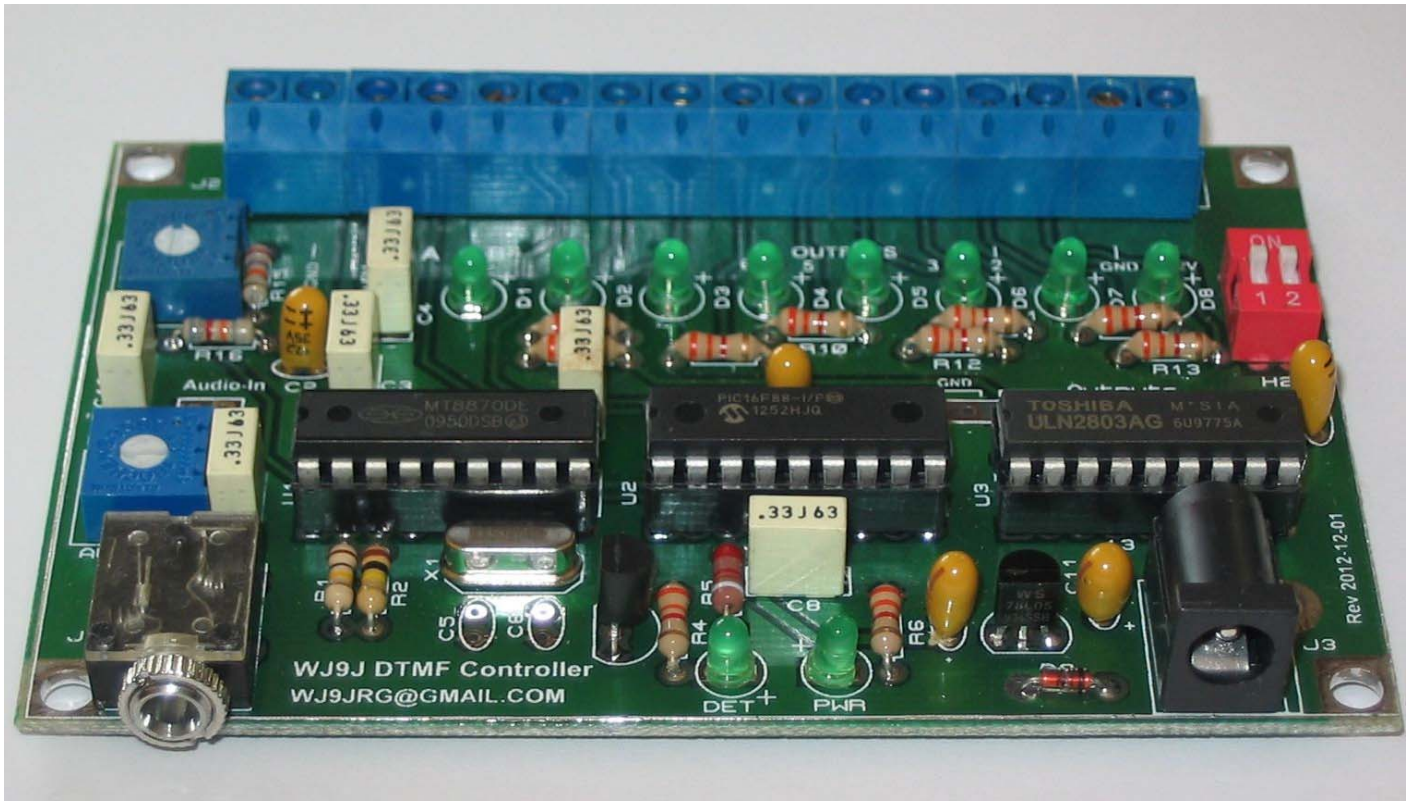
WJ9J Repeater Accessory Board

Version 2019-08-18



This manual

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- Custom programming is also available. Please contact us on what you would like it to do and we will provide a quote.

For support email:
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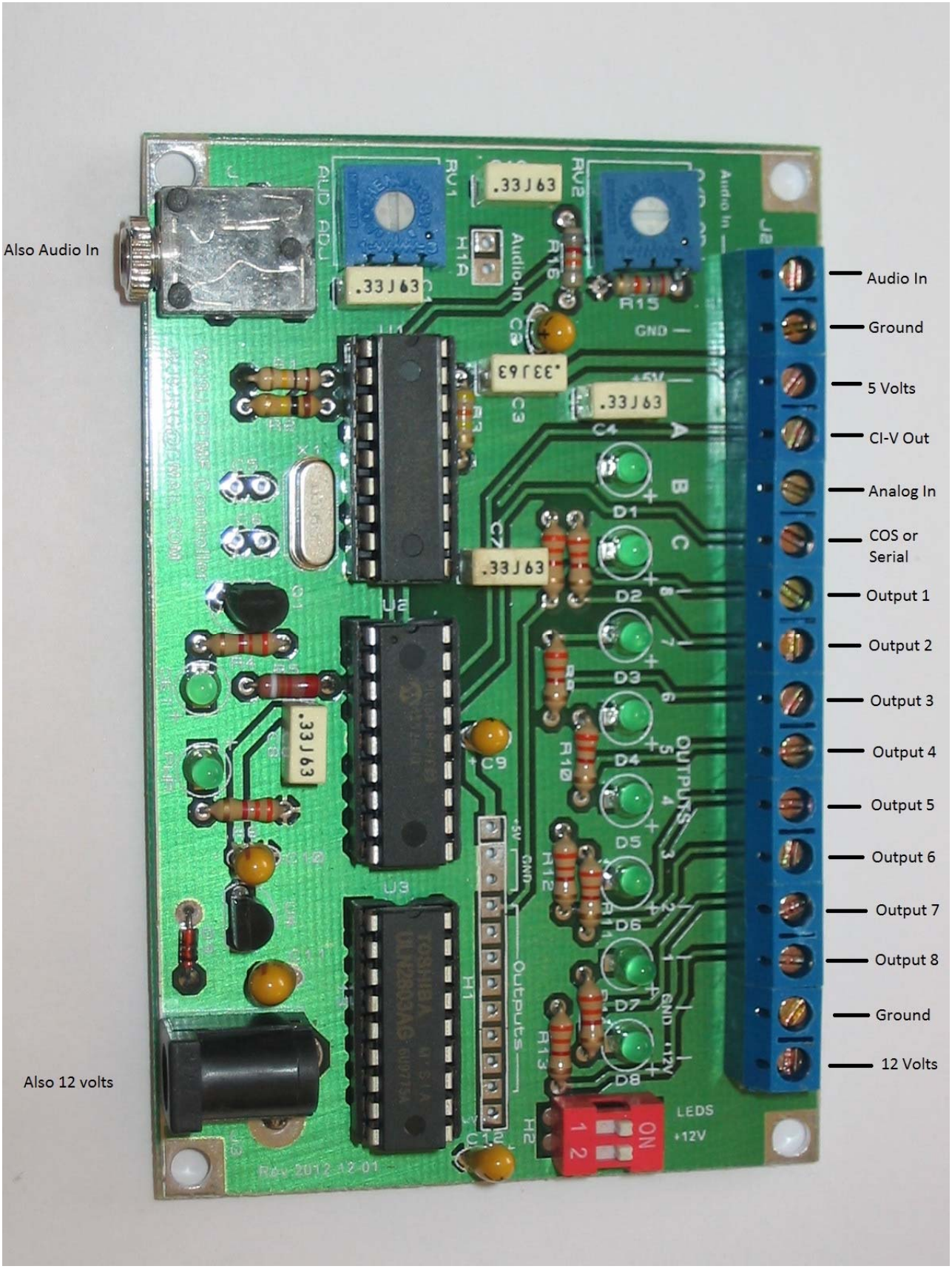
Manual updates can be found by always going to www.qrz.com and looking up WJ9J, and clicking the links from there


Also Audio In
Also 12 volts
Audio In
Ground
5 Volts
CI-V Out
Analog In
COS or Serial
Output 1
Output 2
Output 3
Output 4
Output 5
Output 6
Output 7
Output 8
Ground
12 Volts
LEDS
+12V
Outputs
OUTPUTS
Rev-2012-12-01

Quick Start Guide

As it arrives by default, some of the advanced features are turned off. If all you want to do is control 6 items or relays with DTMF, you will only need to take the following steps:

Hookup:

1. Apply approximately 12V power to the coaxial plug, making sure the positive is on the center conductor. You can also apply this power on pin 1 (+12) and 2 (ground).
2. Provide the DTMF audio source using a 1/8 plug.
3. Turn the volume of the audio source down, and then turn it up (while DTMF is on the signal) until the Digit Valid LED comes on. Go about 20% past that point. You can also adjust the pot for level control. **NOTE: To turn the Pot Level up, you turn counterclockwise.**
4. You are set to start controlling the outputs.

You can now hook your relay coils up, from the +12V source to each output screw terminal for outputs 1-6. To use output 7 & 8, some configuration is necessary. By default, output 7 is a PTT for a transmitter, and output 8 is the audio to feed that transmitter, but that can be changed.

There is much more that this board can do other than just control relays! If you are interested in that, read further.

Just give me the codes … If you do not want to read the manual, but want to figure it out on your own, just skip to the page that says **"1 Page summary of All Command Codes".** It's the last page

Hardware Specifications

- 8 Outputs capable of sinking 100 mA for controlling external relays or devices. An external relay board can be used, or individual relays. It is totally up to you. See schematic and application notes.
- LED Status Indicators are provided for each Logical output.
- LED Status Indicators are switchable to an off state for stealth mode or for solar powered applications.
- The power is on/off switchable in case you are hardwired and need to power off without unwiring. The switch applies to the screw terminal 12V input only. That can also be used to manually disable your relays off if feeding the power into the coaxial input.
- LED Power Indication.
- LED DTMF Digit Valid Indicator.
- Screw Block Terminals for outputs.
- Screw Block Terminals or coaxial plug / jack for power supply
- Screw Block Terminals or 1/8" audio jack for audio connection (plug not included)
- Power supply: Between 3 and 30 volts.
- A/D Input 0-20 Volts with calibration pot.
- Asynchronous serial output of DTMF digits, output status, A/D reading, and some response commands. 1200 baud, N,8,1
- Current **< 8 mA** at 12V with the LED status off and **< 4 mA** when at 3 Volts. Great for solar powered sites. If that is too much power, then you need more panels, not a different controller. If you are using the controller to reset devices, I suggest wiring the relays to use the normally closed contacts.
- A relay board is available from a third party vendor. Just look for "Relay Board" on eBay.
- Comes with Coaxial Plug for DC connection.
- Size: 2-9/16" X 3-15/16"
- Weight: 2.1 oz (Can be less than 1 oz with special order without screw terminals)

Software Features

- Output 8 can optionally be assigned for duty as an audio tone output for output status, command confirmation and CW ID's. This could feed into a transmitter, phone line, or speaker using proper interfacing techniques. (see application notes)
- Output 7 can optionally be assigned for duty as a PTT (push to talk) for a transmitter to have output status, command confirmation and CW ID's transmitted.
- Output 6 can optionally be used as a directional relay (CCW) for Rotator control with A/D feedback.
- Output 5 can be disabled and used for an analog to digital input with 10 bit resolution.
- Output 4 can optionally be used as a PTT enable for either of the remote bases.
- Output 3 can optionally be used as a receiver enable or power up of the remote bases.
- Output 2 can optionally be used as a strobe to play the ICOM voice synthesizer (see application notes) when using an ICOM 706 or variant as a frequency agile remote base.
- Output 1 could be used as a directional relay (CW) control for Rotator control with A/D feedback.
- All of the features can be programmed and changed via DTMF. You don't need a computer to change.
- All changes are saved to EEPROM and do not reset during a power failure.
- A 2 digit or 4 digit password can be created and assigned as active.
- This password can be enabled or disabled. No reprogramming is required. This can be an easy way to also enable and disable the commands.
- Application notes provide a way to hookup to phone line for control.
- There are two modes of CW ID when enabled, Beacon / Foxhunt, and Repeater mode.
- COS input for sensing of repeater activity. Provides a method of the controller sensing when there is no longer any activity and no need to send an ID.
- The identifier interval is adjustable from 5 seconds to over an hour.
- Output status beep frequency and speed can be adjusted.
- CW Frequency and speed for ID and CW status messages can be adjusted.
- Can be setup as just a time to ID reminder with a flashing light.
- DTMF Squelch application. Keep your radio quiet until someone you know calls you.
- All outputs can be latched or pulsed. When pulsed, the length of pulse is programmable.
- Camera mode allows panning a camera across three axis to quickly adjust cameras. Two button action is all that is necessary. You would press 1 digit then the second digit would turn on a specific relay for as long as you held the button. This mode can easily be enabled and disabled for secure control.
- Multiple outputs can be changed in one DTMF sequence.
- Programming configurations can be acknowledged by an "OK" message CW (or not – up to you).
- ON / OFF state can be remembered for same state as before on a power up or can be set to a specific state. This is great if after a power failure, some things need to be on, and some off. In other words, a specific state can be memorized and remembered. Or you can just have it be just as it was when it lost power.
- CW callsign identifier can be programmed with DTMF.
- CW identifier can be turned on or off.
- CW identification can be sent when a status query is made or output is changed (or not).
- A programmable pre-delay after PTT is available for radios that stay keyed after the last touch tone to allow the controlling station to get into receive mode to hear the status in cases where status is sent via radio.
- Outputs can be queried and their status read back. Additionally, the status of outputs can be read back when changed. A high tone means on and a low tone means off.
- ICOM CI-V support for frequency agile remote base control. This controller has some special features not seen in ANY OTHER CONTROLLER. One particular optional feature is "Scan Snap" which pauses during a fast scan on every exact Khz. Another is voice readback option on stop depending on how you

stop the scan. Many other features including CI-V command line mode, letting you send ANY CI-V command.

- Optional read back of frequency and mode using several methods:
  - ICOM's synthesized voice triggered with output 2.
  - ICOM's synthesized voice announced via CI-V command. ICOM 7000 can use this.
  - Morse code.
  - SCOM 7K or 7330 Voice synthesizer using a DTMF output generation chip. (That is a separate chip you must purchase)
- Also memory button mode tuning of ANY radio to use as a remote base limited to a maximum of 255 memory channels in this mode.

Introduction

This device will take DTMF audio from a receiver, telephone answering machine, etc; and decode the DTMF digits in a way that enable you to remotely control electrical and electronic devices. Applications and implementations are limitless and up to the individual.

Additionally, the controller is setup to work as an accessory board to an existing controller as a remote base controller. It can control ICOM radios through the use of CI-V. It also can control any radio that has memory channels that can be changed with an up button on a microphone.

There is also an asynchronous data serial line that can send serially, the DTMF heard, output status, and A/D levels on command. Using this port is up to the user.

Hooking it up

The power supply needs to be between 3 and 30 Volts. Use the diagram in this manual for reference.

If your voltage is > 5.5 Volts, you should feed the 12V terminal only or the Coaxial Jack. When using the coaxial plug (with 12V), the positive connection is the center conductor. If using the screw terminals at greater than 5.5 Volts, be certain that you are using pin 1 (+12V) & 2 (Ground) and not the 5V terminals!

If your voltage is less than 5.5 volts, you need to feed the 5V screw terminal AND the +12 V terminal. You can feed both by hooking a wire between the 5V and the 12V screw terminal. Just be sure not to exceed 5.5 volts.

It is best to put a low current less than 1A fuse in series with your power lead.

The audio is not critical. A 20 K Ohm pot is used to set volume in case you have no other way to do that. It comes set to mid range by default. Counter Clockwise increases the audio level and Clockwise decreases the audio level to the DTMF decoder. (I know it is backwards) An easy way to calibrate would be to turn down all the way (clockwise) and then send a digit and turn the level up about a ¼ turn past the point when the digit valid LED comes on. But you can leave default in the middle and just adjust the level coming in from the receiver audio.

One of the first things you want to do is to set your 2 digit or 4 digit passwords, if you are using the password. The default condition of these is “00” and “0000”. But security is also off by default (meaning you need no password).

Operations

The outputs will pull to ground when on; therefore, you need to hook each external relay coil from your + 12V supply (also available on the screw terminal block) to whatever output you want to control with it. Diagrams are presented later in this manual to help you through the process.

Output 8 **can** be assigned as an audio output. As such, it will always power up in an off condition. If you are driving a transmitter, use a capacitor to isolate (.01 uF). You may also have to add resistance (try 100 K) depending on the level required by your transmitter. If you have the LEDs off, you will also have to add a small pull up resistor (try a 1K) to the + of supply. To make louder, decrease the resistance all the way to 100 ohms if you need to.

Output 7 **can** be assigned to use as a PTT line. As such, it pulls to ground when PTT should be active (as most transmitters require). It will PTT when there is a message to send on Output 8. No other output setting command affects it when it is assigned to use as a PTT line. If you are not using a relay for isolation, take care that your transmitter’s PTT can handle the voltage that is present on the line during the time it is not pulled to ground. You could also use a diode to isolate this.

Relay Output Commands

In the commands below, (PW) is the optional password: none, 2 or 4 digits. X is the output(s) you are changing.

Turn Outputs ON

* (PW) 1 X (s) #
The 1 indicates you want the output(s) ON
Example1: My Password is 88 and I want Outputs 6 and 3 on. Enter
* 88 1 6 3 #
The action occurs on #

Example2: I have not enabled passwords. I just want Output 1 On. I would enter
* 1 1 #
The action occurs on #

Turn All Outputs ON

* (PW) 1 0 #
The action occurs on #

Turn Outputs OFF

* (PW) 0 X (s) #

The 0 indicates you want the output(s) OFF

Example1: My Password is 7542 and I want Outputs 1 and 8 OFF. I would enter
* 7542 0 1 8 #
The action occurs on #

DTMF to Turn All Outputs OFF (Factory Default)

* (PW) 0 0 #
The action occurs on #

DTMF to Pulse Output ON

* (PW) 2 X
The 2 indicates you want to pulse an output
Example: I have security off (No password) and I want to pulse Output 2. I would enter
* 2 2
The action occurs on the output number itself
The length of the pulse is adjustable – see configuration section

Quick DTMF to Output ON

When enabled in the configuration, pressing 5 and any digit turns on that output (1-8) as long as you continue to hold that digit. This is useful when controlling Pan/Tilt/Height of cameras remotely

Test LEDS

*(PW)93 99 Test LEDs. It will turn on and off all LED's sequentially. You can do this test as a test that your board is working. Note: Any relays hooked to the outputs will also trigger.

Entering Configuration Values

When you enter configuration values by DTMF, they are 2 digit values in hex. Here are the hex representations for all your DTMF digits. They have been translated in the firmware to be these values:

DTMF Digit	Corresponding Hex Value
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	A
B	B
C	C
D	D
*	E
#	F

Example:

A timer is calling for an XX value. To enter the highest value, you would enter ## which in Hex is FF, which is a decimal value of 255

Let's say the default value is 95 and you want to see what the nearby range of that is:

The sequence nearby would be:
… 89 8A 8B 8C 8D 8E 8F 90 91 92 93 94 **95** 96 97 98 99 9A 9B 9C 9D …

For the CW code you will find a conversion table.

If you wanted to program a value of 150 for number of memory channels in a remote base, you would covert to 96 in hex. You can make good use of the windows calculator for this. Once you have it up, select view and then programmer. Then use the radio buttons to convert between hex and decimal.

Configuration Commands

CW ID after Output Status

* (PW)90 0 CW ID after Status OFF
*** (PW)90 1 CW ID after Status ON (Default)**
* (PW) # Plays the current output status without changing it.

When turned on, output 8 is used for audio and CW tones for this function.
This ID occurs after every status and is unrelated to the timed ID status.

Enable and Disable Output Status

*(PW)92 0 0 Output and Morse Status OFF
***(PW)92 0 1 Output and Morse Status ON (Default)**

There are two types of status:

- Output status
  The status is sent back in the state of audio tones. A high pitched tone means the state is high (ON), a low pitched tone means the state is low (OFF). The tones are sent sequentially; output 1, 2, etc. Only status for 1-7 is sent, because obviously, output 8 is being used to send the status (if enabled). If Output 7 is also assigned to PTT then only status for 1-6 is sent.

Tone pitch variation is used instead of CW in sending status because:

1. It is easier to instantly recognize a state.
2. It is quicker.
3. Not everyone knows CW.
4. It is a more intuitive way to communicate state.

- Command Acknowledgement Status
  If the status is set to "ON" then all other commands changing features are also acknowledged by sending an "OK" message in CW.

Configuring the sound of the Output Status

The XX are digits you enter. Please see the section on entering values.

*(PW)93 4 XX Status Beep Frequency when output off. By default, this is set to **90**, you should try values of 60-FF.

*(PW)93 5 XX Status Beep Frequency when output on. By default, this is set to **40**, you should try values of 30-50.

*(PW)93 6 XX Status Readback Speed. By default, this is set to **50**.

*(PW)93 7 XX Where xx is between 00 and 20 Delay in status playing. This allows a long keyup before any messages. By default, this is set to **03**. If you want to allow time for your radio to switch to receive, set this to 06 or 07. **Warning, if you set to a long value, you will have to power down and restart, or wait it out.**

Configuration Commands

CW and Morse Identifier Commands

* (PW)90 9 1 XX CW Frequency. Default is set to **50.** Higher values lower pitch.
* (PW)90 9 2 XX CW Speed. Default is set to **95**. Higher values slow it down.

This gives about 18 WPM at about 2000 Hz.

Note: CW timing will be less than perfect at values outside of 7-25 WPM. As a general rule when programming slower speeds, use a lower frequency, and faster speeds, try using a higher frequency. The defaults and values nearby work well.

*** (PW)90 2 CW timed ID OFF (Default)**
* (PW)90 3 CW timed ID ON

*** (PW)90 4 Beacon / Foxhunt CW ID Mode (Don't evaluate COS) default**
* (PW)90 5 Repeater ID Mode (Evaluate COS activity)

*** (PW)90 6 Normal COS input on Terminal C.** >4V for true <1 Volt for false. **Maximum input is 5 volts for COS** See section on using COS
* (PW)90 7 Inverted COS input on Terminal C. >4V for false <1 Volt for true. **Maximum input is 5 volts for COS** See section on using COS

* (PW)90 8 Identify and reset ID interval timer

* (PW)90 9 3 XX ID Interval Length X 5 seconds (The new interval starts after the next ID) **Default 06 = 30 seconds**

*(PW)90 9 4 XX # Program the CW ID using the section later in this manual. The last character should be an EOM (37) character. **Default ID is "I"**

The CW identifier and status audio play through output 8. Status and CW are independent of each other. You can have one of them sent without the other. How to program the CW identifier is discussed later.

Configuring Output Pulse Duration

There may be occasions when you want to either stretch the time of an output pulse (for example – using the application note for timed DTMF squelch).

There are other occasions when you may want the pulse to be very fast such as when controlling the up channel button on a radio.

The long pulse time is added with the short pulse time to give the examples below. When using the examples, it is assumed that the other value is 00.

You can program the durations with the following commands (**Default Values)**:

*(PW)93 0 XX Short Pulse ON Time (**10**)
*(PW)93 1 XX Short Pulse OFF Time (**10**)
*(PW)93 2 XX Long Pulse On Time (**00**)
*(PW)93 3 XX Long Pulse OFF Time (**00**)

The default values produce a pulse which is fairly quick, suitable for controlling memory channel stepping on a ICOM 207H Radio (12 mS). From all 00 to all FF the range is from 45 uS to almost 1 minute

Configuring Security

Security Password Enable

*** (PW)94 0 Disable the use of a Password (Default).**
* (PW)94 1 Enable the use of a Password.

Security Use 2 or 4 Digit Password

*** (PW)94 2 When password is enabled, uses the 2 digit password (Default).**
* (PW)94 3 When password is enabled, uses the 4 digit password.

Set Passwords

* (PW)94 4 XX Set the 2 Digit Password. By default, it is set to **00**.
* (PW)94 5 XXXX Set the 4 Digit Password. By default, it is set to **0000**.

DON'T Forget your password, you will have to buy a new chip! Or only use 2 digits so it would be relatively easy to guess with only a couple hundred possibilities!

Configuring Outputs

Save Output State On Each Change Automatically

* (PW)92 0 2 Disabled so power up will be in the state it was when the state was last saved. The save last occurred when a state was changed while enabled.

*** (PW)92 0 3 Enabled so power up will be in the state it was in when power was removed. (Default)**

Dedicate Output 7 to PTT

* (PW)92 0 4 Disabled – Output 7 used as a normal output.

*** (PW)92 0 5 Enabled - Output 7 is dedicated to PTT, and will NOT be used as a normal output. (Default)**

Setting Function of Output 5 to A/D (or not)

***(PW) 92 1 4 Output 5 is Normal I/O (Default)**

*(PW) 92 1 5 Output 5 is A/D (referenced to 5V)

Note: Changing the mode of output # 5 to A/D (analog voltage measurement) will also require the removing of the ULN2803 pin 5 out of its socket. The best way to do this is to remove the ULN2805 from the socket by gently prying with a small screwdriver. Then bend pin 5 out (that is the 5th pin from the left toward the front) so that it does not enter back into the socket when plugging back in. The device will have to be power cycled after making this change. Removing the connection here is necessary because the ULN2803 will load down the A/D circuit and cause inaccurate readings.

Calibration of A/D

The A/D pot has been set at the factory (to a .2% fluke Meter), however, if you wish to recalibrate it, use the procedure below:

To calibrate the A/D, send a stable voltage between 10 and 15 volts, and adjust the RV2 pot using the morse code read back command (* PW 95 3) for the same reading in morse code as what your Digital Voltage meter reads on the same voltage. Full scale is 20.48 volts.

Setting Camera (Button) Mode Enable/Disable

***(PW)92 0 6 Disabled – Button Mode where 5 + digits 1,2,3,4,5,6,7,8 turns on that output while you hold down the second digit (Default)**

*(PW) 92 0 7 Enabled – Button Mode where 5 + digits 1,2,3,4,5,6,7,8 turns on that output while you hold down the second digit

Analog to Digital to Morse Conversions

You can use this feature to send the morse code value of voltage of a range of 0-20

The resolution is 10 bit, so you get 4 digits.

There are three ways to send the A/D value.

*(PW)95 1 SCOM A/D Send
This will send necessary DTMF digits to an S-COM 7K or 7330 to play the words necessary to read back the voltage. Contact us if you need a specific S-COM password. By default, it sends “DA”

*(PW)95 2 A/D to Async Data 0-20V Scale
The bits are sent LSB first
Preamble of AD Most significant byte first “AD 01 03 0A 08 00” is what is sent for 13.80 Volts

*(PW)95 3 A/D to Morse 0-20V Scale
This Plays “13.80” for 13.80 Volts in morse code.

The DTMF Interdigit Timer

Note, on most of these commands, the interdigit timer is set to 5 seconds, which means that if you pause longer than 5 seconds between digits, the command is cleared and you can start again. Additionally, pressing a # during any command early will also cancel the command.

Play the firmware version

* (PW)95 0 Plays the version and build date in CW.

Programming the CW Identifier

* (PW)90 9 4 XX # Program the CW ID using the table below. Note: By default it will send "I" (Until you program something different).

The last character should be an End Of Message (EOM) character. You can program up to 15 characters.
Example: To Program WJ9J / A * (PW)90 9 4 32 19 09 19 38 10 37 # (But use your own callsign)

DTMF	CW Character	DTMF	CW Character
00	0	1A	Colon [:]
01	1	1B	Semicolon [;]
02	2	1C	Double dash [=]
03	3	1D	Plus [+]
04	4	1E	Hyphen, Minus [-]
05	5	1F	At sign [@]
06	6	20	K
07	7	21	L
08	8	22	M
09	9	23	N
0A	.	24	O
0B	,	25	P
0C	?	26	Q
0D	'	27	R
0E	!	28	S
0F	&	29	T
10	A	30	U
11	B	31	V
12	C	32	W
13	D	33	X
14	E	34	Y
15	F	35	Z
16	G	37	End of Message Character
17	H	38	/
18	I	39	Word Space
19	J		

Remote Base (Up Button Method)

Any tranceiver which supports a button press for memory channel up (such as a button on a microphone) can be selected as a remotely controlled station. The station is controlled by the board knowing how many memory channels there are (up to 255) and by keeping track of where it is at. You can go to any memory channel remotely with DTMF. The speed is programmable (pulse on length and pulse off length). It can be extremely fast, it depends on the radio. For an example, an ICOM IC-207H can be made to spin through all its programmed 160 memory channels in about 4 seconds! Since often the on and off duration are not necessarily symmetrical for most efficient speed, both values are programmable. Just for reference, the fastest speed will do faster than all radios can handle. (over 1000 memory channels per second) You can adjust it to the fastest speed your radio can handle.

Several things you should know when controlling using a mic button.

The controller pin A is used to control the "Up" button. It pulls to ground when on. It is assumed that a pull to ground will step the memory up 1 channel. Also, there should be 5V on the line when floating. In other words, you should measure 5V on the line you are preparing to use for the mic up button press. If the radio is sending any other voltage, do not use. But most radios have a 5V system, and it's easy to measure. The ICOM 207H up button line is easy to get to from the mic jack. On my radio, I ran the pin to one of the unused pins on the packet connector on the back of the radio.

You are responsible for your own radio. At the very least, you should double check the voltage (making sure it is 5V) on the line your are hooking to your radio before hooking to your radio so you don't blow up your Up channel circuit in your radio.

So after hook up, you want to first program the number of memory channels in the radio:

*(PW)98 9 XX Number of memory channels in Remote base (**default = A0 = 160 channels)**

Remember that these settings are in Hex, so you will need your decimal to Hex calculator (windows comes with one).

In my case, I have 160 memory channels, so I programmed the value "A0"

Next thing you should do is program some rather big values in the short duration pulse on pulse off programming. I would start with values of 00 for the normal pulse, then use values of 99 in the short pulse programming. That should get things moving.

Next you should enable the Memory Channel control. This enables all the commands that start with 8.

***(PW)92 1 2 Memory Channel (8X) Commands Disabled**
*(PW)92 1 3 Memory Channel (8X) Commands Enabled

Next thing to do is program the radio to memory channel 1.

85 XX Go to Memory Channel XX, so enter 8501

Note: If your radio starts with memory channel 0, you should think of it as the last channel instead of 0.

Did the radio change channel? It should have. If it didn't, try removing the wire you have going to terminal A and grounding it. Did it move then? You have to get this working first. The radio and the DTMF board

should have common negative grounds. If it did move manually, you will need to figure out why the controller did not move it. You can set the on time to a long time and see if it pulls all the way to ground with a digital multimeter.

Once you get that working, set the memory channel to 1 and also set it on the radio and then ask the radio to go to the last channel. It should step through all the channels and end up on the last. Now ask it to go back to channel 1. That will test if you have the correct number of channels programmed.

The next steps are to continually shorten the pulses until the radio starts failing to see them all, then lengthen them back out. I ended up with values of about 10 on my radio.

Below are some other configurations for the remote base.

*(PW)98 0 Disable Channel Destination Indication
***(PW)98 1 Enable Channel Destination Indication (Play okay)**

This means that after the controller completes movement to a memory channel, it will play "OK" letting you know it is there. Not fancy, but you know what memory channel you told it to go to, right?

86 Start or Stop Scan (If radio supports)

This is really cool. A scanning Remote Base! My ICOM 207 supports a scan if you press and hold the button for about a second. So this is what this function does.

When the radio stops scanning because of a signal, if you have it in auto resume, you will need to send the command again, if you want it to remain there.

Ok, now that you have scanned, the radio is out of sync with the controller.
How do you get it back in sync?

87 Step up 1 Channel (No Sync)

This step up code allows you to step up 1 memory channel, in case somehow you got lost and want to get back in sync. You can step up until you know where it is. I programmed the weather channel in my last memory, so I know which one that is on. But I have also set it to skip scan there. It will not stop there unless I am directly putting it there. Another way to stop it is to transmit on one of the channels it is scanning with another radio. When it stops there, then stop the scan. Now that you know where it is, you can program its memory channel.

88 XX Program Memory Channel number (to obtain sync)

Once you get it back to somewhere you know, this command is what you use to tell the controller where it is again.

This is designed to be used as an auxiliary remote base controller in conjunction with an existing repeater controller.

Since there is no audio paths on this controller to send to a remote base, I have created addition logic to control relays to *simulate* audio paths in case you want to create your own audio paths.

If you want to use that, here is how you would basically need to do it.

Hook the receive relay that is controlled by output #3 so that when on, it gates the audio from your remote base to your repeater transmitter. And another set of contacts should also gate the COS from your remote base to control the PTT (maybe using a 2N7000) on your repeater.

Hook the Transmit PTT Enable relay that is controlled by output #4 so that when it is on, the audio from the repeater receiver is gated to the Remote base transmitter. And on another set of contacts, gate the repeater COS to control the Remote base PTT (maybe using a 2N7000).

Once that is hooked up the commands below give you CW status back, as well as control those relays.

*(PW)92 9 1 RX on	"RX"
*(PW)92 9 2 RX TX	"TX"
*(PW)92 9 3 RX TX	"OFF"

There is no timeout timer for these relays as they are not doing the actual PTT. You should use the timeout timers in your repeater controller, or do this as a locally controlled remote base.

Remote Base using ICOM CI-V

This was developed using an ICOM 706 MKIIG, but will also work with any ICOM radio that accepts CI-V. You **must** set the radio address to 58h, and at 1200 baud. It would also be best if you set CI-V TX to off. Set your radio to these settings before connecting.

The CI-V output is on terminal A. Make sure that a common ground exists between the DTMF board and the radio. Use a diode (almost anything works (1N914, 1N4148) with the cathode in terminal A, and the other end going to the tip connection at the CI-V jack.

You must first enable the 9 commands using the command below:

***(PW)92 1 0 HF CI-V (9X) Commands Disabled**
*(PW)92 1 1 HF CI-V (9X) Commands Enabled

The main HF commands start with 9, and do not require a password, so to avoid accidental or deliberate triggering (or hacking), disable the commands when not using if desired.

Once enabled, the commands you can send follow.

Turning the radio on, and transmitting

91	RB RX on (Responds "RX")
92	RB TX (Responds "TX")
93	RB OFF (Responds "OFF")

These commands control relays that can turn on the HF radio and also enable audio and Transmit paths. For details see the section on "Remote Base (Up Button Method)". In summary, output 3 can turn your radio on and enable the receiver paths. Output 4 can enable PTT.

Hearing the frequency you are on.

94	Announce Frequency

This command (94) will cause an announcement of the current frequency using one of the 4 methods listed below.

The commands to turn on each particular option are listed before the description:

***(PW)92 0 A Announce Frequency with Pulse (Default mode)**
This is the default method. It turns one output 4 for 1 second. See the application notes for how to connect this to trigger the ICOM706 voice synthesizer.

*(PW)92 0 B Announce Frequency with CI-V (ICOM 7000)
Some ICOM Radios have an announce frequency command that works through CI-V. The ICOM 7000 is such a radio and this option will cause it to announce. In this mode, the 94 command will send CI-V to the radio.

*(PW)92 0 C Announce Frequency with Morse Code
This command will send the current frequency in Morse code.

*(PW)92 0 D Announce Frequency with DTMF to SCOM

This option will make it send the required DTMF to an S-COM 7K or 7330 to use its voice synthesizer to announce the frequency. This requires a separate serial DTMF generator chip (HT9200A). These can be purchased for around $2 on eBay. Uses output 1 (CLK) and Output 2 (Data) to send DTMF. Obviously, when it is used in this manner, the outputs cannot be used for other functions. Also the SCOM password for sending a message assumes the password is set to "DA". I could change that, but it would be easier for you to change your control Op password in your S-COM to use that. This allows sending of voice messages with the S-COM.

My preference, here would be to use the synthesizer inside the ICOM itself for reasons beyond this manual's scope.

Remote Base Frequency Control
You can enter the frequency for HF directly. You don't have to enter any leading or trailing zeros. The * represents the decimal point, some examples are:

95MSD*LSDX# Program Frequency

To go to 3.980, enter 95 3*98#
To go to 10.00 enter 95 10*#
To go to 3.98765, enter 95 3*98765#
To go to 146.520, enter 95 146*52#

Scanning around:
Entering the digit A or B will immediately move the frequency up/down 10 hz from where it is for fine tuning

A	Step Up 10 Hz
B	Step Down 10 Hz

Entering the digit C or D will start the scan 2 seconds after you enter the digit. The scan will be slow (Approximately 100 Hz per second)

C	Scan Up
D	Scan Down

Entering the digits CC or DD will start fast scanning 2 seconds after you enter the second digit. The scan speed will be approximately 1 KHz per second)

CC	Scan Up Fast
DD	Scan Down Fast

Note: The two second delay is not only necessary to determine which combination you intend, but it also allows your transmitter to get back in receive to hear the band scan.

To stop scanning …

(Digit #)	Stop Scan and Announce Frequency
(Digit any other)	Stop scan and Do Not Announce Frequency

So if you are scanning on HF, and you press # to stop it, it will announce the resting frequency. If you press **any** other digit, it will stop without announcing the frequency. This way you can decide when you stop if you need to hear the actual frequency or want that out of the way, each time you stop, you can make a different decision!

Using Scan Snap
These options allow the HF radio to pause momentarily while scanning at every Khz in order to precisely tune most conversations easily.

970	Scan Snap Off
971	Scan Snap On

If “Scan Snap” is turned on, the scan will momentarily pause at every even kilohertz for a second awaiting a stop command. This helps quickly tune. I have found that most conversations on the HF bands occur on even kilohertz frequencies.

Mode Selection
These commands set the mode of the ICOM radio.

960	LSB
961	USB
962	AM
965	FM

Repeater Offset
These commands set the offset when in FM mode, mainly used for repeaters.

967	- Offset
968	Simplex
969	+ Offset

Power up frequency defaults
These options load a frequency into the HF rig at power up of the controller. This is so you won’t necessarily have to enter a frequency first before scanning.

972	**Load 3.980 into HF at PWR On OFF (default)**
973	Load 3.980 into HF at PWR On ON

Memory Functions
This command will change the ICOM radio to a memory channel. This is useful if you want to select a channel with pre-programmed tones or other configuration.

977 XXXX	Select Memory Channel and Memory Mode

Memory Scanning
Once in memory channel mode, you can scan the memory channels with this command.

978	Memory Scan OFF (Stop)
979	Memory Scan ON (Start)

Selecting VFO Mode
Sending these commands will take you to either VFO mode, from whatever mode it is in.

97A	Select VFOA
97B	Select VFOB

Selecting Tone in FM Mode
Sending these commands will turn CTCSS encode on or off. This applies to the FM mode only

97C CTCSS PL Tone Encode OFF
97D CTCSS PL Tone Encode ON

Note, since on the IC-706, you cannot change the CTCSS tone remotely via CI-V, I would suggest programming a different tone in each memory channel. That way, you can select that channel (which doesn't have to be any particular frequency) and then change the frequency to anything you want. Since you are still in memory mode, that particular CTCSS tone for that channel will still be selected.

Command Line Mode (Sending ANY CI-V Command)
98 XXXXXXX# Send CI-V (command line mode)

Sending this command will allow you to send ANY CI-V command that the radio supports!
Examples are below:

98 11 00 # Receiver Attenuator OFF
98 11 20 # Receiver Attenuator ON
98 16 02 00 Receiver Pre-Amp OFF
98 16 02 01 Receiver Pre-Amp ON

Note: If a CI-V command is short (like the attenuator on /off) you must end the command with a "#"

Rotator Control

To control a rotator by measuring the Pot voltage coming back from the roatator, use the following.
Only the first 255 values of the voltage are supported, meaning, the rotator pot voltage should be 0-5V (or slightly less than 5V) coming back from the roatator.

*(PW)95 5 XX Rotator Move Value (0-5 V) Stall at 1:20

You enter a value (00-FF) for the XX. The controller will use
Out 6 = Potential Rotate CCW Relay
Out 1 = Potential Rotate CW Relay
To turn the rotator.

When you enter a value, say 88 that represents 136 in decimal. So 136/255 X 360 = 192(degrees). So if your rotator is <192 degrees, the CW relay will turn on, and will rotate until the values match and stop. If your rotator is >192 degrees, the CCW relay will turn on and will rotate until the values match and stop.

If the rotation does not conclude within 2 minutes, a "Stall" message is sent and the relay turns off anyway. In my experience of remotely controlling rotation devices, you need a timeout, so that in the event of mechanical failure of the rotator, it will eventually stop trying.

The best way to use this functionality is to make a table saying what value = what direction.

Like this:

N = 00
NE= 20
E= 40

Etc, etc

Your table may require slightly different values. You will have to play with it and fill out your table.

Using COS to determine activity

There is an input available that can be used to determine receiver activity. This can be useful in determining when the last ID should occur. In repeater mode, the last ID will occur after the interval time expired, however, no more IDs will occur if no more COS activity occurs after that. When at the start of new activity, the ID will wait 5 seconds, and then ID, then the next ID will occur at the regular interval.

The COS comes in on Terminal C, and **MUST** be between 0 and 5 volts. It can be high or low true.

The following configurations are for the COS:

*(PW)90 5 Repeater ID Mode (Evaluate COS activity)
***(PW)90 6 Normal COS Input**
*(PW)90 7 Inverted COS Input

Repeater mode means that we will be looking at the COS to determine activity on the repeater.

Normal COS is active high (3-5 Volts). Inverted COS is active low (<2 Volts)

ASYNC Serial Output

ASYNC Serial data can be found on Terminal C. It is sent as 1200,N,8,1 **The bits are sent LSB first**

The configurations for the data are:

***(PW)92 0 8 ASYNC Data on Pin 15 Disabled**
*(PW)92 0 9 ASYNC Data on Pin 15 Enabled

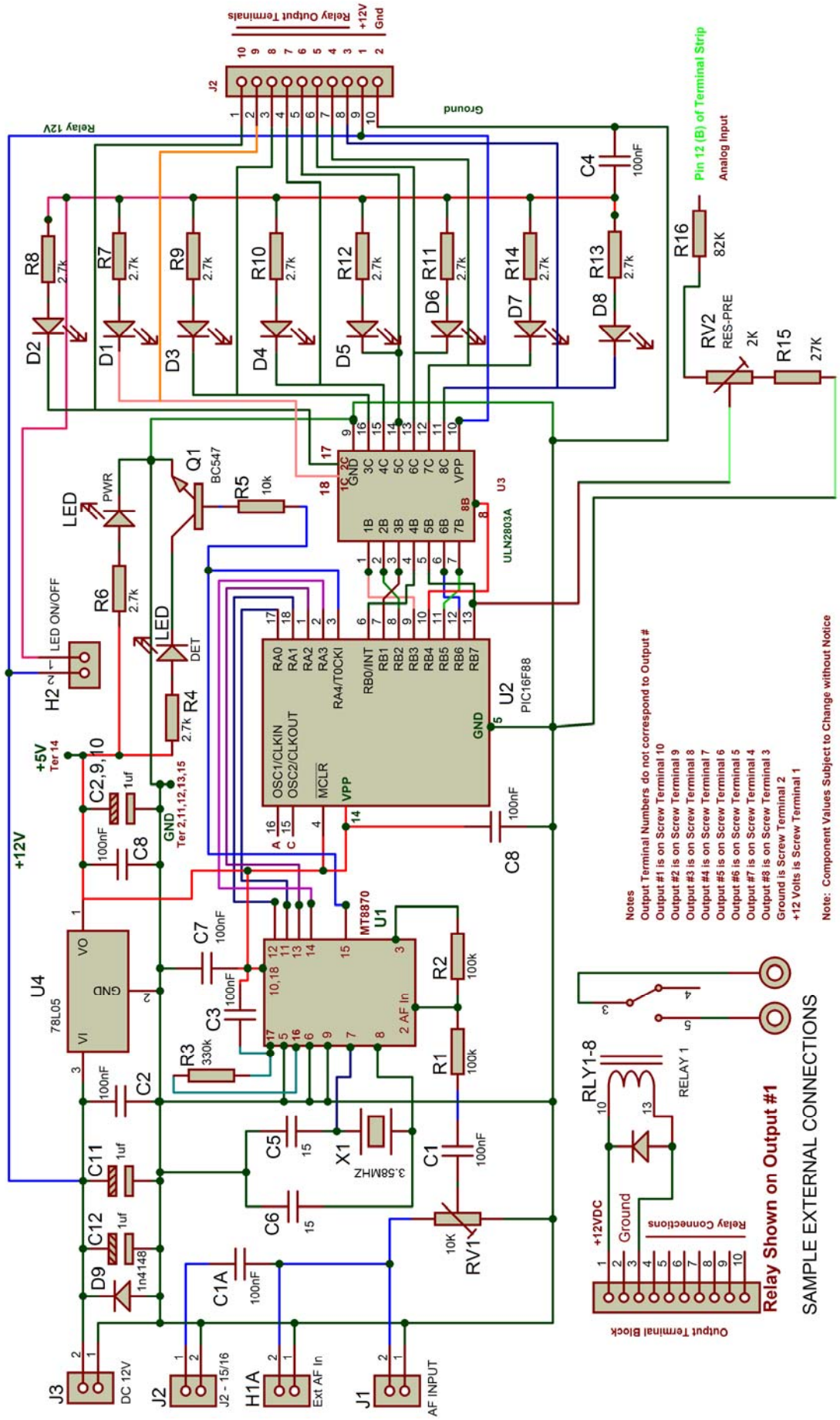
When enabled, here is what is sent:

- Each DTMF digit is sent as it is detected.
- To send A/D values:
  *(PW)95 2 A/D to Async Data 0-20V Scale A/D values are sent like this: "AD 01 03 0A 08 00" = 13.80
- To Send Output Status
  *(PW)# AB = Output status Play the Output status bits in this order (4,3,2,1,8,7,6,5)
  Yeah, I know, they are twisted. It sends AD as a byte, then the byte above.
- Morse messages are also sent when also played: AC is sent as the preamble byte, then **two** bytes for each letter.

Ordering

If you wish to just order the pre-programmed PIC chip, it is $15 plus $3 shipping.

Just email wj9jrg@gmail.com

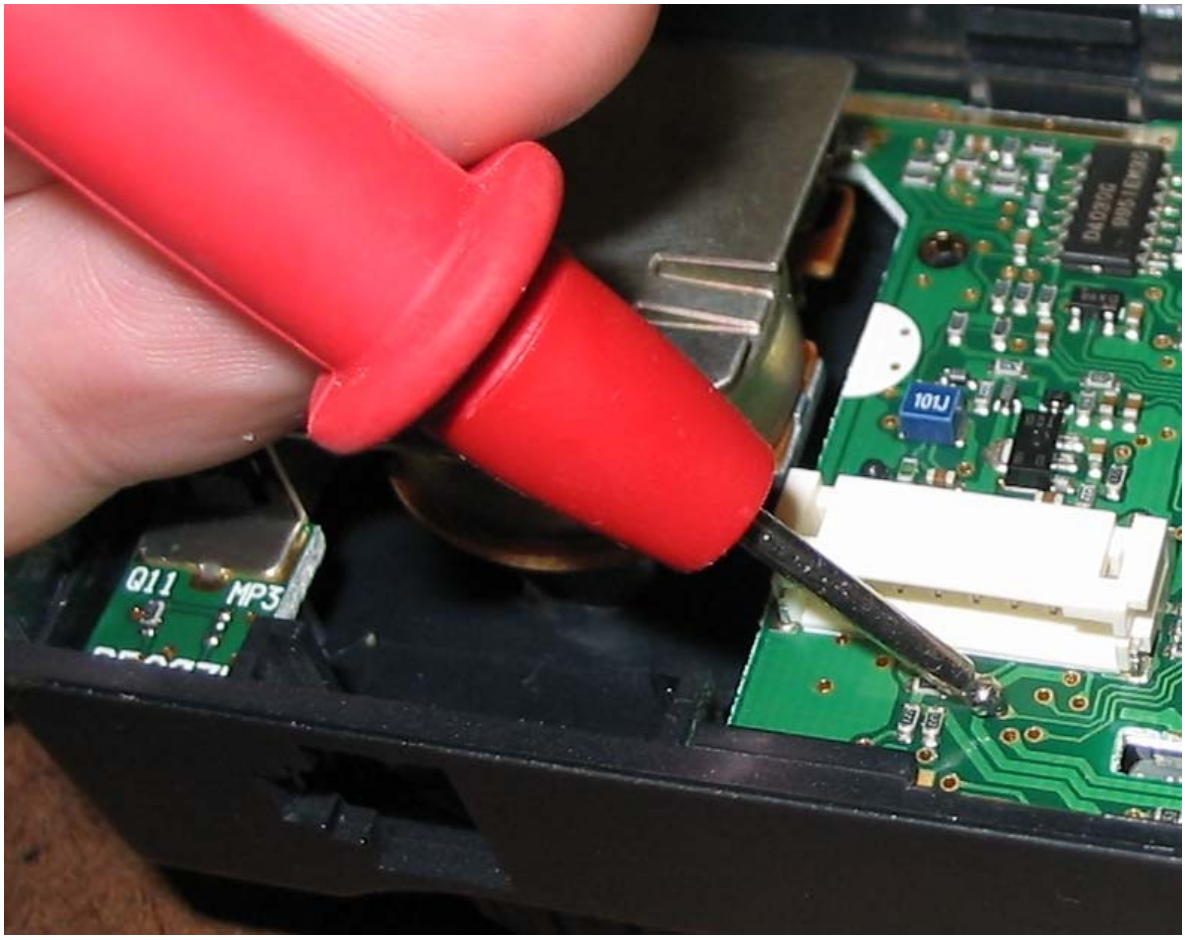

WJ9J DTMF Repeater Controller
WJ9JRG@GMAIL.COM
Version 5
SAMPLE EXTERNAL CONNECTIONS
Relay Shown on Output #1
Output Terminal Block
Relay Connections
+12VDC
Ground
RELAY 1
RLY1-8
Notes
Output Terminal Numbers do not correspond to Output #
Output #1 is on Screw Terminal 10
Output #2 is on Screw Terminal 9
Output #3 is on Screw Terminal 8
Output #4 is on Screw Terminal 7
Output #5 is on Screw Terminal 6
Output #6 is on Screw Terminal 5
Output #7 is on Screw Terminal 4
Output #8 is on Screw Terminal 3
Ground is Screw Terminal 2
+12 Volts is Screw Terminal 1
Note: Component Values Subject to Change without Notice
Relay Output Terminals
+12V
Gnd
Ground
Relay 12V
Pin 12 (B) of Terminal Strip
Analog Input
U2
PIC16F88
U3
ULN2803A
U1
MT8870
U4
78L05
Q1
BC547
LED
PWR
LED
DET
LED ON/OFF
+5V
Ter 14
+12V
GND
Ter 2,11,12,13,15
J3
DC 12V
J2
J2 - 15/16
H1A
Ext AF In
J1
AF INPUT
RV2
RES-PRE
2K
82K
27K
10K
3.58MHZ
1n4148

Controlling the ICOM 706 Voice synthesizer module

Output # 4 is used to strobe the module. Use a relay to isolate the radio from the controller. The relay contacts used are N.O. (normally open) and the command 94 will pulse the relay long enough to make the radio announce.

Below are pictures of what to hook to inside the control head in order to do that.

First you must disassemble the control head. Inside you will see the proper pads to solder to. The probe is touching it. This is the pad for the announce and lock button.



Solder a thin insulated wire to this point. I would recommend drilling a tiny hole for the wire, but I am sure you could also find a creative way to exit the radio head.

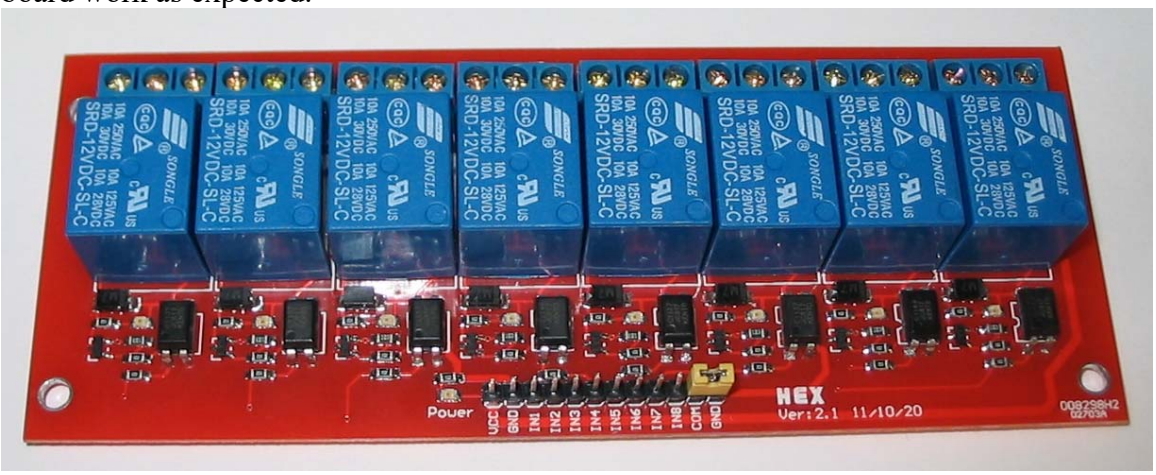
Disregard the piece of electric tape. I was initially going to make a strain relief. I decided to use a small knot instead.

The relay contacts should be wired so when the relay is on, it pulls this line to ground. You should test your voice synthesizer first by grounding this new line for over 1 second (which should make it announce).

Relay Board Available on ebay!

http://www.ebay.com/itm/12V-8-Channel-Relay-Shield-for-Arduino-2560-UNO-R3-ARM-PIC-AVR-STM32-A045-/251053840227?pt=LH_DefaultDomain_0&hash=item3a73f99763

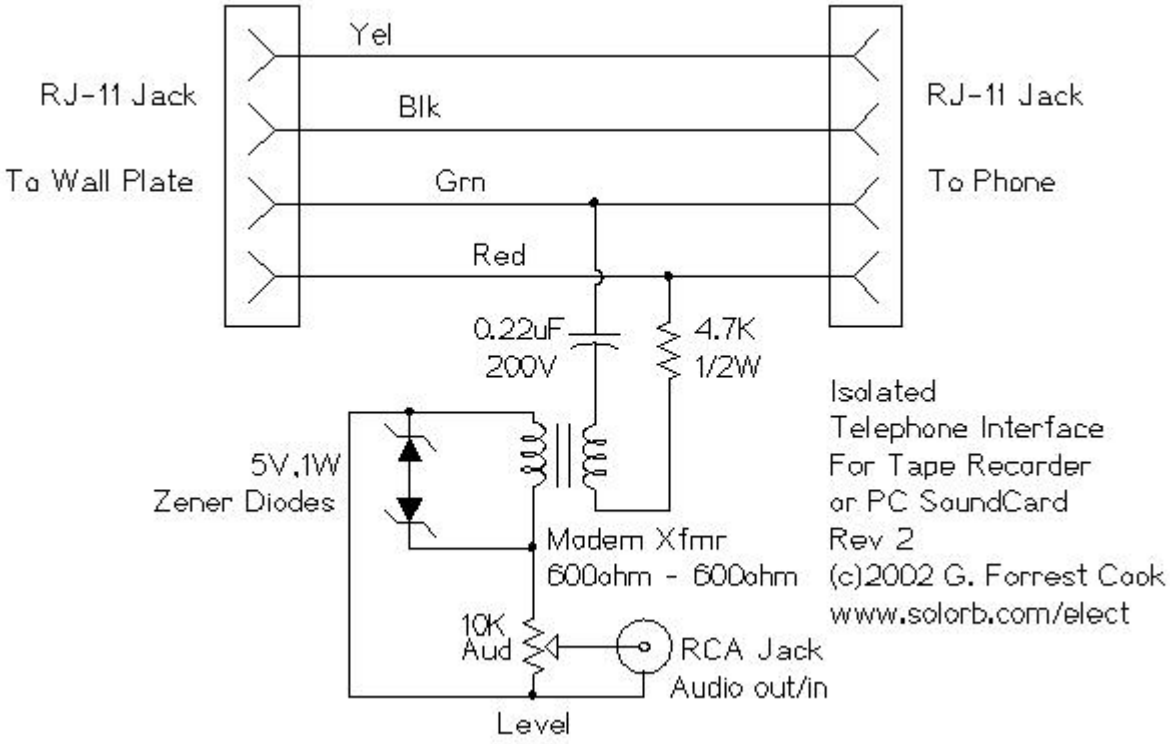
If you use this board, bear in mind that the function is inverted. The outputs are on, when the controller output is off. You can also drive the relay coils directly by using the picture below. The circled pads are indicating what you need to hook to each output. You need to send +12 Volts to the board on the top. When using the board in this manner, the functions are not inverted and the status indicators on the relay board work as expected.



Telephone Line Interface

I will provide some telephone interface circuits. You are on your own with building them. However, I think the best interface would be to buy a cheap answering machine (that lets you screen calls with a speaker) and then let the speaker feed the audio input! That way you have a device that also will answer the phone for you.

Isolated Telephone Interface



Introduction

This circuit allows you to record audio from a telephone line into a tape recorder or computer soundcard. Most of the parts for this circuit can be scrounged from an old modem, with some work, it is possible to rewire the modem circuitry and use the old modem case.

Note that some countries have laws that require the user of a phone recording device to notify the party on the other end of the line that they are being recorded.

Theory

There's not much to this circuit. The two RJ-11 jacks are set up to feed the telephone circuit through from the wall to the phone. The active signal for a single phone is on the red and green wires. Yellow and black are usually used for a second phone line. The 0.22uF capacitor blocks any DC current from flowing through the transformer. The 4.7K resistor limits the current of the 90V ringing signal. The transformer isolates the telephone side of the circuit from the tape recorder side. The zener diodes clamp the 90 volt ringing signal and other transient spikes to protect your recorder. The 10K potentiometer is used to adjust the level to the tape recorder, or in this case, the DTMF decoder.

Use

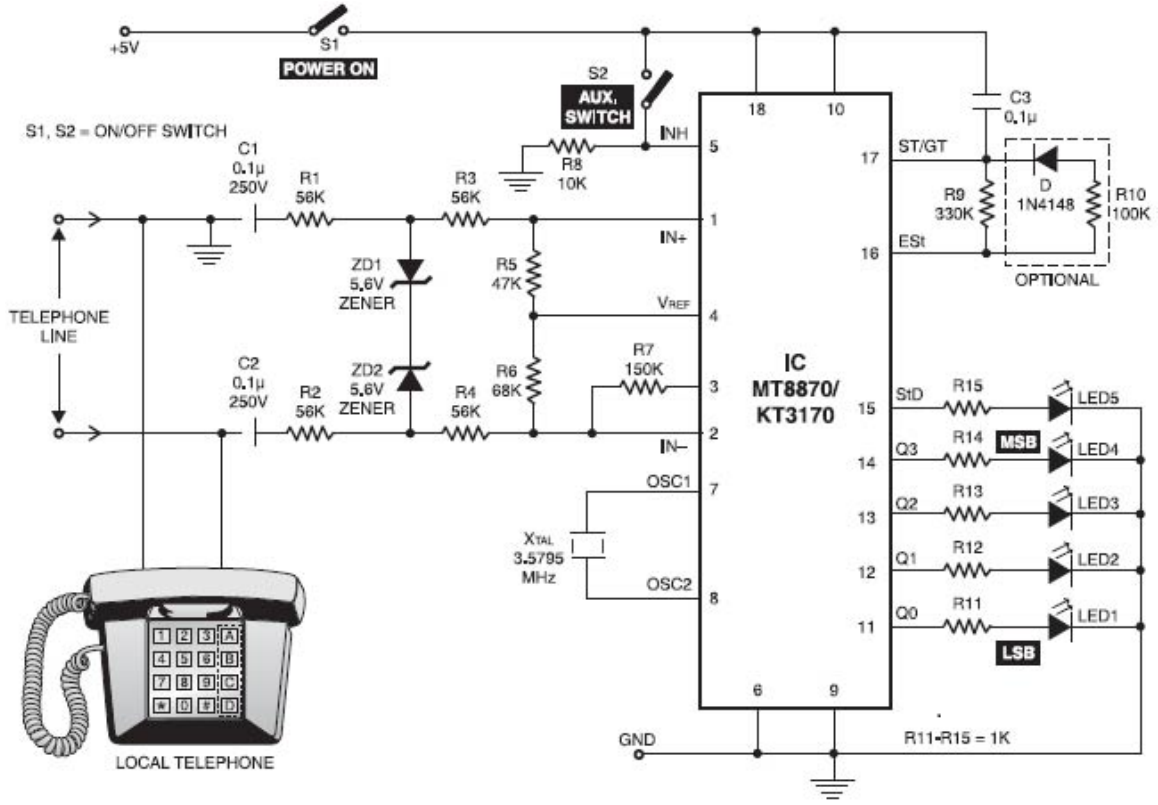
Using two RJ-11 phone line jumpers, connect one side of the interface to the wall plate and the other side to a telephone. Connect the audio out to a tape recorder or PC sound card's auxiliary input. Set the recording

level and start recording. It should also be possible to inject an audio signal into the audio output jack and have it appear on the phone line, the level control should be all the way up, drive the circuit from an amplifier that is capable of running a small speaker.

Parts

2X RJ-11 phone Jacks
1X 0.22uF 200V capacitor
1X 4.7K 1/2W resistor
1X 600 ohm to 600 ohm modem transformer
2X 5V 1W zener diodes
1X 10K audio taper potentiometer
1X RCA audio jack
Suitable transformers are available from Digi-Key, Mouser, and Jameco.

Here is another example of a potential telephone line interface:



DTMF Page or Squelch

A lot of radios no longer come with the intrinsic ability to decode DTMF. That is where this decoder can be handy.

What you do is hook it to the speaker jack of your source radio, and hook it through a relay that is controlled by one of your outputs.

When the proper code is entered, that output will pulse on (and hopefully, you will know to have set it to 10 seconds or something). When the relay is pulsed on, the speaker is activated and the party will now hear you calling.

Application Notes

Basic Repeater

When using basic repeater mode, and hooked to the COS line the ID will start 5 seconds after the COS line on your repeater receiver goes active. After the initial ID, as long as there is activity, the ID will continue to occur at the interval you have selected. If there is no activity after the last ID, the next ID will be suppressed (as well as subsequent ID's) until there is activity again.

You will still need to provide the audio path in your repeater from receiver to transmitter, and you should provide a path from the ID output (output #8) to your transmitter. The transmitter keying from the controller will be accomplished still through the PTT line (output #7) of the controller.

This will allow the controller to control the PTT when it identifies. If you don't wish to connect to the COS line of your receiver, you can still accomplish repeater IDing, but since the controller will not know when the repeater is being used, you will get an ID at every interval. This is known as beacon mode.

Application Notes

Keying of transmitter in CW instead of audio

You can use the audio output to actually key the repeater in CW. To do this, connect a 1K resistor from the output to base of a 2N2222 transistor. Connect its emitter to ground and the collector to one side of a relay coil and the other side of the relay coil to +12 Volts. Place a 100uF capacitor across the relay coil. Some of these values may vary, but basically, you have just made a switch that responds to the CW that comes out.

For sales or support email:
WJ9JRG@GMAIL.COM

Manual updates can be found by always going to www.qrz.com and looking up WJ9J, and clicking the links from there

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1 Page Summary of ALL Command Codes

SWITCHING OUTPUTS

*(PW)1X#	Turn Outputs ON
*(PW)0X#	Turn Outputs OFF
*(PW)10#	Turn All Outputs ON
*(PW)00#	Turn All Outputs OFF
*(PW)2X	Pulse Output On
*(PW)#	Send Status (Responds with Output Status)
5X	Camera Mode (button mode)

90 CW

*(PW)90 0	CW ID after status OFF
***(PW)90 1**	**CW ID after status ON**
***(PW)90 2**	**CW Timed ID OFF**
*(PW)90 3	CW Timed ID ON
***(PW)90 4**	**Beacon CW ID Mode**
*(PW)90 5	Repeater ID Mode
***(PW)90 6**	**Normal COS Input**
*(PW)90 7	Inverted COS Input
*(PW)90 8	Identify and reset interval time
*(PW)90 9 1 XX	CW Frequency (**50**)
*(PW)90 9 2 XX	CW Speed (**95**)
*(PW)90 9 3 XX	ID Interval Length X 5 seconds (**06**)
*(PW)90 9 4 XX#	Program CW ID ("I")

91 & HF Remote Base Commands for ICOM 706

91	RB RX on (Responds "RX")
92	RB TX (Responds "TX")
93	RB OFF (Responds "OFF")
94	Send Freq (Pulse #2 for 1 second or CI-V)
95MSD*LSDX#	Program Frequency
A	Step Up
B	Step Down
C	Scan Up
D	Scan Down
CC	Scan Up Fast
DD	Scan Down Fast
While Scanning …	
(Digit #)	Stop Scan and Announce Frequency
(Digit any other)	Stop scan and Do Not Announce Frequency

960	LSB
961	USB
962	AM
965	FM
967	- Offset
968	Simplex
969	+ Offset
970	Scan Snap Off
971	Scan Snap On
972	**Load 3.980 into HF at PWR On OFF**
973	Load 3.980 into HF at PWR On ON
977 XXXX	Select Memory Channel and Memory Mode
978	Memory Scan OFF (Stop)
979	Memory Scan ON (Start)
97A	Select VFOA
97B	Select VFOB
97C	CTCSS PL Tone Encode OFF
97D	CTCSS PL Tone Encode ON
98 XXXXXXX#	Send CI-V (command line mode)
98 11 00 #	Receiver Attenuator OFF
98 11 20 #	Receiver Attenuator ON
98 16 02 00	Receiver Pre-Amp OFF
98 16 02 01	Receiver Pre-Amp ON

92 Output Configuration

*(PW)92 0 0	Output morse Status Off
***(PW)92 0 1**	**Output morse Status On**
*(PW)92 0 2	No Save output state
***(PW)92 0 3**	**Save Output state on change**
*(PW)92 0 4	Output 7 is normal
***(PW)92 0 5**	**Output 7 is PTT**
***(PW)92 0 6**	**Camera (Button) Mode Disabled**
*(PW)92 0 7	Camera (Button) Mode Enabled
***(PW)92 0 8**	**ASYNC Data on Pin 15 Disabled**
*(PW)92 0 9	ASYNC Data on Pin 15 Enabled
***(PW)92 0 A**	**Announce Frequency with Pulse (706)**
*(PW)92 0 B	Announce Frequency with CI-V (7000)
*(PW)92 0 C	Announce Frequency with Morse Code
*(PW)92 0 D	Announce Frequency with DTMF to SCOM
***(PW)92 1 0**	**HF CI-V (9X) Commands Disabled**
*(PW)92 1 1	HF CI-V (9X) Commands Enabled
***(PW)92 1 2**	**Memory Channel (8X) Commands Disabled**
*(PW)92 1 3	Memory Channel (8X) Commands Enabled
***(PW)92 1 4**	**Output 5 is Normal (requires Power Cycle)**
*(PW)92 1 5	Output 5 is A/D (requires Power Cycle)

93 Output Configs Continued

*(PW)93 0 XX	Short Pulse ON Time (**10**)
*(PW)93 1 XX	Short Pulse OFF Time (**10**)
*(PW)93 2 XX	Long Pulse On Time (**00**)
*(PW)93 3 XX	Long Pulse OFF Time (**00**)
*(PW)93 4 XX	Status Beep Frequency when Output Off (**90**)
*(PW)93 5 XX	Status Beep Frequency when Output On (**40**)
*(PW)93 6 XX	Status Readback Speed (**50**)
*(PW)93 7 XX	TX Keyup Delay time before message (**03**)
*(PW)93 99	Test LEDs

94 Security

***(PW)94 0**	**Disable Use Of Password**
*(PW)94 1	Enable Use Of Password
***(PW)94 2**	**When enabled, Use 2 Digit Password**
*(PW)94 3	When enabled Use 4 Digit Password
*(PW)94 4 XX	Set 2 Digit Password (**00**)
*(PW)94 5 XX	Set 4 Digit Password (**0000**)

95 A/D, Rotators and Other

*(PW)95 0	Play FirmwareVersion (Responds with version)
*(PW)95 1	SCOM A/D Send
*(PW)95 2	A/D to Async Data 0-20V Scale
*(PW)95 3	A/D to Morse 0-20V Scale
*(PW)95 5 XX	Rotator Move Value (0-5 V) Stall at 1:20

98 Memory Channel RB

*(PW)98 0	Disable Channel Destination Indication
***(PW)98 1**	**Enable Channel Destination Indication**
*(PW)98 9 XX	Number of Channels in RB (**A0=160**)

Most Valid Commands send "OK"

Memory Channel control

81	RB RX on (Responds "RX")
82	RB TX (Responds "TX")
83	RB OFF (Responds "OFF")
85 XX	Go to Channel # XX
86	Start or Stop Scan
87	Step up 1 Channel (no sync)
88 XX	Program memory channel #

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