MARS-ALE
Radio Help User Guide

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This MARS-ALE Radio Help User Guide applies to MARS-ALE LE and SE and supersedes all previous edition's of this guide. All previous edition's should be destroyed.

MARS ALE STATION APPROVALS: All U.S. Army MARS members desiring to operate on ALE NETS must get authorization per the guidelines in Chapter 8, Section 8-8 of the US Army MARS NET PLAN. MARS members from other services should get authorization from their respective Chief, through their SMD to operate on Army MARS ALE Networks.

WARNING: Stations that have not received direct authority and direction to do so, should NOT be actively participating in multi-channel Sounding operation on MARS channels.

WARNING: MARS-ALE is NOT authorized for use on the Amateur Bands. NOTE: At this time FCC Part 97 rules do not permit the full use of ALE for data communications on the U.S. Amateur bands, this is especially true of Multi-Channel SOUNDING operation.

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PREFACE

MARS-ALE is a software based ALE Controller/Modem which requires at a minimum an MS-Windows 2000 Professional Service Pack 4 based host computer system running no less than an 866Mhz Pentium CPU (300Mhz if the MIL-STD-188-110 modem is set to OFF) and 512MB RAM (or better and no use of virtual memory) and on-board AC'97 PC Sound Device along with one RS-232 port for HF SSB transceiver command and control where the computer host system is dedicated to MARS-ALE and optional supporting tools but is otherwise not running other software applications.

Upon completion of the ALE 3-way handshake to establish an ALE linked state, the MARS-ALE user has the ability to exchange information using the selected frequency until interference and or propagating conditions result in unreliable information exchange. This information exchange can be in the form of Voice or Data modes of operation using the ALE Advanced Message Display (AMD), Data Text Message (DTM) or Data Binary Message (DBM) protocols.

Additional data signaling protocols supporting higher data throughput rates than available through the basic ALE FSK modem signaling structure may be utilized to include the supported MIL-STD-188-110 PSK modem and FED-STD-1052 Data Link Protocols or the use of external hardware based Terminal Node Controller/Modem protocols such as GTOR and PACTOR.

OVERVIEW

The purpose of this "Radio Help User Guide" for MARS-ALE is to instruct the end user on how to properly interface their radio equipments for use with MARS-ALE. Herein we shall cover the hardware interface between the HF SSB transceiver (hereafter referred to as radio) and PC sound card (hereafter referred to as PC Sound Device Modem or PCSDM) and other external devices interfaced via RS-232 which are supported by MARS-ALE.

Although a radio that is not under computer control can be pressed into service with MARS-ALE, however the radio's application for ALE operations is severely limited when not computer controlled.

NOTE: All PC sounds **MUST** be turned OFF if you are using the primary, default Windows sound device for your PCSDM. Sounds that are generated by other programs (no such program should be running) and the Windows Operating System can end up being transmitted when the system default sound device is used as the PCSMD. These sounds will also mix with ALE transmissions which can cause issues. The best course of action for many reasons is to install a second sound device for MARS-ALE PCSDM. If using the default sound device as the PCSDM **All stations MUST make sure that under Windows, the "Sounds and Audio Device Properties" have the "Sound Scheme" set to "NoSounds" to prohibit systems sounds from be transmitted.**

However, we recommend that the user refer to their user documentation supplied with their radios and accessories for specific details regarding manufacturer specifications and recommended use.

The MARS-ALE software supports radio control out of necessity for Scanning/Sounding operation, as such, that the software when used in conjunction with a radio under computer control will pre-configure your radio for a known good MARS-ALE set of radio configuration parameters at software startup for the best ALE operation. In addition MARS-ALE provides the user a handy way to make fast, accurate frequency/mode changes during casual listening as well as to control the radio PTT via the PC for testing purposes.

The two most important aspects of the MARS-ALE radio control is the accurate frequency setting of your transceiver and the control of Scanning/Sounding of channels with accurate scan rate timing operation.

The ALE mode has very stiff requirements (see FS-1045 requirements in Appendix B herein) as to all users being on the exact same frequency. The standard specifies that the SSB radio must tune in 100-Hz frequency increments for single-channel and 10-Hz frequency increments for multi channel operation. In addition, the SSB radio carrier frequency including tolerance and long-term stability, but not any variation due to Doppler shift, shall be within ± 30 Hz for man-pack equipment and within ± 10 Hz for all others, measured during a period of not less than 30 days.

It has been noted when receiving an incoming ALE signal during LINKING, when monitoring with the SYNC rather than the TUNE display, that a 10hz difference can be noted in the peaking of the SYNC pulse when using the receiver incremental tuning (RIT) and can make the difference between achieving a link or not. Thus maintaining frequency accuracy to 10hz is needed. What this means for older radios that may tune at 10hz steps, but that only provide a frequency display to 100hz to the operator is that you can NOT accurately tune manually. It is recommended that you use the MARS-ALE software and your GROUP/Channel selections to tune to the ALE net frequency rather than manually with the VFO.

If your radio tunes in 100hz steps and displays in 100hz steps and has a Temperature Compensated Crystal Oscillator (TCXO), then you know your frequency in accurate, if not and especially if it displays to only 100hz and tunes in lower steps, you do NOT know your frequency. You can use your radios direct frequency entry keypad if so equipped, but the best way is to use the MARS-ALE software itself and your GROUP/Channel selections as pre-configured. At program start, if your radio is under PC control, the software will ALWAYS set your radio to the first channel of the current GROUP, if that's not the desired net frequency and mode, you will need to step through the channels or even change the GROUP and step or use the radio asset control panel to perform a direct frequency and mode entry using the software.

NOTE: If you radio does not come with but has a TCXO option, it is highly recommended that you install the option in light of pending NTIA requirements and for best ALE results.

Regarding support of ALE Scanning/Sounding operation, this mode of operation will become more and more important within the MARS program itself and not just in support of our customers such as FEMA. The only way to participate in Scanning/Sounding with MARS-ALE is to have full radio computer control, your PTT can be either controlled over the RS-232 link or via an external interface, but your radio's frequency and mode MUST be under the control of the MARS ALE software. So if you have been using a non-PC controlled radio, or a modified radio that does not provide full PC control, such as a TS-930S and PIEXX control board (with PIEXX

the PC can NOT select the sideband) or if you just have not yet bothered to interface your radio and PC, now is the time to make the change to a fully computer controlled HF SSB radio station consisting of a MARS-ALE supported (see the listing of supported radios in Appendix A herein).

For those MARS members that have a PC only controlled radio (e.g. Kachina 505DSP, Kenwood TSB-2000, Ten Tec TT550 Pegasus, etc.) or plan to, as only one serial communications port connection to the radio is permitted, control via the MARS-ALE software will be the only program running that will be able to communicate with the radio. As such, the MARS-ALE program will need to provide additional control and monitoring features for such radios. In addition, there are some radios, mostly older models, that disable all or most front panel radio control when enabled under PC control, such as JRC JST-245, Yaesu FT-767 and FT-980 and others that will require more control via the software. The amount of radio control provided shall be limited to the requirements of the MARS-ALE application and radio make/model requirements. For those radios that go into a remote enabled state that lockout manual user access, the MARS-ALE shall place the radio back into remote disabled at normal program termination.

For MARS-ALE to communicate with your radio, the radio must support an RS-232 serial port communications protocol. Some commercial/military radios that use RS-422, RS-423, RS-485 interfaces will be supported, however, an RS-232 converter to the other interfaces will be required when using such a radio if the radio itself does not support selection of the RS-232 protocol, all Amateur Grade radios support RS-232 only at this time. Any future radios requiring other than RS-232 support shall be addressed as needed, Ethernet (TCP/IP) which also communicate in a serial way and other interfaces can be addressed with and RS-232 converter as well.

For MARS-ALE the radio must support commands on-the-fly for all radio parameters or at a minimum frequency and mode. A radio that can be preprogrammed for channel frequency, mode, etc. but can not be controlled for changes on the fly can not be utilized, a number of commercial radios fall into this category. All suitable Amateur Radio grade transceivers that support Computer Aided Transceiver (CAT) protocol are planned for support by MARS-ALE, as are many non-Amateur radios, please refer to Appendix A herein for full details.

TRANSCEIVERS AND MARS-ALE

Amateur Radio grade equipment is built to a price, and therefore is not as robust as military grade equipment. This poses a number of challenges, as most Amateur Grade transceivers are not made for continuous 100% duty cycle transmit operation, most will cut back power when working into VSWR that exceed 1.5:1 or thereabouts and those that do not, may soon burn up the PA section !

Another problem is that for a given audio drive level, the derived RF output level may be different on each frequency. As a rule, the lower the frequency the less drive that is required. Therefore to be on the safe side, and to protect other users of the MF/HF spectrum, it is advisable to set the transceiver's drive up on the lowest operating frequency that will be used. This means that the radio will be under driven on the higher frequencies. However, this is more acceptable than to overdrive the transmitter.

NOTE: Never use the radio mic gain or RF power control to adjust RF output power after initial setup, ALWAYS use the TX audio drive level control within the tool.

The following procedure should avoid clipping or distorted transmit tones:

MOST IMPORTANT: All audio input and output connections between the PC sound device and radio ports MUST be isolated by the use of 1:1 audio isolation transformers. If you are using a commercial interface you must check that this is being done on both ports, some only do this on the transmit line, some not at all. In addition, all precautions must be taken to ensure that clean, RF and distortion free audio is being processed.

MOST IMPORTANT: For transmit audio you are ONLY to use the tip and ground connections for the left channel of audio output, do NOT wire for use with both channels as it will cause phase distortion, on the PC sound device control panel where supported, change the settings from STEREO to MONO.

1. While making use of a dummy load or after Tuning the transceiver for the best SWR using a 10W CW signal on the lowest frequency that you plan to use.

2. Adjust your transmit mic gain control on the transceiver for voice peaks that stay within the acceptable area GOOD area of the transceiver ALC meter range. Speak the word WOOOF into your mike to peak the mic gain while observing the ALC meter.

3. The transmit audio level settings need to be setup for clean, undistorted audio that does **NOT** drive the transmitter into any movement of the ALC meter. For a normal 100w transmitter that would result in about 30-35 watts output or less with AFSK ALE transmissions if your PC sound device can supply sufficient, clean, distortion free drive levels. On some radios that require more drive than your PC sound device can supply, you may develop less RF power output, do NOT worry, anywhere from 5 to 35 watts on a 100w class radio will work well.

With MARS-ALE, while sending a LINKing call with SCLC set to 20 or after a LINK has been established which sending an 75 character or longer AMD test message such as:

“MARS EXERCISE BT THIS IS A TEST RYRYRYRYRYRYRYRYRYRYRYRY BT MARS EXERCISE BT”

Adjust your PC sound device PLAYBACK audio levels to where you JUST about see ALC movement on the meter. For the typical 100 watt radio, the output power will be about 35% of your transmitter output power capability, basically, for ALE operation that would equate to about 30-35 watts with no ALC reading on the meter.

The external audio control in combination with your settings of the sound card, either in Windows or in the MARS-ALE program, can be adjusted for 35% power or less, depending how much digital power you want to output. Notice that we do not readjust the audio control on the transceiver, your output power is set only with audio drive with an eye on the ALC meter reading.

For MARS-ALE on NVIS paths, do NOT use an external power amplifier to achieve more that 100 watts into the antenna system, NVIS operation at more than 100 watts power levels can cause multi-path problems and the MARS-ALE will detect and display multi-path error messages. In addition, it is recommended that radios operating at less than 20 watts not be used due to absorption.

CABLING FOR MARS-ALE RADIO CONTROL AND PTT

There are numerous ways in which to interface between your PC and your radio, as such MARS-ALE will be designed to support various ways to provide the end user the most flexibility.

As radio control for Frequency and Mode changes is a key MARS-ALE requirement, the PC to radio hookup for radio control is a must. This is accomplished by the use of an RS-232 port or a USB RS-232 emulation/adapter between your PC and your radio/radio level converter. This makes the MARS-ALE configuration radio specific. MARS-ALE supports the selection of physical or USB Virtual Communications Ports (VCP) which are emulated serial ports, as COM1 thru COM9 at present. The later versions of the Windows OS supports up to 256 serial ports, the VCP devices can be set to any available port from 1..256 for most supporting drivers.

Regarding radio make/model, some radios require an external signal converter between the PC and the radio with a radio specific cable between the radio signal converter and the radio and an RS-232 cable between the PC and the radio signal converter. The radio manufacturer sell these units, as do third party manufacturers, you build one yourself from information provided herein and elsewhere. Another option is an external interface that also includes a level converter such as the MixW RigExpert which has a built in USB sound device modem, level converter and PTT isolated port, more on this in the RigExpert section of this manual.

NOTE: In the future MARS-ALE shall also support the use of the first Parallel Printer Port (LPT1) for PTT and other signal lines, more on that later.

Your radio may not need an external level converter, a simple standard RS-232 cable or an RS-232 null modem cable may only be required between your PC and your radio for control. Most radios using direct cabling also support CAT PTT, however, some do not, please refer to your radio manual and Appendix A herein for details.

Some third parties also sell level converters that plug directly into the USB port on your PC for which you setup within the MS-Windows OS as a RS-232 COM port. Some third parties sell external level converters with breakouts for the RTS and DTR lines for PTT and some even have ready to go isolated keying circuits as well.

For the purpose of MARS-ALE development, the SDT has been working with a number of make/model radios and using Kenwood IF-232C, ICOM CT-17, Yaesu FIF-232C and CT-62 and MixW RigExpert v2.2 (with factory cables for Kenwood TS-450S and Yaesu FT-817 and FT-890 radios) and home brew external level converters as well as straight and null modem RS-232 cables as required by the make/model radio for all development efforts.

The MARS-ALE specific part of the RS-232 interface between your PC and your radio comes into play with regard to the make/model radio you select in the software configuration and how

you interface for radio PTT and audio in and audio out to the PC sound card. If you are already using an external interface such as the commercial RigBlaster or other unit for PTT, then you will need to tie into the RS-232C cable from the PC to the radio for either the RTS or DTR line for PTT and Ground (GND) connection to the external interface as most of them are not RS-232C smart to also control the radio regarding RTS and DTR.

NOTE: For PTT with radios using RTS/CTS handshaking, only DTR and CAT PTT can be used.

One way to accomplish this is by use of a off-the-shelf Tri-Port adapter (e.g. Jameco P/N 105195 depicted in Figure 1.) or Y-cable splitter (such as the MFJ-RS-232-Y cable with the correct connectors for your needs) as the RS-232 port being used for radio control must also be the same port used for the RTS or DTR lines for the external interface such as the RigBlaster. Optionally, you can wire your own custom cable to connect the PC RS-232 port to the radio and external interface, just break out the RTS and GRN from the back end of one of the connectors (usually radio end of the cable) and wire the needed connector or directly to your external interface.

Most radio external level converters supplied by the radio manufacturers have 25 pin D connectors, as do most of the external interfaces, such as the rig blaster. The Tri-Port adapter pictured in Figure 1. would for instance be plugged into the radio's external level converter, then the RS-232 cable 25 pin connector from the PC would plug into the rear of the Tri-Port connector and then a 9 pin RS-232 cable would plug into the third port on the adapter to the external interface such as the RigBlaster.

Figure 1.

There are however new models of the RigBlaster (and possibly other makes) that are setup so that this is all plug and play for the radio control and external interface at the external interface, but you pay an additional cost for the higher end RigBlaster model. There are some commercial external level converters that provide ready to go RTS and or DTR ports for this requirement, such as the PIEXX USB ICOM interface that uses a USB port on the PC for ICOM radio control and provides RTS line for hardware PTT keying. Otherwise it is a matter of making a Y-cable or modifying your existing RS-232 cable or level converter to get access to the RTS and or DTR lines.

If you have configured direct cabling between your radio (perhaps to the accessory port) and your PC sound card (sound card in/out with isolation transformers) and have been using VOX

previously to key the radio, you can now add the RS-232 radio control aspect to your setup and key the radio via the CAT PTT command if your radio supports CAT PTT. If you were using com port RTS or DTR you can continue doing so. If you were using a Parallel Printer line from LPT1 etc., you will be able do in the future as that capability is planned for addition to MARS-ALE. However, for the CAT PTT to work, at present you **MUST** have the RTS and DTR for PTT unchecked under Enable/Disable in configuration.

Some radios require the use of RTS at the start of communications to read data back from the radio, this is the case with Kenwood radio's as detailed in Kenwood publication "Interface Kit IF-10A, IF-10B, IF-10C Instruction Manual". This is in order to get the radio's attention and receive back the ID information, we must assert the RS-232C RTS line for a few hundred milliseconds, during this time your radio will go into transmit if RTS is being used for PTT, however it will only transmit briefly. Should this cause any problems, you will need to disable the external interface that is keying the radio at program startup. Radios that use hardware RTS/CTS handshaking will NOT be able to use RTS for PTT.

NOTE: It is possible that some newer Kenwood radios at higher baud rates may actually require full handshaking for consistent operation, however the SDT has not had any of these models available for testing and no specific feedback from user's has yet confirmed this possibility.

At present, when DTR is not checked for PTT or MUTING and radio type "NONE" is not selected, the software ALWAYS holds the DTR line high for those that desire/need to power their external level converter from the DTR line. For those that do not need this feature, this presents a problem at program startup, in that the line is high and will cause any device using the line to receive a constant signal. For instance, an external interface such as the RigBlaster or RASCAL which have the RTS/DTR lines tied together, will cause the PTT to go high even though RTS is selected for PTT or neither RTS or DTR is selected so that CAT PTT is used.

There are two ways to work around this issue with DTR always being high at present. The one that most have implemented, as they do not have any need for the DTR line, is to modify their external interface so that DTR is not an issue.

TECHNICAL ALERT: Regarding the modification of the external interface hardware and the DTR line. The REGION 2 ALE NET AAM2RV/R OPNOTES #6 dated 01/28/04 as follows:

Early Rigblaster's tied the RTS and DTR leads together, causing the PC-ALE controlled station to lock up after the LINK is established. The following changes must be made to allow PC-ALE to operate properly:

Rigblaster: Lift one end of diode "D5" off the printed circuit board. This will open the DTR lead, allowing the RTS lead to operate properly. The DTR lead will be used in the future to Un-Mute speakers or sound an audible alarm.

Rigblaster Plus: Make sure that the DTR lead is open at jumper block "P5" on the printed circuit board. The RTS lead should be strapped at "P5" to the lead going to R3 and D1. The DTR lead will be used in the future to Un-Mute speakers and/or sound an audible alarm.

MFJ-1275: Diode D4 for the DTR line needs to be out of the circuit. If there is an internal jumper in your unit, JMP5, open the jumper. If not, use an exacto knife to cut the trace on the PCB.

TECHNICAL ALERT: In a similar situation, the Rascal interface unit was found to have the same problem. Diode D2 needs to be lifted from the printed circuit board on one end. Leave the diode attached by one lead, since it will be used in a future function muting and un muting the speaker and/or sounding an audible alarm.

OTHER CONTROL BOXES: Check to make sure that only the RTS lead is used to control the PTT function. Let us know if you need help with this issue.

Another complication with the use of DTR as well as RTS is for radios that require hardware flow control where RTS and DTR are asserted. At program start both lines are asserted briefly to be able to read ID data from Kenwood type radios if the radio type "KENWOOD, "KENWOOD2" or "KENWOOD3" have been selected. This is currently also true of the following radios that were coded by Charles Brain, the SKANTI 8250, Ten-Tec Pegasus 550, Ten Tec Argonaut IV and in receivers the AOR AR7030, Rhode & Schwarz EK890 and EK896, Ten Tec RX-320. As we add additional radio support in the area of reading data from existing and new models, there may be more radios added to this list.

For the Kenwood models, the RTS line is high only briefly as we have programmed to drop it after the radio ID has been read. At present we are NOT changing the status of the DTR line; that is currently up to the user to address for now. Regarding the other radio make/models, at present we are NOT dropping either the RTS or the DTR line as we do not have the radios in hand to test with, thus we need user feedback to determine what needs to be done.

In addition, we are analyzing the prospect of adding additional I/O support to facilitate means of control for additional devices within the scope of MARS-ALE operation where switching logic lines and sensing signals will be needed in some installations. This additional support will be in the way of optionally using Parallel Printer port lines for signaling and possibly third party AD/DA interface boards via the USB port.

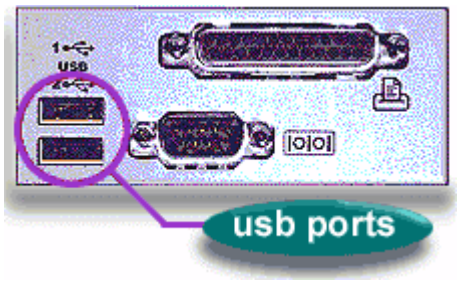
THE BRAVE NEW WORLD OF PC SERIAL COMMUNICATIONS

The radio equipments that are computer controlled with very few exceptions are designed to communicate via an interface standard developed by the Electronic Industries Association (EIA) back in the early 60's generally known as RS-232, more specifically RS-232C, although most radio manufacturers are not really following the standard. EIA RS-232 specifies signal voltages, signal timing, signal function, a protocol for information exchange, and mechanical connectors.

In the period over the 40+ years since this standard was developed, the Electronic Industries Association published three modifications, the most recent being the EIA232E standard introduced in 1991. Besides changing the name from RS232 to EIA232, some signal lines were renamed and various new ones were defined, including a shield conductor.

PC RS-232 connectors were originally 25 pin “D” type on every IBM PC and compatible and then 9 pin “D” connector came along with the IBM AT. At this time all PC’s come with 9 in “D” connectors for the RS-232C port. However, some computers these days don’t have any RS-232 ports, instead they have Universal Serial Bus ports, a.k.a. USB ports. This presents some problems, although there are USB Serial Adapters for RS-232, these adapters are not all created equal. We may find that the next crop of Amateur Radio transceivers coming along no longer have RS-232 but rather USB ports ! The new ICOM IC-7800 is the first such radio, however not for radio control, it supports a “USB keyboard for RTTY and PSK and entry of the CW message memories.

The USB port is on the verge of replacing the RS232 and parallel communications ports in the PC world. USB is now the most used interface to connect devices like printer, mice, keyboards, flat bed scanner’s, external CD-ROM drives and hard drives and more devices. Many people ask if there is a simple way to convert RS232 to USB. After all, they are both serial interfaces. The answer is a little disappointing for most: NO, RS232 and USB can't be connected by just soldering the right connector to the cable, however, there are RS232 to USB adapters sold for this purpose.



Let's look at USB in some more detail. The name of USB tells us in fact a lot. Universal should not need to have a lot of explanation. The definition of USB tries to address a lot of uses of the interface. Not only communication with modems as was the case with RS232, but with all kinds of devices. The second character in USB stands for serial. This is what confuses a lot of people. Serial is not a family of interchangeable communication interfaces. It just tells us that every bit of information is send in a specific time slot and that no two items of information can be send at one moment. This is not only the case for USB and RS232. Ethernet networks also communicate in a serial way. Actually most communications even high-speed are performed in a serial way. Parallel is the minority for the simple reason that you need more lines and thus more expensive material to transfer the data. We see parallel interfaces mostly used at short distances, like connecting a hard disk to the main board. The last character in USB stands for bus. This tells us something about the higher architecture allowed. USB is not designed primarily for 1:1 communication like RS232 (yes RS232 can be used for mutli-drop with station addresses, the Ten Tec RX340 supports this mode) or the parallel printer interface, but it is a bus architecture where you can attach more than two (127 actually) devices to it, in the future MARS-ALE is planned to support two radios as an option, one for the transmitter and one for the receiver.

There are currently three versions of USB, the version numbers describe the USB interface with more features and higher speed. It's simple as that. The USB interface has been under development for more than ten years. Version 0.7 of the USB interface definition was released in November 1994 and the first "real" definition of USB, USB 1.0 came out in January 1996. It was a combined effort of some large players on the market to define a new general device interface for computers. Major pushers of the project were Compaq, Intel, Microsoft and NEC. There are already USB version 1.0, 1.1 and 2.0 fielded. Basically USB 2.0 is 40 times faster that USB 1.1, supporting higher speed data transfers at up to 480Mbps.

The USB definition is in a lot of ways comparable with the RS232 definition. It doesn't only specify things like communication speeds and low level interfacing, but also protocols, and the mechanical characteristics of the connectors to be used. This made USB different from other standards that had seen the light since RS232, like the RS422 and RS485 that focused mainly on the low level interfacing and signal definition and less on the practical implementation. The necessity for a very well defined way of practical implementation has many times been overlooked by those developing standards. With USB the four parties wanted to get rid of these problems. In fact it was one of the three main motivations as described in the USB 1.1 specification.

If you have not yet wired your PC for radio control and if your PC has no RS-232 port, then you can use an USB to RS-232 Serial Port Adapter, a preferred method as no IRQ is needed as with a standard on the motherboard or plug in serial port card. For laptop users, this is the best way go as well. However, not all USB to RS-232 adapters are created equal and with some laptops, timing on the USB port and thus baud rate can be way off.

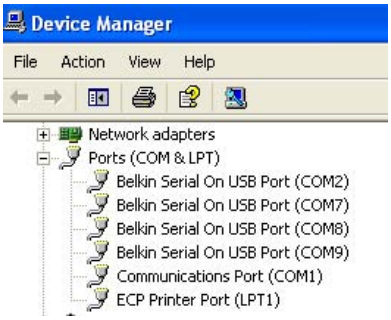
One such USB adapter is the Belden P/N F5U109 and FU5409 units which provide a 9 pin “D” male connector output. If your PC has both RS-232 and USB and you have not interfaced your radio and PC, you can choose your path based on either, taking into account everything described herein. You must review your radio capabilities and how you place to interface to the PC for audio in/out, frequency, mode and PTT control to make your decision.

USB RS-232 adapters are not all created equal. The SDT has tested the most commonly found USB RS-232 adapter, the Belkin F5U109 with mixed results. First, the drivers received on the CD-ROM with the unit were 3 years old and not signed for Windows XP, they worked, but not great. A web search of Belkin' many web sites and found better drivers, but it was not fast, many of their sites do not work correct and had even older drivers. The F5U109_XP.EXE self extracting .ZIP with the drivers are available from the support web site.

AAAR2EY has had perfect results using the Belkin F5U109 with the new drivers through 57600 baud using an FT-847 and TT538 Jupiter. However, poor results were had using an old FT-890 and external IF-232C interface at 4800, it would not control it at all at first, then later it

was spotty, traced it to a bad RS-232 cable. Testing with the F5U109 and Kenwood and ICOM radios with factory external level converters at 4800 and 19200 respectfully was flawless.

Belkin F5U109 unit that is sold just about every were, Staples has tons of them for about $30USD This unit has a 1 foot heavily shielded USB cable, a grayed but see through housing with three LED status indicators and a 9 pin DB male connector. The LED indicators are labeled LINK (plugged into USB port) and RTS/CTS labels TX and RX, for RS-232 data. The unit fully supports RTS/CTS and DTR/DSR flow control and has no problem sinking current for PTT as tested using several RigBlaster M8 units and providing D.C. power on the DTR line as tested using a home made interface. The USB device on the unit is the world renowned FTDI series, same as used in the RigExpert and just like the RigExpert, the drivers supplied at first stunk and better drivers (posted on the SDT web site) had to be located to make it play correctly. Another nice thing about USB VPS are that you can set them up for any free COM port on the PC and change them on the fly hot, so you want it as COM6 or COM9, just change it can the have it.



Should anyone have a telephone modem board or similar device installed that is no longer used, it should be removed as it is taking a COM port and although you can usually disable them in the device manager, removal altogether is best, they are often on COM3.

MARS-ALE AUDIO INPUT/OUTPUT REQUIREMENTS

This MARS-ALE software uses the PC sound device as its modem. The PC sound devices available include on-the-board PC sound chip set's, plug-in PC sound cards and external USB port sound devices. If you have more than one sound device installed, the MARS-ALE software directly supports the selection sound devices form a list of all that installed. Normally the same sound device is used for both input and output.

NOTE: All PC sounds **MUST** be turned OFF if you are using the primary, default Windows sound device for your modem. Sounds that are generated by other programs (none should be running except MARS-ALE) and the Windows Operating System will go to the transmit. These sounds will also mix with ALE transmissions which will cause problems. The best course of action for many reasons is to install a second sound device for MARS-ALE. **All stations make sure that under Windows, the "Sounds and Audio Device Properties" have the "Sound Scheme" set to "No Sounds" to prohibit systems sounds from be transmitted. The only exception to this is when a second sound device is being used for MARS-ALE and is NOT selected as the default sound device.**

All stations that are using less than 2.0Ghz CPU based PC's are cautioned to ensure that **NO** other software or networking tasks are running.

NOTE: All station **MUST** make sure that **NO** software that uses the same sound device being used for the MARS-ALE modem is running when using MARS-ALE.

The normal use of a PC sound device is to directly cable an electret microphone to the mic in, stereo audio sources such as FM receivers, tape decks, CD players etc. to line in and take audio out to speakers or amplifiers. However, for MARS-ALE purposes, it is not advisable to connect the sound card directly to an HF transceiver as output of the card will probably be at too high a level and not at all near the correct impedance.

The MIL-STD-188-141A/FS-1045 specifies that an unbalanced interface shall provide an audio input impedance of a nominal 150 ohms, unbalanced with respect to ground, with a minimum return loss of 20 dB against a 150-ohm resistance over the frequency range of 300 Hz to 3050 Hz.

MIL-STD-188-141A/FS-1045 specifies when a balanced interface is provided, the audio input impedance shall be a nominal 600 ohms, balanced with respect to ground, with a minimum return loss of 26 dB against a 600-ohm resistance over the frequency range of 300 Hz to 3050 Hz. The electrical symmetry shall be sufficient to suppress longitudinal currents at least 40 dB below the reference signal level.

The best interface method is to set the sound card output level to a maximum then use an in-line 10k multi-turn resister (built into the RigBlaster and most other commercial interfaces) to set the correct level for the transceiver. The use of Amateur Radio sound card interface kits or commercially built interfaces is highly encouraged to avoid problems. Please refer to the MARS-ALE Quick Start Guide for RX Audio set up details.

NOTE: Do **NOT** connect PC speakers to your external interface or in any manner to the sound device speaker output as it will degrade audio quality on transmissions.

The correct radio drive level is when **NO** Automatic Level Control (ALC) shows on the SSB radio ALC meter in transmit. Although the 8-ary waveform is an FSK waveform it is permissible to run the system with a little ALC. Starting at ALC threshold, an increase of 20 dB in audio input shall result in an increase of less than 1 dB in average RF power output. For the typical 100w SSB transmitter, that should result in about 30-35 watts or less RF power output. Please refer to the MARS-ALE Quick Start Guide for full details on TX audio setup.

If you are using other software for sound card digital modes and only one PC sound device for MARS-ALE and the other software, you will want to maintain a software database of sound device settings for each application, the best tool that the SDT has identified to do so, that is FREE, is the ‘QuickMix” tool available at: http://www.ptpart.co.uk/quickmix/

After MARS-ALE has been properly configured with your radio for the needed input and output levels in conjunction with the radio and any external interfaces and the PC sound device audio input/output level settings and the MARS-ALE input/output level settings, you would use QuickMix or another tool to save the PC sound device settings. You would then setup any other software that you are using the same PC sound device with for digital communications save those settings. Then, prior to use of MARS-ALE or other software, you would use QuickMix etc., to

load the proper PC sound device settings. This eliminates the need to make and manual setting changes to the radio or the computer software.

SOUND DEVICE SELECTION FOR MARS-ALE MODEM

The MARS-ALE modem is based on the PC Sound Device, a.k.a. PC Sound Card. The type of PC sound device used with MARS-ALE is very important with respect to being capable of full duplex operation, the devices signal-to-noise ratio (SNR), how well it's shielded from other high frequency noise or where it is installed and your cabling between it and the radio.

With today's sound device, Full Duplex support is not a problem. Full Duplex means the sound device can playback while recording. MARS-ALE uses the sound card to listen to the frequency, hears that it is clear and, using a slot time algorithm to transmit, it picks a time to start the transmission. In full duplex mode, the transmission would start immediately. However, if the card was not full duplex-capable, MARS-ALE would have to tell the soundcard to stop recording (listening) and wait for the soundcard to finish recording and switch to playback. This is important for ALE, since RX-TX switching times are critical.

There are three basic categories of PC Sound Devices, the AC'97 on-the-board sound device chip set, the Plug-in PCI card and a host of External sound devices. The laptop (and many other PC's these days) provide AC'97 on-the-board sound chip sets, many of these provide rather poor audio quality, the usual offense is jitter and poor signal-to-noise ratio (SNR) due to large amounts of background noise picked up from the hard drive, various buses, etc. A computer is loaded with RF and other noise, which can mix into the sound card circuits and signal lines and degrade its specifications. Thus is NOT recommended that the on-the-board sound chip set based sound device be used as the PCSDM. However, there are many that have are successfully using on—the-board AC'97 sound devices with great success using the ALE FSK modem and to some data rate, usually no more than 300 or 600bps with the ALE PSK modem.

Sound Device Noise Floor -

One key function of the sound card is to convert the analogue input signal it receives into digital data. The quality of the result depends essentially on two factors: the noise floor (signal-to-noise ratio (SNR)) and the accuracy of the Analog to Digital Converter (ADC). Noise floor means the noise introduced by the card itself and the leads which provide input when there is no signal. It determines a level of hiss due to the card as opposed to what may be received from a tape or other input. For comparison, a very good cassette tape can deliver about 60db SNR. That means that its noise floor is 60db below its maximum signal. Because of quantization (the resolution capability of a digital signal) the SNR for 16 bits such as from a CD is about 96db. A sound card which puts its quality into gaming and MIDI may deliver something like 50db - in other words, it may provide more noise than a good, Dolby B cassette. A less expensive sound card which focuses on WAV quality may deliver 75db. Where those cards typically cost less than $100USD, for $200-$500USD or so, one can buy still higher quality, up to about 82db. Beyond that, the experts use outboard converters to avoid the electrical noise inside the computer's case. Today there are a number of inexpensive external sound devices which work quite well as PCSDM's for MARS-ALE.

Sound Device Sample Rate -

The highest frequency which can be captured in digital form is half the sample rate: thus with a 44.1Khz samples per second sample rate, you can cannot convert more than 22.05 Khz audio signal. However, there are significant effects at lower frequencies, so it is desirable to work at a higher sampling rate when practical. Most audio recording is done at 48Khz and professional mixing is often done at 96Khz. The MARS-ALE software is using a 48Khz sample rate or rather 48000 samples per second, a Sound Device **MUST** directly support 48Khz to be used as the MARS-ALE PCSDM.

Sound Device Sample Rate Error -

The sound device clock for the sample rate needs to be as close as possible to being on frequency. Some Amateur Radio digital mode programs provide a method of entering a correction factor when the sound device clock is in error.

However, this will not work with the ALE 8-ary as it adds distortion to the waveform. It also won't work with the serial tone modem as that modem is very phase sensitive. The ALE-Lite program does add/remove the occasional sample to get the correct sample rate, however it does add distortion to the waveform.

If the sound device clock is not right on frequency, it will result in an error factor with respect to SYNC. For 8-ary ALE, with the top frequency being 2500hz, if the sound device clock had an error of 10hz the calculation would be error in hertz/highest ALE tone in hertz or for a 10Hz. error:

10/2500 = 0.004

This results in a 0.4% sampling error. Thus, if we loose SYNC when we have moved one symbol, it will then take 250 symbols to regain SYNC as there are 147 symbols in an ALE word so with a 0.4% sampling error we could loose SYNC about every 1.5 ALE words.

However the average sound device sample rate error that is seen has been seen, about 6.25Hz. on the average, this does not pose a significant problem. As calculations show that it only requires a 10^6 clock accuracy to meet specifications, the capabilities of the crystal oscillators used on sound devices is well within this tolerance. However, if the soundcard is clock is 20Hz. or greater in error, it **MUST** be replaced, at greater than 10Hz you may want to replace it.

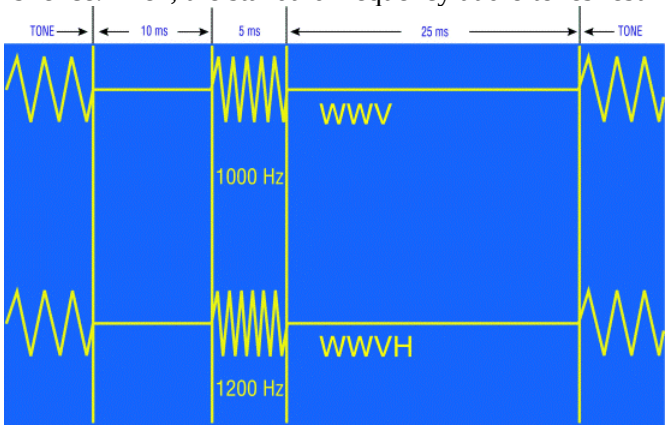
To determine if your PC sound device is suitable for MARS-ALE, it is recommended that you test your sound device to determine how close to being within 10Hz of being on frequency for both transmit and receive by using the popular MMSSTV software procedure commonly used in the Amateur Radio and MARS communities in conjunction with the Time and Standards signals transmitted on WWV.

Standard Time Intervals -

The most frequent sounds heard on WWV and WWVH are the seconds pulses. These pulses are heard every second except on the 29th and 59th seconds of each minute. The first pulse of each

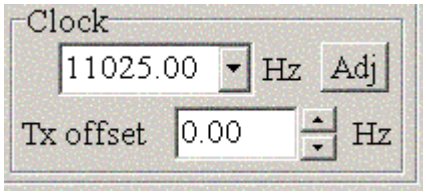
hour is an 800 ms pulse of 1500Hz. The first pulse of each minute is an 800 ms pulse of 1000Hz at WWV and 1200Hz at WWVH. The remaining seconds pulses are short audio bursts (5 ms pulses of 1000Hz at WWV and 1200 Hz at WWVH) that sound like the ticking of a clock. It is the 1000Hz tone that will be used with MMSSTV to check the clock error by most stations, for those that are OCONUS, you must change the MMSSTV setting from 1000HZ to 1200HZ.

Each seconds pulse is preceded by 10 ms of silence and followed by 25 ms of silence. The second marker for the broadcast is at the end of the 10 ms period and the start of the 5 ms period. The station's on-time marker is synchronized with the start of the 5 ms tone. The silence before and after the pulses makes it easier to identify the second pulses. As shown in the graphic below, the total zone around the second pulses lasts for 40 ms, consisting of 10 ms of silence, the 5 ms tone, and another 25 ms of silence. Then, the standard frequency audio tones resume.



Receiving Calibration:

1. In MMSSTV, go to **Option**, **Setup MMSSTV**, **Misc** page, and click **Adj** button in the 'Clock' box.

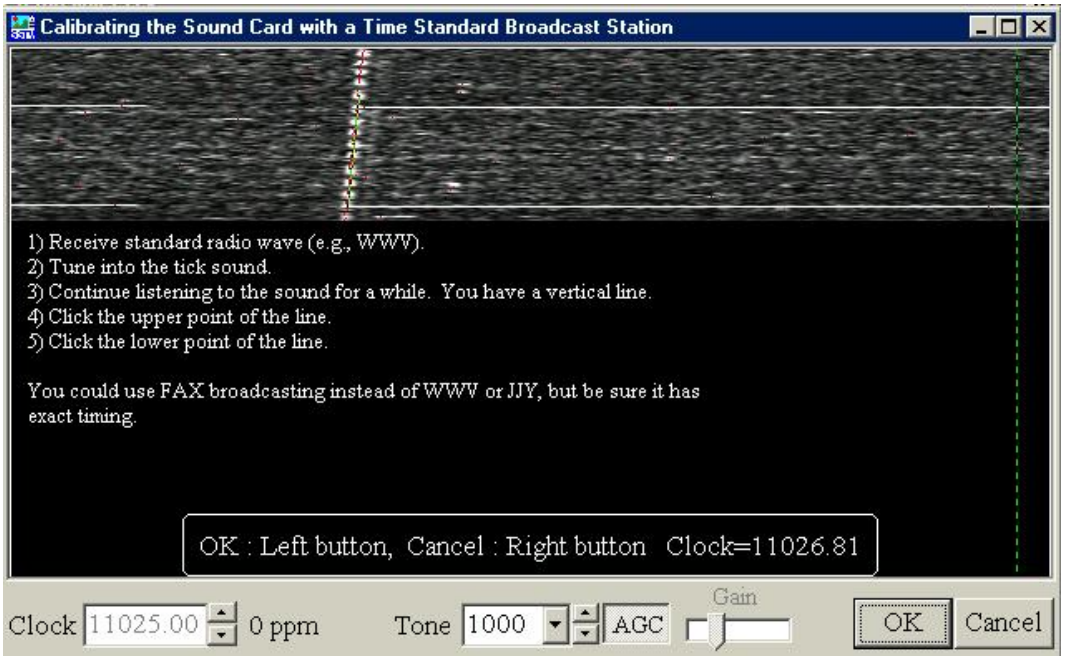


2. Tune your radio to WWV at 5, 10, 15, 20Mz using Upper Sideband (USB).

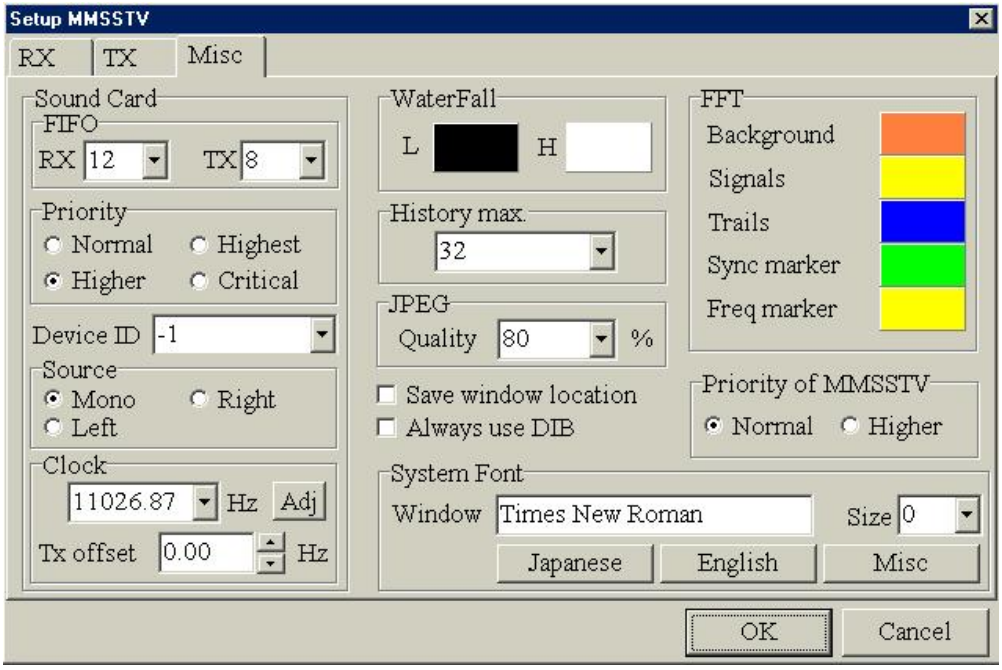
3. Tune into the ticking sound. A number of separated rectangular tick marks in white will appear.

4. Continue listening to the sound for a while. You will have a vertical or skewed diagonal line appear over time.

5. Click the upper point of the line in the center over the RED mark. Then move the mouse toward the bottom part of the line, a RED line will appear, keep it centered over the RED markers on the individual tick marks as seen below.



6. Click the lower point of the line. On some releases you may immediately leave the above screen and return to the previous screen now updated as seen below.



7. Otherwise, Click “OK” and you will return to the screen above, now updated.

8. You have now calibrated the MMSSTV software. (Please note that this did not change anything on the soundcard, only in the software.) NOTE: In this example from the

system that AAR2EY has always used on the air, the error is 1.87hz or 170 parts-per-million (ppm), which is very good. The hoped

9. If you were to again click on "Adj", you will see the error represented in ppm at the lower left as seen below.

Again, if the soundcard TX offset is 20Hz. or greater in error, it **MUST** be replaced, at greater than 10Hz you may want to replace it.

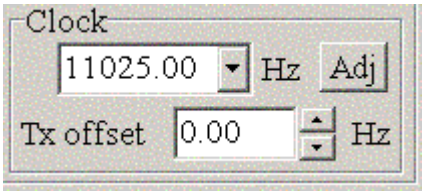
Transmit Calibration:

If your pictures still appear slanted to another (Reference) station that is confident of his calibration, there is likely a difference in your sound card receive and send clock timing. Here's how to set the transmit offset:

1. Ask the Reference Station to turn Auto Slant off, and send a picture to him/her.

2. After receiving the picture, the Reference Station will click on "**Sync**" button and then on the '**Happy Face'** icon. MMSSTV will display a correction factor.

3. You then go to **Option**, **Setup MMSSTV**, **Misc** tab and enter the offset factor from the Reference Station (<u>with the opposite sign</u>) into the **TX offset** box.



4. Click 'OK' and you're done.

Again, if the soundcard TX offset is 20Hz. or greater in error, it **SHOULD** be replaced, at greater than 30Hz it **MUST** be replaced.

On Board AC'97 Sound Device -

On the mother board AC'97 compatible Audio Codec chip set PC sound devices which provide Line In, Mic In (for MARS-ALE, Line In is recommended for all sound devices) and Speaker Out that support a 48Khz sample clock can be used as the MARS-ALE PCSDM, however due to their higher probability of having noise and jitter content they are not the recommended choice. When using the MIL-STD-188-110 modem they will not achieve high data rates as would a PCI or external sound device on the same PC system.

When it comes to making use of an on board AC'97 sound device as the system default sound device and using a PCI card as the MARS-ALE PCSDM, often, the AC'97 device when set to "auto" in the PC BIOS will disable the onboard AC'97 chipset when a PCI sound device is detected. Thus to make the AC'97 device work changing the setting to a choice of "ENABLE" or "ON" will activate it for use as the default sound device.

Plug-in Sound Device -

The PCI plug-in card is the minimum PC sound device suitable for use as a MARS-ALE modem. The higher-quality cards have better on-board shielding and design to help minimize noise, some of these expensive lab quality cards which exceed 100db SNR. It is possible to obtain better than 90 dB SNR ratio with sound inexpensive consumer cards in very high frequency noise quiet PC's, but many internal PC sound cards can't even manage much more than 70 dB SNR. The PC sound card manufacturers, unlike radio communications equipment manufacturers that make internal PC digital modem equipment cards, do not use external shielded covers or thick multi-layer (4-layers or more) Printed Circuit Board (PCB) technology where the outside layers of the boards are configured as noise shielding surfaces and the inside layers contained the circuit traces that require this shielding to solve the noise problems associated with being mounted inside a PC case.

The average consumer internal PC sound cards which plug into the PC mother board back plane have no shielding around them and can suffer in performance in the noisy internal PC environment by picking up high frequency interference from nearby components. In particular, keep the sound card away from the video or HD controller cards or such devices on the motherboard by moving the sound card into a further away slot. If you have plug in video or HD controller cards, you could try and move those card further away and leave empty slots in between. If you still have problems, you may even want to consider constructing some extra shielding around the sound card. What you do is get 2 thin pieces of copper or aluminum sheeting approximately equal to the width/height of your sound card. Glue a thin piece of cardboard or other non-conducting material to each side of each metal sheet (you want to sort of encase each metal sheet in cardboard so that it doesn't make direct contact with any nearby components, including on the sound card). Place these 2 shields around the sound card (one on each side). Connect an insulated wire from each shield to the chassis ground.

None of the above will help you if the noise problem is a result of the sound card's own generated noise from using parts with low "Signal To Noise" ratios. You can't make the components do more than they're designed to do. The above shielding will only eliminate noise that isn't supposed to be inherent in the card's design (noise resulting from interference with other cards). The shielding won't make poor components on your card perform better than their design allows. In this regard, the biggest source of noise on the sound card itself is a poor analog output stage and/or poor analog input stage. When you're not using the Line Input (Line Input is recommended) or the MIC Input on your card, turn the volume all of the way down. Also, use the Line Output of the card, avoid using the Speaker Output on the card.

PCMCIA sound device cards are another Plug-in option, especially for laptop users. Creative Labs offers the Audigy PCMCIA models of interest to laptop users, which have not been tested by the SDT, but should also work well as they are outside the PC, however, their cost may be a deciding factor with respect to the USB MP3+ option discussed under External devices later on.

External Sound Device -

An alternative to the PC card sound device is the external sound devices that make use of a USB port or other interface methods to the PC. The benefit of external computer audio devices is that these devices are removed from the very high noise environment found inside your typical computer case and thus reduce or eliminate noise interference problems. The use of these devices will almost always result in better audio quality on both input and output compared to an internally mounted PC sound card device.

Recommended Plug-In Sound Device -

For desktop computer's, if you are going to use an internal sound card, it is recommended that only PCI sound cards be used with MARS-ALE, even if it seems like you can get an ISA card to work, it won't work properly. This has been true since Charles Brain's debut of PC-ALE version 1.05 and will not be changing back.

The recommended PCI plug-in sound device to use for the MARS-ALE modem is the Sound Blaster Live ! 5.1, P/N SB0060US which uses the EMU10K1™ Digital Signal Processor. However, many other PCI card make/models seem to work well if your PC came with another brand, give it a try and if it is not up to the task you will need to change it. Other slightly more expensive Sound Blaster PCI models are the Audigy series.

The SDT has tested many PCI sound cards and has received feedback from the user base as well. However, based on hands on results, the only other PCI cards that the SDT can recommend at this time are the Turtle Beach Santa Cruz series (http://www.turtlebeach.com/site/products/soundcards/santacruz/producthome.asp) which AAR2EY has installed in an 866Mhz WindowsXp system and has compared to the SB MP3+ USB and has found to come very close in performance, these devices are in the under $60USD range. Also tested was the M-ADUIO 24 bit Audiophile 192 (http://www.m-audio.com/products/en_us/Audiophile192-main.html), which as seen in the picture below, has a D connector that you can customer wire a cable set to your radio or just use the standard fan out cable provided. This device works extremely well, however at just under $250USD range, its in the price class of the RigExpert which offers much more than just a sound device for the expense.

The better PC sound device to use for the MARS-ALE modem is the Sound Blaster Live 5.1 is a 16bit/44khz device, utilizes the AC'97 Audio Codec and provides Line In, Mic In, (for MARS-ALE, Line In is recommended on all sound card devices), line Out and Speaker Out with the following interface:

On-Board Connectors: All 1/8" (except MIDI/Joystick port 15 pin "D" Connector), Analog/Digital Out (Analog Center & Subwoofer/6-channel S-PDIF Output), Line In, Microphone In, Line Level Out, Headphone Out, Telephone Answering Device In, MPC-3 Analog CD Audio In, Digital CD Audio In.

Recommended External Sound Device -

It is highly recommended that an external Sound Blaster MP3+ External USB Sound Card Modem be used in such instances. This unit (P/N SB0270) sells for under $40.00 USD. Hoka (http://www.hoka.com/code300-32/audio_input_uk.htm) recommends this very same unit for use with their professional CODE300-32 SIGINT software. It is what Charles Brain has been using for the PC-ALE development for quite a while now go back prior to PC-ALE 1.05's release. However, it has been recently announced by Creative Labs that they will be dropping this 16-bit device from their line. Other slightly more expensive USB Sound Blaster models are the 24 bit Audigy and Extigy series.

Lastly the SDT was able to test an M-ADUIO 24 bit Audiophile USB (http://www.m-audio.com/products/en_us/AudiophileUSB-main.html) device and have found it to be excellent, although it is just under the $250USD range new. There are other make/models of USB sound devices, but the SDT has not had the opportunity to test them.

In addition the Creative Labs offers the external Audigy FireWire (IEEE-1394A) interface model, that may be of interest to laptop users. This device has not been tested by the SDT, but should also work well as it is outside the PC, however, their cost may be a deciding factor with respect to the MP3+ option.

Another external device that is popular in MARS is the MixW RigExpert, it too is in the $250USD range new, if also purchased with a pre-wired set of radio cables. The older RigExpert models that do not natively on-board support a 48Khz sample clock can not be used with MARS-ALE SE, however can be used with MARS-ALE LE. The RigExpert is an external device connected via a USB port as is the SB MP3+, however this unit was designed for Amateur Radio communications (specifically for use with the MixW and DigiPan software). It offers a number of radio specific features such as PC to radio RS-232 level converter interface and isolated PTT and CW ports and FSK output. As this device is more than just a sound device and more expensive as well, we shall cover the unit in greater detail in a separate MARS-ALE Application Note.

The MP3+ is highly recommended for both performance and price. Windows XP SP2 is recommended, although WindowsMe is supported. Under Windows 2000 and XP (Home or Professional), the card will be recognized as a generic USB Audio Driver by the OS without any further need to load the drivers supplied with the card, however, for best results it is recommended that you do use the supplied drivers, however be careful that those drivers do not create problems. (MP3+ is not in anyway related to the MP3 audio standard!)

The Sound Blaster MP3+ is a 16bit/44khz device which offers a Signal to Noise Ratio of 88db. It provides Line In, but no Mic In, (for MARS-ALE, Line In is recommended on all sound card devices) with the following interface:

- Connections and Controls: USB connector on side, Audio Inputs: Line In (Gold-plated, RCA pair at rear), Mic In (Gold-plated, 1/8" at front), Optical S/PDIF In. Audio Outputs: Line Out (Gold-plated, RCA pair at rear), Line/Headphone Out (Gold-plated, 1/8" at front), Optical S/PDIF Out at rear.
- Controls: Analog headphone volume control (front), Analog/Digital output selector.
- Indicators: - Power LED on top.

The SDT has noted a problem with the Creative Labs Sound Blaster MP3+ USB device from extensive use of the unit which a number of members have experienced. In recent testing, transmitting for hours on end, day after day has been conducted without powering things down. This has included many hours of PSK modem testing with the standard SDT messages and some very LONG messages. What has been discovered is that every now and then:

A. The audio drive level of the MP3+ goes HIGHer than it should and the tones become distorted. This also results in higher RF output from the transmitter.

B. The unit will just STOP providing any audio output what so ever.

C. A and B above will happen in order or just one scenario will happen.

When A-C above happens, the cure is to remove the USB cable from the MP3+ plus wait about 30-60 seconds and plug it back in, then all will be fine for the longest time. I have two of these units, but only one has been getting the heavy workout, so I need to see if the other behaves the same, it is the unit and not the software, no question. What is not known however, is the reason behind it, over heating, RF from the transmitter or what.

INTERFACING TO PC SOUND DEVICES

A typical sound device's external I/O connectors consist of 1/8-in., two-circuit miniature jacks commonly used for stereo headphone connections. Some cards include a DB-15 socket for attachment of an optional joystick or other game-related positioning control.

All inputs are AC-coupled, with one pair of inputs including preamplifiers for boosting low-level signals from a stereo microphone that provides a signal of at least 10 mV. Another pair feeds line-level signals directly into the card's analog multiplexer/mixer, with a typical 500mv RMS to 2v RMS maximum level, a 10kv minimum input impedance, and a nominal 20Hz to 20Khz frequency response. Specifications may vary widely among vendors.

On the output side, another pair of capacitively coupled 1/8-inch jacks provide line-level and amplified audio outputs suitable for driving efficient loudspeakers. Sound cards provide only a modest amount of audio power (2w to 3w) into an 8 ohm impedance with total-harmonic distortion levels of 0.5% or less.

PC sound devices have many different kinds of interfaces. This also applies the sound functions built into some motherboards. The most commonly used interfaces on normal PC sound devices are analog audio output, analog audio input and microphone input. Those are typically all implemented with 3.5 mm stereo jacks. The "normal" color coding of those connectors are the following:

- Blue is normally LINE IN.
- Light green is standardized to be the stereo LINE OUT.
- Pink is the microphone input, MIC IN.

The connections for these sound device ports on some PC's or PC sound cards can be somewhat different and there can be more than the connections listed above. For example some SB Live ! 5.1 sound cards use normal light green for Left+Right main speakers, black for rear speakers and orange for Front+LFE. The PC or soundcard you have should have come with an Owner's manual as well as a large hook-up sheet that explains what all the connections are.

Many on-board computer sound systems now have software-configurable ports, allowing the same sockets to act as surround outputs, Mic or Line inputs, Headphone or Line outputs. Look at the control panel for your sound system. It may be in the System Tray, it may be in Control Panel. See what options you are offered. Some new computer audio interfaces actually auto-sense the kind of device that each jack is connected to, and try to adjust their circuitry and connections to match what they auto-sense. However, as we shall detail in the next section, the use of on board sound chip sets is not recommended.

In addition to analog interfaces some soundcards can have digital interfaces. For example Sound Blaster Live cards often use yellow connector for Digital output (S/PDIF for Digital Receiver/Surround Sound), so be care what you are plugging into on those cards !

MODEM CABLING FOR MARS-ALE RADIO AUDIO IN/OUT

MARS-ALE requires the use of a single channel of audio, not both Left and Right Channels, but JUST Left Channel. Thus if you are using a RigBlaster or other external interface that has the Left, Right, Both selection or your cables are wired for both, you MUST change to use just Left Channel on transmit to avoid problems with phase distortion.

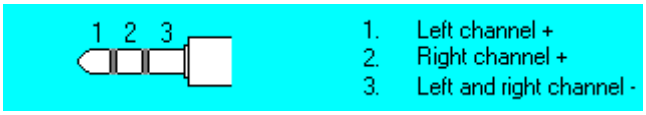
MARS-ALE Channel -

ALL sound devices used with MARS-ALE, and any other digital program, that provide for stereo should be set to "Lap Top Mono Speakers" in Windows. Follow the steps listed below to set your Sound Card for MONO tone output: (>> means Select). In the CONTROL PANEL >> MULTIMEDIA >> PLAYBACK >> ADVANCE PROPERTIES >> SPEAKER SETUP >> LAPTOP MONO SPEAKERS >> OK >> OK

This sets the Sound Card to apply the tones to the tip of LINE OUT and ground the RING and SLEEVE. You will also have to reset your Windows transmit Audio level. If you use high quality mono type audio patch cords, no further changes are required. Otherwise, you must set the CHANNEL SELECT switch on the Rigblaster M8, or any similar interface, to LEFT CHANNEL to avoid any noise pickup by the unused lead. No changes are required to the NOMIC, Rigblaster Plus or Pro, or devices that do not have a BOTH audio switch position. You should use high quality stereo (mono if the above settings are made) patch cords to make the connections.

MARS-ALE modem cabling -

Most sound cards use 3.5mm, 3 conductor stereo jack and plugs, on the standard 3.5mm (1/8 inch) stereo jack/plug (Radio Shack P/N #274-284) used for the mounted in the PC sound cards, for analog interfacing, the tip is the Left Channel as seen in the figure below. For some internal PC sound cards and most external units, separate RCA connectors are used for Left and Right Channel.



Line Out to SSB Radio Transmitter -

Line level outputs on consumer PC sound cards can typically in the range of 0.1 to 2v p-p 2 volts peak to peak (p-p) (NOTE: some may go as high as 5v p-p) of output level and output impedance typically from tens of ohms to few hundred ohms (quite typical is 30-400 ohms). Those line level outputs are designed to be connected to consumer equipments (normal HI FI audio amplifier with -10dB nominal level line input) or powered multimedia speakers. Speaker level outputs on some soundcards (not in many newer ones) have typically around 2W of output power and can drive 8 ohm speakers or 32 ohm headphones nicely, which means lots of drive to the radio transmitter which will need to attenuated.

Typical the signal level is around 1V p-p. The HF SSB radio requires signals that are compatible with microphones, i.e. in the tens of millivolts range. The PC sound device to radio interface (i.e., the RigBlaster, which has a built in potentiometer for level adjustment) must therefore provide some level reduction to bring the signals to the right scale. The actual level required is a function of the microphone gain setting of the rig, the audio level of the PC soundcard and the TX audio level control potentiometer in the interface

Some older soundcards and most laptop PC's only have headphone outputs instead of line output. The specification of headphone output could be for example 100 mW to 8 ohms. This kind of headphone output can be used to drive the MARS-ALE software, you will need to turn its manual volume down some to get the level into the right range. However, the quality will not be quite as good as a line out. In addition, laptop (and desktop) on board sound chips are rather poor in quality. The usual offense is jitter and poor SNR due to large amounts of background noise picked up from the hard drive, various buses, etc. It is highly recommended that an external Sound Blaster MP3+ USB Sound Card Modem be used in such instances.

Noise and RF Feedback are a problem with lower level input is that any signal picked up on the transmit audio wiring can approach the expected signal level, degrading S/N and putting unwanted signals on the transmitted audio. If the noise source is the RF created by the transmitter, feedback will occur with broad band noise resulting on the transmitted audio.

There are several lines of defense that can be taken to ensure clean, quiet operation:

In the audio cabling, it is strongly recommend the use of an in-line isolation transformer be made to break the ground path between the radio and computer grounds for two reasons:

- Eliminate any potential ground loop hum on the signal
- More importantly, to reduce the risk of any damage to the computer or radio from any difference in voltage potential between it and the radio equipment

Although simple, non-stereo cables may come with some commercial interfaces, for example, the Rigblaster Plus and Nomic (and maybe other models), that do not have internal receiver audio isolation transformers. These simply cables are generally shielded but do not have any additional circuitry or transformers. Thus you want to build a shielded cable that provide good ground connections for all components of the system, including the PC and only use the Left Channel of audio.

Also, you need to provide a filter in the interface to remove unwanted RF signals that have been picked up. This combined with short lead lengths in the cables from the interface to the rig can be very effective. Eliminate any ground loop between the components that placed along the signal path which may inject common mode noise into the audio. This is done in the interface by using audio transformers on both the input and output audio paths. All wiring between the radio receive audio output to sound card line input (mic input should not be used) and the sound card line out (or speaker or head pones out as needed) and the radio transmitter input should be isolated with 1:1 ratio isolation transformers of the appropriate impedance.

A cheap example audio isolation transformer off the shelf, Radio Shack's P/N 273-1374, 1:1 ratio 600 ohm audio line transformer which has a 300 Hz to 5 kHz frequency response range good for sound card to radio mic and accessory jack inputs as well as radio high impedance outputs to sound card inputs. In some cases where levels are found to be too low, 2:1 or higher ratios may be needed. For an 8 ohm radio speaker output, in most cases is Radio Shack's P/N 273-1380 1K CT to 8 ohm will work well, the same is true of a sound card headphone or speaker 8 ohm output to radio mic or accessory port input. The RigBlaster provides and isolation transformer for the sound card audio into the transmitter, so all that is additionally required is one on the radio receiver to the sound card input as pictured below.

Some stations monitored on the air have nasty sounds coming from their transmitters at PTT start and just after ALE tones prior to PTT drop. This type of problem is usually attributed to poor cabling and grounding. Here is a litmus test, use the Manual PTT, the RED button bar button, with nothing but a speaker plugged into your sound device output, what do you hear ? Hopefully NOTHING. If not you have a bigger problem. Now replace the speaker back to the input to the radio or external interface (remember we do NOT keep speakers in this circuit) and with your radio powered on and connected to a dummy load, hit that RED PTT again, do you see any RF power output at all ? If you do, you have a problem, next you need to get an ear on that audio and start to determine why you have this occurring and fix it. The fix 99% of the time is the addition of an isolation transformer in the audio path to the radio transmitter that everyone should be using. The same goes with the audio on receive to the sound card line in.

Also, ensure that the audio created by the PC is in fact the ONLY audio created by the sound card software. Other inputs to the sound card exist, and can be active unless positive steps are taken to ensure that they are turned off. You must also make sure that your microphone audio is muted, this is covered in next section "MUTING THE RADIO MICROPHONE".

Sound Card Line In From SSB Radio Receiver -

In the audio cabling, it is strongly recommend the use of an in-line isolation transformer be made to break the ground path between the radio and computer grounds for two reasons:

- Eliminate any potential ground loop hum on the signal
- More importantly, to reduce the risk of any damage to the computer or radio from any difference in voltage potential between it and the radio equipment

All wiring between the radio receive audio output to sound device line input (sound device mic input should not be used) and the radio transmitter input should be isolated with 1:1 ratio isolation transformers of the appropriate impedance.

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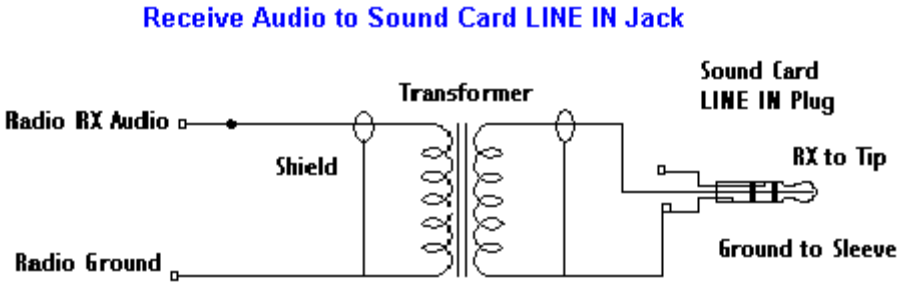
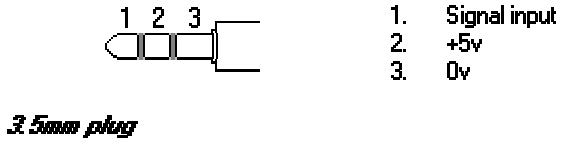


Receiver audio outputs are consistent with driving speakers or headsets. These signals have an extremely wide dynamic range: from a few millivolts to around 5 V p-p. The PC Sound Card accepts levels up to about 5v p-p. In general, the audio levels from the rig to the sound card are compatible. If signals approach the maximum range of the sound card input, a warning message from the software will be given for the operator to reduce the audio level. The receive audio level can be controlled by RF gain of the receiver, input gain of the sound card, or the RX level control potentiometer in the interface. In practice, all of these controls are used during setup and operation of the system.

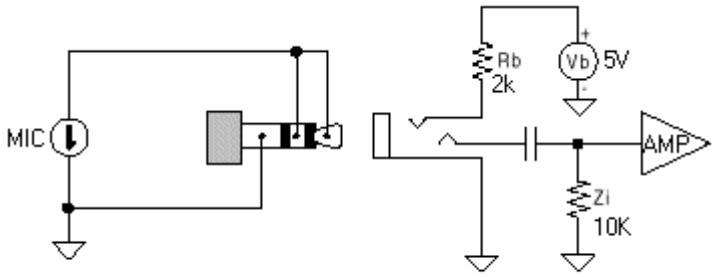
Sound Card Mic In From SSB Radio Receiver -

If you **NEED** to use the sound card's Microphone jack instead of the LINE IN jack, then you will probably need to add an attenuation circuit on the RX audio line so that you do not overdrive the sound card. The exact attenuation will depend on the maximum output voltage of your radio RX line and the maximum input voltage on the MIC jack of your sound card. The typical Sound Blaster card has a maximum of 200 mVpp on the Microphone jack, where the Line In jack has a maximum of 2 Vp-p. Other cards accept a maximum of 100 mV.

PC sound cards vary as to how the mic in port is actually configured. Sound Blaster soundcards from Creative Labs use 3.5 mm stereo jack and support electret microphones. The microphone connector uses he following wiring pin out:



The 5V voltage on the connector is heavily current limited (typically goes through around 2.2 k ohm on the sound card). Depending on the card the voltage might not be exactly 5 volts (usually something between 3v and 5v when no microphone is connected). Practically all other soundcard makers have copied this pin out and connection idea to their soundcards, thus when wiring your cabling to bring the audio from your receiver into the mic port on the sound card, do NOT use the ring as its HOT with 5 volts, the basic circuit is shown below:



Sound Blaster Microphone Input

Most sound card mic inputs require a minimum signal level of at least 10 millivolts, some Sound Blaster cards need 100 millivolts. Practically all consumer soundcard supply bias voltage on their outputs to power the electret microphones (the only microphone type which works with this kind of cards). The input impedance of the typical PC soundcard microphone input is typically in order of 1500 to 20000 ohms (however it can vary widely from card to card).

MUTING THE RADIO MICROPHONE

Muting the microphone audio during ALE (or any data transmission) is very important. When using the radio mic jack for both the microphone and sound card input with a RigBlaster or most any external interface, the interface provides the switching to take the mic audio line of the circuit so that its audio pickup is not mixed with the data transmission audio feed.

However, when interfacing to other audio input ports on a radio, such as phone patch or accessory ports, the mic audio line is not always muted, in some cases you must wire particular pins for grounding during PTT to achieve muting and in cases more than pin is need as may be an isolation diode. For example, when using the ACC2 port on the older, yet very popular Kenwood TS-440S and TS-940S radios for digital communications, if you only connect to ACC2 pin 13 for PTT, then when transmitting, the microphone audio line is still hot and any sound pressure it picks up with go out on the air. Both pin 13 and pin 9 must be connected, however an isolation diodes is also required, else the microphone is kept out of the circuit while the accessory jack has a plug in it. In later model Kenwood radios that only pin 9 is used for PTT, we can confirm that this is true for the TS-450/690S. See the note on this with schematic pictorial of the isolation diode in the Kenwood section later in the manual.

On some newer radios the problem of a hot MIC is NOT a hardware wiring issue, but rather a selection of operating mode/port issues with the radio. This involves poor thinking on the part of some radio designers, in many cases where you can only use the accessory port when a radio specific radio mode, like DIGITAL is selected, here are three scenario's:

Scenario 1: Some make/models have U-DIGITAL/L-DIGITAL for USB and LSB on the DIGITAL Port, which means if the software instructs the radio to be in USB and the wiring is to the DIGITAL port, the digital data will be sent but the mic will be hot and mixing in audio.

Scenario 2: Some make/models just DIGITAL where a radio setup menu is used to specify the mode for use during DIGITAL mode operation using the accessory digital port, which limits Scanning/Sounding to just a single sideband of operation, this is fine for example with

NAVMARCOPR MARS and FEMA were only USB is used, however for VOICE operation, the software must place the radio back into USB.

Scenario 3: Then some other make/models just require the software to select mic port or accessory port regardless of mode during operation and make sure that the mic port is selected when the operator goes back to VOICE operation.

The MARS-ALE SDT is reviewing all these scenarios and looking at how to best provide solutions all these scenarios. We are working on the ICOM radios that fall into scenario 1 where we need to place the radio into U-DIGITAL and L-DIGITAL for scanning/sounding where code must be written for an extended memory command that is not the normal way of command the ICOM radios. The operator must use a VOICE/DATA button to toggle when phone transmissions are needed, the radio is set to USB on normal program termination, later is will be set to whatever mode was in use at program start.

The MARS-ALE software has been coded to add “FT817DIG” for the Yaesu radio’s that fall into scenario 2 where no matter sideband has been programmed into a GROUP/Channel, the radio is always placed into DIG mode during SCANNING/SOUDNING, the operator must use a VOICE/DATA button to toggle when phone transmissions are needed, the radio is set to USB on normal program termination, later is will be set to whatever mode was in use at program start.

The Ten Tec radios and any others that fall into scenario 3 will be addressed by providing a VOICE/DATA button that the operator will need to click on to toggle the mic/accessory port and at normal program termination mic port will be selected.

To test if your mic is hot or not during MARS-ALE PTT operation, click on the RED “Push to Talk” button and talk into the mic, if you have no output then your in compliance, else you have some troubleshooting to perform. **The PTT control of your PC to radio interface should also provide ground loop isolating opto isolator devices.**

AUTOMATIC ANTENNA TUNER SUPPORT

The support provided by MARS-ALE includes ALE Scanning/Sounding, which requires either a single Broad Band NVIS antenna or two or more antennae to cover the frequencies being used in each Scan GROUP. In some installations, this will also require the use of an Automatic Antenna Tuning unit (ATU), be it internal to the radio or external. In this section we shall discuss the implementation and ramifications of the use of Automatic Antenna Tuning Units (ATU) with MARS-ALE taking into account Scanning/Sounding operation. The support for the selection of multiple antennae shall be detailed in the next section.

The purpose of an ATU is to transform (or match) the complex load impedance of an antenna system to 50Ω resistive for the transmitter/receiver, and to maintain the matched condition automatically as the operating frequency and load impedance change. This will assure optimum RF power transfer, good transmitter low pass filter (LPF) termination and best Power Amplifier (PA) linearity over a reasonably wide range of frequencies and load-impedance variations.

A key item regarding an ATU and ALE operation is whether or not the tuned circuit of the ATU is in line during transmit or during both transmit and receive. Many older internal ATU units were only in-line when enabled, during transmit, some radios could be modified (e.g. Kenwood TS-850) so that the internal ATU was in-line during transmit and receive. Having the ATU in-line during both transmit and receive provides greater selectivity to the radio receiver when receiving a signal at the frequency for which the ATU is tuned.

The ATU receives band/frequency information either from the associated transceiver (both internal and external ATU's of the same manufacturer only, usually) or by measuring the RF drive frequency. The actual tuning operation is controlled by detectors at the input to the matching network. These detectors provide information on the matching condition to the control electronics, which adjust the matching-network constants to achieve the required match.

Those ATU's that work on frequency information from the associated transceiver will also tune the ATU during frequency changes when in receive to the closest settings stored in the ATU memory from last use with the antenna used. In addition, the ATU's that work closely with the associated transceiver, whether internal or external (local or remote) can be easily bypassed manually and under CAT control for later models. Thus these ATU's do NOT present a problem for MARS-ALE Scanning operation where the present of the ATU tuned to a particular frequency would attenuate the receive signals as the MARS-ALE software was Scanning.

However, most external ATU's that are NOT associated with the transceiver as they are made by a third party manufacturer and NOT made to be 100% compatible, only retune when an RF signal is applied during transmit and many use latching relay's which maintain the settings, even when powered off and back on again (refer to your ATU user manual for complete details and options). As such, some mechanism must be provided to allow for unimpeded, broadband receive operation during MARS-ALE Scanning operation.

Under the MARS-ALE GROUP/Channel configuration, MARS-ALE shall provide the MARS-ALE user with the selection of Logic Lines from the serial port (RTS and DTR lines), Parallel Printer Port lines and possibly other logic lines to select from for use with ATU operation regarding both ATU transmit and ATU receive. These Logic Lines shall have user programmable

HIGH duration periods. The implementation of these lines shall require external interface circuitry and relays to provide isolated contact closures. These Normally Open (NO) Form C contacts in most cases will be wired across the contacts of a momentary switch that the user must manually depress for normal ATU operation.

It will be up to the MARS-ALE user to select and configure these properties properly and to provide the external interface(s) to the external ATU or any needed modifications to the ATU device as may be required for control interface purposes so that the logic lines controlled by MARS-ALE can provide control of the ATU.

The commands for the ATU shall be:

ATU On - 1. CAT command.
2. Logic line, with user programmable HIGH duration setting from .1 to 3.5 seconds in .1 second increments.

ATU Off - 1. CAT command.
2. Logic line, with user programmable HIGH duration setting from .1 to 3.5 seconds in .1 second increments.

ATU Start - 1. CAT command.
2. Logic line, with user programmable HIGH duration setting from .1 to 3.5 seconds in .1 second increments.

ATU Bypass/ Reset - 1. Logic line, with user programmable HIGH duration setting. from .1 to 3.5 seconds in .1 second increments.

Regarding the use of external ATU's made by a third party other than your transceiver manufacturer. There may be configuration options that can be selected in the ATU itself or options that can be purchased from the ATU manufacturer or circuits that can be built and interfaced that can preclude problems on receive when the ATU does not directly act on information from the transceiver during receive, however are resources do not allow us to cover all such makes/models, the MARS-ALE user will have to research these options.

However, for an example, we can provide details on one popular make/model of ATU in MARS use, the SGC, Inc. SGC-230 ATU which provides a few such options. The SGC-230 has an internal jumper (JP1, adjacent to U1 must be set to YES) which will always drop the tuning circuits out of the line on receive for broadband receive operation. In addition, if you are using the SG-230 with more than one antenna during MARS-ALE operation, you will want to change the internal jumper (JP2) that bypasses the ATU's memories so that each time the ATU is used on a new frequency it will retune rather than attempt to use previously stored information which may be from the wrong antenna when multiple antennae are being switched in for use.

The SG-230 also offers another option of interest to MARS-ALE users for Scanning operation, the "Smartlock" feature, where the ATU may be bypassed for broadband antenna scanning operation by pressing the Smartlock reset button (manually) or by momentarily powering the ATU off and on, as when the ATU comes back on, the tuning circuits will remain out of line until activated by the next transmitted RF signal. The SGC manual on the SG-230 provides the full

schematic of the Smartlock, the MARS-ALE user can easily build one to integrate for use with the MARS-ALE software.

Regarding ATU use with multiple antennae and automatic antenna selection (covered in additional detail in the next section), some manufacturers are now providing combination ATU/antenna switch, such an example is the SGC MAC-200 product. It provides in one desktop unit, both an ATU and antenna selector for both unbalanced coax fed (3 antennae), balanced (1 antenna) and a long/random wire antennae. The MAC-200 and other similar such units (unless they provide a remote control interface) would require modifications to place Normally Open (NO) relay contacts across the contacts of the momentary switches used for manual control, where the relay's are driven by PC logic lines under the control of MARS-ALE. The MAC-200 has basically the same ATU inside as does the SGC-230, the JP1 and JP2 settings serve the same purpose and the unit can also be placed into bypass on receive for broadband receive in the same manor.

For those MARS-ALE user's that have ATU's where multiple antennae are supported on various ATU ports by preset switches inside the ATU, such as the ICOM AT-500, it will be up to the MARS-ALE user to configure an interface for what we have been able to provide with the MARS-ALE software.

LDG AT-200PC EXTERNAL ATU

A new type of external ATU is being developed which was brought about by discussions between the MARS-ALE SDT and the LDG Electronics Inc. This new external ATU shall be very similar to their existing AT-200PRO unit, with the major difference being that it shall be under full computer control via an RS-232 port allowing for direct control of the ATU and tracking of frequency when the radio frequency is being changed by the software and no RF is being transmitted. It will be commercially marketed as AT-200PC, two units can be seen in the photo below.

The AT-200PC specifications have not been published by LDG as of yet, but as the AT200PRO, the AT-2000PC will handle up to 250 watts SSB or CW on 1.8-30.0MHz, and 100 watts from 30-54MHz. It features LDG's state-of-the-art, processor-controlled Switched-L tuner and will match virtually any kind of coax-fed antenna and will typically match a 10:1 SWR down to 1.5:1 or less

in just a few seconds. You can also use the AT-200 with long wire, random wire and antennas fed with ladder line with the optional LDG balun. It will feature over 16,000 3D memories, automatically storing tuning data for frequencies and bands as you use them. When you transmit on or near a frequency you've used before, it can restore the tuning data almost instantly. It learns as you use it, adapting itself to your operating patterns for faster and faster tuning. The 3D memory system allows up to eight antenna settings to be stored for each frequency.

The AT-200PC will essentially operate as a standard AT-200PRO ATU with the addition of the PC software having full control as well and the software having the ability to read from the unit all pertinent data. This shall provide for the MARS-ALE tool to perform a number of interesting things with the ATU to be detailed later, the main capability is that after RF has been applied at a given frequency for the antenna at least once and the data has been stored to memory, all that is needed for the ATU to re-tune for that frequency is for the PC to send the frequency via the RS-232 port to the ATU. This means that the ATU can be tuned even during ALE Scanning and that less RF transmissions are needed during Sounding as the ATU can be tuned without additional need of RF.

Below is the basic Computer/Tuner communications, aside from the basic needs, we shall have the ability of returning Forward and Reflected RF Power, VSWR and other data from the ATU that can stored for antenna analysis as well as real time antenna warning status indicators to lock out an antenna or GROUP/Channel due to failed antenna or port device.

Computer	Tuner
Tuner Sense	SW version number
Bypass	Bypass Ok.
Cap up	Cap up Ok.
Cap dn	Cap dn Ok.
Ind up	Ind up Ok.
Ind dn	Ind dn Ok.
Tuner setting	Send relay settings.
Meter reading	Send FWD, REV, SWR
Freq reading	Send Freq
Set Ant1	Ant1 Ok
Set Ant2	Ant2 Ok
Set Ind value	Ind Ok
Set Cap value	Cap Ok
Set Hi/Lo value	Hi/Lo Ok
Save current	Save Ok
Recall Freq	Recall Ok or bypass
Tune	A) ready for RF B) finished tuning, turn RF off 1) pass/fail with SWR
Memory dump	Send memory data (8K bytes)

AUTOMATIC/REMOTE ANTENNA SELECTION

The support provided by MARS-ALE includes ALE Scanning/Sounding, which requires either a single Broad Band antenna or two or more antennae to cover the frequencies being used in each Scan GROUP. As such, the MARS-ALE Scan GROUP Channel setup facility shall provide for the configuration of antenna port selection at Channel configuration/edit. This capability shall provide support for either an antenna port that is within the CAT controllable radio and can be selected via CAT command or an external antenna port switch device. For an external antenna port switch device, the MARS-ALE software shall provide the user with the selection of serial port RTS and DTR lines, Parallel Printer Print lines and possibly other logic lines to select from for use. These Logic Lines shall have user programmable HIGH duration periods. The implementation of these lines shall require external interface circuitry and relays to provide isolated contact closures. These Normally Open (NO) Form C contacts will be wired to the contacts for normal antenna switch operation. It will be up to the MARS-ALE user to select and configure these properties properly and to provide the external interface to the external antenna switch device.

Many manufacturers have been providing additional antenna port selection on their radios for receive only and as actual antenna switching for years. However, it has only been on the higher end radios and then only recently has the selection changed from being manual only to also being available on the CAT bus, please refer to your user manual on your particular radio.

The radio's that we currently support with internal antenna port control via CAT command are:

FTDX-9000	(4 RX/TX antenna ports and 1 RX only port)
IC-756PRO	(2 antenna ports) (a.k.a. Signal One Milspec 1030E-DSP)
IC-756PROII	(2 antenna ports)
IC-756PROIII	(2 antenna ports)
IC-7800	(4 antenna ports)
JST-245	(3 antenna ports)
Kachina 505DSP	(2 antenna ports)
Kenwood R-5000	(2 antenna ports)
Kenwood TS-480	(2 antenna ports)
Kenwood TS-870	(2 antenna ports)
Kenwood TS-2000	(2 antenna ports)

The new ICOM 7800 provides a complete setup (see Figure 2) of antenna port selection with band frequency pairing to support automatic antenna selection. Once you program the operating band to the antenna port set mode, the antenna port is automatically selected as you change the operating band.

Figure 2.

The ICOM 7800 for example, has four antenna ports (ANT1 to ANT4 as depicted in Figure 3) which can be utilized from within the radio, most make/models only support two.

Figure 3.

Each antenna port can be set to the antenna usage type such as for TX/RX use, RX only use and off line. The antenna switch button allows you to change an antenna port temporary as needed. However, you will not need to setup any of this on the radio, as you can simply designate in the MARS-ALE software which antenna port to use when setting up a Scan GROUP Channel.

Regarding the use of external electronic antenna switch devices, there are numerous commercial makes available and the MARS-ALE user can also build their own unit as desired. Some can be controlled directly via TTL logic and some via an RS-232 port such as the LDG Electronics DTS-4 and DTS-6 (see figure 4), some are 2 port while others are 4 or 6 port, with indoor and tower mounted models available.

Figure 4.

For an example, if more than one antenna is planned for use, then an antenna A/B selector switch (e.g Top Ten Devices units pictured in Figure 5) or a multi-antenna selector (e.g. Top Ten Devices 6-port wall unit pictured in Figure 6 or 6-port tower mounted unit in Figure 7.) must be utilized to select the appropriate antenna for the given channel in the scan group.

Figure 5.

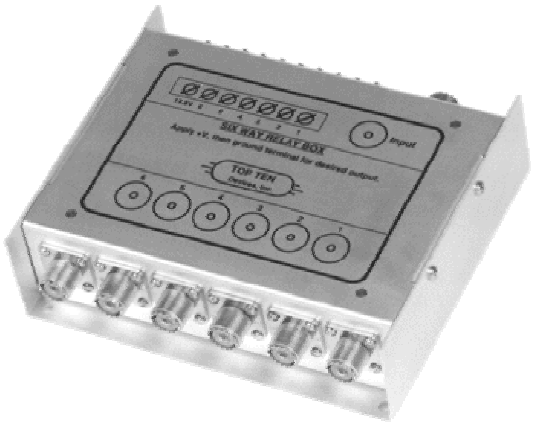


Figure 6.

Figure 7.

You can also make your own antenna switch, there was recently a good article on the subject in the April 2005 QST on page 38 by KO4NR on a 6 port switch. The circuit board for this design is available from FAR Circuits at http://www.farcuits.net and the relays can be had from http://www.relaycenter.com, see the QST article for the full details. This design would be best used with the LPT1 signal lines.

Another design available on the Internet at http://www.dk7uy.de/ft920_mixw.html is for a two port unit using the RS-232 port (or LPT1 lines) and the RTS and DTR lines for selection as depicted below.

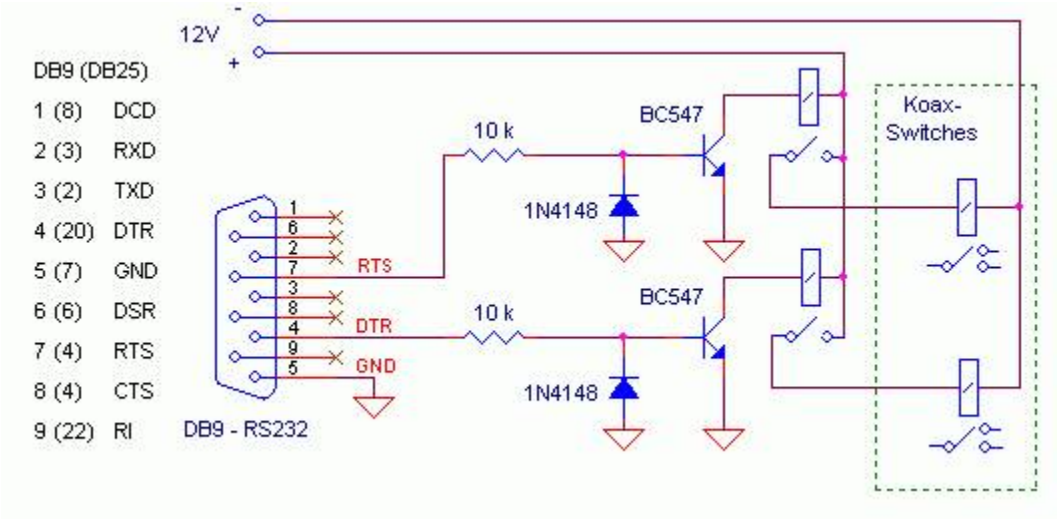


Figure 8.

For those that are already using some sort of Amateur Automatic Antenna Band Switching system, where the band information is being read from the radio, MARS-ALE will not be able to provide any support.

AUTOMATIC EXTERNAL IN LINE FILTER SELECTION

PLANNED

As a station may require due to interference from strong nearby RF signals (from broadcast stations or being co-hosted at/near other commercial/government/military transmitters) a MARS-ALE can add low pass, band pass, band reject or band splitter filters. These filters may be installed as needed on particular selected antenna for single frequency use or a unit that supports the automatic selection of multiple filters may be place in the line where one or more antennae are used and in GROUP/Channel setup, the needed filter can be programmed for selection.

The MARS-ALE user should design their system for such use of filters taking into account the placement of the filter in the antenna transmission system prior to any external antenna so as to avoid damage to the filter. The user should refer to the band pass or band reject or band splitter filter manufacturers instructions, e.g.:
http://www.arraysolutions.com/Products/wx0bbpf6.htm#MARS

The configuration and selection of these external transmit filters when configured with an electronic selection system is similar to the user of external antenna switches as detailed in the previous section.

RADIO SPEAKER MUTING

During MARS-ALE Scanning/Sounding, should the user desire to mute the audio from the receiver, if the audio output from the receiver to the PC sound card is NOT taken from the speaker output, the MARS-ALE software shall provide CAT Control Muting (where the selected radio supports such control) and Logic Line Muting.

On the main screen of the software there is a button with the icon of a speaker which is the "Toggle Receiver Muting" control that the user manually toggles with the mouse to turn receiver muting On or Off. This action will then invoke the chosen method of receiver muting selected during MARS-ALE configuration.

NOTE: At present a few radios that support MUTING via CAT are always active such as the ICOM MARINE radios, JST NRD-545, Skanti 8250, Ten Tec TT538 and TT550.

For the CAT Control Muting, the radio in use must support reading/setting the volume level over the CAT interface (such as later model ICOM's e.g. IC-703, IC-746, IC-746PRO, IC-756PRO series and IC-7800, ICOM Marine/Commercial Grade, Kachina 505DSP, Kenwood TS-480, TS-570, TS-870, TS-2000, Motorola Micom 2E, Ten-Tec Pegasus and Jupiter and others) and this must be independent of the audio supplied to the PC sound card for the MARS-ALE modem. The volume level will first be read and then set to minimum during Muting, when muting is turned off, the volume level will be reset to the value read prior to Muting.

For those radios that support the control of receiver volume over the CAT interface, but do NOT support reading the current volume setting, the user will need to also supply a integer value for the volume level to be set for both Muting On and Muting Off, typically the value for Muting On shall be zero (0). The value for Muting Off is the level that the receiver audio output will be set to upon a return to receive audio output. The MARS-ALE shall at program startup, for those radios that support volume control and support reading of the setting, read the volume setting and use it upon returning to Muting Off, unless the user has not checked automatic volume levels.

For Logic Line Muting, the MARS-ALE software shall place the selected logic line high (radio com port RTS or DTR, or Parallel Port Line etc.) that the user shall interface to their receiver Speaker Muting line (if the radio so provides) or to custom circuitry to switch out their speaker and place an appropriate load on their receiver output.

The planned automatic muting modes are:

1. MUTE when Scanning: Operator audio is muted during Scanning/Sounding.
2. MUTE when LINKED: Operator audio is muted when LINKED.
3. MUTE when NOT LINKED: Operator audio is muted when not LINKED.
4. MUTE ALWAYS: Operator audio is always muted.
5. MUTE NEVER: Operator audio is never muted unless the user makes use of the manual button bar "Toggle Receiver Muting" button.

At present, items 2 and 3 are supported as the software is written for the radios that support CAT muting with no user selection. In addition, the RTS or DTR lines can be used for external mute circuitry if not otherwise being used.

The DTR line will start off with the receiver speaker MUTED and you will need to toggle it with the button bar "Toggle Receiver Muting" button as at present DTR is hard coded for D.C. power use. This will change in the near future when the setup menus are re-done and the ALE.DAT database structure is updated.

 Manual muting is always available to the operator via the button bar "Toggle Receiver Muting" button.

RADIO RECEIVE PREAMP

PLANNED

During MARS-ALE Scanning/Sounding operation, should one or more antennae (e.g. Low noise, negative gain Beverage, Loop, Pennent etc.) require a receive preamp activated, MARS-ALE software shall provide CAT Control Preamp activation (where the selected radio supports such control) and Logic Line Preamp activation.

Many modern radio's have internal fixed 10db or greater preamps, some radios offer two or more levels of preamp gain. Those radio's that support CAT Control of their preamp and offer more than one setting shall require a zero (0) entered under the PREAMP selection in GROUP/Channel setup to indicate that the preamp is to be set off. For the preamp to be turned On, a one (1) shall be entered, if there is more than one level of preamp gain, a two (2) shall be entered for the second level, the MARS-ALE software shall accept entry of values from 0..2 at this time as we know of no radio that offers more than two gain settings.

For Logic Line Preamp activation, the MARS-ALE software shall place the selected logic line high (radio com port RTS or DTR, or Parallel Port Line etc.) that the user shall interface to their external receiver Preamp custom circuitry to switch in and out their receive preamp. One line shall be provided for this application. Whether the external receive preamp is a simple unit or a more complicated unit (e.g. Ameco PT-3) there is no need for more than one logic line. However, a unit that requires the gain to be adjusted manually and or the frequency of operation (e.g. Ameco PT-3) shall not be supported by the MARS-ALE software for more than Preamp On/Off

or In/Out of circuit operation depending on the particulars. It will be up to the MARS-ALE user to configure an interface to utilize their external preamp for what we have been able to provide with the MARS-ALE software.

SETUP FOR RADIO CONTROL

All radio's are not created equal, this is true of many features, including setting the radio up for RS-232C CAT operation. Some make/model radios are hands off to the user in this regard, its address (if any), baud rate, start/stop bits and parity settings are not open to change. As far as MARS-ALE operation is concerned, that's not to bad, as there is nothing for the user to setup in the radio.

If the radio is on the MARS-ALE radio selection menu and the cabling and hardware is all correct, you should have no problems. However, some radios allow for all the parameters to be changed and this adds some level of complication to the initial setup for the user, as well as how you may need to configure the radio or other software for use with the radio for other uses.

MARS-ALE supports Scanning and Sounding with supported scan rates of 1, 2 and 5 Channels per second and the future MIL-STD-141B scan rate of 10 channels per second. The baud rate which your radio communicates with the PC has a lot to do with how well your radio will perform and the faster scan rates. Thus, if your radio supports a number of baud rates, the fastest baud rate should utilized for best results. MARS-ALE at present is being coded to support the highest baud rate that each particular radio is capable of working at.

What this means is that your radio may need to be changed by you to a higher baud rate than it was shipped from the factory as configured. It may also mean, that another software which you plan use with your radio may need to be reconfigured for the higher baud rate and if that other software only supports one baud rate, you may need to change your radio baud rate when changing between software applications.

However, some radios as stated only work at one baud rate and some radios can be set to AUTO BAUD, which allow them to operate at whatever baud rate the PC is sending data to the radio. The AUTO BAUD feature using an ICOM IC-706MkII-G has been tested with MARS-ALE and found to work without any problem.

Typical radio baud rates range from 1200, 2400, 4800, 9600 and 19200, with some make/models going to 38400 and 57600 baud. For newer radios, this baud rate is not to be confused with the digital mode baud rate that some radios may support user configuration. If your radio supports AUTO BAUD, then make that selection else select the highest baud rate provided.

Some make/model radio's also require the selection of start/stop bits and parity, MARS-ALE shall use the factory default settings in all such cases unless otherwise specified, please refer to Appendix A herein for details.

RTS and DTR lines for radio PTT –

1. When NOT using radio type "NONE" and when DTR is NOT selected for PTT or Muting, the DTR is currently ACTIVE all the time from program start to provide D.C.

power for anyone that uses an external level converter between their PC and radio requiring DTR as their source of power. This means that a RigBlaster and other units need to be modified to untie the RTS and DTR lines for proper PTT operation, otherwise the signal on the DTR line will lock your unit in transmit.

However, the above only applies when the chosen radio does NOT require the DTR and RTS lines for hardware flow control. If your particular make/model radio falls into that category then DTR and RTS will NOT be available for any other use. At present, such radios have NOT yet been coded, but that is subject to change.

The MARS-ALE software will be changed to provide a selection for DTR for Radio Hardware Flow Control or D.C. power or PTT etc. When the code has been written to provide this, the DTR line shall be free for other uses when not needed for a Hardware Flow Control or D.C. power source in that order. The options menu shall provide a single panel where only ONE use for DTR can be selected at a time.

When Hardware Flow Control is required, the RTS line will NOT be available for PTT either. However, it is planned that the software will support the use of the first Parallel printer port (LPT1) for nine (9) signal lines, of which one can selected for PTT as needed. There is more information on the planned use of the LPT1 port in the next section.

2. CAT PTT is automatically disabled when either or both (currently, only one will be selectable in the future) RTS or DTR is enabled for PTT. This is done on the fly, so if your setup supports both means of PTT, you can switch back and fourth as needed/desired for testing. In the future the LPT1 lines set aside for PTT shall also be interrogated.

3. Many make/model radios do NOT support CAT PTT, thus an external interface such as the commercial RigBlaster is required. Do NOT use VOX operation, only hardwired PTT or CAT PTT can be used for reliable ALE operation.

QUIET SCANNING/SOUNDING

Most Amateur Radio grade transceivers and many Commercial and even some Military make/models use Band Pass Filters (BPF) to meet spectral purity which are either switched with diodes or relays. With ALE operations employing Scanning/Sounding those relays will take one heck of a beating in a relatively short period of time.

Quiet Scanning/Sounding (QS/S) is a method used by MARS-ALE only during Scanning/Sounding operation and only with radios that support it to keep those relays from energizing and de-energizing for the switching in and out of the BPF needed for a new frequency range each time the MARS-ALE controller changes the RX frequency, they will then only do so when the TX frequency is changed. QS/S either uses a pre-existing control code is sent to the radio to bypass BPF relays (such as the Harris RF-350/RT-1446 series) or a transceiver is placed into SLPIT VFO operation with “VFO A” being used for the RX frequency and “VFO B” being used for TX frequency.

The TX frequency is sent to the transceivers TX VFO just before TX during Sounding or any type of Call or other transmission under computer control for the given GROUP/Channel selected. That frequency change will only cause the BPF relays to work if the frequency is different from the last TX frequency sent to the transceiver.

In addition, it is planned that for those radios which support computer control of the internal antenna tuner (ATU), that when the program has been coded to support the addition of ATU information on the GRPOUP/Channel setup dialog, that the program will also manage the state for the ATU so that it is only engaged when the TX is called.

Most modern Amateur Grade radios use mechanical relays for BPF switching (some use expensive linear or less expensive non-linear semi-conductors, which can cause distortion if the best devices are not used, which are costly) as these less expensive mechanical relay prevent 2nd order distortion at the primary stage of signal processing, most manufacturers use relays. However, when the radio is subjected to rapid frequency changes that exceed the current BPF range, the relays switch this switching is audible. The use of these types of radios with an ALE controller (hardware or software) can make these relays sound a bit like a machine gun cycling. In addition, the extra amount of relay activation decreases the
overall life of the relays.

However, as these BPF are used for filtering transmitted signals, they are engaged on the transmit VFO of most radios that offer split frequency operation, thus, if we operate the radio in SPLIT MODE, the BPF relays for most make/model radios will not come into play during Scanning/Sounding. If split mode is selected, then during Scanning and Sounding these BPF relays are not energized until the radio in Sounding goes into transmit mode, thus the noise is reduced and the life of the relays is decreased.

The SDT has found that the QS/S approach works perfectly on many of the newer radios, however it does not work on all radios, examples being the Ten Tec TT538 Jupiter (and perhaps all Ten Tec radios?), the ICOM Marine Grade radios and most Yaesu radios fail to comply, many of the Commercial radios tested also fail to comply. A comprehensive list of radios know to comply is provided herein and the software announces if the radio selected for use complies for QS/S at program start up. The ICOM IC-7800 partially supports QS/S in that the BPF relays work for QS/S by there are front end mixer relays still be switched with relays.

Another issue is radios where QS/S will work, but SPLIT MODE cannot be enabled automatically, thus the user will NEED to enable split mode manually. For these radios, the software will send the frequency and mode information to both VFO A and B even if SPLIT MODE is not enabled, in this case its in the user's hands.

Also, if the radio has an ATU and it is engaged, it will still be playing while Scanning and Sounding, some will only do so at TX, but most internal ones will do so during RX, some are only in line in the TX, but some are in line during both RX and TX. It is planned to code to only enable the ATU just prior to TX for those radios that support bus control of the internal ATU, not all do and some may be to slow to be ready, experimentation is still required in this area.

The approach taken to make QS/S work via SPLIT VFO is:

1. At startup, the radio is placed into normal VFO operation, whenever Scanning/Sounding operation is started, SPLIT VFO mode operation is invoked. “VFO A” is the RX VFO and “VFO B” is the TX VFO. When Scanning/Sounding operation is terminated, normal VFO operation is automatically resumed.

2. During Scanning/Sounding and any frequency selection for most radios, the RX frequency is written to the radio “A VFO” along with the mode.

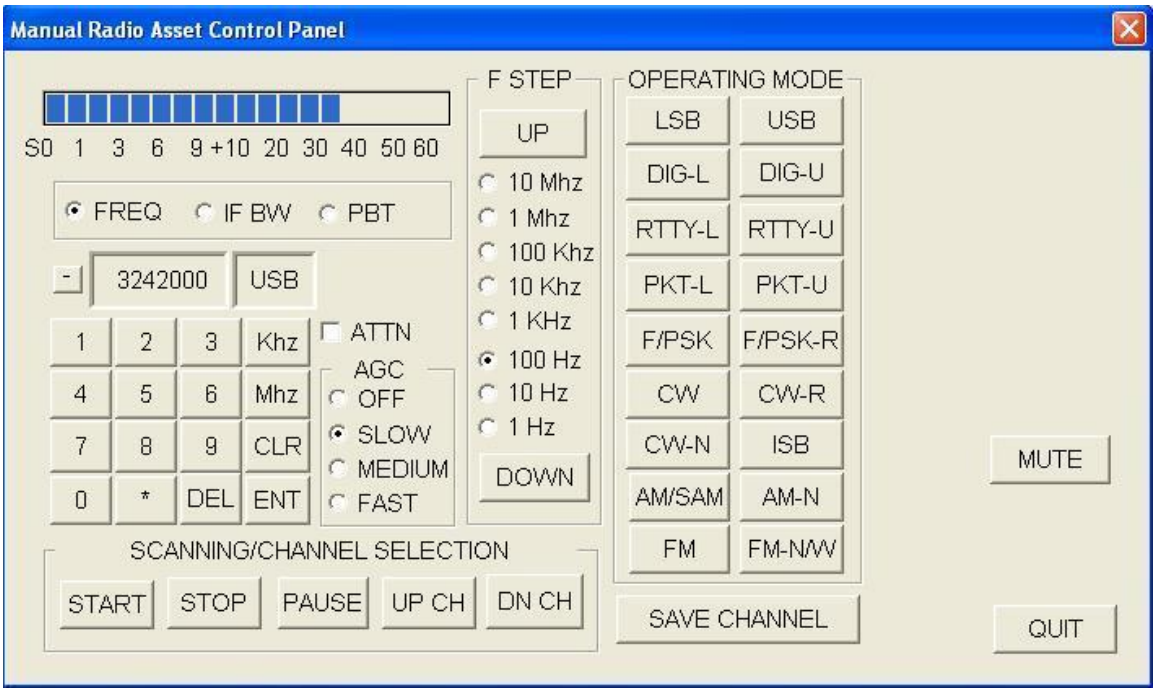
3. When it comes time to transmit the radios frequency is written to the radio “B VFO” along with the mode if the TX frequency is not the same as last used.

4. When Scanning/Sounding is terminated, so is SLIT VFO operation.

A simple test to determine if a radio will work with QS/S or not is to turn your internal ATU OFF and RIT/XIT OFF, using ‘VFO A’ change frequency on your radio using what ever means desired, until your hear the BFO relays come into play. Then back up in frequency and you will hear the relay’s again, then enabled “SPLIT VFO” and once again tune through the frequency cross over point that the BPF relays previously activated, if nothing is hear, your radio is QS/S qualified, if its not listed as such in Appendix A herein, please send a message to the SDT so that it can be added. Like wise, if you radio is on the list, but does not work, please inform the SDT.

MARS-ALE MANUAL RADIO ASSET CONTROL PANEL

This asset, which is not yet fully implemented, was begun by Charles Brain and he labeled it “Manually Radio Asset Control Panel”, the details of this dialog can be found in the MARS-ALE MANUAL RADIO ASSET CONTROL PANEL Applications Note.



This panel at first provided just basic frequency and mode selection, however it now provides radio specific control for a number of make/model radio with respect to radio specific parameters. As many existing radios are PC controllable only (the way of the future is Software Defined Radios) they have no manual interface for data display, entry or parameter adjustments without using their specific software and as said software can not be used in conjunction with the MARS-ALE software, this panel provides those missing radio control capabilities.

We are talking radios that have been in MARS use for years, such as the Kachina 505DSP, Ten Tec TT550 Pegasus (TT538 Jupiter in Pegasus emulation mode) the Kenwood TS-B2000 and others, there is a trend in the commercial/military and now Amateur Radio world for Software Defined Radios (SDR) where no manual user interface is provided, so over time, this panel will be much more important.

Manually Control Radio Asset Panel and Griffin Technology PowerMate:

This panel has been configured to support the Griffin Technology PowerMate USB multimedia controller knob (under $50USD) for use as a remote manual VFO when this panel is active. This device is available in a brushed aluminum or black anodized offering and is sold through various retailers or direct, see:

http://www.griffintechnology.com/store/usb_solutions.html

This support has been added basically provide manual VFO support for computer controlled only radios such as the Ten Tec Pegasus, Jupiter (when used in Pegasus emulation), Kachina505DSP, TS-B2000 and others. However, it can be used for any radio that the user desires.

The MARS-ALE software contains NO specific code for this support, all that has been done is Hot Keys have been specified for a number of the Push Button's on the panel that are controls with ALT key strokes which the driver for the PowerMate provides. The PoweMate simply pipes these ALT keystrokes into the buffer as if the AKT-key x on the keyboard was pressed by the user. What this means is that the PowerMate should NOT be touched when the focus of the program is on another dialog screen as it will still be inserted ALT-x combinations that the program will to some extent respond to, thus ONLY use the PowerMate when the Radio Asset dialog is active.

The ALT-Key combinations which the used from keyboard or invoked by the PowerMate are:

ALT-U, for the PowerMate it equates to "**Rotate Right**", this will cause the radio to increase frequency step selected as: 1, 10, 100hz, 1, 10, 100khz, 1, 10Mhz

ALT-D, for the PowerMate it equates to "**Rotate Left**", this will cause the radio to decrease frequency step selected as: 1, 10, 100hz, 1, 10, 100khz, 1, 10Mhz

ALT-P, for the PowerMate it equates to "**Click & Rotate Right**" (user must hold the know down) which will trigger the "Up Channel" selection for the current GROUP/Channels.

ALT-N, for the PowerMate it equates to "**Click & Rotate Left**" (user must hold the know down) which will trigger the "Down Channel" selection for the current GROUP/Channels.

ALT-S, for the PowerMate it equates to "**Click**" (Single Click), which will Start Scan (or Sounding as defined on MIL-STD-188-110 Options menu) of the current GROUP/Channels.

ALT-T, for the PowerMate it equates to "**Long Click**" which will Pause/Stop Scan (or Sounding as defined on MIL-STD-188-110 Options menu) of the current GROUP/Channels.

All of the above has been tested using a current model PowerMate under Windows 2000 Professional SP4 and Windows XP Home SP2 with the PowerMate v1.5.3 Driver installed. After plugging in the PowerMate and installing the driver if the bottom of the unit does not light BLUE, then reboot. If upon rebooting the unit still fails to light BLUE, check your system hardware settings for the unit. If you had a code 10 displayed, you need to update your operating system via automatic updates as there was a change made to the OS earlier in 2005 that affected this category of Human Interface devices.

The setup for use of the PowerMate using the PowerMate Properties panel under Windows Control Panel is simple. First, you need to start MARS-ALE (ALE.EXE) or any program that you would be using the PowerMate with. Then start the PowerMate Properties panel. Then click on "Add Setting" and select ALE.EXE. Next the action panel click the pull down menu for "User Action" to select the action, for MARS-ALE we shall be using six actions: Rotate Right, Rotate Left, Click & Rotate Right, Click & Rotate Left, Click, Click Long and assigning "Send Key" as the "Computer Action" for each action. For the "Send Key" for each action we shall be using "ALT" and the letter designator for each action as seen about, e.g. "S" for ALT-S to Start Scanning, in all cases you will enter a capital letter for the Keystroke entry. It's that simple, when finished, from the many panel click on "Apply Now" and "OK" and then you can start using your PowerMate as a VFO tuning knob and much more with MARS-ALE.

Use of the PowerMate, mouse or computer keyboard to continuously send frequency stepping data to any radio is best done at a minimum of 9600 baud, actually you really don't get the best performance until about 57,600 baud. Older radios that operate at less than 9600 baud will not benefit from the use of computer controlled frequency changes even at 1khz steps, let alone less, discrete channel steps a different matter. The biggest problems are with those radios that loose receiver audio when receiving CAT data, such as the Yaesu FT-890, FT-990 as mentioned earlier.

NOTES ON SPECIFIC RADIO MAKE/MODELS

General –

There are various characteristics that will rule out a radio from being suitable for ALE operation at all, or for certain aspects of ALE operation. In many cases, the radio may work well in all regards for ALE operation, however it may take a beating that will shorting the life of various components. For example, many radios utilize numerous relays for spectral purity band selection filters and for internal Automatic Antenna Tuner Unit (ATU) operation. These relays will be subjected to one heck of a workout during ALE Sounding operation and many will likewise be exercised during Scanning alone. If your radio is one of the models that you here a lot of relay chattering during Scanning, turn off its internal antenna tuner and see how much it quiets down as it is planned for MARS-ALE to control the state of the internal (and external) ATU in the near future. A radio that makes no mechanical sounds during Scanning would be the better choice for component longevity, an FT-890S/AT is a big offender, where as the FT-817 and FT-847 are soundless.

Regarding multi-channel Scanning/Sounding operation, some radio make/models, such as the FT-890S/AT and FT-990 will not work 100% for scanning or sounding as the receive audio is interrupted by processing PC commands being sent to the radio with frequency/mode updates per the channel scan rate selected. Even at 1 channel per second this can be a problem.

Two Radio Operation -

PLANNED

The MARS-ALE software will be written to support combinations of computer controlled transceivers for transmitting and computer controlled receivers for receiving. Government and Military fixed position and some portable installations still make use of separate units for their communications needs and the MARS-ALE software may as well. The reasons are obvious, less wear and tear on the equipments during Scanning/Sounding operation being the main thrust. However, in many cases depending on the make/model transceiver involved, it would also provide for an improvement in receiver capability.

Today there are many high quality computer controlled receivers available, some of which are quite inexpensive, even new, then there are the used Amateur/SWL grade and Commercial/Government/Military grade units about. A key requirement for our application would be that the receiver is capable of being totally muted by a signal line from the transmitter when in transmit, otherwise a modification will need to be made. Another key aspect is whether the unit selected can be operated on the same serial port as the existing transceiver (transmitter in the case of Commercial/Government/Military grade units) or if an additional serial port will be needed. In some cases some slight medications will be needed to the radios to provide ant port relay and control lines, however this will be minimal.

The first such “RX/TX Combination” to debut will likely support ICOM make/models as the ICOM computer/radio interface protocol supports up to four (4) radios on the serial port bus (will plan only support 2 radios, one for receive and one for transmit) with individual addresses. Thus one could for example pair an IC-756PROII and all those relays that chatter away with an R-75 and have quiet operation except when during Sounding at the interval called for by the Sounding and Resound Period to transmit.

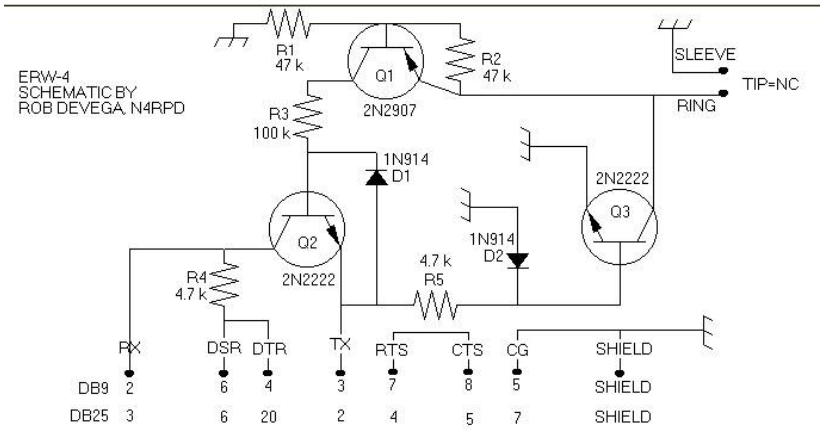
The second “RX/TX Combination” to debut will likely support the Ten-Tec Pegasus or Jupiter paired with an RX-331 or RX-340 receiver. There will be modifications needed to provide antenna connection to the receiver when a single antenna system is being used, this can be done in transceiver or external with a switch over relay, details on these subjects will be provided in the future.

Basically any combination of transceiver/transmitter and receiver can be supported when two serial ports are utilized. Trying to limit this support to one serial will limit the make/model combinations of radios that can be utilized.

The user of “RX/TX Combination” configuration would select an RX radio and a TX radio during hardware configuration and when this pairing is desired for use, at GROUP/Channel setup, they would check the “RX/TX Combination” check box. When the “RX/TX Combination” is NOT checked, only the TX radio will be addressed by the software.

ALINCO -

A compatible ERW-4 circuit by N4RPD.



CODAN RADIOS -

9323, 9360, 9390:

The Codan 9300 series of radios utilize an external ALE controller. Those units that do not have the external ALE controller can work stand alone with MARS-ALE. In the future, those units that have the external ALE (9300) controller can use it for MIL-STD-188-141A operation for Single Channel, Scanning, Sounding etc. and MARS-ALE and the PC sound device for all else that the tool offers.

NGT AR, AR Voice, SR:

The Codan Next Generation Transceiver (NGT) series of radios utilize an internal ALE controller. At first only stand alone operation with MARS-ALE will be supported. In the future, the internal ALE controller can use it for MIL-STD-188-141A operation for Single Channel, Scanning, Sounding etc. and MARS-ALE and the PC sound device for all else that the tool offers.

ELCRAFT K2/100 –

The K2/100 for compatibility with existing radio control software emulates a Kenwood TS-570SD ID code. As such the "KENWOOD" radio type selection will recognize the K2/100 as a TS-570SD. However the radio supports extended commands beyond the standard Kenwood protocol for which specific code will need to be written.

You will need to have either the RS-232 interface adapter installed (model KIO2), or the 100-watt stage (KPA100), to be able to use MARS-ALE to control the K2. Both the KIO2 and KPA100 provide true RS-232 levels (at 4800 baud 8N2) with no need for an external level converter, thus a straight RS-232 cable between the PC and radio is all that is required. Refer to the K2/100, KIO2, KPA100 manuals for more details.

ICOM AMATEUR GRADE RADIOS –

The MARS-ALE SDT would like to thank AAR2EX for the loan of an IC-706MkII-G for development and on-the-air testing purposes with MARS-ALE.

All older ICOM radios supported are being operated at 9600 baud with the exception of the IC-735 at 1200 baud. All newer ICOM radios are being operated at 19200 baud and the newer radios can all be set to AUTO BAUD as desired.

Some make/model radio's also require the selection of a radio address. This is true of all ICOM radio types. In all cases, MARS-ALE shall use the factory default address. If you desire to use another address other than that at this time for ICOM radios, you will need to use the GENERIC ICOM setup, however that interface will only allow for the very basic ICOM radio type control. Some older Ten-Tec radios that emulate ICOM can be supported if not listed on the radio selection menu using the GENERIC ICOM interface, however, only the basic ICOM commands will be supported.

Regarding ICOM radios, some older ICOM radios such as the IC-751 and IC-751A require the installation of the optional UX-14 converter to changes the radio's parallel interface to a serial interface to be able to work with the CI-V level converter. Please refer to your radio's user manual and the UX-14 instruction manual.

For MARS-ALE, set CI-V Transceive to OFF. Due to the CI-V single-wire bus design, data collisions can occur when two rigs (or a rig and the computer) transmit data at the same time. The protocol offers some limited means to detect and handle collsions. Each rig offers the option of "CI-V transceive" set to ON or OFF. With "CI-V Transceive" set to on, two things happen: 1. The rigs transmits data over the bus when frequency or mode changes; 2. The rig reacts to data sent over the bus which is adressed not only to it's own adress but also to a special adress meaning "all rigs connected". With "CI-V transceive" set to off, the behaviour changes: 1. The rig doesn't send data when you turn the dial or change mode; 2. The rig reacts only to data sent to it's specific adress, data sent to "ALL" is ignored.

The standard ICOM CI-V interface can support up to four devices. The PIEXX company has stated they tested their USB port interface with three radios for fan out and depending on bus loading, that it may also support four. The device combination can be Transceivers, Receivers or other devices that adhere to the ICOM CI-V standard. As the interface between the PC and the CI-V is the PC RS-232 port, only one program can communicate with the CI-V at a time. Thus no other program can be in control of the other devices on the CI-V if you have any when MARS-ALE is in use. There are plans to support one transceiver and receiver on the CI-V interface for RX/TX Operation to reduced were and tear on all those relays during scanning/sounding.

NOTE: Important information for all users of ICOM radios featuring Dual Watch with the exception of the IC-7800.

The IC-781 and all the radios after it that have the "Dual Watch" feature, must be operated with Dual Watch set to OFF for ALE operation. The software sets Dual Watch OFF at program

startup, however that is only if your radio is under computer control and properly being controlled with the radio power on when the software is started.

The Dual Watch feature provides a second received signal on a different frequency within the front-end band filter (BPF1), without the need for a second IF-stage, a second receiver AGC circuit (automatic gain control) or AF stage as compared to a fully-fledged main/sub receiver system like found in the ICOM IC-7800 or Yaesu FT-1000. Thus the ICOM "Dual Watch" is much more cost effective, thereby enabling ICOM to add an attractive feature to the transceiver while be cost competitive, in other words its not as good, but usable within limitations.

In order for ICOM to provide their Dual Watch mode, the received signal is split at the front end RF level. The first local oscillators (LO1a and LO1b) oscillate on different frequencies, thereby providing reception on separate frequencies using two PIN diode attenuators to provide a means to vary the balance between the two branches. Subsequently the two signals are combined again to one as the first IF signal being amplified.

As Dual Watch is simplistic compared to a main/sub receive system, in which the latter has separate IF-stages and an AGC-circuit, making the two receivers work more or less independently of each other, with Dual Watch things are very different, a.k.a. poorer performance. It is not possible to listen to a signal using a narrow IF filter and at the same time listen to another signal using a wide IF filter as there is really just one receive.

The really BIG problem with Dual Watch is switched ON, is that your noise floor increases by about 3 dB or more, so with marginal signals, it is advisable not to use Dual Watch, for all ALE operation its my opinion that you should NEVER us it, even on much better signals, this is a problem.

Another limitation is caused by the AGC circuit during Dual Watch. The AGC voltage is a function of the sum of the two received signals, irrespective of how weak or strong each individual signal happens to be at any time. Thus, when the two signals are of about equal strength, they both produce enough audio to be copied successfully. When one signal is much stronger than the other, there still is no problem because ICOM has provided a manual control to adjust the balance ("bal ctrl" in the block diagram). The real trouble starts when the signals vary in strength, or when strong QRM appears on the frequency. The weaker signal will be wiped out by the AGC. Then you may restore the balance and there it is again. When the QRM is gone, restore the balance once more. To cut a long story short, due to this effect, Dual Watch is unsuitable for a dynamic environment such as we experience on our MARS channels with static crashes, QSB etc.

NOTE: The ICOM DSP system is used in the IC-756 and most later models.

All late model ICOM users will need to determine if this is true of their models as I have not had the time to review the block diagrams and schematics of each model.

However, I have looked at the IC-756 DSP system, a review of the block diagram shows that the DSP filtering is placed after the 455 kHz IF and AGC detector/amplifier. In my opinion, you want to have DSP filter the desired signals out before it reaches the AGC detector, not after, when your

filter after the AGC detector, undesired and strong signals will still influence weak signals, in other words, you want the DSP to control the entire AGC performance.

In the IC-756 however, the DSP apparently has a more auxiliary function, thus for good filtering, you must rely upon the crystal filters in the 9.01 MHz IF (BPF 5) and the 455 kHz IF (BPF 6) stages. I would recommend that FL-257: 3.3 kHz/-6 db SSB wide filter, nothing less that 2.4Khz.

You need to keep all the DSP NR and NOTCH stuff turned off as well, basically the radio as I have always stated needs to be run wide open for things like that to include have IF shift center, NB OFF etc. Also, the use of IPO/AIP/PRE-AMP OFF (in your case) and AGC, Attenuator etc., can be brought into play as needed.

The radio AGC should be on SLOW from now on as default based on recent testing results, the software is being updated to make this so when radios supporting such commands are under computer control.

ICOM MARINE AND ALE GRADE RADIOS –

Do you have an ICOM Marine Grade radio wasting away on your boat in the off season, or would you like to have a more rugged radio than the normal Amateur Grade radio for use with MARS-ALE.

The Marine Grade radios do not offer all the features that one would want in an Amateur Radio transceiver to be competitive in DXing and Contesting, however that is not the case for MARS operation. These radios are solid units with large up front speakers and plenty of clear audio, a large back lighted LCD display for aging eyes, a minimum number of controls, plenty of features and sell new at reasonable prices and often used at bargain prices.

The size and weight of the ICOM Marine Grade radios turns out to be related to their biggest advantage. These radios are built on a cast aluminum chassis with a substantial heat sink and a large diameter fan internally, and are real “workhorses.” These are the only Marine radios that are currently capable of running continuously at 150W output in digital Maritime networks.

The MARS-ALE SDT would like to thank Ed Thomas, N2IHN for the loan of an IC-M710-21 (no 2182khz alarm option) transceiver (seen below) and hand microphone, along with an external AT-130 ATU for MARS-ALE development and on-the-air testing purposes. This particular unit has the TXCO installed and has been configured for full 1.6-30Mhz. Two-way operation on all modes.

ICOM Marine and ALE HF SSB radios are specifically designed for Maritime use, however they are more than suitable for MARS operations, especially ALE. A recent review of the "HF Equipment Compliant Summary Report" on 06 Feb 2005, found the Marine Grade models listed herein, among the radios that meet NTIA HF Specifications, refer to:

https://ntc.cap.af.mil/comm/equipment/hf_summary.cmf

Where needed, they can easily be modified for full frequency operation using the ICOM "FIELD PROGRAMMING SOFTWARE" and they support the ICOM series of automatic external antenna tuners as well as third party models. They also provide numerous features desirable for MARS-ALE operation, such as CAT controllable functions of AGC, RF Gain, RF power, Volume, Muting, PTT, ATU, Squelch and Noise Blanker.

When these radios are placed into "REMOTE" operation, having been addressed over their computer control port, the manual front panel controls are disabled.

Marine Grade Models: IC-M700PRO, IC-M710, IC-M710RT, IC-M802

Commercial ALE Models: IC-F7000 ALE

These ICOM series radios have a unique REMOTE ID (Address) configurable in the radio setup panel, any ID number for 01..99 can be set. However, the factory default address settings with the exception of the IC-F7000 are to be used by the MARS-ALE as follows:

IC-M710 = 1
IC-M700 Pro = 2
IC-M710 RT = 3
IC-M801E = 7 (Factory setting is 11) NOTE: Remote connector must be set to NMEA.
IC-M802 = 8
IC-F7000 = 9 (Factory setting is 10)

These radios support the NMEA 0183 version 3.01 computer interface for programming and on the fly command and control to the ICOM-NMEA extended command set. The NMEA baud rate is 4800 with settings of N81.

The IC-M700PRO does not have the NMEA connector, but does have a 1/8" mini-phone jack which can be connected to a serial port with an appropriate level converter (see below).

In addition to the NMEA interface, some of these radios, like the IC-M710 also supports the standard ICOM CI-V (a.k.a. ICF-3) interface from the radio cloning port. The NMEA interface voltage levels are at 8 volts, RS-232 is found at 5 volts and 12 volts. As such, it is possible to remote control (e.g. have the computer change frequencies and modes) on these ICOM radios using a standard RS232 serial port.

General/Radio Specific features that can be controlled on most of these radios are:

REMOTE CONTROL	- ON (REMOTE WITHOUT DSC)/DSC/OFF	
AGC	- ON/OFF	
RADIO DISPLAY DIM	- ON/OFF	
RECEIVE FREQUENCY	- F Mhz.	
TRANSMIT FREQUENCY	- F Mhz.	
RADIO MODE	- USB/LSB	(Any mode the radio supports) (Also ALE-U/ALE-L for IC-F7000)
AF GAIN	- 0..255	(0 = MIN, 255 = MAX)
SPEAKER MUTING	- ON/OFF	
NOISE BLANKER (NB)	- ON/OFF	
RF GAIN	- 0..9	(0 = MIN, 9 = MAX)
TRANSMIT POWER	- 1..3 STEPS	(HI/MED/LOW see user manual)
PTT	- ON/OFF	
ATU	- ON/OFF/TUNE	(AH-3, AT-120, AT-130 and AT-130, AT-140, AT-230 for IC-F7000)
SQUELCH	- ON/OFF	
S/RF/ANTC METERING	- METERING 3 PARAMETERS	

CAT CONTROL:

When these radios are addressed by the MARS-ALE software, the front panel display will show REMOTE. When the MARS-ALE software is shutdown properly, the REMOTE will clear and the frequency and mode of the radio will return to what was displayed prior to the MARS-ALE software addressing the radio.

During MARS-ALE control under GROUP single channel step or scanning/sounding operation, the radio will display "DUP" if the TX and RX frequency are not the same and will display "SIMPLEX" when the TX and RX frequency are the same.

MANUAL CONTROL:

Programming an M700RT, M700PROT and M710 manually

The instructions below do not apply to the M802, instructions for manual frequency and mode control for that radio are listed under its section.

Normally Maritine SSB communications are conducted using the frequency and mode data stored in the radios memory channels stored in the "User Channel Group". These channels can contain any marine simplex, duplex, weather FAX, ham or MARS frequencies. However, the radios can be used with on the fly frequency and mode changes as well. There are two large knobs, a keypad, and a Mode button on the front of the radio. These are the tools used to reprogram frequency and mode data on the radio.

The large left-hand knob is the *Group Channel Selector* knob. Use it to select the channel group you want to use. The right-hand knob is the *Channel Selector* knob. Use the Channel Selector knob to select a radio channel within a selected Channel Group.
The *CH/Freq* keypad key toggles the radio LCD dial display between Channel and Frequency.
The Mode button selects USB, LSB, H3E, etc., modes.
Follow the instructions below to program new frequencies into the User Channel Group of the ICOM M-700PRO, M-710, and M-710RT.

Turn the radio on.

Rotate the **Group Channel Selector Knob** until you have found the User Channel Group.

Turn the **Channel Selector Knob** to the radio channel to be programmed.
Press the **RX** keypad key.

Press & release the **CH/Freq** keypad button until the LCD display shows frequency.

Press the **CE** keypad key. A caret symbol will appear on the top line of the dial LCD display.

Press the **MODE** button until USB (J3E) mode shows on the LCD display.
Enter the new receive frequency using the keypad.
Press and hold the **RX** keypad key until the caret disappears. The new receive frequency is now stored.

Press the **TX** keypad key. "TX" will flash on line two of the dial LCD.
Press the **CE** keypad key. A caret symbol will appear to the right of the flashing "TX".
Enter the new Transmit frequency (the same as the receive frequency for simplex) using the keypad.

Press and hold the **TX** keypad key.

Press and hold the **TX** keypad key again.

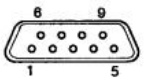
IC-M710:

This model has an ICOM FL-3- 2.3Khz/–6db SSB filter installed, soldered in and a plug in slot for an optional FL-100 500hz/-6db CW filter. The example unit used for testing had an ICOM CR282 TXCO installed which the manual states that this is standard in the European Global Maritime Distress and Safety System (GMDSS) model.

The IC-M710 supports the standard ICOM CI-V (a.k.a. ICF-3) interface from the M-710 radio cloning port, labeled “CLONE”.

The IC-M710 GMDSS version is also equipped with a 9-pin connector for NMEA control. The connections are not the same as RS-232 but can be connected to a computer serial port with a suitable cable. The IC-M710 9-pin NMEA “Remote” connector (labeled “DSC” on some models) can be used for remote control of the transceiver mode and frequency with any HF modem type, by using an additional computer serial COM port.

NMEA signal levels are a differential version of RS-232 voltage levels, approximately +8 and –8 volts. With appropriate wiring the “+” NMEA connections can be connected directly to a RS-232 serial port. (Note that the “-“ input must be grounded as a reference, but do not ground the “-“ output).

DSC	PIN	PIN NAME	DESCRIPTION	SPECIFICATIONS
(GMDSS versions only) 	1	DMD+	Modulation input from a DSC terminal unit	Imput impedance : 600 Ω Imput level : Approx. 0.75 V rms
	2	DMD–	Coaxial ground for DMD+	
	3	DAF+	AF detector output for a DSC terminal unit.	Output impedance : 600 Ω Output level : 0.25–2.5 Vrms
	4	DAF–	Coaxial ground for DAF+	
	5	NMI+	NMEA data input	NMEA standard format/level
	6	NMI–	Coaxial ground for NMI+	
	7	NMO+	NMEA data output	NMEA standard format/level
	8	NMO–	Coaxial ground for NMO+	
	9	GND	Ground for digital equipment	

ICOM IC-M710 series control cable description is a DB9 Female on computer end and a DB9 Male on the transceiver end. On the computer side pins 1, 4, 6, 7 and 8 are not connected. Pin 5 on the computer is connected to pins 6, 8 and 9 on the radio. Pin 2 on the computer is connected to pin 7 on the radio. Pin 3 on the computer is connected to pin 5 on the transceiver.

An IC-M710 serial cable to a standard 9-pin PC serial port can be made up as follows:

(Radio 9-pin male) - - (PC 9-pin female)
- -

NMI+ 5 - - - - - - - 3 TxD

NMO+ 7 - - - - - - - 2 RxD

NMI- 6 - - - - - - - 5 GND

NMO- 8 - - - - - - - 5 GND

GND 9 - - - - - - - 5 GND

Shell - (shield)- Shell

In order to use the NMEA interface, it must first be selected using the front-panel "Set Mode" functions (turn power on while holding down the "Func" and "1" buttons). Select the "REMT-IF" (remote interface) setting and change it to "d-Sub" (or "RS-232" on some models). Also check that "REMT-ID" is set to "01".

NOTE: The IC-M710 provides not speaker audio output when the hand microphone or headset is **NOT** plugged into the radio.

NOTE: Current IC-M710 units support VFO tuning, however early IC-M710 units did not. This is drawback for Amateur Radio (not on the 60m band) operation as the lack of "VFO" tuning (this is NOT the case with the IC-M802 or IC-M700-PRO) is required, however for MARS operation, this is not at all a problem.

As of July 2002, there is only one version of the IC-M710 available, it includes ham radio transmit and the 2182 kHz alarm is now available as an option. Thus your IC-M710 may be Ham transmit ready or not, whether it is all frequency MARS ready is another story. You will need to check and see if your unit will transmit outside the Marine and Ham bands, an IC-M710-21 should not, an IC-M710-22 should.

If it does NOT, it can be easily modified by use of ICOM DOS based "FIELD PROGRAMMING SOFTWARE" for the IC-M710, P/N EX-1726. This so called cloning software (you can read the setup from one radio and load it into another or just read/save/change and reload from the same radio) will work with the standard CI-V external level converter and cable. In /EXPERT (a command line argument when starting the program) mode, it will allow the user to change the frequency operating range and enable all modes (normally the IC-M710 will not transmit in LSB as Maritine only uses USB) and much more.

There is also a hardware modification that can be found on the Internet, however, it will ONLY open the radio for all frequency use, it will NOT enable all modes, if your radio does not now transmit on LSB, it will not after the hardware modification. This modification which requires the removal of a number of surface mount diodes is NOT recommended.

IC-M710RT:

We have not developed with an example IC-M710RT in hand to test with, however everything that has been coded for the IC-M701 should work with the IC-M710RT, should anyone have the data to control more features, please let us know, feedback is welcomed.

The IC-M710RT uses a standard 9-pin RS-232 connector on the front of the transceiver as the face of the radio, although similar in appearance to the IC-M710, is remote mounted.

NOTE: The IC-M710RT can be ordered as IC-M710RT-22, a version that operates on frequencies, to include the ham bands.

IC-M700PRO:

We have not developed with an example IC-M700PRO in hand to test with, however everything that has been coded for the IC-M701 should work with the IC-M700PRO, should anyone have the data to control more features, please let us know, feedback is welcomed. The IC-M700PRO is very similar to the IC-M710 in appearance and features.

The M700PRO an 1/8" TTL-level jack labeled "Clone". This connector is normally used by dealers for radio setup but can also be used for NMEA remote control. However, it is NOT compatible with the standard ICOM CI-V interface. It requires an different external level converter for use with a PC COM port, the ICOM OPC-478 cable available from ICOM dealers is required.

For the 9 pin D connector, the IC-M700PPRO requires the same DB9 Male to DB9 Female cable as can be used with the IC-M710.

Setting up the radio is the same as for the IC-M710 above (including selection of "d-Sub" or "RS232" for the radio's REMT-IF setting). Note that some ICOM documentation refers to this as a CI-V jack, but it only works with NMEA data formats, not the standard ICOM Amateur protocols. Also note that ICOM does not officially support the use of this jack for remote control,

and if you go to ICOM with questions they will disavow all knowledge. While this connection works at the time of this writing it is also possible that ICOM may make some changes, which will make it incompatible. Please send us an email if you have any questions or difficulty.

IC-M802:

We have not developed with an example IC-M802 in hand to test with, however everything that has been coded for the IC-M701 should work with the IC-M802, should anyone have the data to control more features, please let us know, feedback is welcomed.

The IC-M802 has a detachable control head and uses a standard 9-pin RS-232 connector mounted on the front of the transceiver main body.

The IC-M802 has IF DPS filtering that can be set to 2.8 kHz bandwidth for ALE. In addition the IC-M802, according to literature, should be HAM/MARS ready for transmit out of the box, literature states “IC-M802 includes HF HAM RADIO TRANSMIT & RECEIVE”, however it also states that frequency coverage is:

Rx: 0.5–29.9999 (continuous)

Tx: 1.6– 2.9999, 4.0– 4.9999, 6.0– 6.9999, 8.0– 8.9999, 12.0–13.9999, 16.0–17.9999, 18.0–19.9999, 22.0–22.9999, 25.0–27.5000.

Thus there are gaps where the ham bands would be, we can not confirm this as an M-802 has not been available to the MARS-ALE SDT for testing. We understand that there is also “FIELD PROGRAMMING SOFTWARE” for this model.

Manually programming the ICOM M802 & the Hidden Dial Mode has an undocumented "Open" mode not discussed in early documentation. Putting the M802 in to the "Open Mode" is the first step to custom programming the radio with the frequencies you use, and it's the key to accessing the Hidden Dial Mode. The dial mode is a key feature of the M802 as it makes it possible to tune the radio like a regular AM or ham radio. Here's how to put the radio into the dial mode and set frequencies:

Step		Instruction	Dial Display Change/Notes
1.	Put the radio into the OPEN mode.	With the radio turned off hold down the ***2, mode,*** and ***TX*** keys at the same time, and turn the radio on.	Normal dial display. The M802 doesn't indicate if its in the open or closed modes.
2.	Select Frequency display	Press the CH/Freq button to select Frequency display	LCD information toggles from channel display to frequency display
3	Select tuning capabilities	Press the clar/rx button. If the radio is in the open mode, a cursor (looks like an underline) will appear beneath one of the displayed frequency numbers. If the cursor is not there the radio is in the closed mode. Repeat steps 1, 2, & 3.	8152.**0**
4	Selecting a Frequency	Turn the left knob until the cursor is under the number in the column you want to change.	**8**152.0
5	Selecting a Frequency	Turn the right knob left or right until the desired number in the selected column displayed (in this example 14 MHz).	**14**152.0
6	Selecting a Frequency	Turn the left knob clockwise to move the cursor to the next column you want to change (in this example the 100KHz column).	14**1**52.0
7	Selecting a Frequency	Turn the right knob left or right until the desired number in the selected column displayed in the 100 KHz column (in this example 3).	143**3**52.0
8	Selecting a Frequency	Turn the left knob clockwise to move the cursor to the next column you want to change (in this example the 10KHz column).	1435**5**2.0
9	Selecting a Frequency	Turn the right knob left or right until the desired number in the selected column displayed in the 10 KHz column (in this example 1).	14311**1**2.0
10		Turn the left knob clockwise to move the cursor to the next column you want to change (in this example the	14312**2**.0

		1KHz column).	
11		Turn the right knob left or right until the desired number in the selected column is displayed in the 1 KHz column (in this example 3).	14313.0
12	Transmit & receive on the new frequency	Press the tx to set both the transmit and receive frequencies to the dialed-in frequency. In this example the radio will transmit and receive on 14.313 MHz.	The first line of the LCD dial will display SIMP above the frequency.
13	Only receive on the new frequency	Press the Rx button to only set the receive frequency to the newly dialed-in. In this case, the radio will listen on 14.313 MHz, but transmit on the previously set frequency	The first line of the LCD dial will display DUP above the frequency.
14	Returning to Channel Mode	Pressing the clar/rx button will toggle the radio back to the channel mode.	
15			Note: It is not necessary to set each column individually. Put the cursor under any of the columns and tune the radio as you would a regular AM radio using the right-hand knob. Remember, the farther to the right a column is located, the finer the tuning increment.

IC-F7000 ALE:

This model is NOT a Marine radio but rather an HF Land Mobile Radio (LMR) meant for Commercial, Government and Military users. However, for such use in the U.S. it does not currently meet NTIA requirements.

We have not developed with an example IC-MF7000 in hand to test with, however everything that has been coded for the IC-M701 should work with the IC-M701, should anyone have the data to control more features, please let us know, feedback is welcomed.

The IC-F7000 has built in Automatic Link Establishment support to MIL-STD-188-141A/FS-1045 (as do the Motorola MICOM 2 series of radios) and will work independent of the MARS-ALE software for basic ALE operation. However, the MARS-ALE software provides features in excess of the basic ALE operation supported buy the IC-F7000. At this time, there is not enough interface information in the possession of the MARS-ALE SDT to know whether MARS-ALE will be able supplement the internal ALE capability or if MARS-ALE will only be of use as a stand alone tool with this radio.

The IC-F7000 supports PC control with NMEA format via the ACC connector or AF/MOD connector. REMOTE CONNECTOR [REMOTE] Connects to a PC via an RS-232C cable (9 pin D-sub connector) for remote control in the NMEA or RS-232C format. Remote connector interface item selects the interface format for [REMOTE] connector for NMEA or RS-232C operation.

The IC-F7000 power output is selectable and rated at 1.6–3.9999MHz 125/50/10W pep and 4.0–27.9999MHz 100/50/10W pep according to the ICOM manual.

NOTE: The IC-F7000 has an Amateur Band option allowing TX/RX on the appropriate Amateur Radio bands.

NOTE: ICOM CS-7000 programming software and Optional OPC-478 RS-232 or OPC-478U USB interface is required to setup radio with computer.

IC-M710 SOUND CARD INTERFACE:

The IC-M710 is the only IOMC Marine Grade radio that was available to the SDT for for development and testing, however there are all similar, mic port uses a weird connector and wiring, I stayed away from it, if the radio was mine, I would have bought a connector and given it a try with a RigBlaster.

The M710 ACC1 connector is what you want to use, Pins:

2 GND
3 PTT
4 Audio IN - from sound card Line-Out
5 Audio OUT - from radio to Sound card Line-In

You and use any interface, just use 1:1 isolation transformers and provide a RS-232 RTS line for PTT with a transistor switch to PIN 3.

The radio only has a 2.3Khz SSB filter standard, thus its not great on the high speed PSK modem modes, but it works well otherwise, the TXCO is a huge factor. The SSB crystal filter can be swapped out, they use the same ones are in their Amateur rigs, the 2.8Khz unit would be the proper choice.

KACHINA RADIOS -

The Kachina K505DSP and KC105CTX are the only computer controlled HF transceivers ever manufactured by Kachina prior to leaving the market place. These radios are fully DSP and offer a number of characteristics which make it suitable for ALE operation, such as a transmit audio response (TX Equalization) extending from just under 100 Hz to approximately 4 kHz and receiver DSP IF BPF selections of 2.7 and 3.5Khz, perfect for ALE operation.

However, the Kachina internal ATU is not the best, it will not even attempt to tune when the VSWR is greater than 3.1:1, as such, an external ATU may be needed for many antenna type for ALE Scanning/Sounding operation. Also, as the radio is fully under computer control, it requires more attention for user interface, as does the Ten Tec Pegasus, both designed by the same engineer, with the Pegasus being a later development.

On the MARS-ALE SDT, AAR2EY and AFA4AE actually own example Kachina (AAR2EY also owns an older Kachina 1 6/10m rig) that was used for development. At first only basic operation of the radio for ALE use will be supported, later all features will be coded.

If your Kachina is not all ready configured for MARS operation, the radio will require installation of the MARS firmware ROM set v4.49 or the plug in PCMCIA ROM card firmware upgrade to work with MARS-ALE. The Kachina software needed to validate and use the v4.49 firmware for other than MARS-ALE is “Kachina 505DSP Radio Control Software v4.41”. The ROM’s may be ordered from the Kachina authorized repair POC, Mr. Dan Kimball, e-e-e-mail dkimball@commspeed.net and the PCMCIA card may possibly be acquired from Sherman Leifer, a past Kachina 505DSP reseller, used or possibly new if anymore are even made, e-mail sherman@mscomputer.com

KENWOOD RADIOS –

Kenwood has been the most consistent with its CAT command interface and is the only manufacturer since day one that has provided a means of reading an ID from the attached radio to determine its specific model. As such, there is only one selection for all models of Kenwood radios, the software reads the radio ID and informs the user of the model attached and then provides to configure and control the radio appropriately.

However, if your RS-232 cabling, external level converter or the radio itself is not properly working, then no ID is returned from the radio and the software will assume no radio is attached. If however, after start up the radio begins to communicate with the PC, it will be properly commanded, however, it NOT have been properly identified and pre-configured. You will know when this is true, as NO startup configuration messages will be displayed on the screen.

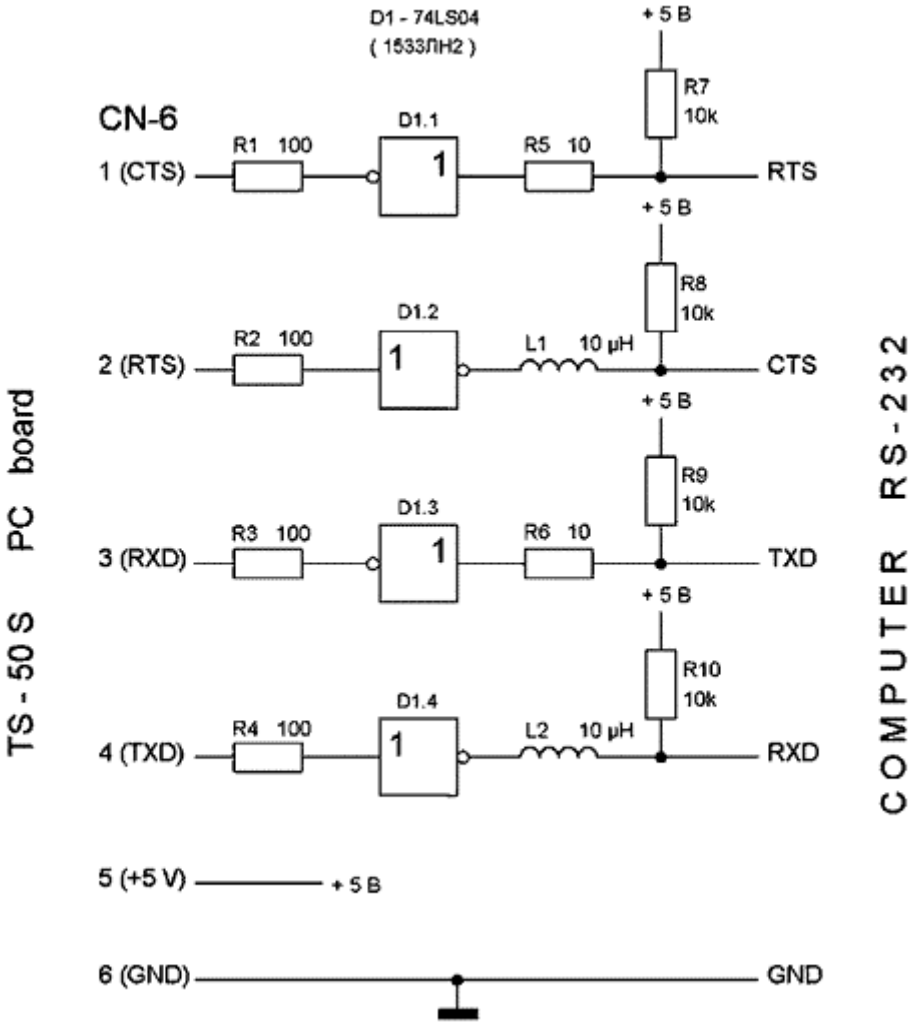
At the time this is being written the TS-480 series is the latest, thus any Kenwood radio attached that returns an unknown ID will be treated as a TS-480 assuming that its command will be a subset of the attached new models commands. This documentation and the MARS-ALE software shall be periodically updated to address new radios that come on the scene.

Kenwood had always used 4800 baud in the past, however beginning with the TS-870S and then TS-570SD/SG, TS-2000/TS-B2000 and TS-480HX/SAT series radios, they now support baud rates up to 57600 and higher. To utilize the 9600 baud rate, setup your radio baud rate for 57600 and select “KENWOOD2” from the MARS-ALE radio menu list. To utilize the 57600 baud rate, setup your radio baud rate for 57600 and select “KENWOOD3” from the MARS-ALE radio menu list. To reliably use the 57600 baud transfer rate, the serial port of your computer must support high-speed communications, all PC’s that will support MARS-ALE should. It is recommended that 57600 be used to achieve the best channel scan rate results with these radios. The TS-480 series can be set to 115,200 baud, as such “KENWOOD3” has been added to the list.

TS-50 -

Unique in the Kenwood HF line up is the TS-50 and its IF-10D interface as seen below, not enough room inside the radio, so this unit plugs into the bottom and still an external IF-232C level converter is required !

If you have TS-50 and don't have the IF-10D, you are not going to get one new, as even though Kenwood is still selling the TS-50 remaining stock, these are all gone. Below is a schematic of what is required to replace the IF-10D, an external level converter is also required.



KC2CNB of Holland Electronics (web: http://hollandelectronics.net/ e-mail: wholland@hollandelectronics.net) in New Jersey can supply ready to go compatible units or an integrated unit that also includes the external level converter circuitry.

TS-440 and R-5000 -

These older Kenwood models also are unique in the Kenwood line up in that they require optional parts to be installed in the radios to provide RS-232 PC interfacing. Kenwood sold as an optional upgrade kit to provide computer control as the Amateur Radio community at the time was not yet sold on the need for rig PC control. The "IC-10 Interface Kit" from Kenwood, is no longer

available from Kenwood, however, it contains ONLY two parts and less instructions than are in this file.

In the TS-440 IC 54 is a uPD-8251-AC Serial Communications Interface, commonly called an 8251A and IC 55 is a TC-4040-BP 12 Stage CMOS Divider, commonly called a 4040. Finding the parts at Radio Shack is a problem, buying them from supplies in single lot quantities is a problem. However, currently you can purchase a IC-10 Equivalent Kit – Required for select Kenwood Radios $8.00 from JBI at :

http://jbiproducts.bizland.com/store/page1.html

With the IC-10 interface, or equivalent, installed, the output at ACC-1 is as follows: baud rate is 4800 (1200 Opt.), format is ASCII Serial; 1 Start, 8 Data, 2 Stops.

The Baud rate may be changed to 1200 Baud by removing jumper W50 and installing a jumper from the left pad to the center pad as viewed from the front of the radio. This will become obvious once you have the radio opened up. Many other baud rates are possible, just look at the schematic. However, we shall use the Kenwood standard 4800 baud.

TS-140, TS-680 and TS-940 -

The TS-940 requires the installation of the IF-10B or the PIEXX TS940 Interface Board.

The TS-140 and TS-680 require the installation of the IF-10C or the PIEXX IF-10C.

NOTE: KENWOOD TS-930 with PIEXX control board is supported as a TS-850 as described in the PIEXX documentation, however, as computer control of the mode is not available, Scanning and Sounding operation will be limited to single mode, which does not meet Army MARS needs as both LSB and USB are used. However, Navy MARS for example only uses USB, under such circumstances this limitation of a lack of mode control is moot.

NOTE: The Kenwood TS-940S when addressed by the PC will go into REMOTE mode and there will be almost no LOCAL control until such time the MARS-ALE program terminates, at which point it will commanded back to LOCAL control.

NOTE: Kenwood TS-850S, TS-450S, TS-690S and other radios that use the optional DSP-100 unit which plugs into the connector where the external level converter normally goes Need to use the level converter with and the DSP simultaneously, plug the DSP into the rig, and the level converter into the CONT OUT jack on the DSP unit.

NOTE: Kenwood Service Bulletin no. 919 (21-7-1987). “R-5000 receivers below serial number 804xxxx may not change frequency when operated with a personal computer/interface. To allow correct operation, replace IC-52 on the Control Unit. The correct part number for IC-52 is MBM27C128-25JA2. CAUTION: The R-5000 incorporates CMOS technology. Observe precautions for handling electrostatic sensitive devices. This modification may be performed under warranty. Time required for this change is 1/2 hour or less.”

NOTE: There is a problem with the TS-450/TS-690 and audio distortion from RF when using the ACC-2 for TNC/Sound Card interfacing. To cure this, use PIN 4 and 8 on ACC-2 as PIN 4 and 8 that are directly connected inside the radio to ground. However, PIN 12 on the other hand is connected to ground via a 0.001 capacitor from a review of the TS450/690 service manual. Also, connect a heavy ground between your PC and the same ground bus that the radio is connected. Also, be sure to use an audio isolation transformer on the input and output audio lines and well shielded cables.

NOTE: Muting the microphone audio during ALE (or any data transmission) is very important. When using the ACC2 port on the TS-440S or the TS-940S for digital communications, if you only connect to ACC2 pin 13 for PTT, then when transmitting, the microphone audio line is still hot and any sound pressure it picks up with go out on the air. In later model Kenwood radios that only pin 9 is used for PTT, we can confirm that this is true for the TS-450/690S.

In order to prevent this you must ground pin 9 as well as pin 13 in the ACC2 port on these radios. However, if you just join the two, the microphone will not work if the modem cable is connected to the ACC2 port. An elegant solution was published for this problem in the March 1993 issue of QST by Dave Sittner, N0DET. Dave installed a diode (1N914) in the ACC2 plug "which only allows PTT switching outboard of the diode to put the radio into transmit and mute the mike. PTT closures made via the rig's SEND and mike PTT switches put the radio into transmit without muting the mike. A schematic is available from that article which demonstrates Dave's suggestion.

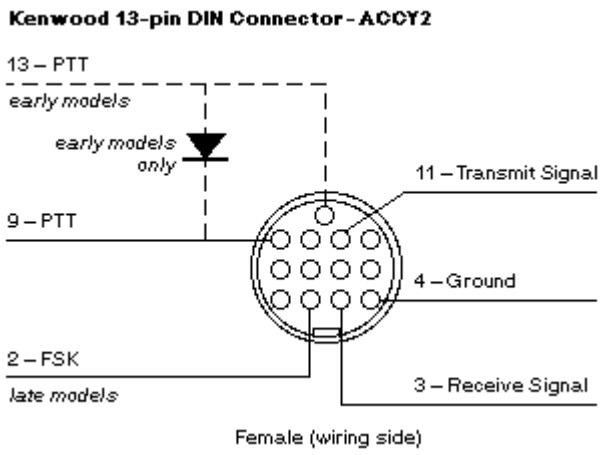


Figure 9.

NOTE: It has been determined that the TS-570 series**,** when wired to the ACC2 port, does not properly handle audio in or MIC audio muting when CAT PTT is being used. This may be the case with other Kenwood models as well, not to mention other makes and models.

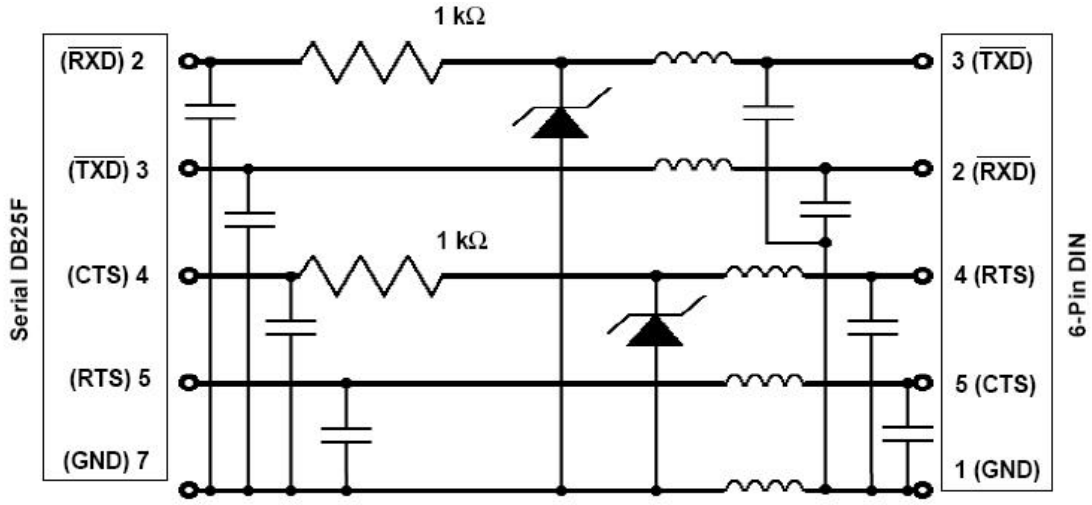
The diode fix for hardwiring as previously described is not the cure. The problem with the TS-570 is that when the transmitter is keyed via CAT control, it does not induce a LOW state on Pin 13 and therefore the diode will not drag Pin 9 to a LOW state. This results in two things, the first

of which is that the microphone remains hot and the second of which is that no transmit audio is allowed via the ACC2 port. At present, those users who use want to use CAT PTT control and the ACC2 port, will instead have to break out the RTS line and feed it to Pin 9 of the ACC2 port and also select Use RTS for PTT in MARS-ALE software.

In conjunction with AAR5PG, the SDT is working on seeing if a fix can be brought about to this issue. A test where the diode fix is replaced on pin 9 with a wire that you can manually take to ground will be made, with the equipments powered, the RED PTT button in the software will be used to key the radio, then PIN 9 will be taken to ground. Observations will be made to see if it mutes the MIC audio and allows the ACC port audio to work. If it does, then an isolated switch to ground, using PIN 13 to an inverter to drive the switch to make the ground connection will be needed to use CAT PTT.

Computer Interface for Kenwood radios:

Aside from the models that can directly be attached to a PC and the TS-50/TS-60 series, all Kenwood radios require and external level converter between the radio and the PC. Also, you should use one that supports RTS/CTS hardware handshaking for the best results when scanning at greater than two channels per second. The circuit below is the cheapest way to go, it is passive, noise reduction is accomplished through pi low-pass filters to isolate the rig from the PC. The computer and radio ground connections are isolated at RF by an encapsulated choke. The other lines have 0.01mF disc ceramic capacitors from each input to their respective ground, plus a series encapsulated choke.



Also, if desired, tiny LEDs for TXD, RXD, RTS, CTS indicators can be added to the circuit as well. The SDT has tested this interface complete with LED's and it works flawlessly. For PTT, either DTR or CAT PTT can be utilized, RTS is obviously not an option, in the future LPTx port lines for PTT will be another option with the program. As to the components, the Zener Diode can be any 3.5v to 5.1v and resistor tolerance and wattage are not issues, the chokes are 100mH RF Chokes, plastic encapsulated and the capacitors are .01mf disc ceramic. To stick all of this inside a DB-9 shell will require a

PCB and surface mount parts, getting it all in a DB-25 with the LEDs is not easy, but not to difficult. KC2CNB of Holland Electronics (web: http://hollandelectronics.net/ e-mail: wholland@hollandelectronics.net) in New Jersey can supply ready to go passive or non-passive (pricing varies if power is from radio or RS-232 port or external) units with DB-25 shells. The status LED's are an extra option and can be wired from the radio or PC perspective as requested.

MOTOROLA MICOM RADIOS -

PLANNED

SGC RADIOS –

There are two models of SGC radios popular within the MARS program, the SGC-2000 Marine/PRC-2250MIL Commercial grade transceivers and the SGC-2020 Amateur grade transceiver. The SGC-2020 lacks computer interface as such it's only suitable for single channel operation. In addition, the SGC-2020 is a 20w SSB transceiver and should not be operated at more than 5-8 watts output in ALE operation.

The SGC-2000/PRC-2250MIL on the other hand is fully computer controllable and supported by the MARS-ALE software. The RS-232 port is connected to a PC to control most of the functions that are available on the front panel of the radio. There is no provision to control the receiver volume or mic gain functions via the PC. The SG-2000 is ready to operate on any frequency between 1.6-30 MHz, no modification are required.

Current models of the SG-2000 have a very sensitive audio input connection, requiring low drive levels and also making the input very sensitive to RF feedback. There is also no RF filtering on the audio-in connection. It is helpful to add a (shunt to ground) resistor to the SG-2000's audio input, to reduce the input impedance and hence the sensitivity to RF feedback. (This also requires a higher audio drive level). A suitable value is 220 ohms between terminals 1 and 2 of J301. Also consider adding a 0.001 uF capacitor in parallel, to further reduce the impedance at RF frequencies and filter some of the RF.

NOTE: The SGC-2000 does not require an external level converter. A standard straight RS-232 cable is all that is required. However, the radio can be configured for use with a Null-Modem cable, if you can NOT communicate with the radio, please follow the

directions in the user manual to check the orientation of J3 on the microprocessor board. The SGC-2000 manual for the PC Cable assembly is NOT correct. It states and depicts an RS-232 9-pin D-connector pin out as a straight cable with pins 2, 3 and 5 being used. It also lists a 9 pin D on the radio to 25 pin D on the PC as pin 9-2 to 25-2, pin 9-3 to 25-3 and pin 9-5 to 25-7. However the wiring for proper operation (as determined with a breakout box and a review of the SGC-2000 schematic J30100930, "MICROPROCESSOR PCB/MAIN") is really pins 1 to 1, 2 to 2 and 3 to 3 regardless of 9 or 25 pin D connectors:

2 TX Data
3 RX Data
1 PROTECTIVE Ground

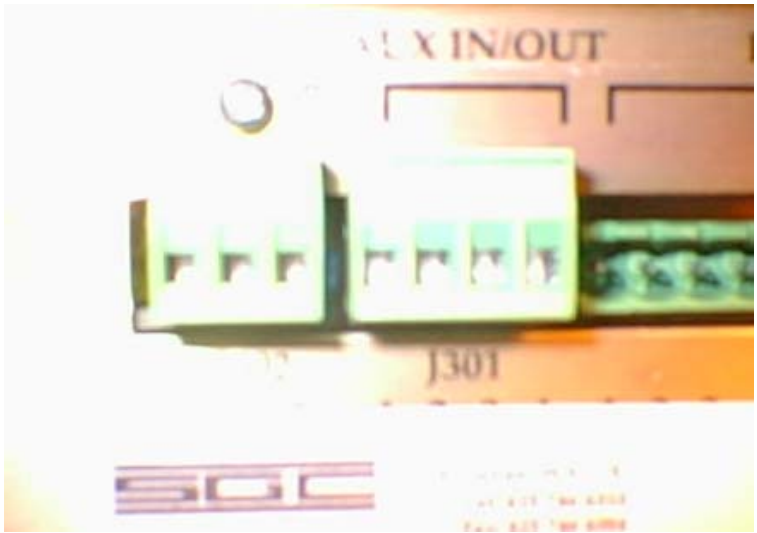
NOTE: If a cable with more than pins 1, 2, 3 is connected to the SGC-2000, the radio will pull down the DTR line, this will not allow for other uses of the DTR line with a Y-cable. As the DTR line is NOT needed by the SGC-2000, the cable should NOT carry the DTR or RTS lines through to the SGC-2000.

NOTE: The SGC-2000 can be controlled without having a control head attached for manual operator control according the manual. However functions of the radio dealing with audio such as audio volume, speaker On/Off, squelch, etc. can not be controlled over the RS-232 bus, thus must be preset as the situation requires.

NOTE: For direct cabling between the PC sound card and the SGC-2000, it is recommended that isolation transformers be used in the audio lines. The use of 1:1 600 or 1000 ohm transformers is recommended. The following lines as detailed in the SGC-2000 user's manual should be utilized:

Transmit Audio - SGC-2000 Pin J-301-1
Ground - SGC-2000 Pin J-301-2
Receive Audio - SGC-2000 Pin J-301-3
PTT line - SGC-2000 Pin J-301-4 (Need transistor switch/use of RST/DTR)

The SGC-2000 audio output impedance is 600 ohms and delivers 500 to 800mv/RMS from pin J-300-3 according to the user manual.



NOTE: The external speaker output on J-505 on the rear of the radio only operates when an additional remote control head is attached according the user manual. When this is so, this output is in parallel with the internal speaker and both are active.

NOTE: A review of the radio schematics shows that a headphone audio output is available on Pin 6 of the 8 pin microphone connector. This is a high impedance output from an LM-388 1 5W Audio Power Amplifier. Its use does NOT disconnect the internal speaker. In addition radio BEEPS are not fed to this separate audio path. However, volume is controlled for both this audio port and the speaker by the same front panel control.

NOTE: For wiring either the SGC-2020 or the SGC-2000 via the 8 pin microphone connector, observe the standard wiring for 8 pin Kenwood radios. If using a commercial external interface such as a RigBlaster, set the jumper blocks for Kenwood as referenced at: http://www.westmountainradio.com/supportplu.htm

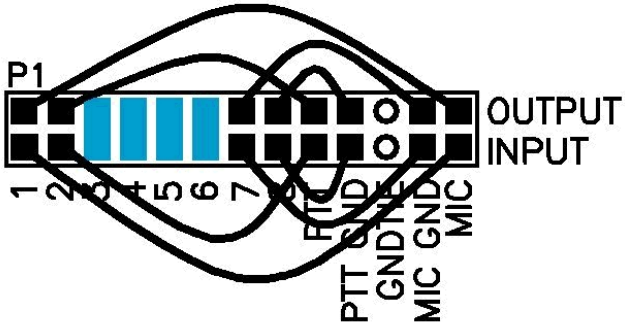


Figure 10.

NOTE: The SGC-2000 does not come with a fan, and is not capable of continuous full power without one. Thus with an SGC-2000 radio, you will need to reduce audio drive levels to avoid causing the radio to go into high-temp power reduction. The SGC-2000 is capable of 50 watts continuous output without a fan kit, and 100 watts continuous output with the fan kit installed.

TEN-TEC RADIOS –

Some early Ten Tec radios which provided computer control did so using a unique protocol (e.g. Paragon I) and later models emulated ICOM models (e.g. Omni-VI and Paragon II) with extended commands providing control of radio features (such as PTT ON/OFF) beyond what ICOM radios of the time provided. Later Ten Tec radios reverted to Ten Tec unique protocols and are pretty much unique to each Ten Tec model.

NOTE: Omni-VI (TT563) uses the same commands at the ICOM IC-735. The Omni VI must have EPROM version 2.22 or later. For the IC-735 selection (the only one currently supported) the radio must be configured for 1200 (8N1) baud. When a specific TT563 selection is added, baud rate shall then be 19200 (8N1). Also, when the TT563 selection becomes available, the support of CAT PTT will be provided. A Ten Tec model 305 level converter or the Icom CT-IV level converter or compatible is required.

NOTE: The Paragon I (TT585) use a unique command protocol, a copy of which we have been able to acquire to program for Paragon I support. The Paragon I also uses an optional interface board (Ten Tec model 258), which is no longer available from Ten Tec. In addition the radio firmware must be version 1.7 or greater. The radio/PC cabling requires the use of Null Modem or Cross Over Cable where pin 1-1 and pin 7-7 are connected and pins 2-3 and 3-2 are crossed over. The protocol for this radio basically emulates the front panel manual control. In that regard, frequency and all data entry is the same, only coded, a frequency is sent to the radio in the same manor it is entered on the radio keypad, one digit at a time followed by Enter. Timing requires sending each character with 150ms of pacing between each character. However, even at that, testing by AAR3UO has verified that the radio performs properly at 1, 2 and 5 ch/sec scanning rates.

NOTE: The Paragon II (TT586) use the same commands as the ICOM IC765 plus a number of additional extended commands. The extended command for PTT is supported by the selection of TT586. Using either IC-765 or the TT586 selection, the Paragon II will only communicate at 1200 baud. A Ten Tec model 305 level converter or the Icom CT-IV level converter or compatible is required.

YAESU RADIOS –

Yaesu radio's to date are the most difficult to program for given the fact that Yaesu as has never standardized on basic protocol and remained true to it. They nearly come out with a new set of op codes for each radio released. There are families of Yaesu radio's grouped on basic command op codes, but that is only with respect commanding the radio and then only for a subset of the basic commands. When it comes to reading the data from a Yaesu radio, each model is unique.

In addition, Yaesu has not come close to providing control of all radio features, for some models of very recent manufacture, they have not even provided access to basic features over the CAT system, the FT-847 being a good example.

NOTE: Full 100% Scanning/Sounding operation on some models, such as the FT-890/AT and FT-990 cannot be properly achieved as receiving is interrupted by the PC talking to the radio with frequency/mode updates per the channel scan rate selected. Even at 1 channel per second this can be a problem. If the radio audio is not active the second a station transmits a calling frame to be missed.

NOTE: The FT-847 requires a standard Null-Modem a.k.a. Cross Over Cable for computer control, see the FT-847 section of Appendix A for details.

NOTE: The FT-847 when addressed over the RS-232 port goes into "CAT" mode as indicated on the radio display, but this does NOT inhibit the operator from manual control of the radios features. There are not many things that can be controlled on the FT-847 via the CAT, which is a shame, thus the user will need to make sure most of the radio's parameters are properly set for the best ALE results.

NOTE: The FT-847 first ROM release of this rig was incapable of sending mode and frequency data to the computer. The vast majority of FT-847's have the new ROM that provides full two-way communications. At present MARS-ALE is not reading this information from the radio, however that may change, so if you have the old ROM it is recommended that you contact Yaesu for an upgrade, radio's starting with serial number 8G05xxxx and above are in the good category.

NOTE: The CAT control for the FT-847 does not convey the final digit (i.e., the ones digit) under any circumstances, so no external software can ever resolve any frequency better than 10 Hz. The FT-847 itself resolves to 1 Hz.

NOTE: FT-847 and the FC-20 tuner. One of the problems with the FT-847 is the inability to use both the CAT and FC-20 tuner at the same time. A work-around assumes you are running the serial link at 57,600 baud:

1. Connect your FC-20 to the FT-847 transceiver.
2. Connect the computer to the FT-847 using the null modem serial cable.
3. Go to the internal transceiver menu and switch the cat interface speed to 9600 baud.
4. Leave the menu.
5. Again go to the menu and change the speed back to 57600 baud.

From now on you are able to use both rig control program and your FC-20 tuner at the same time.

NOTE: FT-847 transmit is stuck ON, but there is no transmit audio and the Control Panel and Display are locked, the VFOs don't work, there's no TX audio from your mike, and there may be and Error Message on the display. What may have happened is that you have managed to turn on the PTT for the Data In/Out port at the radio rear, on this radio and on many other make/models, these ports and there control has some strange properties.
This usually happens when you have connected some kind of interface to the rig for PC controlled digital operations. The digital interface between the rig and the PC must have a way to turn on the PTT when you want to send data. It you must assert PTT via the Data In/Out port if you want to send data via that port. When you use the port to assert PTT, your mike audio is disabled (Muted). Conversely, if you press PTT on the mike or use MOX, typically the rig will not pass the TX data coming in the Data In/Out port. The data PTT is often asserted by using one pin of the COM port, typically the RTS or DTR pin. Much of the digital operations software for the rig uses this method of keying the rig.

When your PC is first turned on, or when a program first runs that uses the COM port that's connected to your rig, it will often pull the COM port control pin (typically either RTS or DTR) low. In most interfaces, this will assert PTT via the Data In/Out port on the back of the rig. Usually, this will clear after a few seconds and things will be normal again. If you are having a port conflict or other problem, though, the rig might stay locked into TX mode until you pull the plug from the COM port or the Data In/Out port. Sometimes a quick press and release of the MOX button will "release" the PTT situation.

This problem doesn't always have to come from the interface. It was relayed to me that you can accidentally plug an external speaker into the Data In/Out port and have the PTT lock on, but with no TX audio. Something to watch for, since the plugs are the same size ! One characteristic of this problem (and a good clue) is that your mike audio is cut off. If you key the rig via the Data In/Out port, then the mike audio is disabled (and vice-versa; if you key with PTT, MOX, or the External PTT on the back of the rig, the Data In/Out port is disabled).

Another thing that can cause this is the fact that CW port is always active, so if you have a pair of paddles plugged in and they are pressed or if you have an electronic circuit in place to key that port which has gone bad, you have PTT locked in the ON mode.

NOTE: The FT990 and FT1000D need to have a particular ROM version installed for proper CAT control operation. The FT990 requires ROM version 1.2 or later, 1.3 or later is better from what the SDT has learned, but 1.2 seems to work with the tool for basic needs as the SDT has tested with that ROM version. The FT1000 requires ROM version 6.0 or later.

To determine the software ROM version of the radio, hold the "1" and "3" keypad buttons down at the same time that power is turned on. This puts the radio through a self-test and ends by displaying "YAESU" and the ROM version.

If your radio has the old ROM, we recommend that you contact Yaesu to upgrade it to the latest ROM version available, which will require sending your radio to Yaesu.

When last checked, the FT-990 new ROM part# is G1091594

When last checked, the FT-1000D new ROM part# is G1093217

Some Yaesu models have special interfacing needs when using other than the mic and speaker ports. The OE1RIB design below is the preferred home brew design used by SDT member AAR2EY for the FT-817 and most other compatible radios. It provides complete versatility for PTT and D.C. power and is just as compact as the original Yaesu CAT-62 cable. The design can easily be modified for any radio requiring an external level converter, here is the schematic of the unit:

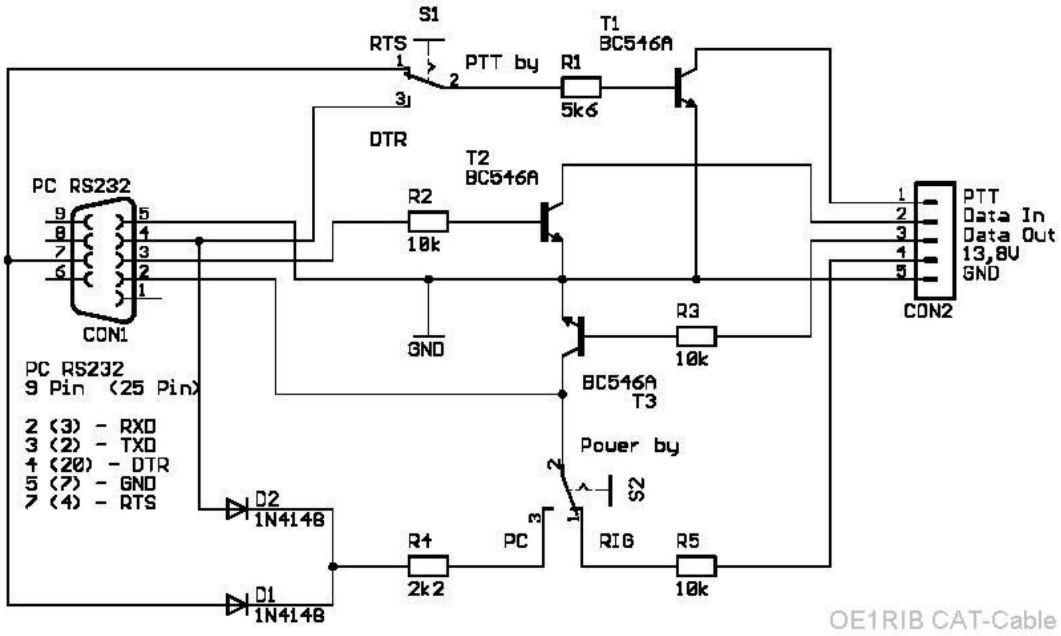
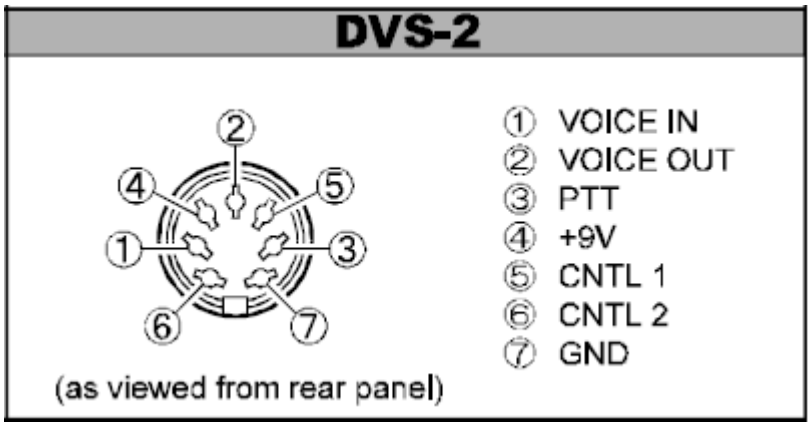


Figure 11.

DVS-2 Ports:

The DVS-2 port for the audio recorded/playback unit makes a good data ports on radios that support it. I am using an isolation transformer (RS 273-1374) on both input and output and I have 1k ohm pots to adjust levels. For PTT I have wired to RTS with a switching circuit and I have bias Control Lines 1 and 2, here a pin out:



1 Voice In - Input from sound card speaker out
2 Voice Out - Output to sound card line or mic input, will depend on your gain
3 PTT - Push To Talk control line to your switch circuit
4 Vdd - +9-12 volts D.C.
5 DVS0 - Control line 1 Record.

6 DVS1 - Control line 2 Playback.
7 GND - Ground

You need to tie pins 5 and 6 together through 1k resistor and a forward biased switching diode to the RTS or DTR line as these seem to be logic lines for muting the Voice in and Voice out in conjunction with the state of the PTT line. When PTT is high, Voice In will mute, when PTT is low, Voice Out will mute. This negates using the port with CAT PTT, I tried !

So, if you have an older Yaseu without a Data Port, guess what? you do have a data port, you (me a least) just did not know it ! The added plus, it works with normal LSB and USB etc. and it is NOT at all weird !

```
LOGIC OFF PTT AND DVS0 and DVS1 LINES ON DVS PORT:

PTT  DVS0 DVS1 Function
"1"  "0"  "0"  Receiver Audio at Voice Out Voice In muted
"0"  "0"  "0"  Voice Out and In both muted
"1"  "0"  "1"  Transmitter Mic. audio at Voice Out, Voice In muted
"0"  "0"  "1"  Transmitter Mic. audio at Voice Out, Voice In muted
"1"  "1"  "0"  Voice Out muted, Voice In signal at Receiver Audio
output
"0"  "1"  "0"  Voice Out and In both muted
"1"  "1"  "1"  Voice Out and In both muted
"0"  "1"  "1"  Voice Out muted, Voice In signal at Receiver Audio
output
               and Transmitter Audio
LEGEND:
"0" means pin at 0V, "1" means pin at +12V.
```

FT-847:

AAR2EY of the SDT also owns and has tested the FT-847 and has found it to be very good for the MIL-STD-188-141 and MIL-STD-118-110 data protocols. The 2.7Khz SSB filter and 1hz tuning steps are part of the reason. The FT-847 requires an RS-232 Null-Modem cable. The software is written to control the radio at 57600 baud. You need to press MENU and dial up CAT control and then select 57600.

As a null-modem is required, the use of an external interface on the mic port and either RTS or DTR for PTT is more special. In addition to using the RS-232 Y-port adapter, the adapter must slip off to the Null Modem cable and to the external interface. Should you have a double ended null-model cable, commonly know as a LapLink cable where you have both DB9 and DB25 connectors on both ends, you can NOT connect your external interface to the null-modem DB25 connector.

The use of the DATA port on the FT-847 requires special attention as detailed in the manual. Below is a circuit devised by AAR2EY that works well, when wiring the cable, pick up the DTR

or RTS lines directly from the back shell of the PC side of the RS-232 cable connector. The use of a decade resistor and capacitance box may be needed to determine the best values for a particular FT-847 radio.

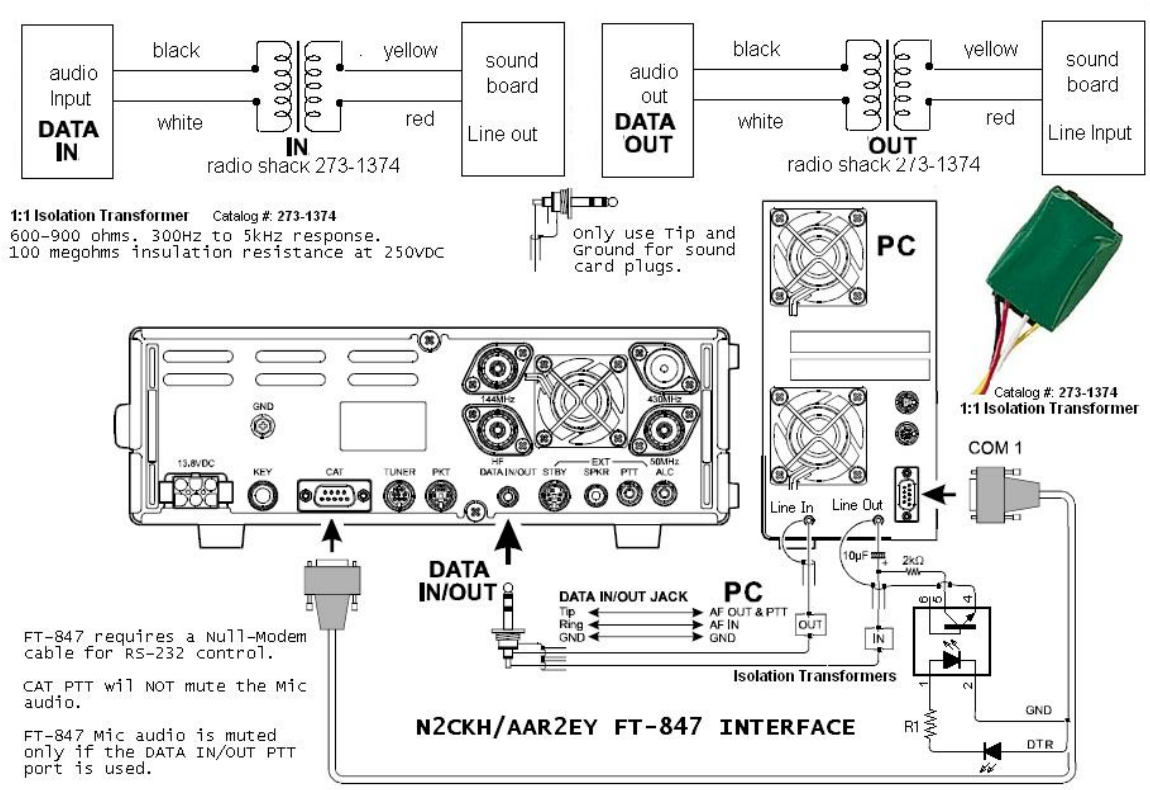


Figure 12.

However, the audio output from the radio is a bit much with most PC sound devices, thus external attenuation may be needed, in addition, the transmit audio may be a bit low with some PC sound devices. The capacitor that is in series with the transmit audio prevents the radio from going into PTT upon connection to the PC sound device, this will happen on most all PC sound devices if the capacitor is NOT used to get more audio drive.

It has been determined that without the capacitor, PTT will go high upon connection to the radio and PC sound device, but that upon any source of radio PTT, the radio will thereafter act correctly. The powering on of the radio or PC sound device may also cause the PTT to go high. It is also obvious that although CAT PTT can be used to simplify interfacing, as the mic port is NOT muted unless the DATA PTT is used, you MUST disconnect the mic or turn the mic gain all the way down during digital mode operation.

When using the DATA port PTT, the radio display will indicate DATA during PTT.

NOTE: The FT-847 radio will NOT transmit if you are in a menu, thus you must leave the menu when switching between ALC and PO meter selection during setup.

FT-857 -

The FT-857 microphone jack can be used to as an interface to an external level converter to PC instead of using the rear CAT/LINEAR port so that an external ATU can be interfaced.

For MARS use, you will need to make an Y-adapter cable from a CAT-5 cable and jack to support plugging your CT-62 and hand microphone. Also you will need to access menu 059, "MIC SEL" select CAT as listed in the manual:

MENU MODE No•059 [MIC SEL]
Function: The choice of the equipment which connects to the MIC jack.
Available Values: NOR/RMT/CAT
Default: NOR
NOR: Normal Microphone.
RMT: Optional MH-59A8J Remote Microphone.
CAT: CAT system: if you are using the optional FC-30 antenna tuner, you can still use the CAT system by connecting the serial Data cable to the MIC jack.

The thing is, that you will need to select menu 059 to switch to VOICE and back to DATA, but this easily done.

The pin out for use of the mic port is:

RJ-45 Pin	NOR Mic.	CAT
1	DN	TXD
2	UP	RXD
3	+5v	+5v
4	Mic GND	Mic GND
5	Audio	Audio
6	PTT	PTT
7	PTT GND	PTT GND
8	FAST	Power Switch (hold 1 sec.)

In your wiring of the Y-adapter your need to drop the DN and UP tuning lines from the mic in favor of the CAT TXD and RXD lines from your external level converter and tie into the GND lines for the external level converter and if needed the +5v line if you are not using RTS or DTR for DC power, for the standard CT-62 you will need the +5v line as well as a mini 6 pin DIN socket if you still want the ability to plug into the CAT/LINEAR port. Also, from Menu 019 select 38400 baud operation.

MENU MODE No•019 [CAT RATE]
Function: Sets the transceiver's circuitry for the CAT baud rate to be used.
Available Values: 4800bps/9600bps/38400bps
Default: 4800bps

Lastly, you will need to access Menu 020, .CAT/LIN/TUN., to select your use of Antenna Tuner or Linear Amplifier for the CAT/LINEAR port as detailed in the manual:

MENU MODE No•020 [CAT/LIN/TUN]
Function: Selects the device which is connected to the CAT/LINEAR jack on the rear panel.
Available Values: CAT/LINEAR/TUNER
Default: CAT

MARS-ALE RADIO COMMUNICATIONS CONFIGURATION

From the MARS-ALE main program screen begin by selecting the **"CONFIGURATION"** menu and then the **"MIL-STD-188-141 Options".** On this screen, under **"Parameters"** the **"Radio Comm Port"** must be entered. So, whatever RS-232C serial port is being used on your PC, COM1, COM2 etc, enter the numerical designation such as "1", the default, for COM1 for **"Radio Comm Port". Your selection, if you change from the default for Radio "Comm Port" will not take affect until after the program has been shut down and restarted.**

Under **"Radio Type"** a selection must be made that corresponds to your actual radio make/model if you plan to work with MARS-ALE in other than single channel operation for which radio type "NONE" should be selected. Even for Single Channel operation, control of your radio is useful, although not needed. At present, aside from Kenwood and Pegasus transceivers, MARS-ALE does not perform any tests to validate that a radio is actually connected to the PC RS-232 port or what make/model may be connected. So, except for the Pegasus selection, any radio type can be selected regardless of what radio is actually attached to the PC if radio control is not being used.

At present some of the planned radio makes to be supported are ALINCO, ELECRAFT, ICOM, JRC, KACHINA, KENWOOD, MOTOROLA MICOM, SGC, SKANTI, TEN-TEC and YAESU (HEATH SB-1400 a.k.a. FT-747). Any radio that provides adequate on-the-fly command and control of frequency and mode at a bear minimum via a serial data port can be supported.

In some cases depending on the make, you have only one choice and with others there are many choices within a make. However, you particular model of radio may not be listed. In such cases, you will need to select the make/model that is in the same make/model group as your radio, presently this applies to ICOM and YAESU radios for the most part.

However, other make/model radios such as some older Ten-Tec models emulate the ICOM command set (the Signal One Milspec 1030C is actually a modified IC-781 and the Milspec 1030E-DSP is based on the ICOM IC-756PRO). Other make/models such as Elecraft K2/100 for one, emulate the KENWOOD command set, however, those radios that emulate others in many cases also have extended commands that will not be supported if you use the emulate radio choice, so please refer to your user manual.

MARS-ALE provides support for both Transceivers and Receiver's. Receivers are limited to reception of Sounding information for LQA and non-ARQ data modes. At present the MARS-ALE software does not support the pairing of receivers with any transmitter or receiver for command and control.

Appendix B

FS-1045A RECEIVER REQUIREMENTS

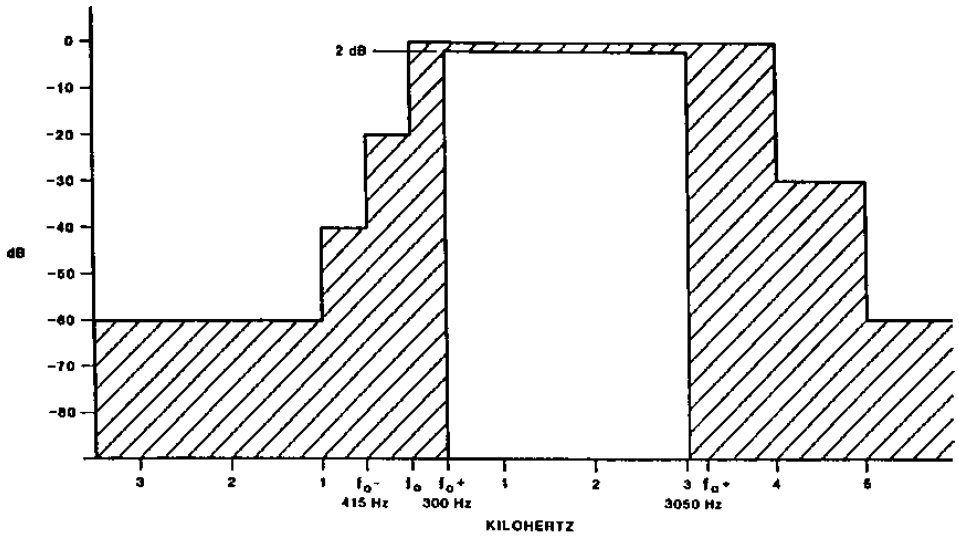
20.4 Receiver characteristics.

20.4.1 Receiver rf characteristics. NOTE: All receiver input amplitudes are in terms of available power in dBm from a 50-ohm source impedance signal generator

20.4.1.1 Image rejection. The rejection of image signals shall be at least 80 dB for HF receivers (DO: 100 dB).

20.4.1.2 Intermediate frequency (IF) rejection. Signals at the intermediate frequency (frequencies) shall be rejected by at least 80 dB (DO: 100 dB).

20.4.1.3 Adjacent channel rejection. The receiver shall reject any signal in the undesired sideband and adjacent channel in accordance with Fig. 36.



NOTES:

1. CHANNEL RESPONSE SHALL BE WITHIN SHADED PORTION OF CURVE (A1 SHOWN).
2. f_o FOR A SINGLE CHANNEL IS THE CARRIER FREQUENCY.
3. f_o FOR 2-CHANNEL ISB IS THE CENTER FREQUENCY.

20.4.1.4 Other single-frequency external spurious responses. Receiver rejection of spurious frequencies, other than IF and image, shall be at least 65 dB for frequencies from +2.5 percent to +30 percent, and from -2.5 percent to -30 percent, of the center frequency, and at least 80 dB for frequencies beyond ±30 percent of the center frequency.

20.4.1.5 Receiver protection. The receiver, with primary power on or off, shall be capable of survival without damage with continuously applied signals of up to +43 dBm (DO: 53 dBm) available power delivered from a 50-ohm source.

20.4.1.6 Desensitization dynamic range. The following requirement shall apply to the receiver in an SSB mode of operation with an IF passband setting providing at least 2750 Hz (300 Hz to 3050 Hz) of bandwidth at the 2-dB points. With the receiver tuning centered on a sinusoidal input test signal and with the test signal level adjusted to produce an output SINAD of 10 dB, a single interfering sinusoidal signal, offset from the test signal by an amount equal to ±5 percent of the carrier frequency is injected into the receiver input. The output SINAD shall not be degraded by more than 1 dB as follows:

a. for radios whose frequency determining elements are temperature controlled, the interfering signal is equal to or less than 100 dB above the test signal level

b. for radios whose frequency determining elements are not temperature controlled, the interfering signal is equal to or less than 90 dB above the test signal level.

20.4.1.7 Receiver sensitivity. The sensitivity of the receiver over the operating frequency range, in the sideband mode of operation (3-kHz bandwidth), shall be such that a -111 dBm (DO: -121 dBm) unmodulated signal at the antenna terminal, adjusted for a 1000-Hz audio output, produces an audio output with a SINAD of at least 10 dB over the operating frequency range.

20.4.1.8 Receiver out-of-band intermodulation distortion (IMD). Second and higher order responses shall require a two-tone signal amplitude, with each tone at least 80 dB greater than that required for a single-tone input, to produce an output SINAD of 10 dB. This requirement is applicable for equal amplitude input signals with the closest signal spaced 30 kHz or more from the operating frequency.

20.4.1.9 Third-order intercept point. Using test signals within the first IF passband, the worst case third-order intercept point shall not be less than +10 dBm.

20.4.2 Receiver distortion and internally generated spurious outputs.

20.4.2.1 Overall IMD (in-channel). The total of IMD products, with two equal-amplitude, in-channel tones spaced 110 Hz apart, present at the receiver rf input, shall meet the following requirements. For frequency division multiplex (FDM) service, the receiver shall meet the requirements for any tone spacing equal to or greater than the minimum between adjacent tones in any FDM library. The requirements shall be met for any rf input amplitude of 0 dBm PEP (-6 dBm/tone) and for any audio output of +12 dBm PEP (+6 dBm/tone) or less. All IMD products shall be at least 35 dB (DO: 45 dB) below the output level of either of the two tones.

20.4.2.2 Adjacent channel IMD. For multiple channel equipment, the overall adjacent channel IMD, in each 3-kHz channel being measured, shall not be greater than -35 dBm at the 3-kHz channel output with all other channels equally loaded with 0 dBm unweighted white noise.

20.4.2.3 Audio frequency total harmonic distortion. The total harmonic distortion produced by any single frequency rf test signal, which produces a frequency within the frequency bandwidth

of 300 Hz to 3050 Hz, shall be at least 25 dB (DO: 35 dB) below the reference tone level with the receiver at rated output level. The rf test signal shall be at least 35 dB above the receiver noise threshold.

20.4.2.4 Internally generated spurious outputs. Spurious signals at the output of the receiver, produced in the absence of rf signals by mixing of signals that are generated internally in the receiver, shall not exceed -112 dBm (DO: -122 dBm).

20.4.3 Automatic gain control (AGC) characteristic. The steady-state output level of the receiver (for a single tone) shall not vary by more than 3 dB over an rf input range from -103 dBm to +13 dBm.

20.4.3.1 AGC attack-time delay (nondata modes). The receiver AGC attack-time delay shall not exceed 30 ms.

20.4.3.2 AGC release time (nondata modes). The receiver AGC release time shall be between 800 and 1200 ms for SSB voice and intermittent continuous wave (ICW) operation. This shall be the time period from rf signal deterioration until audio output is within 3 dB of the steady-state output. The final steady-state audio output is simply receiver noise being amplified in the absence of any rf input signal.

20.4.3.3 AGC requirements for data service. In data service, the receiver AGC attack-time shall not exceed 10 ms. The AGC release-time shall not exceed 25 ms.

20.4.4 Receiver linearity. The following shall apply with the receiver operating at maximum sensitivity and with a reference input signal that produces a SINAD of 10 dB at the receiver output. The output SINAD shall increase monotonically and linearly within ±10 percent for a linear increase in input signal level until the output SINAD is equal to at least 40 dB (DO: 60 dB). This requirement shall apply over the operating frequency range of the receiver.