Ham Tips

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Number 18

Adding an ID-O-Matic II Morse Identifier to an MSR 2000 Squelch Gate Module

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The MSR 2000 is a line of FM base/repeater stations offered from the early 1980s through the early 1990s by Motorola Communications. The one I acquired is a model C73KSB-1105AT. This unit has a receiver, a 100-watt transmitter rated for continuous duty, an ac power supply, and several plug-in control modules all contained in a compact cabinet measuring 39 inches high by 22 inches wide by 10 inches deep and weighing about 125 pounds.

As received, the station contained all the modules necessary for repeater operation except an automatic identifier to send my call sign in Morse code. Although Motorola made such modules (TLN640-CDX, QRN8424A, and QRN8425A), they each stored the alphanumeric identification message in a programmable read only memory (PROM) that is not re-writable; therefore, a new PROM would have to be purchased and programmed. Since those modules rarely appear on the surplus market and the PROMs they use are nearly impossible to find, a need for this project was born.

This was my GO (goals and objectives) list:

- The modification process should have minimal impact on the MSR 2000 station so that other factory plug-in modules could be used in the future.
- The conversion should be a clean one, i.e., no cut traces on the backplane or in any of the modules; and no direct wiring between the modules.
- Indicators should show when the identifier's timing cycle has begun and when the ID message is being sent.

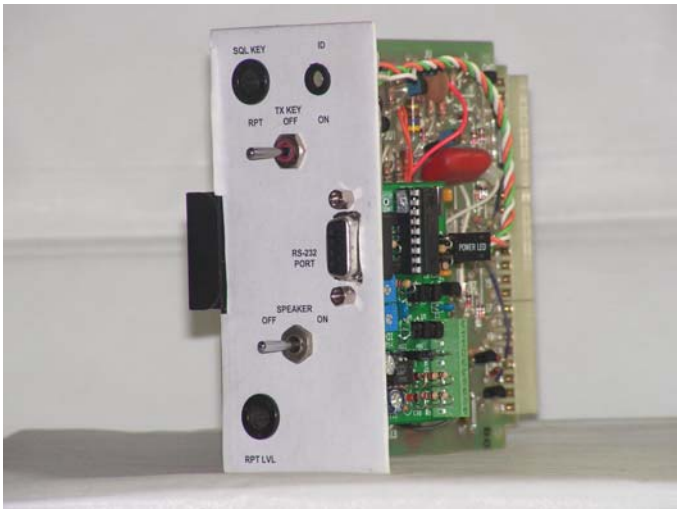

Figure 1 — The YAP 2000 ID module is designed to replace the factory Squelch Gate module in an MSR 2000 RF-Control Chassis.

- The identifier circuitry should have minimum current drain so that it can be powered from the RF-Control Chassis power supply.

In addition, it would be nice to have the capability to force the transmitter to be keyed as well as prevent the transmitter from being keyed while performing maintenance. It would also be nice to control whether or not audio is sent to an internal speaker for local monitoring.

Although I have designed and built identifier circuits in the past, I didn't want to start from scratch this time. So, after researching options on the internet, I chose the HamGadgets (www.hamgadgets.com) ID-O-Matic II kit; here's why.

The ID-O-Matic II had all the features I needed and the size of the printed circuit board was a good fit for the MSR 2000 module form factor. The board draws minimal current and can be powered from the MSR 2000 power supply without the risk of overloading the regulator circuit. It has a LED to indicate the status of ID timer and it was easy to incorporate the LED into the front panel design. The ID-O-Matic II kit is easy to assemble, easy to program, and easy to use. Choosing the ID-O-Matic II saved me a great deal of time and effort.

In a nutshell then, the overall design concept was to piggyback an ID-O-Matic II board onto a squelch gate board and mount both boards behind a double-wide front panel. The new module, designated the YAP 2000 ID, would plug into the slot of the MSR 2000 RF-Control Chassis formerly occupied by the stock Squelch Gate module. YAP, by the way, stands for Yet Another Project. The remainder of this Ham Tip describes how I built this module.

Making the Front Panel

I made the new front panel from an MSR 2000 Line Driver module. The one I had available was a 1-line version so I needed to drill a 3/8-inch diameter hole in order to be able to access the RPT LVL potentiometer on the squelch gate board. See Figure 2. If you have a 2-line version, it will already have a hole in the proper location so you won't need to do this.

The ID-O-Matic II board is secured to the front panel using the two fasteners supplied with the 9-pin subminiature D connector. Since I don't own any chassis punches that make D-shaped holes, I had to improvise.

I found an IBM PC video adapter card in the junk box whose bracket had a D-shaped hole for a 15-pin high-density connector. Since this is the same physical size as the 9-pin connector, I removed the bracket and used it as a template to make the hole in the new front panel.

I did this by drilling the two small holes in the front panel first and then bolting the bracket to the front panel. Next, I drilled two 3/8-inch diameter holes inside the D-shaped cutout. Then, I used a variety of small round and flat files to clear the rest of the metal from the D hole. Finally, I removed the bracket. The whole procedure took about a half an hour and yielded a result that was quite acceptable.

I also drilled 1/4-inch diameter holes for the LED clip and two miniature single-pole double-throw toggle switches. The upper switch is the transmitter key switch;. the lower switch is the speaker switch. These two switches come in handy during setup and testing.

When the TX KEY switch is placed in the left-most position, the PTT signal from the squelch gate board can key the transmitter in response to a valid input signal and the ID-O-Matic II board can key the transmitter to send the station identification message. In the center position, the transmitter cannot be keyed by the signal from either board. When placed in the right-most position, the transmitter is keyed manually. This position is convenient because it leaves both hands free for making adjustments or measurements.

Figure 2 — The new front panel was made from a Line Driver module because it is twice as wide as the Squelch Gate module's front panel and can accommodate both the squelch gate board and the ID-O-Matic II identifier board.

The SPEAKER switch selects whether or not audio will be applied to the local speaker. When placed in the left-most position, repeater audio is applied only to the exciter. In the right-most position, repeater audio is applied to the local speaker as well as to the exciter.

During normal repeater operation, all of the switches on the YAP 2000 ID module should be in their left-most position. This conforms to the operation of the slide switches on the Station Control module.

Building ID-O-Matic II Board

Although the ID-O-Matic II can be used as a basic repeater controller, I did not use it as such for this application. Since the squelch gate board performs all of the functions necessary for controlling the repeater except identification, I only needed the ID-O-Matic II to provide the Morse identification.

Assembling the ID-O-Matic II printed circuit board is straight forward. The only exception to the instructions provided was that I prefer to install the IC sockets first and then use the skyscraper method of construction. By that I mean installing components based on their height above the printed circuit board. I install the lowest components first and then build my way up with the taller ones.

C12 was not required because de-emphasis is performed by the MSR 2000 modules; and, R10 was not required for the PTT to function properly. Therefore, neither of these components were installed during the build. Instead of soldering the LED directly to the board, I installed it on the front panel and connected it to a 3-position header I mounted on the board where the LED was supposed to be mounted.

I positioned the COR jumper so that the board would accept an active-low COR signal. I did not install the INH jumper.

After the board was populated, I visually inspected it for shorts and cold solder joints. Then I applied power and verified that 5 volts was present at the appropriate pins of the IC sockets. After completing these initial checks, I installed the ICs, connected the serial port to my laptop PC running HyperTerminal under Windows XP, and edited the programmable parameters. See Table 1.

Modifying the Squelch Gate Board

The modifications to the squelch gate board are minimal. They consist of removing jumpers JU11 and JU12, removing the solder from these pads, and removing the solder from backplane pin pads 1, 12, and 22. These pads will be used as connection points for wires from the ID-O-Matic II board and the front panel switches.

The squelch gate board has fifteen jumpers that need to be set correctly. Most of them are either staple type wire jumpers or zero ohm resistors; however, jumpers 13, 14, and 15 are different. Each one of these consists of a short length of hookup wire terminated with a female socket. These three jumpers allow the user to choose field-selectable options. Unless you have a specific reason not to do so, I suggest you set all of the jumpers as shown in Table 2.

Connecting the Boards

Refer to Figure 3 for the wiring diagram. Figure 4 is a view of the YAP 2000 ID module opened up to show how I ran the wires. I used short lengths of heat shrink tubing as a wire management aid. Figure 5 shows the module after wiring was completed.

Wiring the Power Supply Circuit

I ran a black wire from J1 pin 1 on the ID-O-Matic II board to backplane pin 1 on the squelch gate board but didn't solder it at this time. This is the ground line.

Then I ran a red wire from J1 pin 2 on the ID-O-Matic II board to backplane pin 12 on the squelch gate board and soldered it. This is the +12 volt dc supply line.

Wiring the COR Circuit

I ran a violet wire from J1 pin 7 on the ID-O-Matic II board to backplane pin 22 on the squelch gate board and soldered it. This is the COR line. It lets the active-low Time-Out Timer Reset signal from the squelch gate board initiate the identification timing interval.

Wiring the PTT Circuit

I soldered two orange wires to the pad of jumper JU12 near Q17. One wire was from J1 pin 3 on the ID-O-Matic II board; the other wire was from one side of the TX KEY switch.

Next, I ran a black wire from the other side of the TX KEY switch to backplane pin 1 on the squelch gate board and soldered it.

Table 1
ID-O-Matic II Programming Selections

Parameter	Value	Remarks
ID Interval	600 seconds	10 minutes
Yellow Time	90 seconds	
Blink Time	30 seconds	
ID Message	KH6CQ	
Beacon Message		Not used
Alternate Message		Not used
Auto CW ID	Yes	
CW Speed	20 WPM	
ID Audio Tone	1200 Hz	
Repeater Mode	Yes	
Courtesy Beep Tone	1000 Hz	
Courtesy Beep Delay Time	0 seconds	
Courtesy Beep Character		Not used
Alt Beep Character	A	
Beacon Time	0 seconds	
PTT Hang Time	0 seconds	
TOT Interval	180 seconds	3 minutes

Table 2
Jumpers on the Squelch Gate Board

Jumper	Status	Description or Function
JU1	OUT	Local control priority
JU2	OUT	Delayed keyed A+ to Q10
JU3	IN	Repeater PL indication
JU4	IN	PL indicator
JU5	IN	Keyed A+ for the F1 channel element switch
JU6	IN	F1 oscillator ground to enable exciter
JU7	IN	Line or remote push-to-talk
JU8	IN	Push-to-talk signal to option relay
JU9	IN	A+ to option relay
JU10	IN	R1 unsquelch indication for the audio gate driver
JU11	Remove	Audio to local speaker (see text)
JU12	Remove	Transmitter push-to-talk (see text)
JU13	User	Transmit turn off delay (tail timer); set to 0 seconds
JU14	User	PL indicator; put it on the PL pin if using PL; otherwise, put it on the CS pin
JU15	User	OR gate; put it on the PL pin if using PL; otherwise, put it on the CS pin

Finally, I ran a gray wire from the pole of the TX KEY switch to the pin 18-side pad of jumper JU12 on the squelch gate board and soldered it. This is the PTT line. It lets the dc control signal from the Squelch Gate module key the transmitter via the Station Control module.

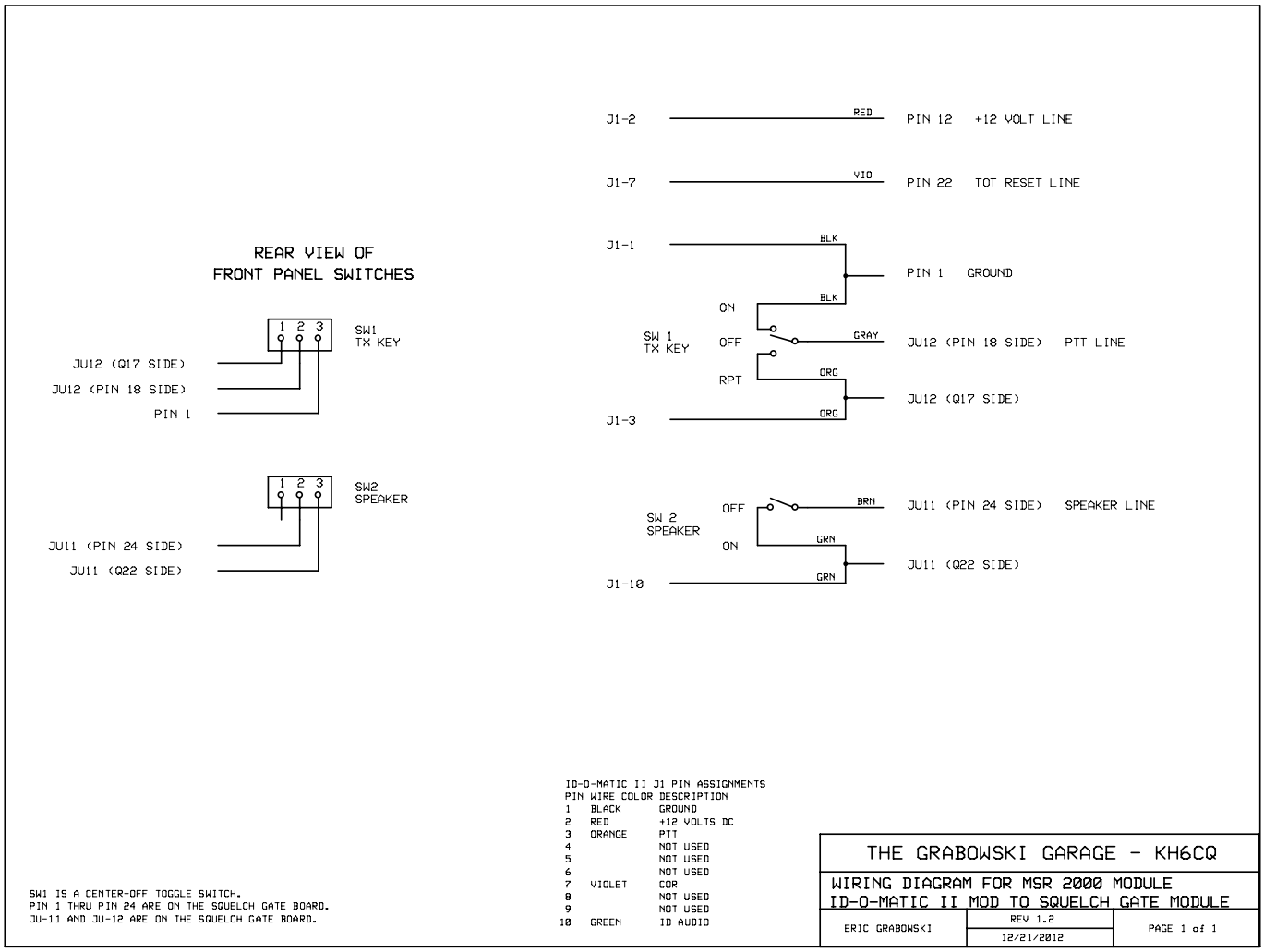

Figure 3 — Wiring diagram for the YAP 2000 ID module.

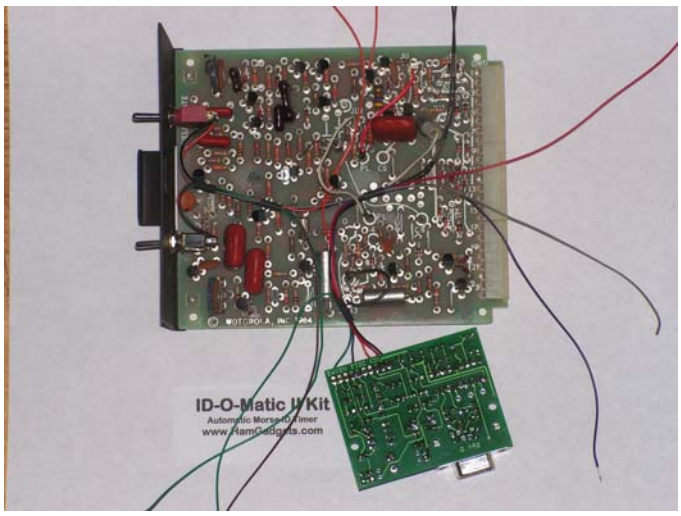

Figure 4 — The YAP 2000 ID module "opened up" so you can see how the squelch gate and ID-O-Matic II boards are wired to each other and to the front panel switches. A few short lengths of heat shrink tubing keep the wires neatly bundled.

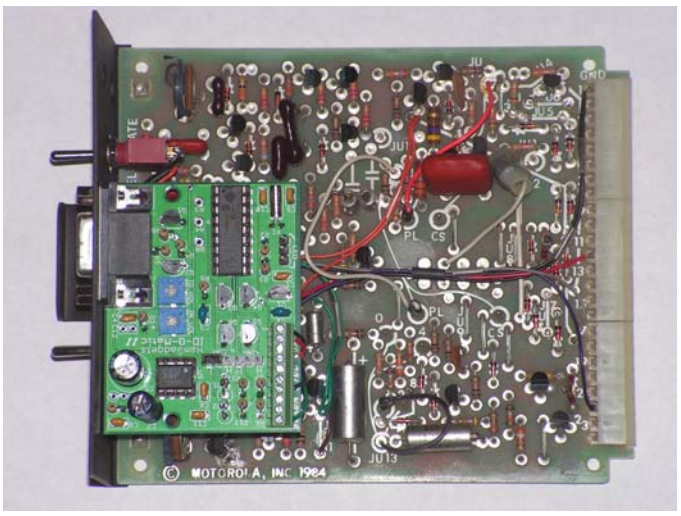

Figure 5 — The YAP 2000 ID module after all wires were soldered in place. The LED and its wiring have not yet been installed.

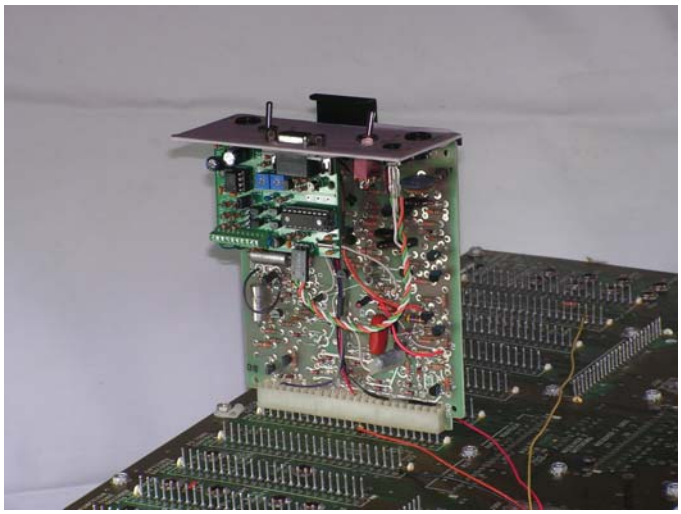

Figure 6 — The YAP 2000 ID module plugged onto the rear of the backplane in the Squelch Gate module position. If you do this, there are two caveats you need to be aware of: First, you should only insert a module onto its own backplane connector; otherwise, it may not function properly and it may be damaged. Second, you have to pay attention that you don't insert the module up-side-down, i.e., pin 1 to pin 24.

Wiring the Audio Output Circuit

I soldered two green wires to the pad of JU11 closest to Q22. One wire was from J1 pin 10 on the ID-O-Matic II board and the other wire was from one side of the SPEAKER switch.

Then I soldered a brown wire from the pole of the SPEAKER switch to the pin 24-side pad of JU11. This is the local speaker audio line. It allows repeater audio be applied to the local speaker through the R1 Audio and Squelch module.

Setting the Levels

Squelch crashes can be virtually eliminated by setting up the system so that a slightly higher input signal is required to gate the audio than key the transmitter. When this is done, the audio signal applied to the squelch gate board will remain muted when an input signal is strong enough to break the squelch but still noisy.

Place the SPEAKER switch in the right-most position. Then use the screwdriver adjustable VOL control on the R1 Audio and Squelch module to adjust the volume to the desired level.

I installed the YAP 2000 ID module on the Squelch Gate module's backplane pins as shown in Figure 6 and set the RPT LVL and SQL KEY controls according to the procedure in the MSR 2000 instruction manual. Then I adjusted the ID-VOL control on the ID-O-Matic II board so that the identification message had 1 kHz deviation.

Preparing for Normal Operation

After all the adjustments were made, I removed the YAP 2000 ID from its test position, placed each front panel switch in its left-most position, and then inserted the module into the squelch gate slot of the fully-optionable RF-Control Chassis as shown in Figure 7.

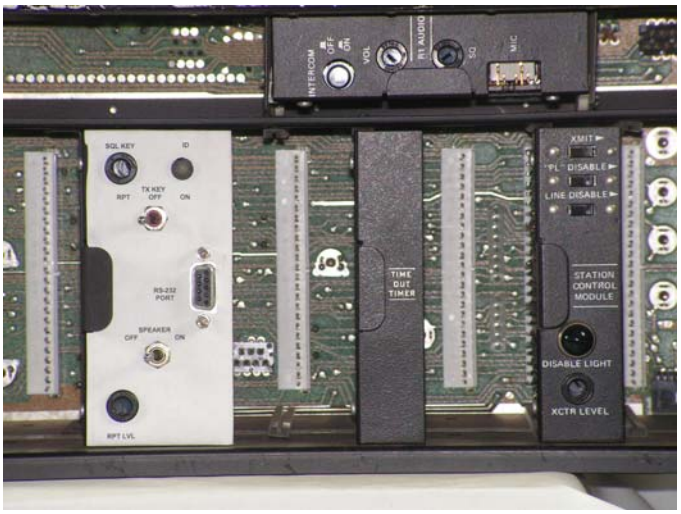

Figure 7 — The YAP 2000 ID module plugged into the Squelch Gate module slot in the MSR 2000 station's fully optionable RF-Control Chassis.

Table 3 identifies the subassemblies used in this C73KSB-1105AT repeater cabinet. Table 4 identifies the jumpers needed for the fully-optionable backplane. Table 5 summarizes the operational functionality of the LED indicator.

Table 3
Subassemblies in this MSR 2000 Station

Nomenclature	Name
TLN2475B	Fully Optional RF-Control Chassis
TLE5512A	Duplex Exciter Module
TRE6262A	Duplex Receiver Module
TRN9689A	R1 Audio and Squelch Module
TRN5324A	Squelch Gate Module (factory)
TRN5295A	Time-Out Timer Module
TRN5321A	Station Control Module
TRN5073A	Private Line Encoder-Decoder Module
TLD2601A	RF Power Amplifier
TRN1191A	AC Power Supply

Table 4
Jumpers Installed on the Fully-Optional Backplane

Jumper	Function
JU1	Permits audio from the local microphone to reach the exciter.
JU4	Permits the XMT switch on the Station Control module to key the transmitter for testing.
JU5	Permits the PL Disable switch on the Station Control module to disable PL Decode so the receiver can be used in carrier squelch mode for testing.

Table 5
Front Panel Indicator

LED Color	ID-O-Matic II Status
Solid Green	Power is on.
Blinking Green	ID timing interval in progress.
Solid Yellow	60 seconds to ID start.
Blinking Red and Yellow	30 seconds to ID start.
Solid Red	ID message in progress.

Summary

This Ham Tip described an economical way to add an alphanumeric Morse identifier to the MSR 2000 station. An ID-O-Matic II Identifier board was piggy-backed onto an MSR 2000 squelch gate board and both boards were mounted behind a double-wide front panel fashioned from a MSR 2000 Line Driver module. The indicator and switches on the front panel come in handy during initial setup and for routine maintenance.

Acknowledgements

Projects such as this one are built on the work of others who have gone before and shared their experiences with the rest of the amateur radio community. In particular, I would like to thank the following authors for their articles:

Richard D. Reese for his article “Micor Repeater Controller Interface” (http://wa8dbw.ifip.com/interface.html)

Skipp May for his article “A straight-forward modification to place an external controller into operation on a Motorola MSR 2000 (and Micor) repeater, connection via the squelch gate module” (www.radiowrench.com/sonic)

Mike Morris for his article “Information and Modifications for the MSR 2000 Station” (www.repeater-builder.com/msr2000/msr2000-index.html)

Robert W. Lawrence for his article “Adding a Ham Gadgets ID-O-Matic II Controller to a Kenwood TKR-720 (VHF) or 820 (UHF)” (www.repeater-builder.com/kenwood/pdfs/tkr-n20-idomatic.pdf)

Eric Grabowski for the article “Ham Tip 17: An In-Cabinet Repeater Controller for the MSR 2000 Station” (www.repeater-builder.com/motorola/msr2000/pdfs/kh6cq-internal-repeater-controller.pdf)

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