



**MFJ RTTY/CW
COMPUTER INTERFACE**



MODEL MFJ-1224

OWNER'S MANUAL

MFJ-1224 RTTY/CW COMPUTER INTERFACE









Thank you for purchasing the MFJ-1224 Interface. The MFJ-1224 will allow you to transmit and receive RTTY and CW when used with your transceiver. During reception, the MFJ-1224 converts the CW or AFSK tones from your receiver into computer compatible TTL level signals. The computer then translates these signals into the represented alpha-numeric characters and displays them on the screen. In the Transmit Mode, the computer generates the TTL signals which are converted by the Interface into AFSK tones for RTTY or into CW keying for CW transmission.

NOTE: The interpretation of the TTL signals requires a specialized HAM program which is not provided with the interface. This allows you to select a program which is compatible with your computer and which has the features you want.

When unpacking, make sure that all of these items are included: (1) INTERFACE, (1) FOUR PIN MIC PLUG, (1) RCA CABLE, (1) FIVE PIN PLUG, (1) MIC CABLE WITH FIVE PIN PLUG ATTACHED and (1) OWNERS MANUAL. THE 12-VDC AC-ADAPTER IS OPTIONAL.

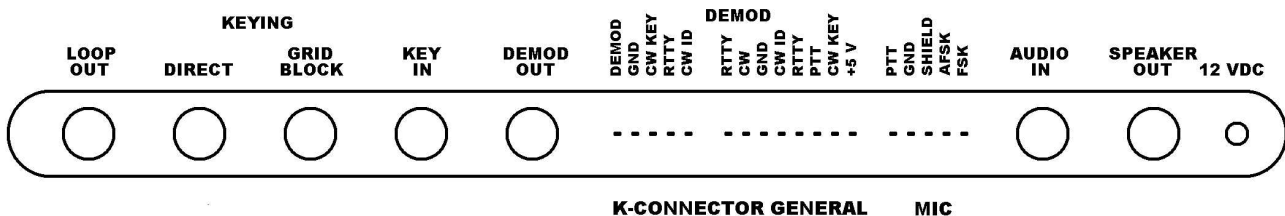
FRONT PANEL

The front panel controls and indicators consist of five push button switches and four LEDs. From left to right, they are as follows:

ON/OFF	This switch controls the power to the interface.
POWER LED	This indicator is lit when the power is on.
PHASE LOCK LED	This indicator is used with the DATA indicator to aid in tuning the receiver. It indicates when the interface is locked onto an RTTY signal. It flashes with the Morse Code tone for CW reception.
DATA LED	This indicator is used with the PHASE LOCK indicator to aid in tuning the receiver. It flashes on and off with RTTY shift and also flashes with the Morse Code tone for CW reception.
CW Transmit LED	This indicator is activated by the CW keying circuit. It flashes during CW transmission.
RTTY/CW	This switch selects either the RTTY or CW mode of operation.
Shift	<p>The next two switches control the shift for RTTY:</p> <div><div></div><div></div><p>In this position the interface is set for a 850 Hz audio shift</p><div></div><div></div><p>In this position the interface is set for a 170 Hz audio shift</p><div></div><div></div><p>In this position the interface is set for a 425 Hz shift and 170 Hz sending shift</p><div></div><div></div><p>In this position the interface is set for a 425 Hz shift and 850 Hz shift</p></div>
NORMAL/REVERSE	This switch inverts the demodulated RTTY signal being sent to the computer.

BACK PANEL

The MFJ-1224 provides inputs and outputs to allow interfacing to nearly any possible combination of computer and transceiver. The back panel diagram below shows all the interface connections and the paragraphs below describe their uses. Only a few of the available connections will be used for any given application; however, the available of a variety of signals greatly enhances the versatility of the interface.



- LOOP OUT** The loop-out jack provides the ground return to drive loop type teletypes. The user must connect the negative supply voltage to the sleeve. The center pin is a continuation of the negative supply. The loop out merely acts as a spst switch switching the loop current on and off.
- DIRECT KEYING** This output keys rigs requiring direct keying (most rigs with solid state finals)
- GRID BLOCK KEYING** This output keys rigs requiring grid block keying (most rigs with tube finals)
- KEY IN** This input jack allows you to externally key the transmitter with your own electronic keyer or keyboard.
- DEMODO OUT** The demodulated output provides a TTL level signal which corresponds to the incoming RTTY or CW signal. This output is high on RTTY mark and low on RTTY space. It is also low for CW tone.

The next connector is a five pin jack, labeled K-connector because it is specifically designed for use with KANTRONICS software. From left to right the pins are as follows:

- DEMODO** This pin produces the same output as the DEMODO out jack.
- GROUND** This pin provides the ground connections between the interface and the computer.
- CW KEY** This input pin allows the computer to key the transmitter through the interface. A low on this pin causes the interface to key the transmitter.
- RTTY** This input controls the AFSK for RTTY transmission. It works in conjunction with CW ID signals and to operate the push-to-talk switch. This will be covered in detail later.
- CW ID** This line controls the audio tone for CW identification. It works in conjunction with the RTTY line to produce RTTY and CW ID signals and operate the push-to-talk switch. This will be covered in detail later.

Next is a eight pin general purpose connector which allows you to adapt the interface to almost any computer and software. An internal DIP switch allows the inputs and outputs to be inverted if necessary to correspond to the requirements of your computer. From left to right, the pins are as follows:

RTTY DEMOD	This output is a TTL version of a received RTTY signal.
GROUND	This pin provides the ground connection between the interface and the computer.
CW ID	This input pin controls the shift for CW ID transmission.
RTTY	This input pin controls the mark and space shift for RTTY transmission.
PTT	This input controls the push-to-talk switch of the transmitter.
CW KEY	This input controls the transmitter keying circuit.
+5 VDC	This input provides a 5 volt supply for external circuitry such as an RS-232 converter.

Next is a five-pin jack which is used for the microphone connection. From left to right, the pins are as follows:

PTT OUT	This pin is connected to the high side of the push-to-talk line. It is shorted to ground to key the microphone.
PTT GROUND	This pin is connected to the ground side of the push-to-talk line.
AFSK SHIELD	This pin is connected to the ground for shield side of the AFSK line.
AFSK OUT	This line carries the audio signal for AFSK RTTY to the microphone input.
FSK OUT	This line provides FSK signal for keying FSK rigs.
AUDIO IN	The audio input jack should be connected to the external speaker jack or headphone jack of your receiver with a shielded audio cable. The interface end of the cable requires an RCA type plug.
SPEAKER OUT	The speaker output jack may be connected to a speaker using shielded audio cable. The interface end of the cable requires an RCA type plug.
12 VDC	The power jack requires 12 VDC from a 2.5 mm subminiature plug with the tip positive and the sleeve ground.

PRELIMINARY CONNECTIONS

Input and output signals must be TTL level (+5 VDC and ground). Inputs are RTTY and CW KEY (RTTY and CW on general purpose connector). There is also a separate CW ID input for identifying in MORSE while operating RTTY. Outputs are DEMOD (RTTY DEMOD and CW DEMOD on the GENERAL PURPOSE CONNECTOR) and DIRECT and GRID BLOCK. Connections depend on the type computer and transceiver used. Either the GENERAL CONNECTOR or the K-CONNECTOR will be connected to the computer.

CONNECTIONS

FOR CW For transmission and reception of CW, the following connections are necessary.

- 1.) A 12 VDC power supply to the POWER jack of the interface.
- 2.) A shielded audio cable from the external speaker jack of the transceiver to the AUDIO in jack of the interface.
- 3.) If desired, a speaker may be connected to the SPEAKER out jack of interface.
- 4.) If the interface is to be used to key the transmitter by hand, the key should be connected to the KEY in jack.
- 5.) The control cable from the computer to the interface.
- 6.) A cable from one of the KEY out jacks of the interface to the key in jack of the transceiver. If you are not sure whether your transceiver requires GRID BLOCK or DIRECT KEYING, try one and then the other to see which one works. No damage will be done if the wrong one is selected.

FOR RTTY/ASCII For transmission and reception of RTTY or ASCII signals the following connections are needed:

- 1.) A 12 VDC power supply to the POWER jack of the interface.
- 2.) A shielded audio cable from the external speaker jack of the transceiver to the AUDIO in jack of the interface.
- 3.) If desired, a speaker may be connected to the SPEAKER out jack of the interface.
- 4.) The microphone/PTT cable to the transmitter. This cable is supplied with the proper push on the connector on one end and with the other end unwired. This allows the cable to be connected properly for various types of transmitters. For transmitters that have three wire microphone connectors, only three of the microphone cable are needed. AFSK shield should be connected to ground, PTT should be connected to PTT OUT and AFSK should be connected to the AUDIO INPUT. The FSK OUT is not connected when used for AFSK operation. Consult the owner's manual for your transceiver to determine the proper connection of the MICROPHONE JACK. The white wire is the audio line, the red wire is the PTT line, the black wire is the PTT ground line, the bare (shield) wire is the audio ground and the green wire is the FSK line.
- 5.) The control cable from the computer to the interface.
- 6.) If the interface is to drive a TTY current loop, the TTY should be connected to the LOOP out jack. The sleeve is the negative side of your supply. The LOOP OUT pin is usually connected to the negative side of your selector magnets.

INTERNAL CONTROLS

Caution: Improper adjustments of the internal controls will prevent the interface from functioning.

The MFJ-1224 has several internal controls and adjustments, as shown in the diagram and described below. The layout is shown in FIGURE 4.

AUDIO OUT GAIN This controls the level of the audio for AFSK output. It is preset at the factory to a reasonable level for most transmitters. Some adjustments may be required if your transmitter requires a higher or lower setting. The best results usually occur with high level from the interface and a low mic gain setting on the transmitter.

INPUT LEVEL It is very important that the input is set to the proper level for use with your rig. First tune the radio until no signal is heard (static only), then set the volume slightly louder than your normal listening level. Turn the input level pot to the point where the static does not cause any flickering of either the PHASE LOCK LED or the DATA LED.

OPERATION

SETTING UP THE MFJ-1224 for CW

Computer Operation:

Enter the program into your computer. Follow the directions provided with your software. If using the Kantronics software, it will ask you to "PRESS K" for Kantronics interface or "T" for user terminal unit. You must press "K". If you press "T", your transmitted RTTY will be inverted.

Teletypewriter Operation:

If your radio teletype provides TTL voltages for input and output, you can hook it directly to the MFJ-1224. If not, you will have to use the loop supply circuit and a current loop to the TTL interfaces. (SEE *CQ*, November 1983, page 49.)

CW OPERATION:

The MFJ-1224 uses it's Active RTTY filter to give selectivity for Morse signals and is tuned to 2125 Hz., one of the RTTY "High Tones"; considerably higher than the usual 900 – 1000 Hz. In order to center your CW signal to the CW frequency of the station you are working, some adjustment to your receiver's controls will be necessary.

ON/OFF SW to ON
RTTY/CW SW to CW
SHIFT SWITCHES to 170
NORM/REV SW to NORM



TOP VIEW

FIGURE 3

MFJ-1224 CONTROL SETTING

1. Set the front panel switches on the MFJ-1224 as shown in Figure 3.
2. Tune the receiver until you hear only noise.
3. Turn the audio gain up to maximum.
4. Reduce RF gain for a comfortable listening level.
5. Remove the cover of the MFJ-1224.
6. Adjust the internal input level trimpot (next to the NORM/REV switch) until the PHASE LOCK LED and the DATA LED do not flicker with the audio input (noise). (SEE Figure 4.)

Transceiver Settings:

SET: Mode to CW
X-tal to ON
RIT to OFF
IF-Shift to ZERO (Center)

Tune in the X-tal Cal as a Morse LO-Tone (900 – 1000 Hz).

Turn ON the RIT.

Please do not touch the VFO.

Transceivers without CW Filters:

Adjust RIT for a higher pitch until the MFJ-1224's PHASE LOCK and DATA LEDs light. Finish the setting under the heading "FINISH".

Transceivers with CW Filters, RIT and IF-SHIFT:

Adjust RIT for a higher pitch. Note that as the pitch goes up, the signal begins to move out of the PASSBAND of the CW FILTER (S-Meter starts to fall). Using IF-SHIFT, move the CW FILTER PASSBAND, keeping it over the signal (S-Meter UPSCALE). Continue raising the pitch with the two controls also watching the MFJ-1224's PHASE LOCK and DATA LEDs. When the LEDs come on, carefully adjust the RIT to center the signal in the PASSBAND of the MFJ RTTY FILTER. Carefully adjust the IF-SHIFT to center the signal in the PASSBAND of the transceivers CW FILTER. Finish under the heading "FINISH".

Transceivers with CW Filters, No IF-Shift:

Switch to USB and adjust the RIT, as above, for "Transceivers without CW Filters." You will receive and tune stations in the USB MODE, transmit in the CW MODE. Finish the setting under the heading "FINISH".

Transceivers with CW Filters, No RIT:

Remove the CW FILTER so that the MORSE may be copied via the SSB FILTER. The MFJ-1224 will provide the selectivity as needed for computer work. Proceed as per "Transceivers without CW Filters".

Finish:

Log the settings of the CONTROL(s) for future reference. Turn the X-TAL CAL OFF.

With the controls of the MFJ-1224 set for CW, all Morse Tuning will be made with the VFO. Your transmit signal will appear on the frequency to which the other station is listening. If the transceiver has a digital display frequency counter, then your actual transmit frequency will be displayed DURING TRANSMIT. Please resist any temptation to adjust the RIT and IF-SHIFT from their "preset" positions.

CW TUNING

1. Tune the receiver to start at a low pitched tone, then progressively tune for a higher pitch. As you tune higher in pitch, the following occurs:
 - A. The PHASE LOCK LED blinks On and Off with the code.
 - B. Both PHASE LOCK and DATA LEDs blink On and Off simultaneously.
 - C. Both LEDs remain Off.

*** IMPORTANT ***

The only correct tuning occurs at 'B' above when both the PHASE LOCK and the DATA LEDs blink ON and OFF simultaneously with the code.

When the PHASE LOCK and DATA LEDs are blinking simultaneously with the code and you don't see noise spikes triggering the LEDs, the DEMOD output will be low (0 VDC) for no tone and high (+5 VDC) for a tone.

2. Look at your TV screen. The Morse should be followed correctly.

NOTE: It may take several lines for the computer to start receiving the Morse correctly.

SETTING UP THE MFJ-1224 FOR RTTY

Tuning RTTY signals is much easier than tuning CW because reception is not affected so much by noise. Since the signal is always present, noise doesn't have a chance to affect the reception as in CW where the signal is absent for so much time. If adjustment for CW has already been made, then adjustment for RTTY will probably not be necessary. If the input level trimpot has not been adjusted, follow the procedure for CW, steps 1 through 6.

*** CORRECT TUNING ***

The only correct tuning condition on RTTY is when the PHASE LOCK LED is ON continuously and the DATA LED is blinking on and off the most pronounced.

1. Set the switches on the MFJ-1224 for RTTY, 170 Hz shift, and NORMAL (SEE Fig. 3A).
2. Set the computer for 60 WPM RTTY. Most RTTY on the Amateur HF bands is set at 60 WPM, 170 Hz shift.
3. Select an RTTY station on the receiver. The receiver should be LSB. Start tuning from a low pitched tone to a high pitched tone. When the mark frequency of 2125 Hz is received, the PHASE LOCK LED is on.
4. Continue tuning until you see the most pronounced ON and OFF blinking of the DATA LED.



Figure 3A

TO CALIBRATE The MFJ-1224 Computer Interface is adjusted at the factory. However, should re-calibration be necessary, here is the procedure for all frequency related devices in the Computer Interface.

CALIBRATION OF THE PLL FREQUENCY

1. Set the MFJ-1224 Computer Interface to receive ASCII at 300 baud, 170 Hz shift.
2. Record from AFSK Connector of the GENERAL PURPOSE CONNECTOR, two minutes of "*" and "U" (Capital U) repeatedly on a tape recorder. NOTE: The audio tone control should be set high.
3. Play the tape back into the audio input of the MFJ-1224.
4. Observe the flashing rate of the PHASE LOCK and the DATA LEDs.
5. When the LED of the PHASE LOCK is on steadily, and the "*" and "U" is occurring on the screen error free, the PLL frequency is at 2210 Hz.
6. Turn the tab of the PLL trimpot until the PHASE LOCK LED is on steadily, and the data is running across the screen correctly. SEE Figure 4.

NOTE: The DATA LED light will emit only while data flows. The PHASE LOCK LED will emit steadily when the PLL frequency is correct. Indiscriminate emission of the PHASE LOCK LED means, that either PLL is off frequency or that the audio level is too high, allowing copying of random noise.

CALIBRATION OF THE MARK FREQUENCY

1. Connect the computer or radioteletype control cable to the MFJ-1224.
2. All DIP switches in the 1224 should be OFF.
3. Turn the Interface On and set the front panel switches for RTTY, 170 Hz shift, and NORMAL polarity.
4. Enter the program into the computer. If using a radioteletype, go down to 9.
5. If you are using Kantronics Hamsoft™, press "K" when asked to choose "K" if using a Kantronics Interface or T-User Terminal Unit.
6. Connect a frequency counter with a 1:10 probe to the AFSK output pin of the MIC jack.
7. Go to the RTTY section of the program.
8. Put the computer into RTTY TRANSMIT with no characters in the buffer. For Hamsoft™ on the VIC-20™ this is CTRL-T. Now go to 10.
9. Put the radioteletype in the MARK condition (Loop Current Flowing).
10. Adjust VR2 trimpot (see Fig 4.) for a frequency of 2125 Hz (± 2 Hz).

<p>NOTE: The MARK and SPACE frequencies must be set while the Interface is connected to the computer or radioteletype.</p>
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Calibration of 170 Hz Shift

1. Put the computer into RTTY RECEIVE. For Hamsoft™ on the VIC™.
2. Connect a frequency counter in the same manner as setting the MARK Frequency.
3. The counter should read 2295 Hz.
4. If the counter doesn't read 2295 Hz, then adjust VR3 (see Fig 4) for a reading of 2295 Hz (± 2 Hz).

Calibration of the 850 Hz Shift

1. Set the MFJ-1224 front panel switches for 850 Hz shift.
2. Connect a frequency counter as in Calibration of the MARK Frequencies.
3. The frequency counter should read 2975 Hz.
4. If the counter doesn't read 2975 Hz, adjust VR4 (see Fig. 4) for a reading of 2975Hz (± 2 Hz).

SOFTWARE CONSIDERATIONS

DIP SWITCH There is an eight switch DIP package on the PC board. These switches are used to configure the inputs and outputs of the GENERAL PURPOSE CONNECTOR to work correctly with your computer and software. The following chart illustrates functions of each switch:

SWITCH	POSITION	FUNCTION	SIGNAL AT PIN
1	ON	CW KEY	LOW-KEY
1	OFF	CW KEY	HIGH-KEY
2	ON	CW ID KEY	HIGH-CW-SHIFT
2	OFF	CW ID TONE	LOW-CW-SHIFT
3	ON	KANTRONICS PTT	N/A
3	OFF	GENERAL PTT	N/A
4	ON	RTTY INPUT	LOW MARK
4	OFF	RTTY INPUT	HIGH MARK
5	ON	GENERAL PTT	N/A
5	OFF	KANTRONICS PTT	N/A
6	ON	PTT INPUT	HIGH PTT
6	OFF	PTT INPUT	LOW PTT
7	ON	CW DEMOD OUTPUT	LOW TONE
7	OFF	CW DEMOD OUTPUT	HIGH TONE
8	ON	RTTY DEMOD OUTPUT	LOW TONE
8	OFF	RTTY DEMOD OUTPUT	HIGH TONE

MFJ-1223 RS-232 INTERFACE

The MFJ-1223 is used to connect the MFJ-1224 to RS-232 Ports. Since the MFJ-1224 uses TTL voltage (+5 VDC) and RS-232 ports are ± 12 VDC, an interface becomes necessary to interconnect. Our MFJ-1223 allows the use of the port.

I. VIC 20™

A. Used with the MFJ-1252 or the MFJ-1264 Software.

NOTE: The connector cable supplied with the Software has the proper connections for the GENERAL CONNECTION PORT and the VIC USERS PORT. The DIP-Switches are set at the factory for this computer and software, and cable.

<u>MFJ-1224 General Connector</u>	<u>User Port</u>	<u>MFJ-1224 DIP-Switches</u>	
RTTY DEMOD	B, C, L	1	ON
CW DEMOD	B, C, L	2	ON
GND	N	3	ON
CW ID	H	4	OFF
RTTY	J, M	5	OFF
PTT (IN)	NOT USED	6	OFF
CW KEY	K	7	ON

B. Using Kantronics Hamsoft™ and Hamtext™ software.

NOTE: The connector cable supplied with the software will connect directly between the K CONNECTOR and the USERS PORT. The DIP switches will have to be set for use with this software:

<u>MFJ-1224 "K" Connector</u>	<u>Control Port</u>	<u>MFJ-1224 DIP Switches</u>	
DEMOM	6	1	OFF
GND	8	2	OFF
CW KEY	3	3	ON
RTTY	2	4	OFF
CW ID	1	5	OFF
		6	OFF
		7	OFF
		8	OFF

C. Using RAK Electronics RTTY/CWII Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 General Connector</u>	<u>User Port</u>	<u>MFJ-1224 DIP Switches</u>	
RTTY DEMOD	B, C	1	ON
CW DEMOD	D	2	ON
GND	I	3	OFF
PTT	J	4	OFF
RTTY	M	5	ON
PTT (IN)	NOT USED	6	OFF
CW KEY	K	7	ON
+5 VDC	NOT USED	8	OFF

II. C-64™

A. Using the MFJ-1265 or MFJ-1253 Software.

NOTE: The connector cable supplied with the software has the proper connections for the GENERAL CONNECTION PORT and the C-64 USERS PORT. The DIP Switches are set at the factory for this computer, software, and cable.

<u>MFJ-1224 General Connector</u>	<u>User Port</u>	<u>MFJ-1224 DIP Switches</u>	
RTTY DEMOD	B, C, L	1	ON
CW DEMOD	B, C, L	2	ON
GND	N	3	ON
CW ID	H	4	OFF
RTTY	J, M	5	OFF
PTT (IN)	NOT USED	6	OFF
CW KEY	K	7	ON
+5 VDC	NOT USED	8	OFF

B. Using Kantronics Hamtext™ Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 "K" Connector</u>	<u>Control Port</u>	<u>MFJ-1224 DIP Switches</u>	
DEMOM	6	1	OFF
GND	8	2	OFF
CW KEY	3	3	ON
RTTY	2	4	OFF
CW ID	1	5	OFF
		6	OFF
		7	OFF
		8	OFF

C. Using the AEA-SOFT and MBA-TEXT, VERSION 1.2 Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 GENERAL CONNECTOR</u>	<u>User Port</u>	<u>MFJ-1224 DIP Switches</u>	
RTTY DEMOD	J	1	ON
CW DEMOD	J	2	ON
GND	1, 12, A, N	3	OFF
CW ID	NOT USED	4	ON
RTTY	F	5	ON
PTT (IN)	E	6	OFF
CW KEY	H	7	OFF
+5 VDC	NOT USED	8	OFF

III. APPLE™

A. Using the C. H. GALFO Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 General Connector</u>	<u>Apple Game Port</u>	<u>MFJ-1224 DIP Switches</u>	
RTTY DEMOD	2	1	ON
CW DEMOD	4	2	ON
GND	8	3	ON
CW ID	NOT USED	4	OFF
RTTY	15	5	ON
PTT (IN)	14	6	ON
CW KEY	13	7	ON
+5 VDC	NOT USED	8	ON

B. Using the Kantronics Hamsoft™ Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 "K" Connector</u>	<u>Apple Game Port</u>	<u>MFJ-1224 DIP Switches</u>	
DEMOM	3	1	OFF
GND	8	2	OFF
CW KEY	14	3	ON
RTTY	12	4	OFF
CW ID	13	5	OFF
		6	OFF
		7	OFF
		8	OFF

C. Using the AEA-Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 General Connector</u>	<u>Apple Game Port</u>	<u>MFJ-1224 DIP Switches</u>	
RTTY DEMOD	2 (PBO)	1	ON
CW DEMOD	4 (PBO)	2	ON
GND	8 GND	3	OFF
CW ID	NOT USED	4	OFF
RTTY	15 (ANO)	5	ON
PTT	14 (AN1)	6	OFF
CW KEY	13 (AN2)	7	OFF
+5 VDC	NOT USED	8	ON

IV. TRS-80 COLOR COMPUTER™

A. Using the Kantronics Software.

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 "K" Connector</u>	<u>Hamsoft Pac</u>	<u>MFJ-1224 DIP Switches</u>	
DEM0D	DEM0D	1	OFF
GND	GND	2	OFF
CW KEY	CW KEY	3	ON
RTTY	RTTY	4	OFF
CW ID	CW ID	5	OFF
		6	OFF
		7	OFF
		8	OFF

B. Using Clay Abrams Software

NOTE: The DIP Switches must be set for this software as follows:

<u>MFJ-1224 General Connector</u>	<u>Serial I/O (P2)</u>	<u>MFJ-1224 DIP Switches</u>	
RTTY DEMOD	PIN 2	1	OFF
CW DEMOD	PIN 2	2	ON
GND	PIN 3	3	OFF
CW ID	NOT USED	4	OFF
RTTY	PIN 4	5	OFF
PTT (IN)	NOT USED	6	OFF
CW KEY	PIN 4	7	OFF
+5 VDC	NOT USED	8	ON

- NOTES:
1. A TTL TO RS-232 CONVERTER MUST BE USED WITH THE CLAY ABRAMS SOFTWARE. (We recommend the MFJ-1223).
 2. PLACE A 1 μ F ELECTROLYTIC CAPACITOR FROM PIN 2 (DATA IN) OF THE SERIAL I/O TO GROUND.

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VIC-20™ is a trademark of Commodore Business Machines, Inc.
TRS-80™ Color Computer is a trademark of Tandy Corporation

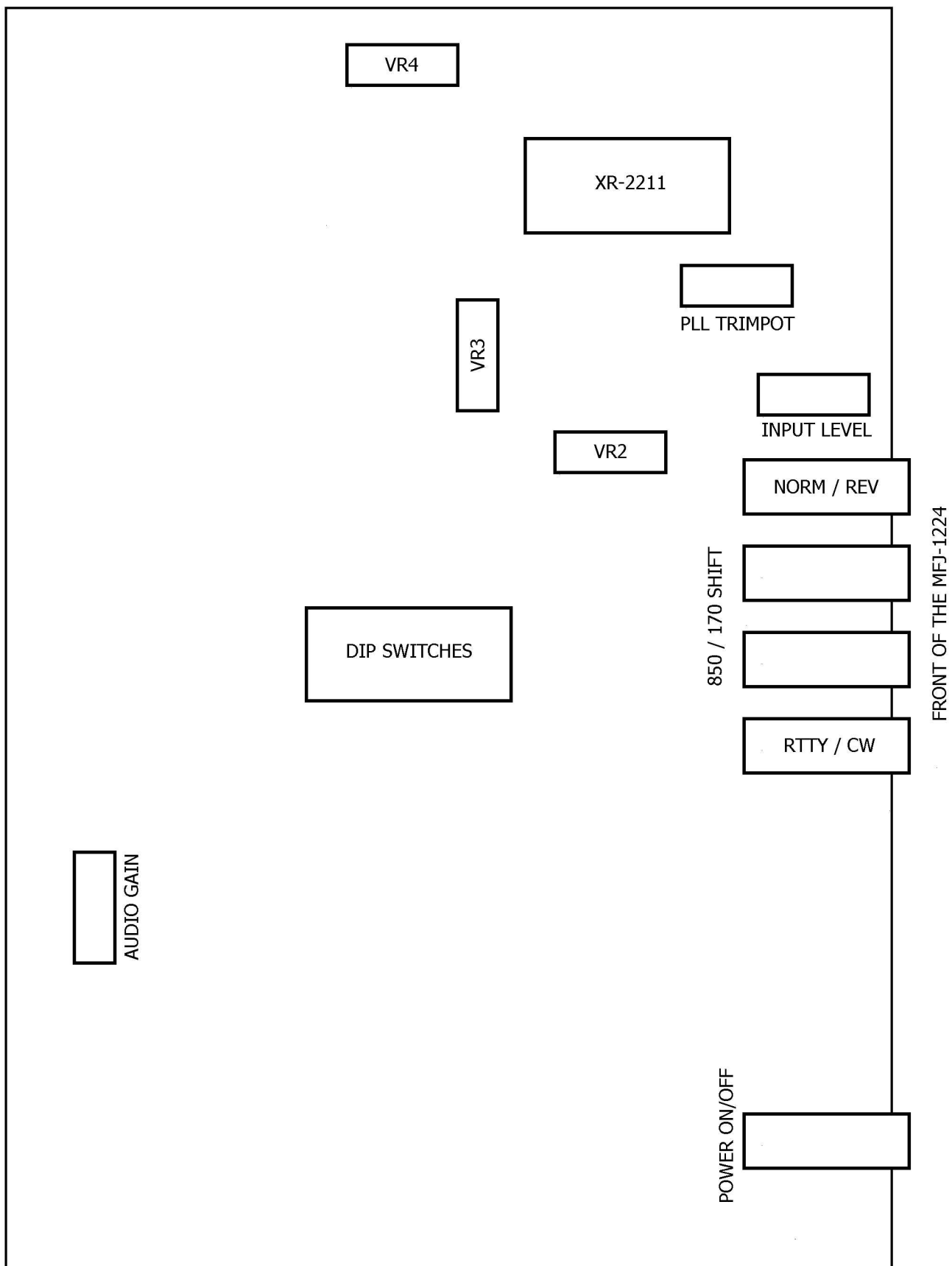


Figure 4

