access to the writable store, software revision level and hardware revision level. The format for the U3 command is shown in Table 3-6 below:

Table 3-6. Revision History.



* YY is replaced with current software revision level. ZZ is replaced with current hardware revisions levels.

3-59. IBM PC/XT Programming Example - Enter and run the program below to obtain and display all 4 status words.

```
10          OPEN "COM1:2400,N,8,2" AS #1
20          FOR I = 0 TO 3 : READ B$
30          PRINT #1, B$; :PRINT #1, "ENT";
40          IF LOC (1)<21 THEN 40
50          A$= INPUT$(LOC(1),#1)
60          PRINT A$
70          NEXT I
80          STOP
90          DATA "U0","U1","U2","U3"
100         END
```

3-60. In the example program, a loop is set up to request all 4 status words (line 20). The status word command is then sent to the instrument (line 30), and status is then requested and displayed (lines 50 and 60).

3-61. **SELF TEST (J0)**

3-62. The self test command, allows you to test much of the internal circuitry of the Model 4380A-232.

3-63. The self test is run by sending the following command over the bus:

J0

3-64. The instrument will then run the test and set the self test bytes in the U1 status word. A complete description of the U1 (error) status word may be found in paragraph 3-49. J0 must be given each time you wish to have the self test run. Note: the default condition in the status is "FL". You must send J0 to get "PS".

3-65. Refer to Section IV - Maintenance for troubleshooting procedures if the self test should indicate a failure. Upon power up or after a "INT" command the 4380A-232 will be in the J0 mode (no self test).

3-66. IBM PC/XT Programming Example - Use the program below to run the self test and obtain and display the U1 status word.

```
10          OPEN "COM1:2400,N,8,2,RS,CS" as #1
20          PRINT #1, "J0U1ENT";
30          FOR I = 1 to 1000 : NEXT I
40          If LOC (1)<21 then 40
50          A$ = INPUT$(LOC(1),#1)
60          PRINT A$
70          END
```

3-67. In this program, the instrument is programmed to perform the self test (line 20). The program waits 10 seconds for the instrument to perform the self test (line 30), and then obtains and displays the error status word (lines 40-70). PS will indicate PASS and FL will indicate failure in the U1 status word.

3-68. WRITABLE STORE (W)

3-69. The W command gives control of six (6) bytes on RAM memory on the 4380A-232. The six bytes could represent the configuration of Bird equipment the 4380A-232 is controlling or the six bytes could be used to store any 6 bytes of ASCII the system designer desires.

3-70. The six (6) bytes are sent back in the U3 status response. The format to send the command is as follows:

WXXXXXX where XXXXXX are the six bytes

Note - The 6 bytes are taken no matter what they are - no error checking is done for 6 bytes.

3-71. Upon power up the six bytes will contain ASCII nulls (Hexadecimal 00).

3-72. IBM PC/XT Programming Example - Enter the following statements to program the instrument for a W response.

```
10          OPEN "COM1:2400,N,8,2,RS,CS," as #1
20          PRINT #1, "W4391--";
30          PRINT #1, "U3ENT";
40          If LOC (1)<25 then 40
50          A$ = INPUT (LOC(1),#1)
60          PRINT A$
70          END
```

3-73. In this program the instrument receives its 6 bytes and U3 command gives that request to the computer (line 30). For the example above the response would be.

BRD4380A-232-4391 YYZZ* RS232

* YY is replaced with current software revision level. ZZ is replaced with current hardware revisions levels.

3-74. TALKER ALWAYS

3-75. With the CMD OFF switch selected on the front panel cycle the power on the 4380A-232. This places the unit into the Talker Always Mode, continuously. The power up default conditions are in effect for all other parameters.

3-76. The operator is now able to press any key on the wattmeter (with exception of the DELTA key) and generate a measurement to be written to the bus. Upon completion of the measurement the 4380A-232 will output the information to the interface. The Log LED will go on momentarily indicating the 4380A-232 is ready and another key can be depressed.

Note - This mode of operation can be used if you do not desire Request/ Response message protocol. With the switch in the CMD OFF (Talker Always) position any triggered response will get an automatic data send back when reading is completed.

SECTION IV - MAINTENANCE

4-1. GENERAL

4-2. The Model 4380A-232 requires no internal adjustments or periodic calibration. The connectors should be cleaned frequently with alcohol to insure good contact.

4-3. TROUBLESHOOTING

4-4. Due to its complexity, repair of the 4380A-232 in the field is recommended only for certain malfunctions. The following is a list of these malfunctions and corrective action.

PROBLEM	POSSIBLE CAUSE	REMEDY
Power Supply or No Power Indicator	Blown fuse	Replace fuse.
	115/230 switch	Check for correct setting.
	ac power cord	Check for shorted cord.
	Broken LED	Replace LED (DS2).
No Device Response	RS232 cable	Clean contacts and check for good connection.
	Dip switch	Verify proper setup and function selection. Replace dip switch if broken.
	Command format	Verify RS232 interface command(s) sent in right order.
	Inoperative Device	Contact factory.
Incorrect Measurement	Interface cable	Clean contacts and check for good connection. Replace cable if suspect Verify operation of wattmeter.

For problems more complex than those listed, it may be necessary to return the unit to Bird for analysis and repair. A call or telegram to the Bird Customer Service Department will help determine the best solution for the problem.

CAUTION

The 4380A-232 contains MOS integrated circuits which may be damaged by static electricity. Open the housing only when sure that there are no static producing materials such as carpeting or styrofoam where the work is to be done. Work on a conductive, grounded work surface touching it frequently to discharge static from your body. If a part is to be stored or shipped, wrap it in conductive packaging materials designed for static sensitive circuitry.

WARNING

If removal of cover becomes necessary, unplug device. The potential of electrical shock exists.

4-5. DISASSEMBLY

4-6. To remove top cover, remove the 10 button head machine screws. Disassemble beyond this point is not recommended since complete disassembly is required to remove PC board.

SECTION V - REPLACEMENT PARTS LIST

5-1. MODEL 4380A-232

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
1	1	Assembly, P.C. Board	4380-236
2	1	Assembly, A.C. Receptacle	4380-004
3	1	Switch, Power	5-1301
4	1	Switch, Dip	5-1264-2
5	1	Fuse	5-721-14
6	2	Stand-off, Stud Mount	5-1639
7	2	Stand-off, Stud Mount	5-1312
8	1	Cable Assembly	5-1663
9	1	Cable Assembly I/O	5-1626
10	1	Cable RS-232 Bus (10 ft.)	5-1662-2
11		Cable RS-232 Bus (5 ft.)	5-1662-1
12	1	Cord, Power	5-1286

SECTION VI - RS232C (SERIAL I/O) INTRODUCTION

6-1. GENERAL

6-2. Serial I/O simply means the transmission of data, one bit after another, over a line. Contrast this with IEEE 488 I/O, which transfers eight data bits simultaneously. Each method of data transmission has unique advantages and disadvantages. IEEE 488 I/O can transfer eight data bits at a time but requires one wire (or line) for each bit. Serial I/O transfers data one bit at a time but only requires one wire for the data and one wire for the ground. The cost and logistics of IEEE 488 I/O become prohibitive when considering communication over distances greater than 60 feet. Serial I/O allows for inexpensive long-distance communication through use of an existing telephone system through modems.

6-3. EQUIPMENT CONFIGURATION

6-4. Serial I/O devices are described according to the functions that they perform. These functional descriptions are: Data Terminal Equipment, and Data Communications Equipment.

6-5. DATA TERMINAL EQUIPMENT

6-6. Data Terminal Equipment (DTE) is any location in a network where information can enter or exit. Items included as DTE are:

* The remote terminal.
* The remote terminal interface.
* The host computer.
* The host computer interface.

Note - The Model 4380A-232 is configured as DTE.

6-7. DATA COMMUNICATIONS EQUIPMENT

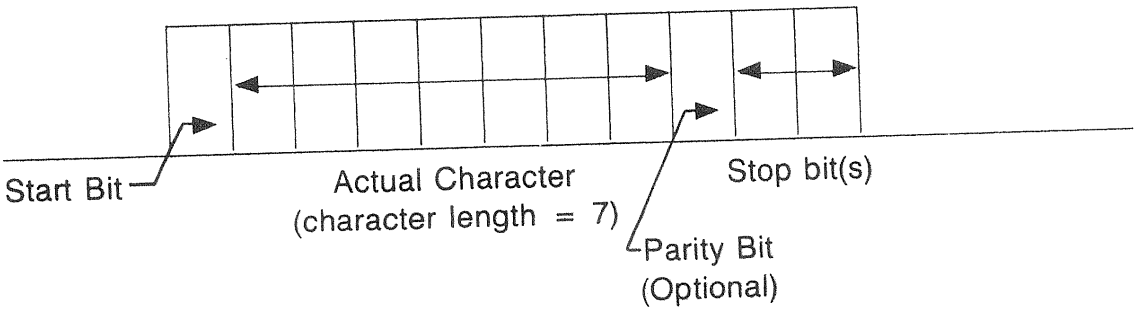
6-8. Data Communications Equipment (DCE) is the equipment used to convey information between locations. Items included as DCE are:

* The modems.
* The modem interfaces.
* The link (e.g., telephone lines).

6-9. ASYNCHRONOUS DATA TRANSMISSION

6-10. The RS232C Interface communicates asynchronously with other devices. Asynchronous communication means simply that each character is sent over the line (or line) with synchronization built into the character. The next drawing shows typical asynchronous transmission of characters.

Figure 6-1. Character Definition.



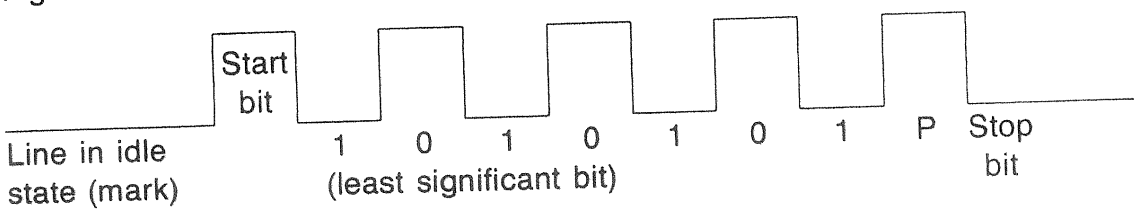
6-11. The actual data is transmitted over the line using two voltage levels to represent the two possible states of a binary digit. The following table shows the two binary states and the voltage levels assigned to each state.

Figure 6-2. Binary Digit States.

Binary State:	Logic 0	Logic 1
Voltage Range:	+3V to +25V	−3V to −25V
Level Name:	SPACE	MARK
Line State:	high	low (idle)

6-12. When data is not being transmitted, the line is held in the low (or mark) state. When the transmitting device has data to send, it places the line in the high (space) state for one bit time. This change to the high state for one bit time is called the start bit. The remaining digital data is then transmitted to the receiving device. The following drawing shows how a typical character (an ASCII "U") is transmitted over the link.

Figure 6-3. Character Transmission.



6-13. The previous figures show characters that consist of a start bit, the actual ASCII character, a parity bit, and a stop bit. The meaning of each of these parts of the character is given below:

6-14. **START BIT**

6-15. The start bit is inserted at the beginning of the character by the interface. The start bit is used to signal the receiving device that the transmission of a character is starting. When the start bit is detected, the receiver starts its internal clock to synchronize the receiver to the input data.

6-16. DATA CHARACTER

6-17. The character is the binary bit-pattern of the actual transmitted character. For example, the bit pattern 0101 0101 is transmitted for the ASCII "U" character. Assuming that the receiver expects ASCII characters, it interprets the bit pattern as a "U".

6-18. Note that the ASCII code is made up of seven bits. Other codes may be made up of five, six, or eight bits. The interface provides a "character length" specification to define the number of bits that make up a character. This "character length" specification does NOT include start, stop, or parity bits. The factory setting for the switches specifies eight bit character length.

6-19. PARITY

6-20. Parity provides a method of error checking. The parity bit (if specified) always follows the character. No parity bit is added when parity is not specified (parity = none). The parity bit is always a "0" when parity = mark is specified. Parity = even and parity = odd specify that the parity bit is determined as shown below:

Table 6-1. Parity Bit Settings.

Number of Bits in Character	Parity Specified	Parity Bit
Odd	Odd	0
Even	Odd	1
Odd	Even	1
Even	Even	0

6-21. For example, the bit pattern for the ASCII "2" character is 0 110 010. There are three "1" bits in this pattern. If odd parity is specified, the parity bit is "0". If even parity is specified, the parity bit is "1". The factory setting for the reset default switches specifies no parity.

6-22. STOP BITS

6-23. Stop bits are added following the parity bit by the interface. The stop bits are not really bits. The transmitter holds the line in the "idle" state for the amount of bit times specified by the stop bits parameter. This amount of bit times is referred to as stop bits. Allowable stop bits parameters are 1 and 2. The factory setting for the switches specifies two stop bits.

6-24. TRANSFER RATES (OR BAUD)

6-25. When two devices are communicating, they must transfer and receive information at compatible data rates. If the transmitter sends data at a faster rate than the receiver is expecting the data, information will be lost. Most devices (such a printers) provide a switch to select the data rate. The RS232 interface provides programmable data rates and a switch selectable data rate. The factory setting for the switches specifies 2400 Baud.

6-26. HANDSHAKES

6-27. Handshakes are used to communicate status information from one device to another. The handshakes are used to indicate a buffer full condition, received data errors, and modem status. Some devices use modem lines to indicate an input buffer full condition (i.e., Printer Interfacing).

6-28. ENQUIRE/ACKNOWLEDGE

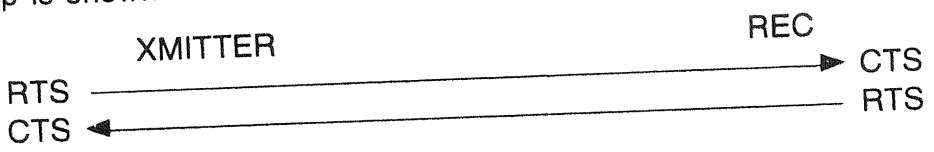
6-29. Some peripherals and host computer systems use the ENQuire/ACKnowledge protocol for buffer-full or not-ready indication. When the transmitting device sends a line of text to a receiver, an ENQuire character, e.g., CHR$(5), is also transmitted following the text. The transmitter waits for an ACKnowledge character, e.g., CHR$(6), from the receiver before sending another line of text. The receiver responds with the ACKnowledge response if the input data contained no errors and there is sufficient space in the input buffers for at least one more line of text. This discussion uses the ASCII ENQ and ACK characters for the handshake sequences. Other ASCII characters such as ENQ/ESC may be used for these sequences.

6-30. XON/XOFF

6-31. Another handshake protocol used in peripherals and host computer systems is the XON/XOFF handshake (commonly referred to as the DC1/DC3 handshake). During data transfers, the receiver monitors its input buffers to ensure that sufficient space remains for at least one more line of data. When there is not sufficient space remaining in the input buffers, the receiver sends and XOFF (normally a DC3) to the transmitter. The transmitter then suspends further transmission until the receiver sends an XON (normally a DC1) to indicate that transmission may resume. The receiver sends the XON when sufficient buffer space becomes available for at least one more line of text. The Model 4380A-232 uses the XON/XOFF handshake protocol as its software protocol.

6-32. HARDWARE RTS/CTS

6-33. In addition to software handshakes above, hardware handshakes can also be provided. One such handshake is the RTS/CTS handshake. (Its' operation is similar to XON/XOFF.) During data transfers, when the trans- mitting device sends a line of data the receiver monitors its input buffers to ensure that sufficient space remains for that line of data. When there is not sufficient space the receiver unasserts the xmitters CTS line, to indicate to the transmitter that it must suspend further transmission until the receiver again asserts the CTS line. A typical hook up is shown below:



6-34. The Model 4380A-232 uses this RTS/CTS handshake protocol. It can be defeated by hardwiring RTS to CTS on each device and not letting the other device control the line.

SECTION VII - CONTROLLER PROGRAMS

7-1. GENERAL

7-2. The following programs have been supplied as a simple aid to the user. Each program allows you to send a device-dependent command string to the instrument and obtain and display an instrument reading string.

7-3. Programs for the following controllers are included:

* IBM PC or XT
* Hewlett-Packard Model 85

7-4. IBM PC OR XT

7-5. The following program sends a command string to the Model 4380A-232 from an IBM PC or XT computer and displays the instrument reading string on the CRT. The computer must be equipped with an asyncronous RS232C communications adapter, the DOS 2.00 operating system, and BASIC (or BASICA).

7-6. DIRECTIONS

a. Set the dip switches to 2400 Baud, 2 stop bits, 8 data bits and no parity.

b. With the power off, connect the Model 4380A-232 to the RS232 interface installed in the IBM computer.

c. Type in BASICA on the computer keyboard to get into the IBM interpretive BASIC language.

d. Enter the lines in the program below.

e. Run the program and type in the desired command string. For example, to place the instrument in the forward carrier wave, type in FC.

f. The instrument reading string will then appear on the display. For example, the display might show NFC 1.234.

g. To exit the program, type in <CNTRL><BREAK>.

Note - Remember to install a null modem in this application.

PROGRAM	COMMENTS
50 SCREEN 0,0:CLS	Set screen and clear it.
60 PRINT "BIRD RS232 TEST IN PROGRESS, DEPRESS <CNTRL><BREAK> TO STOP"	
70 PRINT	
80 FALSE=0: TRUE=NOT FALSE	Define flags.
90 XOFF$=CHR$(19) :XON$=CHR$(17)	Define Xon/Xoff.
100 OPEN "COM1:2400,N,8,2,RS,CS" AS #1	File #1 is COM, 2400 Baud, No parity, 8 data bits, 2 stop bits
110 OPEN "SCRN:" FOR OUTPUT AS #2	File #2 is display.
120 LOCATE ,,1	Cursor to top.
130 FULL =FALSE:ON ERROR GOTO 240	Start with Xon flag=ok.
140 B$=INKEY$:IF B$<>""THEN PRINT #1, B$;:PRINT B$;	If not a null send to COM.
150 IF EOF(1) THEN 140	Wait for a char to be typed.
160 IF LOC (1)>128 THEN FULL =TRUE : PRINT #1,XOFF$;	
170 A$=INPUT$(LOC(1),#1)	Get char which came in.
180 LFP=0	Strip line feed's.
190 LFP=INSTR(LFP+1,A$,CHR$(10)	
200 IF LFP>0 THEN MID$(A$,LFP,1)=" " :GOTO 190	
210 PRINT #2,A$;: IF LOC(1)>0 THEN 160	Display incoming char's.
220 IF FULL THEN FULL =FALSE:PRINT #1,XON$;	Room now avail allow in char.
230 GOTO 140	
240 PRINT "ERROR NO.";ERR : RESUME	

7-7. HEWLETT-PACKARD MODEL 85

7-8. The following program sends a command string to the Model 4380A-232 from an HP-85 computer and displays the instrument reading string on the computer CRT. The computer must be equipped with the HP82939A RS232 Interface and an I/O ROM.

7-9. DIRECTIONS

a. Set the dip switches to 2400 Baud, 2 stop bits, 8 data bits, and no parity on the Model 4380A-232 and the HP85.

b. With the power off, connect the Model 4380A-232 to the HP RS232C interface installed in the HP-85 computer.

c. Enter the lines in the program below, using the END LINE key after each line.

d. Press the HP-85 RUN key and type in the desired command string. For example, to place the instrument in the forward carrier wave mode type in FCENT and press the END LINE key.

e. The instrument reading string will then appear on the CRT. A typical display is: NFC 1.234.

PROGRAM

```
10  DIM A$[50]
20  CONTROL 10,11;194,13
30  INPUT A$
40  OUTPUT 10;A$
50  ENTER 10 USING"%,%K";A$
60  DISP A$
70  GOTO 30
100 END
```

COMMENTS

```
!Dimension string.
!Set Xmit flag for Xon/Xoff.
!Send programming command.

!Get value.
```

SECTION VIII - IBM BASIC STATEMENTS

8-1. GENERAL

PROGRAM STATEMENT	COMMENT
OPEN"COM1:2400,N,8,2" AS #1	Open communications channel #1 2400 Baud, no parity, 8 data bits, 2 stop bits, as File #1
IF LOC (1)<15 THEN 30	Wait for incoming char in File #1
A$ = INPUT$(LOC(1),#1)	Read character from input file into string variable A$
PRINT #1,B$;	Send character to interface from string variable B$ NOTE; suppress <CR> <LF> and other characters

-NOTES-