Tips and Hints for the Motorola MCS2000



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This article was originally drafted as a part of another article written as an introduction to the use of commercial radios by amateurs. That article became too large and the decision was made to split these further tips into a separate article specifically relating to the Motorola MCS2000 radio.

In Part One we showed where and how to gain information about commercial radios intended for use by amateur radio operators. We gave advice on where to find radios and how to figure out which radios were useful to hams. We showed how to identify radios by decoding model numbers and ID numbers on the radio data plate. We suggested where to look for programming software and how to find a programming cable.

In this article we will build upon the information in Part One and give you specific tips for use with the MCS2000. But many of the ideas shown here can be adapted and used with many other Motorola commercial radios.

Putting the Pieces Together

The MCS2000 radio comes in a number of different forms. Some radios are self-contained as we typically think of a two-way radio in one piece. But the MCS2000 was also designed to be used with a separation cable that allowed just the control head to be mounted in one place while the bulk of the radio was located remotely. Many high quality amateur radios are now including this convenient design option. I've found a good number of eBay listing for the MCS2000 but the listing only includes the electronics without the control head, the connecting control cable or the microphone. Surely these radios were pulled out of busses or other fleet vehicles and the salvagers simply abandoned the control cables, mounting brackets, speakers, etc. Usually these radios are offered at a very reasonable price because: 1) salvagers didn't bother to take the time to remove the various parts; and 2) without the rest of the parts the radio unit by itself may not have much value or use.

On eBay you will find complete MCS2000 radios with all parts and accessories for around \$150 and up. But for the radio unit by itself you can pick up these for \$50 and less. There is one eBay seller offering two 450 MHz ("S" split UHF) MCS2000 radio units only for a mere \$40 plus \$15 in shipping.



If you find a MCS2000 radio and a separate control head you are very close to having a working radio.

On eBay you'll find reasonably priced MCS2000 Type II control heads that were intended use with a control cable. Unfortunately, the control heads won't mate directly to the radio. But you can connect the control head to the radio using inexpensive DuPont jumper pins, the kind you use with Arduino and Raspberry Pi micro controllers.



The pins use a straight through connection scheme. When the radio is facing up (with accessory port facing down) the pins on the radio unit will match up just like an extension cord. I built jumper cables and use blue masking tape to hold the individual connection pins in a smooth unit. You don't even need to separate to split the ribbon of the jumper cables. By the way, these female jumpers also work great on the accessory ports for Motorola MaxTrac and CDM series radios.

The Power Connection

Motorola uses simple SAE type polarized power cables. Looking at the back of the radio the positive terminal in sticking out and the ground terminal is recessed. They're available in many places. My favorite source is (you guessed it) eBay.



That (in)convenient accessory jack

The MCS2000 has an accessory jack on the bottom of the radio with all the needed connections under the radio. It fits the exact form for a DB-25 female connector. There's just one problem. How do you reach it with a DB-25? The side tabs on the DB-25 won't fit into the radio case recess for the connector. The expedient solution I used is to simply bend the DB-25 side tabs back against the connector with pliers and a hammer so that it fits down into the recess. You can make the on/off, PTT, speaker, microphone, and CAS connections through the accessory cable. The female DB-25

connector is much easier to make connections to than the insecure Motorola plastic accessory plug. The problem is turned into a great solution.





The functions of all the accessory pins are well documented in the MCS2000 documentation found on Repeater Builder. At the end of this article I have also included a chart summary of each pin's function.

Honey, who shrunk the antenna connection?





The smaller funny looking UHF style antenna connection on the MCS2000 radio is called, appropriately enough, a mini-UHF (female) connector. Unless you have a bunch of mini-UHF cables laying around you'll probably want to use an antenna adapter to make it more useful for some other

antenna cable connector, such as a BNC or N-Type. A good source for adapters is eBay. I prefer a BNC female to UHF-mini male adapter. Buy a lot of 4 to 6 connectors, they're only a few bucks more. And use some needle nose pliers to snug up the connector to the radio so it won't be loose.

Keep it Cool, Baby

Mobile radios are not designed for continuous transmission. If you plan to use any mobile radio as a transmitter in a repeater system you'll want to *use the repeater sparingly and make sure you have more than adequate cooling* with the biggest fan you can find. Conveniently, the MCS2000 accessory jack on the bottom of the radio does not interfere with the mounting of a big muffin fan right on the transmitter heat sink. I drilled holes through the cooling fins fastened a large muffin fan to the heat sink with cable ties.



Notice in the photo above the radio has been mounted *upside down* for convenient mounting of the cooling fan and access to the accessory port.) The 120 mm fan is strapped to the radio with cables ties through holes drilled into the heat sink. I tested the cooling efficiency by keying up the radio into a dummy load for 10 minutes continuously with power output of

30 watts. Using an infrared thermometer, I measured the temperature of the heat sink at 138 F after 10 minutes. It was pretty warm but not scorching hot. After releasing the transmitter, the heat sink temperature was about 110 F two minutes later. The more cooling you can bring to the heatsink the longer life you can expect from your transmitter.

Need a mounting bracket? Make your own!

I use old license plates for mounting radios. License plates are easy to bend and drill. And they're dirt cheap! With just a bit more planning they can serve as a mounting plate both for the radio and the separate control head. Motorola uses M3 screws with thumb knobs for many of their mobile radio mounts. But you can also substitute SAE size 6-32 screws which are close enough and generally cheaper option, but not a perfect fit.







I hope these tips help you with your next radio project.

MCS2000 Series Radios

Pin	Name	Function	Description
1	SPK+	Speaker+	Speaker+ and Speaker- (Pin 3) are used to connect an external speaker. The audio PA is a bridge amplifier with a minimum load of 3.2 Ohms.
2	INT_SPK+	Internal Speaker Return	A jumper from Pin 1 to Pin 2 will enable the internal speaker.
3	SPK-	Speaker-	Refer to Speaker+ Pin 1
4	(GND)	Digital ground	Used as ground for Digital signals.
5	BUSY	SB9600 Busy	This is part of the Motorola Bus to connect external devices.
6	BUS+	SB9600 Bus+	This is part of the Motorola Bus to connect external devices.
7	IO_6	HUB/Monitor Input Line or R5232 RTS or GP I/O 6	This line has an internal pull-up resistor. The radio will enter the monitor mode when this line is not connected to ground.
8	IO_5	Car radio mute or RS232 CTS or GP I/O 5	The function of this pin can be programmed by RSS as car radio mute, speaker on, carrier on or no function. This line is active low.
9	EMERGENCY	Emergency	This pin must be connected to ground by jumper on accessory connector if emergency is disabled, even if disabled by the RSS. If emergency is enabled, this line must be grounded via a switch, which is normally closed. The emergency debounce time is programmable via the RSS.
10	(GND)	Analog Ground	Used as ground for Analog signals.
11	RX_HI:FIL_AUDIO	Filtered Audio Out	This is a fixed level received audio. The signal has passed the received filtering and contains the alert tones. This audio is controlled by the squelch logic. Flat or Deemphasis are as programmed by the RSS. The output voltage is approximately 230 mV at a nominal deviation at 1 kHz. The DC offset is 4.6 V.
12	AUX_RX_1N2	Aux Rx1n2	
13	MIC_IN	Mic In and Radio On-Off	This Microphone input is parallel to the Microphone input of the control head microphone connector. The nominal input level is 80 mV for 60% deviation. The DC impedance is 1000 Ohms and the AC impedance is 1100 Ohms. Pulling this line low (below 1.7 VDC) will switch the radio on or off, depending of the previous state. Note: Only one Microphone should be active at the same time, to make sure that no on/off function is detected by the radio.
14	SW_B+	SW B+	This voltage is available, when the radio is switched on.
15	IGNITION	Ignition	Refer to Table 6 in Appendix A2 for details about the ignition sense function.

MCS2000 Series Accessory Connector Pin Functions

Page Two MCS2000 Series Accessory Connector Pin Functions

Pin	Name	Function	Description
16	IO_2	External Alarm or GP I/O 2	This line is active high (Battery Voltage). This line can directly drive the Motorola Buzzer GLN7282 or the Motorola External Alarm Relay GLN7283. The other pin of the Buzzer or Relay must be connected to ground. The active time can be programmed via the RSS. External Alarm must be enabled by the RSS and must be activated by the user via the control head.
17	RESET	SB9600 Reset	This is part of the Motorola Bus to connect external devices.
18	BUS-	SB9600 Bus-	This is part of the Motorola Bus to connect external devices.
19	SC I_RX_DATA	RS232 Rx Data	
20	IO_4	RS232 Rx Data or GP I/O 4	Serial Data Input. Digital R5232 type asynchronous serial data to the radio.
21	IO_3	PTT or Vpp or GP I/O 3	This line has an internal pull-up resistor. Pulling this line to ground will activate the PTT function. Mic Input Pin 13 is active. The response time is about 30 ms. Used also when FLASHing the radio.
22	RSSI_OUT	RSSI (Radio Signal Strength Indicator)	This is an analog output which indicates the strength of the received signal.
23	EXTERNAL_MIC_IN	External Mic In	Used for a vehicular speaker mic (VSP) or a 2nd microphone.
24	AUX_TX_IN2	Aux Tx (Auxiliary TX input)	
25	BUFFERED DISCRIMINATOR	Universal I/O Out	This is a buffered output of the discriminator audio. The output voltage depends on the channel spacing of the received channel. Approximately 200 mV at 12.5 kHz channel spacing for 60% of FSD full system deviation.