A Guide to ASTRO™ Digital Radios

R03.00.00 – August 2007

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Preface

The guide encompasses many modularized pieces of information which are scattered throughout Internet discussion boards, Motorola Inc. radio service manuals, service bulletins, technical briefs and personal technical notes assembled over the last six years. It is meant to serve as a technical outline and basis of understanding, to be used by radio-hobbyists, system planners and others who have an interest in learning about Motorola Inc.'s ASTRO™ and ASTRO25™ radio platforms.

In this third edition of the *Guide to ASTRO™ Digital Radios*, improvements have been made to better organize the content and improve the formatting of key sections.

Additional sections have been added including an advanced "hacking" introduction, an eBay™ listing & buying guide for ASTRO™ equipment and a brief introduction to system infrastructure including the Motorola Inc. Quantar™ station.

The *Guide to ASTRO™ Digital Radios* fulfills a need for accurate and current information relating to this tier of communications equipment. It is apparent by the repetitive questions posted on certain Internet discussion forums and limited information posted in eBay™ auctions there's a definite need for the information in this guide, which otherwise may not be known.

The purpose of the *Guide to ASTRO™ Digital Radios* is to educate and enlighten radio-hobbyists and combine all available knowledge into one portable document.

Corrections and contributions to the guide are always welcome. You may submit your correspondence to shaun@p25.ca via email. All correspondence will be treated as confidential unless stated otherwise.

History

Development of Motorola Inc.'s ASTRO™ products began sometime around 1992. This is evidenced through reference to the 1992 time-line in all versions of product firmware at address C03Dh.

```
0000C030 38DF 27D7 29BD D460 7EC0 5B01 5043 6F70 8.'.)..`~.[.PCop
0000C040 7972 6967 6874 2031 3939 322C 204D 6F74 yright 1992, Mot
0000C050 6F72 6F6C 612C 2049 6E63 2EDC 27C3 000C orola, Inc..'...
```

Figure 1.1 Screen-shot of host firmware code referencing 1992 development.

It is believed Motorola Inc.'s first ASTRO™ product, the ASTRO Digital Saber™, was released in 1995. When it was introduced, it was marketed to the U.S. Military and federal government as a replacement and upgrade over existing SecureNet™ products.

The ASTRO Digital Saber™ was capable of transmitting digital voice at 9.6Kbps using the C4FM modulation scheme, in addition to transmitting regular analog FM signals and CVSD SecureNet™.

ASTRO™, Motorola Inc.'s first digital voice platform, utilized the Vector Sum Excited Linear Prediction (VSELP) codec. (A variant of the Code Exciter Linear Prediction (CELP) codec family) VSELP codec implementation in the ASTRO™ radio platform was at 4.8Kbps, with 2.1Kbps error correction coding (6.9Kbps).

In 1995 or thereabouts, the Association of Public Safety Communications Officials (APCO) devised a plan called APCO Project-25, which outlines the standards for digital public safety radio-communications systems.

Digital Voice Systems Inc.'s (DVSI) Improved Multi-Band Excitation (IMBE™) codec was chosen as the APCO-25 standard after tests were carried out to determine the most effective low-bitrate codec. It was determined the 4.4Kbps codec with 2.8Kbps of error correction coding (7.2Kbps) was best-suited for APCO Project-25.

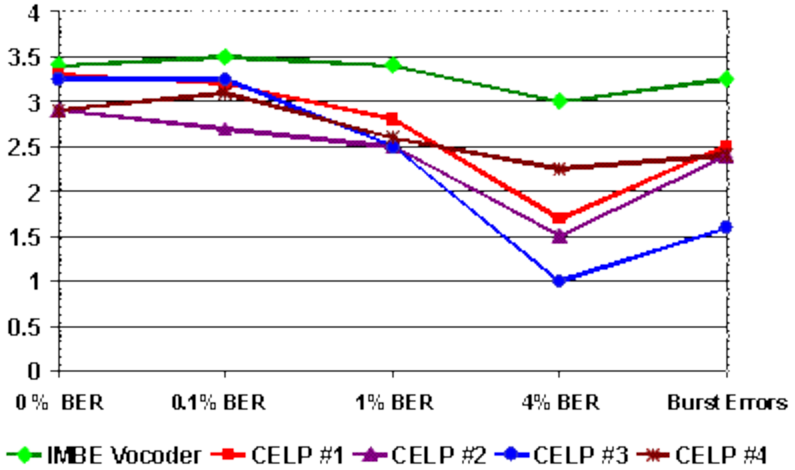

Figure 1.2 Speech quality vs. channel condition. Inmarsat has formally tested the IMBE™ vocoder against a variety of CELP based codecs to determine the speech quality under various channel conditions. The results of this evaluation illustrate that the IMBE™ Vocoder is very resilient to high Bit Error Rates. (Source: DVSI)

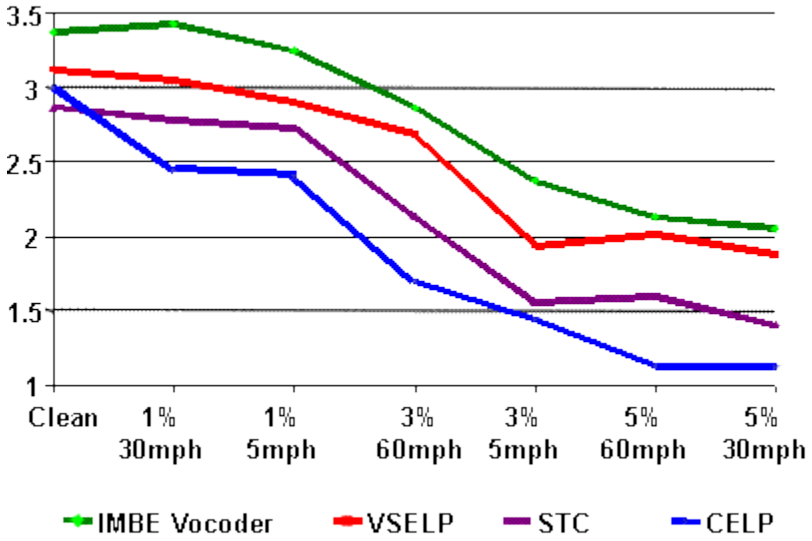

Figure 1.3 Voice coder vs. channel condition evaluation. The evaluation of four 7.2 kbps speech coders by the Telecommunications Industry Association (TIA) for the purpose of selecting a speech coder for the APCO Project 25 North American land mobile radio communication system produced the above results. During this evaluation, the IMBE™ Vocoder outperformed all codecs in every category. (Source: DVSI)

Motorola Inc. engineers worked with DVSI to implement the IMBE™ codec into the ASTRO™ radio platform. In 1996, the first versions of host firmware which supported the IMBE™ codec were made available along with Motorola Inc. FLASHport™ feature Q806/G806 (IMBE™/APCO-25 digital operation).

Upgrading an ASTRO Digital Saber™ or ASTRO Digital Spectra™ for ACPO Project-25 compliancy was as simple as ordering the update from Motorola Inc. and refreshing the radio's host and DSP firmware builds, and reconfiguring the codeplug to enable Q806/G806. New Radio Service Software (RSS) was also required.

Another industry name for the APCO Project-25 IMBE™ codec is Common Air Interface (CAI).

Later in 1996, Motorola Inc. released a new portable radio—the XTS 3000™. The XTS 3000™ is almost electronically identical to the ASTRO Digital Saber™, with the exception that it has a four line display, and has separate vocoder (**Vo**ice-**cod**er/decod**er**) and controller PC boards, whereas the ASTRO Digital Saber™ and ASTRO Digital Spectra™ share a common vocon (**Vo**coder-**con**troller) board. Model-specific details are discussed later in this guide.

The second-generation ASTRO® products debuted in 2002. They are referred to as ASTRO25™ radios. These include the MT 1500™, PR 1500™, XTS 1500™, XTS 2500/2500RB™, XTS 4000™, XTS 5000™, SSE 5000™, XTL 1500/1500RB™, XTL 2500/2500RB™ and XTL 5000™ models. ASTRO25™ series radios offer a dual-core CPU, expanded flash memory and full APCO-16/APCO-25 simultaneous support. More specific details are discussed later in this guide.

Model-specific Discussion: ASTRO Legacy Series

ASTRO Digital Saber™

As stated earlier in the guide, Motorola Inc.'s flagship ASTRO™ radio was the ASTRO Digital Saber™ which was released in approximately 1995.

Figure 2.1 Motorola Inc.'s ASTRO Digital Saber™ (Model III)

The ASTRO Digital Saber™ comes in four different band-splits. The VHF "K" split (136-174 MHz), the UHF range 1 "R" split (403-470 MHz), the UHF range 2 "S" split (450-520 MHz) and the 800 MHz "U" split (806-870 MHz). These band-splits may be slightly extended through Radio Service Software (RSS) and Customer Programming Software (CPS) hacks which are not covered in this edition of the *Guide to ASTRO™ Digital Radios*. **For UHF amateur radio operation, the UHF range 1 "R" (403-470 MHz) is desired**. The band-split is identified in the fourth character of the model number. Example: H04**U**CH9PW7AN. (ASTRO Digital Saber, Model III, 806-870 MHz).

There are three different case-styles. Model I (no keypad or display), model II (display and six green soft-key buttons) and model III (display, six green soft-key buttons and a full 12-digit numerical keypad. Model I and II ASTRO Digital Sabers™ also come in an "R" ruggedized option. The casing found on these versions is much thicker and the radio may be vacuum sealed for submergibility. They're also approved for intrinsic environments. In both scenarios, the radios MUST be pressurized by a certified technician for compliance and proper operation.

There are two versions of the ASTRO Digital Saber™: Versions manufactured prior to November 1996—which contain a 512K vocon board and models manufactured post-November 1996, which contain a 1-meg vocon board. What's the difference?

512K vocons utilize three flash ROMs—two 256K flash ROMs (512K) for storage of the host firmware, and one 256K flash ROM for storage of the DSP firmware.

1-meg vocons utilize a 1MB flash ROM to store the host firmware and one 256K ROM to store the DSP firmware.

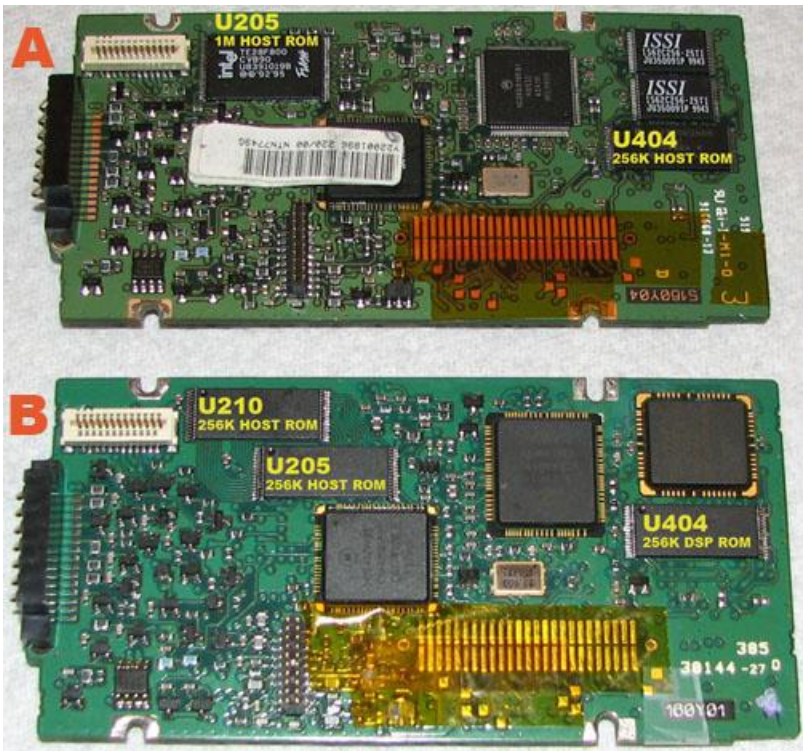

Figure 2.2 ASTRO Digital Saber™ vocon boards. Photo "A" shows a 1-meg vocon. Photo "B" is a 512K version. ASTRO Digital Spectra™ vocons are identical in appearance and layout, however a different connector is present and some components are missing. Note the distinguishing 1-meg flash ROM (U205) in photo "A".

How do you know which version (vocon size) you have? Maybe you're looking at an eBay auction or a table of "teh astors" at Dayton. Some ASTRO Digital Sabers™ have a distinct 1-meg sticker on the back—but you can't always rely on this indicator. Some radios are parts-built (more on this later) or perhaps someone has swapped a 512K vocon in place of the original 1-meg vocon. The serial number can help one determine the vocon size, if the radio is original or a second-hand surplus unit from a federal government or police auction. Here is an example of a Motorola Inc. serial number which could represent an ASTRO Digital Saber™:

310A<u>XA</u>0399

The serial number can be broken down into sub-components which identify the year and week of the original production. You may ignore the **310A** (first four digits) of the serial number. Digit five (**X**) of the example serial number identifies the year of manufacture.

In year 2000, Motorola Inc. started their alphabet calendar from "A". So a radio with an (**X**) representing the build year, indicates a manufacture year of 1998. Here's a breakdown to become familiar with this scheme: (The alphabet keeps going up as each year passes. G=2007)

U=1995	Y=1999
V=1996	Z=2000
W=1997	A=2001
X=1998	B=2002

Motorola Inc. discontinued the ASTRO Digital Saber™ in December 2002. The sixth digit in the example serial number (**A**) indicates a two-week manufacturing period. (**A**) would indicate a radio manufactured in the first two weeks of January. Here's a week-by-week breakdown:

A=1/2	B=3/4	C=5/6	D=7/8	E=9/10	F=11/12	G=13/14
H=15/16	I=17/18	J=19/20	K=21/22	L=23/24	M=25/26	N=27/28
O=29/30	P=31/32	Q=33/34	R=35/36	S=37/38	T=39/40	U=41/42
V=43/44	W=45/46	X=47/48	Y=49/50	Z=51/52		

This serial number breakdown also applies to the ASTRO Digital Spectra™, XTS 3000™ and all ASTRO25™-family radios.

But it gets even more confusing. Any ASTRO Digital Saber™ or ASTRO Digital Spectra™ that visited the Motorola Inc. Service Depot after November 1996 received a 1-meg vocon upgrade at no charge, as part of the flat-rate repair service. Why? Because it's standard practice to refresh a radio's firmware during each visit to the depot. Before this is explained in further detail, it's necessary to explain the host firmware size-limitation of the 512K vocon.

In 1999, Motorola Inc. released the final versions of host firmware which could fit into the limited flash ROM space present on the 512K vocon. Since new radio-features, bug-fixes and audio-enhancements required additional memory space which necessitated more memory than current boards could offer, the 1-meg vocon was created. (Radio firmware is discussed later in this guide.)

The last releases of IMBE™ 512K host firmware are:

R05.60.04 / DSP x06.05.04 (ASTRO Digital Saber)
R09.60.04 / DSP x06.05.04 (ASTRO Digital Spectra)

In 2000, Motorola Inc. released the first builds of R07.xx.xx host firmware for the ASTRO Digital Saber™ and XTS 3000™, and R11.xx.xx host firmware for the ASTRO Digital Spectra™. This firmware requires the 1-meg vocon.

Another method of obtaining information about an ASTRO Digital Saber's™ firmware version/revision,encryption module firmware, encryption algorithms, band-split, serial number, vocon size and FLASHport features is to put it in **service mode**. This is accomplished by **powering on the radio, and pressing the ".." button on the side of the radio five times, within the first 10 seconds of completing the SELF TEST sequence**. The radio will beep once and show **SERVICE** on the display. It will slowly (or quickly, depending host firmware version) scroll through this critical information. You may repeat the process several times if the information goes by too fast.

The final, and most logical way to determine an ASTRO Digital Saber's™ vocon size, is to disassemble the radio. Disassembly instructions are outlined in the ASTRO Digital Saber™ Basic Service Manual. (68P81076C05) Compare your findings with the photographs in **figure 2.2** of this guide.

Despite being out of production, the ASTRO Digital Saber™ is still a favourite among radio-hobbyists and public-safety officials for its robust design and solid RF performance.

XTS 3000™

Released in 1996, this was Motorola Inc.'s first Cosmo-series portable radio. It is compatible with nearly all Jedi-series audio accessories, including speaker-mics, hirose adapters, key-loading cables, 3.5mm threaded earphone adapters and other surveillance accessories. (Desirable at the time because of the MTS 2000™ popularity)

Figure 3.1 Motorola Inc.'s XTS 3000™ (Model III) with speaker-mic.

The XTS 3000™ comes in identical band-splits as the ASTRO Digital Saber™.

Unlike the ASTRO Digital Saber™, the XTS 3000™ does not have a vocon board. Instead, there are four PC boards which make up the radio. They are: The Voice coder/decoder (vocoder), the controller, the RF board and the optional encryption module.

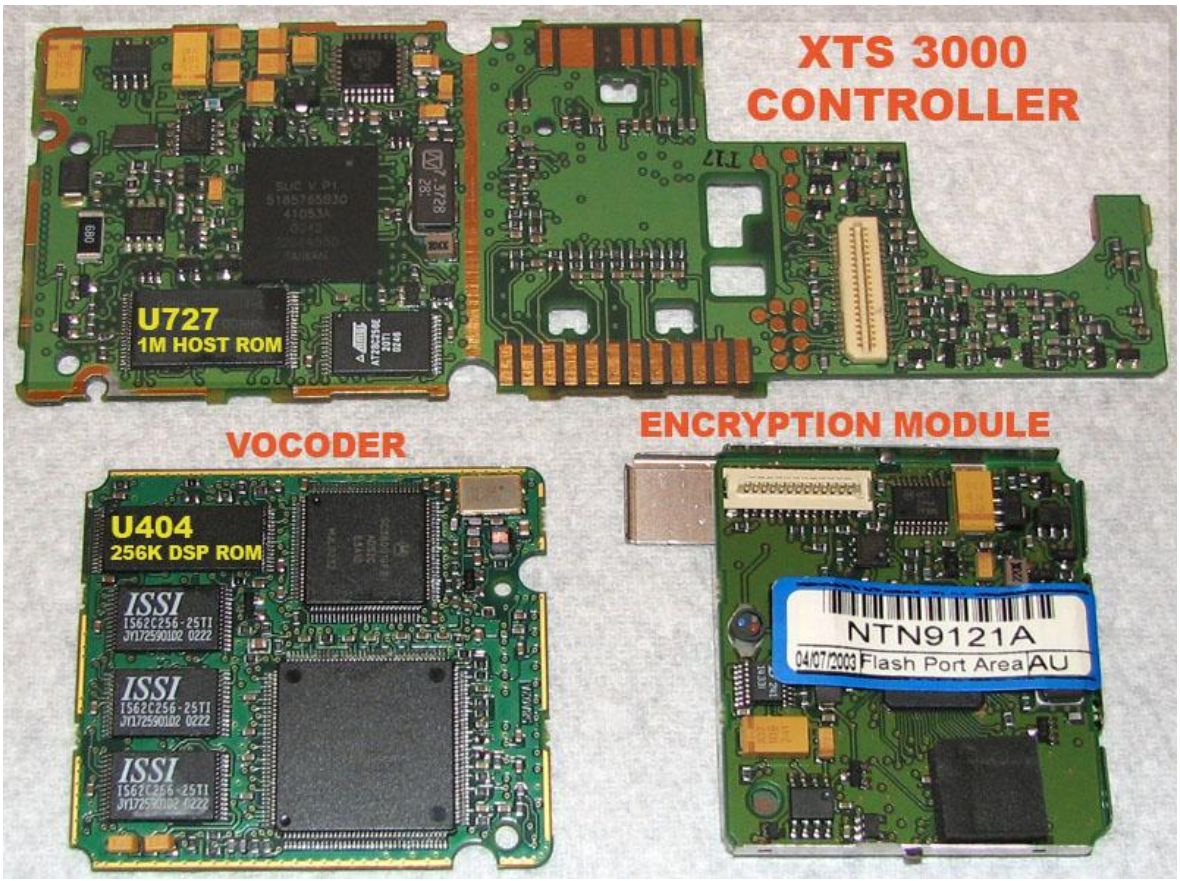

Figure 3.2 A photo illustration of various PC boards found inside of the Motorola Inc. XTS 3000™. The NTN9121A encryption module is of the new UCM (version R03.xx firmware) generation. Note the lack of a "vocon" (combined vocoder-controller) board, which is only found in the ASTRO Digital Saber™ and ASTRO Digital Spectra™ products. Much confusion surrounds this issue on various Internet discussion forums.

A common technical blunder which is often perpetuated on various Internet discussion boards is that the XTS 3000 has a "vocon". Posts are made where someone is selling or wishing to buy an XTS 3000™ vocon—no such item exists.

There are two different controller-board versions: Type "A" and type "B". The earlier "A" series boards have a different flex connector, which often fails during the disassembly/maintenance process, because of a weak mechanical design.

Another redundant question that gets raised from time-to-time is how large an XTS 3000™ "vocon" is, in terms of memory size. At this point you know there's no vocon. But all XTS 3000™s have 1M of flash ROM memory on the controller board to store host firmware in. There's an urban legend about a 512K XTS 3000™ controller board, however there's no such reference in the XTS 3000 Detailed Service Manual (6881083C90-B) to a 512K controller. Additionally, there hasn't been a 512K XTS 3000™ offered for sale on "Bat Board" or eBay™, in the last seven years.

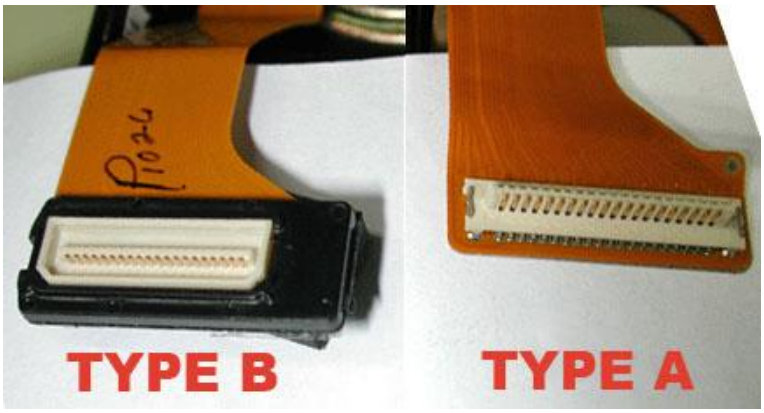

Figure 3.3 A photo illustration of the two different flex connectors used on Motorola Inc. XTS 3000™ controller boards. This connector interfaces the user-electronics (knobs, buttons and switches) to the radio. Type "B" connectors are the most common. Type "A" connectors are rare and found only in early-production radios with older controller boards. Note the brittle design of the type "A" connector, which is susceptible to damage during the removal process.

As Motorola Inc. customers begin replacing aging XTS 3000™s with newer ASTRO25™-family portables, XTS 3000™s are available in mass quantity on eBay™. One way to increase the value and performance (New speaker, microphone, switches and knobs) of your XTS 3000™ is to purchase a new housing assembly on eBay from highly recommended seller panter88. His prices are typically 20-25 per cent of what Motorola Inc. charges for the identical part. These replacement housings are Motorola Inc. original parts. Hundreds of hobbyists have had solid transactions with this person.

Other topics relating to buying and selling ASTRO™ and ASTRO25™ radio equipment online are covered later in this guide.

XTS 3500

The Motorola Inc. XTS 3500 was introduced as a bastard cousin to the XTS 3000. It was a supposed stepping-stone to the XTS 5000. The purpose was to increase the CPU speed and provide Type 1 encryption support—or at least that's what the rumour was.

Figure 4.1 A photo illustration of a Motorola Inc. XTS 3500 portable radio. It is identical in appearance to the XTS 3000, except it has a purple keypad and a different model number sticker above the speaker-grill.

Make no mistake about it: This radio is just as feared and avoided as the Motorola Inc. Saber Si—another bastard radio. (Basically a MTS 2000 in a Saber case.)

The Motorola Inc. XTS 3500 does not officially support trunking, yet there are plenty of them floating around with trunking options installed. The radio uses its own firmware—independent of other ASTRO firmware platforms. The radio doesn't even support transmit AGC—a very important feature which is discussed later in the guide.

The bottom line is, yes the XTS 3500 exists, no you shouldn't buy one unless you want a headache and inferior audio with no features. Encryption modules for this portable are also quite rare on the used market.

ASTRO Digital Spectra™

The ASTRO Digital Spectra™ was released in approximately 1995. It shares the same vocon design as the ASTRO Digital Saber™, however the boards are not compatible with each other.

ASTRO Digital Spectras™ manufactured prior to November 1996 included 512K of flash ROM memory for the host firmware. The same story of the ASTRO Digital Saber's™ evolution to a 1M flash ROM and the vocon swap-outs after a depot visit also apply to the ASTRO Digital Spectra™. Please see the ASTRO Digital Saber™ outline if you skipped down to this page.

Figure 5.1 A photo illustration of a Motorola Inc. ASTRO Digital Spectra™ in a W7 dash-mount configuration. Pictured is the 50W version.

The ASTRO Digital Spectra™ was manufactured in seven band-splits. They are:

J	136-162 MHz
K	146-174 MHz
Q	403-437 MHz (R1)
R	438-470 MHz (R2 15W only)
	450-482 MHz (R3)
S	482-512 MHz (R4)
U	806-870 MHz

The band-split information is indicated in the model number as the fourth character. Information about the configuration of the radio is also indicated as the first character. (**D**) indicates a dash-mount radio, (**T**) indicates a trunk/remote mount radio and (**L**) indicates the radio is configured to operate in a console (dispatch) configuration. There are also rarer (**M**) (motorcycle) configuration ASTRO Digital Spectras™ in circulation. The main differences are a different plastic face which does not expose a microphone connector and a low-power (15W) PA. Many are 438-470 MHz split radios.

Figure 5.2 A photo illustration of a model number tag on the rear of a Motorola Inc. ASTRO Digital Spectra™. There are several useful pieces of information displayed in the tag, including the model number, serial number, manufacture code (FLASHport™), host firmware flash ROM size (1M) and indication of a 2.5 KHz narrow-band RF board.

The ASTRO Digital Spectra™ has been through many different revisions of command boards. The command board is what interfaces the vocon to the control head, PA and RF boards. It is the nerve-centre of the radio. If you're buying a second-hand ASTRO Digital Spectra™, you'll need to become acquainted with the command board, as there are several modifications that must be performed to ensure stable operation.

In 2003, Motorola Inc. discovered their new Universal Cryptography Module (UCM) had a timing issue with the ASTRO Digital Spectra™. The fault caused the module to intermittently fail when key-loading, receiving an over-the-air re-key communication (OTAR) or when the radio is first powered on. When the failure occurs, "Fail 09/10" or "Fail 01/90" may display on the control head. This issue is discussed in detail in **SRN-1364**.

The fix is simple, but not for the faint of heart. It involves complete disassembly of the radio and **removal of the command board and access to the RF board on the underside of the radio**, under the shield. A SMD rework station is required—or a steady hand and a <30W iron with a fine tip will suffice.

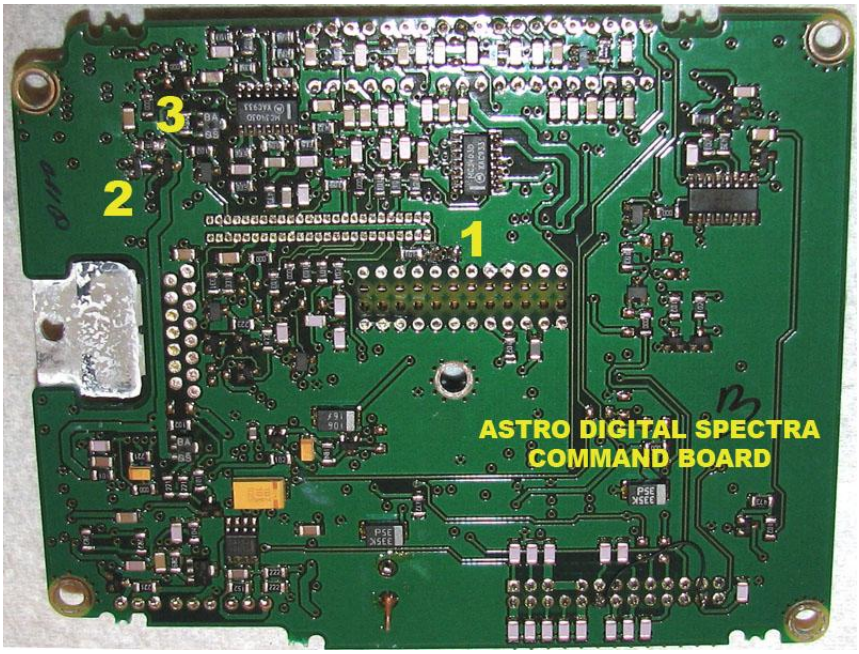

Figure 5.3 ASTRO Digital Spectra™ command board. Note areas 1, 2 and 3. These areas require special attention as per SRN1364.

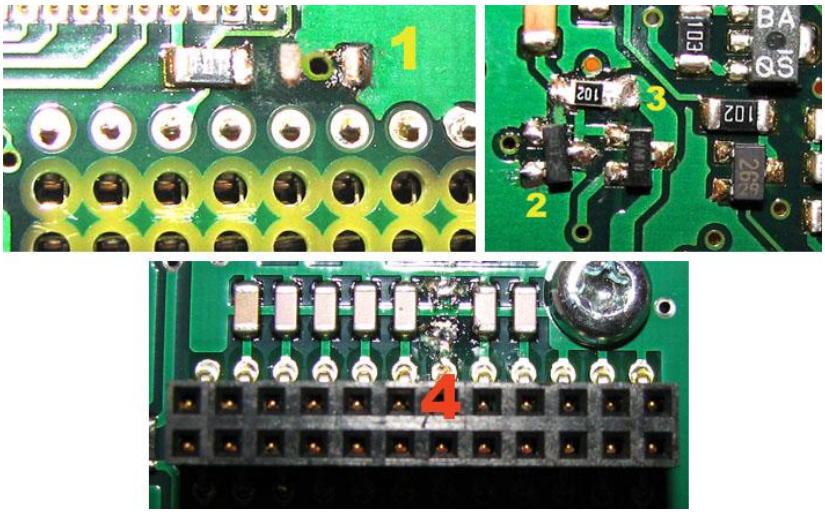

Figure 5.4 A photo illustration which identifies various components which must be replaced or discarded. (Modifications have already been performed in this example.)

Point 1 is **C562**. **Remove and discard**.

Point 2 is **VR40**3. The original part number is 4813830A22—a 9.1V Zener. You must **replace it with 4813830A26**—a 13V Zener diode.

Point 3 is **R520** (10K). The original part number is 0611077A98. You must **replace it with 0611077A74**—a 1K chip resistor.

Point 4 is **C334** on the **RF board**. The RF board is accessed under a shield, on the bottom side of the radio. **Remove and discard**.

Once these modifications are complete, there are two more tweaks to do. One involves installing a jumper between pins 2 and 8 of the accessory connector header on the command board. This completes the normally-closed emergency button switch. Hobbyists have no use for an emergency button, and without the normally-closed switch installed, the radio will display random "Fail 01/90" errors upon power-up, and could cause malicious interference to occur on trunking/conventional systems when emergency beacons are transmitted. Installing this jumper is the equivalent of having the emergency switch in the "normal" non-activated state.

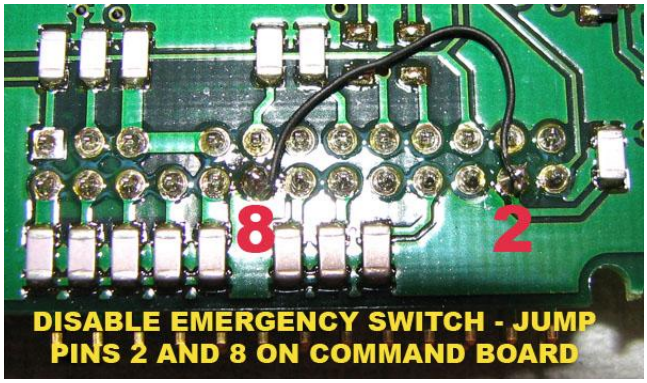

Figure 5.5 A photo illustration showing pins 2 and 8 jumpered on the ASTRO Digital Spectra™ command board. This completes the normally-closed emergency button switch, and prevents it from becoming activated. The radio behaves erratically when this switch is left open.

Note not all command boards must be modified. Newer production boards have had modifications/changes made at the factory. If your serial number indicates a pre-2000 radio, you must perform all modifications. Radios made in 2000 and 2001 (A and B in 5th place of serial number) must have C562 from the command board and C334 from the RF board removed. No further modifications are required. Do a physical inspection of the command board if in doubt.

A second modification is made to the control head to disable the ignition-sense circuit. Normally a second ignition-sense line is required to be attached to an ignition-switched power supply. This activates the radio when you start your vehicle. However, it's extremely annoying if you're using this radio in a base-station configuration or have no use for this particular feature. The ON/OFF button will control power to the radio.

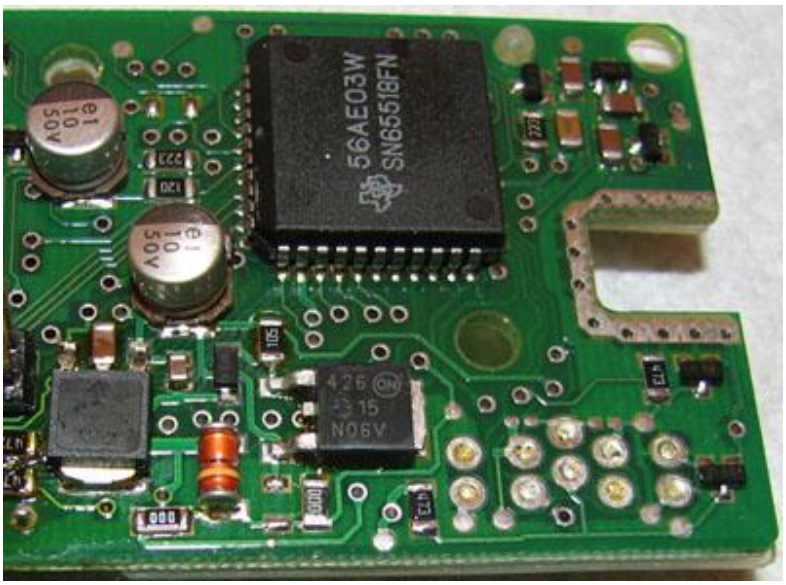

Figure 5.6 A photo illustration detailing the distal-end of a Motorola Inc. ASTRO Digital Spectra™ W5/W7 control-head.

Photographs of the W5/W7 control-heads are detailed below.W3 (Hand-held control-head) models should work without any modifications and W9 models cannot be modified—or at least there is no data suggesting this can be done by manipulating jumpers in the control-head.

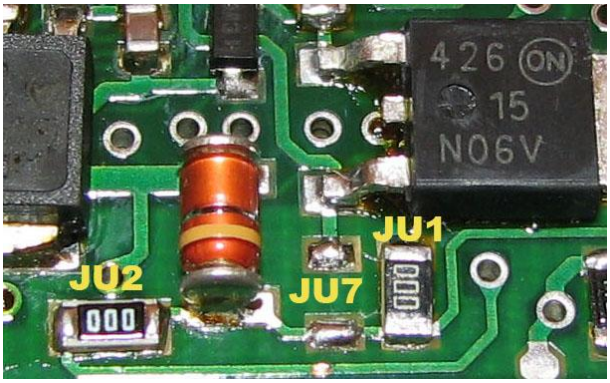

Figure 5.7 A close-up photo illustration showing jumper configuration on a Motorola Inc. ASTRO Digital Spectra™ W5/W7 control-head, which disables the ignition-sense circuit, and allows for ON/OFF button operation.

The W4 control-head can also be modified to disable the ignition-sense. JU1 and JU2 must be installed.

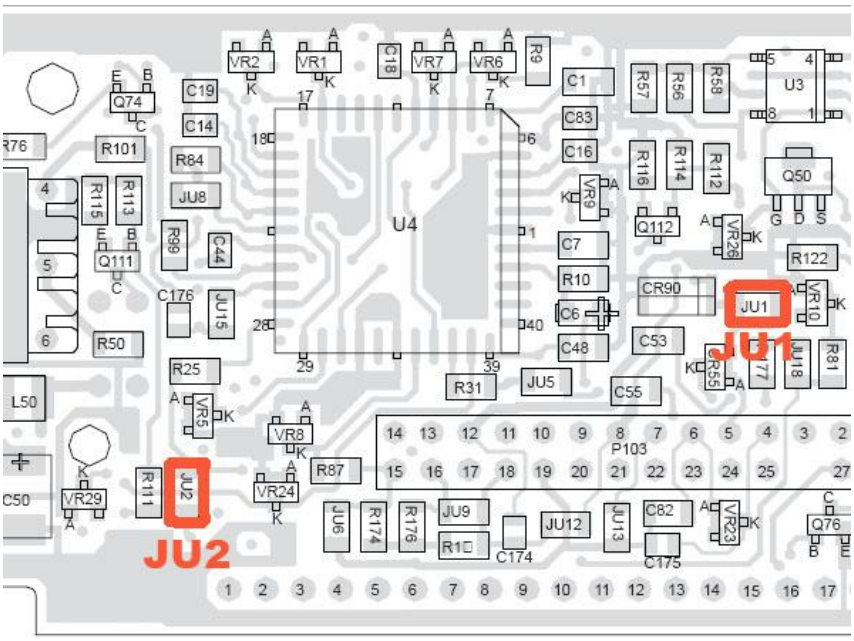

Figure 5.8 blown-up schematic illustration of 0-ohm chip resistors JU1 and JU2 which must be installed on the Motorola ASTRO Digital Spectra™ W4 control-head if the ignition-sense circuit is to be disabled.

The ASTRO Digital Spectra™ is available in low-power (15W) motorcycle versions, mid-power 40-50W versions and 110W remote/trunk-mount high-power versions. Command boards, control-heads and vocon boards found in these various models are all compatible with each other, provided you have the right interconnect board and cabling. (Refer to service manual for part numbers.) Additionally, you must install a new codeplug/s-record with Lab-tool RSS when swapping heads. More on these procedures is discussed later in the guide.

Encryption hardware modules used in the ASTRO Digital Spectra™ are 100% compatible with those found in ASTRO Digital Sabers™. As stated earlier in the guide, the vocons for both radios (The encryption module attaches to the vocon) are nearly identical, with the exception of different interface connectors. There are firmware-specific details to be aware of for compatibility. More about the encryption capabilities of Motorola Inc. ASTRO™ products is discussed later in the guide.

Model-specific Discussion: ASTRO25 Series

XTS 5000™

This is the first ASTRO25™-series portable released to the market back in approximately late 2003. It may look similar to the Motorola Inc. XTS 3000™ portable, but under the case is a far superior radio.

The Patriot IC is the powerhouse of the radio. It's a dual-core processor which contains both a 32-bit micro-controller unit (MCU) and a 16-bit digital signal processor (DSP) in one IC package. What does this mean to you? Much faster boot-up time, superior audio tone and artifact removal and support for many internal/external options which are somewhat CPU intensive. The keypad operation is much faster and menus which may've lagged in the XTS 3000™ are no longer an issue.

Figure 6.1 Photo illustration of a Motorola Inc. XTS 5000™ in a model III configuration.

The cosmetics of the radio are also improved. The DTMF keypad is flush with the flat-front of the radio, the side-buttons are much more responsive (especially the PTT, which has a definite click when pressed) and the channel knob feels much more solid. The XTS 3000™ is inferior to these differences.

Under the hood it's quite simple: An RF board (band-specific) and a vocon.

Is the XTS 5000™ worthy of an eBay purchase? It depends on your wallet and need for features. The ASTRO25™ series radios are not easily manipulated for unauthorized features. (Lab-tool hacking, for example.) What you purchase on eBay is what you will end up with, unless you pay for a legitimate FLASHport™ update to add features and/or upgrade radio firmware.

With this said, the Motorola Inc. ASTRO25™ line has been compromised. There exists a very covert market which offers XTS 5000™ portables with nearly all FLASHport™ features enabled, latest host and DSP firmware and legitimate serial numbers. While there is no definite source for these radios, they do appear for sale on eBay and certain radio-related Internet discussion boards from time-to-time. The value of a featureless XTS 5000™ with old host and DSP firmware (anything below R07.xx.xx) is about $1000 US.

Meantime, a feature-rich XTS 5000™ with the latest firmware can easily fetch $2000 or more. Some hobbyists dispute this price, but if you want to play, you've got to pay. The main incentive of an "enabled" XTS 5000™ is the FLASHport™ Q52 feature, which is a restricted US Government Front Panel Programming option. This allows the radio to be programmed without the need for a computer. This option supports conventional programming only—trunking systems cannot be manipulated by Q52.

The Q52 FPP menu allows a user to change the transmit and receive frequencies, the transmit and receive PL/DPL tones, the transmit and receive Network Access Codes (NACs) which are used for ASTRO™ transmissions, the transmit and receive modulation types (analog, digital and mixed), the transmit and receive bandwidth and the channel and zone names.

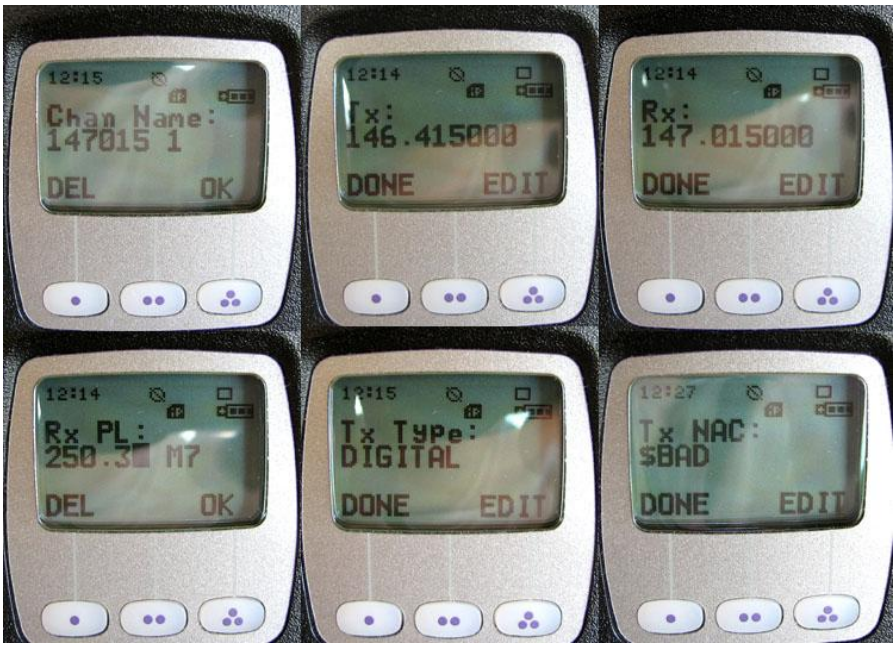

Figure 6.2 A sampling of some of the various options which can be changed via the Q52 FPP option in the Motorola Inc. XTS 5000™ portable radio. The FPP option is available for VHF, UHF and 800 MHz models. FPP ranges are the same as what may be entered normally in CPS.

Despite the contrary information on certain Internet discussion forums which suggests Q52 and H37/H38 (trunking) options cannot be in a radio together, this is untrue. There are several Q52 + H38 (SmartZone) radios in existence—but again, trunking is not user-programmable via the keypad. FPP+trunking radios are NOT offered legitimately through Motorola Inc. at the time this guide was published. This is a stable "community hacked" feature.

There's also a Q53 FPP FLASHport™ option which requires an external hardware key for operation. This is similar to the aged JT 1000™ Jedi-series portable operation. Q53 is an option for non-government users, however many have reported having no troubles ordering Q52, even if they're not qualified as government customers. It's also said Q53 is required for the Radio Cloning feature.

The XTS 5000™ supports Type 1 encryption algorithms, which are used to convey secret and top-secret communications exchanges. Proprietary UCMs (Universal Cryptography Modules) and modifications to the vocon are required. Type 1 encryption modules are not available to the public.

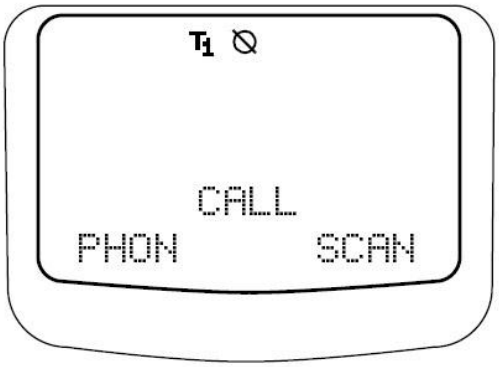

Figure 6.3 Motorola Inc. XTS 5000™ screen display when Type 1 encryption algorithm is in use. Note the T1 indicator.

When the XTS 5000™ is transmitting an encrypted signal with a Type 1 algorithm, the LED indicators also work much differently. On transmit, the LED will be a steady green. When receiving a Type 1 transmission, the green LED turns on for 125 ms, then goes off for 125 ms, then on for 125 ms, then off for 750 ms. When transmitting securely with a Type 1 algorithm with a low battery, the green LED will light for 675 ms, and then remain off for 1350 ms. This behavior is identical when the radio is transmitting securely with a Type 3 algorithm, except the LED is red instead of green in all instances.

The XTS 5000™ does not support older Type 4 algorithms (DVI, DVP) nor does it support the auto-detection of DES-XL vs. DES-CFB in SecureNet receive operations.

Supported Type 3 algorithms include DES-OFB, DES-XL, DES-CFB (SecureNet only) and AES-256.

The XTS 5000™ may be key-loaded with a legacy Key-Variable Loader (KVL) such as the T3011DX, the KVL3000™ and the KVL3000 *plus™*. The XTS 5000™ is capable of holding up to 48 keys (16 of those being type 1 keys).

The XTS 5000™ utilizes the same KVL cable as other Jedi-series radios; the TDN9390D.

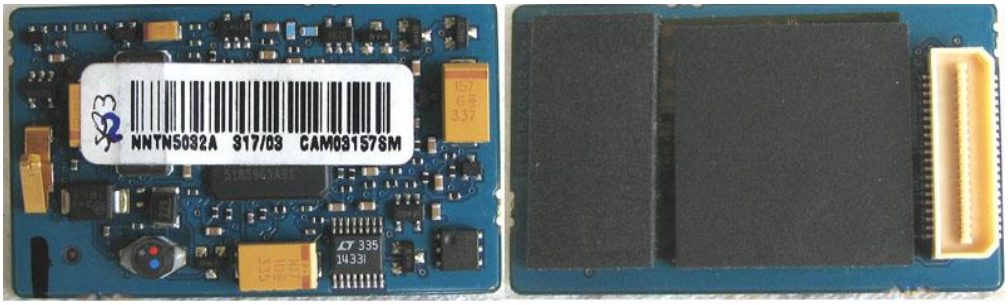

Figure 6.4 A Motorola Inc. NNTN5032 UCM (hardware encryption module) for the XTS 5000™. The NNTN5032 modules can be ordered with any Type 3 encryption algorithm. Care must be exercised when purchasing these modules on eBay or from other Internet sources as they could be blank, have AES-256 only, or contain other unwanted algorithms contrary to what the seller is advertising. Avoid "I think it is" auctions.

There are many eBay auctions which offer NNTN5032 encryption modules for sale. Sometimes there are deals to be had but other times these modules are sold in "blank" configurations (no algorithm installed) or they come with AES-256 only, which is useless unless you possess a KVL3000 *plus* with AES-256 algorithm capability. An ideal module comes with DES-OFB, DES-XL and AES-256 installed, with R05.05.02 UCM firmware or newer—although these are hard to find.

Typical after-market prices for the NNTN5032 modules range from $100 USD (AES-256 only) to $150-175 USD, for a triple-algorithm module with recent firmware. If you have doubts as to what you're buying, do not make the purchase.

There is not much "hacker" related information available about the Motorola Inc. XTS 5000™ portable, but there are a few things to be aware of in terms of supported features and firmware dependencies.

The Motorola Inc. XTS 5000™ is capable of supporting up to 850 modes. In an FPP-enabled radio, 254 (maximum) of those modes may be conventional FPP channels, and 596 (more if you decrease conventional modes) may be trunking modes. To benefit from this massive memory capability (default is 512 modes) you must have firmware version R07.00.00 or higher and program the radio with CPS R07.00.00 or higher. Some may argue about the maximum FPP-capable conventional mode capacity, but 254-mode FPP radios do exist—although they may not be factory supported radios.

The XTS 5000™ also supports the HMN4080A GPS-enabled speaker-microphone. With this accessory attached to the radio, the user may display GPS data on the screen. A host and DSP firmware combination of R07.00.00 or greater and CPS of R07.00.00 or greater is required for operation.

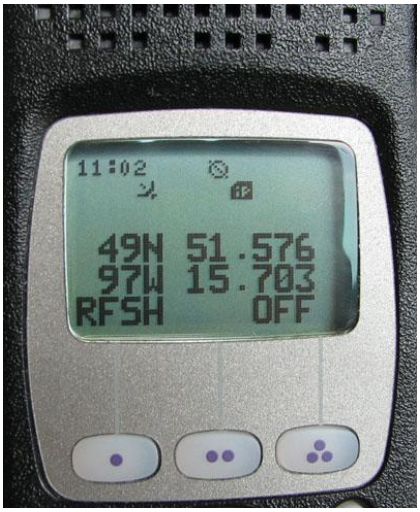

Figure 6.5 A photo illustration of an XTS 5000™ with the location-data feature enabled, with a HMN4080A GPS-capable speaker-microphone attached. Note the awkward and dysfunctional display format of the data, which is not supported by many third-party mapping applications. When configured as such, the user may opt to disable the data feature (OFF) so the radio does not send GPS data over the air.

The XTS 5000™ model II and III models are also capable of displaying Intelligent Motorola Portable Radio Energy System (IMPRES™) data on the display. When an IMPRES™ battery is attached to the radio, and the BATT soft-menu is enabled in the CPS, the user is able to observe the rated capacity, the remaining capacity and the total number of established charges since the battery has seen. A compatible IMPRES™ charger must be used if a user wishes to use the IMPRES™ features of the battery. Otherwise, the IMPRES™ chip in the battery will disable itself and the IMPRES™ functionality is null.

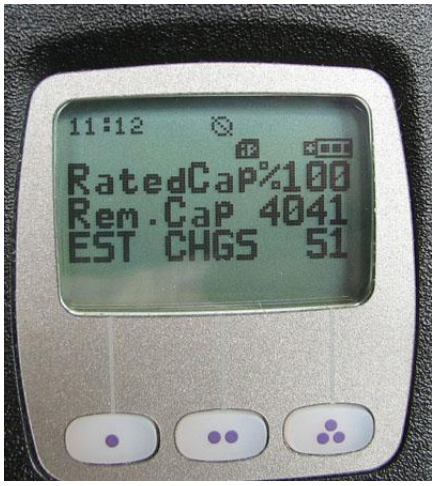

Figure 6.6 A photo illustration of a Motorola XTS 5000™ displaying IMPRES™ battery data via the BATT soft-menu. In addition to this data, note the battery gauge in the upper-right display.

The XTS 5000™ and XTS 2500™ ASTRO25™ portable radios also support a new feature called Text Messaging Service (TMS). It allows users to send short text messages (almost identical to SMS messaging on cellular networks, except with a different addressing scheme) to each other. This feature is also useful for dispatching call-related information to emergency services. This feature requires two prerequisites: Host and DSP firmware version R09.00.00 or newer and CPS version R09.00.00 or newer.

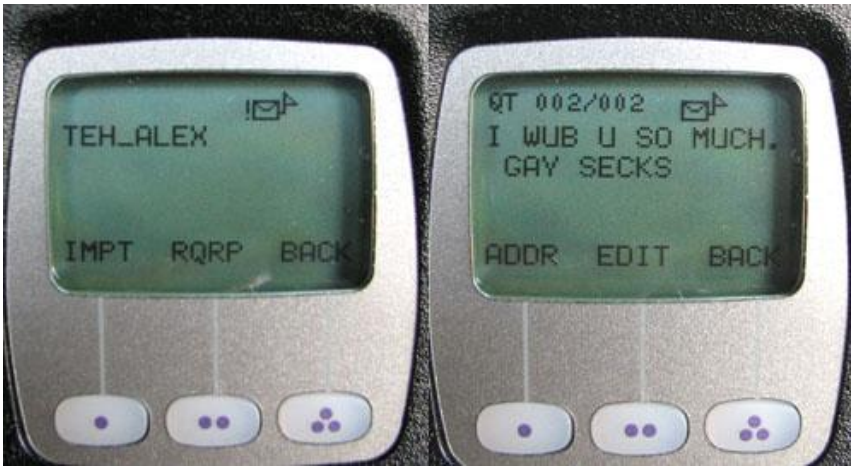

Figure 6.7 A photo illustration of a Motorola Inc. XTS 5000™ engaged in the TMS menu. Recipients and message templates may be predefined in CPS. Note THE_ALEX is the recipient of the corresponding message.

Hobbyist “akardam” has prepared a most useful and comprehensive guide about using and configuring the TMS feature. It may be downloaded at the following URL:

http://www.akardam.net/moto/docs/xts5k-tms.html

A further note about the XTS 5000™: To determine host, DSP and UCM firmware versions, band-split information, model, serial and ESN information, vocon size and FLASHport code, the radio may be put into service-mode by pressing the “..” key on the side of the radio five times, within the first 10 seconds of powering the radio on. This is applicable to model II and III versions only. Model I versions of the XTS 5000™ must be read with CPS to determine this information.

More information about the Motorola Inc. XTS 5000™ portable radio will be published in upcoming guides. There is still a lot of undocumented information and the radio is a current product—meaning it’s under constant development.

XTS 2500™

The Motorola Inc. XTS 2500™ is a compact version of the XTS 5000™. It utilizes waris-series batteries, but has a jedi accessory connector.

Figure 7.1 A photo illustration of a Motorola Inc. XTS 2500 portable radio, in a model III configuration.

According to Motorola Inc., the XTS 2500™ supports 512 modes, whereas the XTS 5000™ supports 850.

Another difference is the lack of Type 1 encryption algorithm support. Motorola Inc. confirmed this fact (which is not listed on their website) via correspondence while this guide was being written.

The Motorola Inc. XTS 2500™ operates almost identically to the XTS 5000™, with the exception of the user-controllable high/low power setting option. The only way to set transmitter power is through personality settings for each mode. This option is not assignable to an external switch, button or soft-menu.

The Q52 and Q53 FPP FLASHport™ options are available for this radio.

For encryption module part numbers, refer to batdude's encryption primer guide. A link is provider later in this guide.

XTS 4000™

Supposedly, this is an SP product developed for a federal agency. The design mimics an iDEN™ phone, and offers very discrete operation when compared to a bulky ASTRO™ or ASTRO25™ portable.

Figure 8.1 An illustration of the XTS 4000™, taken from an FCC document.

At the time of its release, the XTS 4000™ was only available in VHF. It supports encryption (unknown if Type 1 is supported) and all trunking features. It programs with the ASTRO25™ portable programming software.

XTS 1500™, SSE 5000™, XTL 2500™, XTL 1500™, XTL 2500™, XTL 5000™, MT 1500™, PR 1500™and Digital Spectra Plus™

Not enough information about these radios is known, however they function identical to other Motorola Inc. ASTRO™ and ASTRO25™ products, with the exception being they do not support the Q52/Q53 FPP options—or at least there is no documentation advertising as such.

These radios program with the ASTRO25™ series mobile and portable CPS.

The XTL 5000™ supports Type 1 encryption algorithm operation.

Information about these radios may be included in a future *Guide to ASTRO™ Digital Radios*.

Radio Operating System (ROS) and DSP Firmware Discussion

ASTRO™ Firmware

Motorola Inc. ASTRO™ and ASTRO25™ radios function much like computer. They require an operating system to function. The Digital Signal Processor (DSP) also has its own code which consists of instructions on how to process calls. These could be a mixture of analog, IMBE™ or VSELP communications.

Firmware updates are applied to Motorola Inc. ASTRO™ and ASTRO25™ products via a FLASHport™ upgrade. The firmware comes in the form of an encrypted "CVN" file, that is loaded into the radio via RSS or CPS. In terms of hardware, a programming/flash cable is required (specific to each radio), a Smart RIB (SRIB) for ASTRO™ radios (ASTRO25™ products do not use the SRIB or RIB boxes), and a i-button. The i-button is a special proprietary piece of hardware which attaches to a USB port, and contains information about the total number of FLASHport™ upgrades used and number remaining. This device ensures Motorola Inc. gets every last penny out of their customers for firmware updates, even when Motorola Inc. is at fault for buggy firmware. Why else would one need to order an i-button to apply firmware updates?

There's some information about Motorola Inc. ASTRO™ products which not too many hobbyists (and customers) are aware of: All Motorola Inc. ASTRO™ products of the same model, are the same. There are **three** areas inside of the radio which determine their capabilities: The **host firmware**, the **DSP firmware** and the **customer-specific data (CSD)**, aka the codeplug.

The **host firmware** is the ROS. This controls the entire operation of the radio, including support for codeplug options, audio characteristics, encryption algorithm support, signalling options (PL, DPL, etc.) and functionality on trunking systems.

The **DSP firmware** contains information the DSP interprets about how it should operate when modulating or demodulating analog and digital signals. The DSP firmware may also contain an audio codec algorithm such as IMBE™ or VSELP, for operation in ASTRO™ digital mode. Both codecs are never present at the same time.

The **CSD** is essentially a database file. When the radio successfully boots, the CSD is loaded into Random Access Memory (RAM) and the radio determines how to operate based upon the parameters outlined in the CSD. The CSD contains frequency programming information, zone configuration and all configurable options which a user can manipulate in RSS/CPS. There are also hidden options or fields which cannot be modified by the user by means of normal RSS/CPS, such as the band-split information, serial number and FLASHport™ options. When a user saves a codeplug with RSS/CPS, they are saving a database file to disk. Obviously you may also write this database file to the radio.

All three of these determinants are modifiable with little or no effort. Motorola Inc. may've tried to deter unauthorized upgrades by means of the FLASHport™ system, however there's no physical security involved in terms of the data stored on the flash ROMs which hold the host and DSP firmware,

or EEPROM which stores the CSD. At the time this guide was written, this statement applies only to Motorola Inc. ASTRO™ series radios. ASTRO25™ radios are not manipulated using the same process. More is discussed later in the guide.

The first version of host firmware ever released is unknown. The earliest version I've come across is cp_D01.04.00. Another confirmed VSELP revision is ap_R03.20.01. are internally dated as ©1996 by Motorola Inc. I'm inclined to believe there's much earlier firmware than this.

The prefix designations of **cp** and **ap** have no known meaning, however it has been noted **ap** always prefixes VSELP host firmware.

The **R** means RELEASE, which is stable firmware intended for the public.

D means DEVELOPMENT, which signifies the firmware is intended for a special application or a customer-specific issue which may or may not be in the testing phase.

The first number in the firmware version signifies the major release. It also indicates which type of codec (DSP firmware) it's compatible with. Example: R0**7**.71.00. The 7 indicates it's compatible with the IMBE™ DSP firmware. More on this is discussed later.

Let's discuss major firmware versions. The following chart identifies significant information associated with each ASTRO™ release. For the purpose of conveying factual information, the guide covers firmware from major version 3 and up, as little is known about earlier releases. These tables do not apply to ASTRO25™-family firmware releases.

Host Firmware (ROS) Version	Notes
ap_R03.xx.xx (Portables)	VSELP ROS firmware
R04.xx.xx (Portables)	IMBE™ ROS firmware 1996 -era
R05.xx.xx (Portables)	IMBE™ ROS firmware 1996-1999
R06.xx.xx (Portables)	IMBE™ ROS – ASTRO25™ 9600bps trunking
R07.xx.xx (Portables)	IMBE™ ROS 2000-current (R07.71.00)
R08.xx.xx (Digital Spectra)	IMBE™ ROS—ASTRO™ modem only?
R09.xx.xx (Digital Spectra)	IMBE™ ROS 1996-1999
R10.xx.xx (Digital Spectra)	IMBE™ ROS—ASTRO25™ 9600bps trunking
R11.xx.xx (Digital Spectra)	IMBE™ ROS 2000-current (R11.70.00)
am_R75.xx.xx (Digital Spectra)	VSELP ROS firmware

DSP Firmware Version*	Notes
x05.xx.xx	VSELP/Analog operation
x06.xx.xx	IMBE™/Analog operation (1996-1999)
x07.xx.xx	IMBE™/Analog operation 2000-2001
x08.xx.xx	IMBE™/Analog operation 2001-current

*Analog/digital operation dependent on firmware revision letter.

DSP firmware capabilities also depend on the revision letter which prefixes the major release number. They are:

DSP Firmware Revision	Notes
A	Analog only. Paired with N/F.
F	Analog/digital. Field testing? Paired with A/N
I	Analog/digital operation. Paired with M.
M	Anaog only. Paired with I.
N	Analog/digital. Paired with A/F.

F revision DSP firmware is extremely rare. It has been paired with host version D08.97.26 in a Motorola Inc. ASTRO Digital Spectra™, configured as a dedicated RF modem. When this particular radio was later upgraded, the DSP was compatible with DSP revision **N** firmware. Radios which indicate **DSP firmware revisions beginning with A or M, will not function in IMBE™ or VSELP mode**, regardless of what FLASHport™ options are forced into the radio through illicit means. An example of an analog-only capable radio is: **DSP A08.03.03**. This would be displayed on the screen during a service mode operation or while viewed in the radio information screen in RSS or CPS. The radio would need to be upgraded to **DSP N08.03.03** in order to support ASTRO™ digital operation in the IMBE™ mode. As of the publication date of this guide, the current 1MB firmware versions are **R07.71.00/DSP 08.03.03** for portables, and **R11.70.00/DSP 08.03.03** for mobiles.

Now that you're aware of the major firmware version and DSP revisions, there are several footnates to be aware of that are specific to each major version . These notes detail changes which occur at certain versions and are quite important.

Host Firmware (ROS) Version	Note(s)
ap_R03.32.00	Premature low-battery alert on XTS 3000™. VHF, UHF R1/R2. SRN1227. Affects 3.32.00 or older.
ap_R03.40.00	When ordering replacement LCD display (5185633C42), this firmware version or newer must be installed. New LCD requires new drivers.
R04.02.01	Premature low-battery alert on XTS 3000™. VHF, UHF R1/R2. SRN1227. Affects 4.02.01 or older.
R05.00.00	SmartZone Omnilink™ trunking support added.
R05.60.04	Highest firmware version that installs on 512K ASTRO Digital Saber™ vocons.
R06.10.00	Transmit AGC added to ASTRO25™ firmware for XTS 3000™ & ASTRO Digital Saber™.
R06.22.00	When ordering replacement LCD display (5185633C42), this firmware version or newer must be installed. New LCD requires new drivers.

R07.01.00 R07.01.00 continued…	XTS 3000™ / ASTRO Digital Saber™ trunked priority talkgroup scan problem. (missed calls) SRN1330. XTS 3000™ displays "REMOTE" on screen when removed from XTVA. Upgrade to R07.01.00 or later. SRN1320
R07.01.01 – R07.07.00	ASTRO Digital Saber™, XTS 3000™ Equipped with DVP-XL may experience missed words. SRN1368
R07.01.01 and newer	Transmit Audio Gain Control (AGC) is introduced. This is the most significant enhancement to digital audio on ASTRO™ digital systems ever implemented. SRN1370 (April 2002) Support for Soft-ID decode in ASTRO Digital Saber™ and XTS 3000™.
R07.12.00-R07.14.00	ASTRO Digital Saber™ and XTS 3000™. Radio re-affiliates every few seconds when in talkgroup scan. SRN1433
R07.20.00 (fixes)	XTS 3000™ may experience premature low-battery alerts/distorted or no TX audio when used with IMPRES “smart” battery packs NNTN4435, NNTN4436, NNTN4437, HNN9031, HNN9032, and NTN9862. SRN1463
R07.22.01 and newer	ASTRO Digital Saber™ and XTS 3000™ gain support for Analog Radio ID Display on APCO-16 trunking systems. Must be used with CPS R04.01.02 or newer.
R07.23.00 and newer	When ordering replacement LCD display (5185633C42), this firmware version or newer must be installed. New LCD requires new drivers.
R07.70.00 and newer	Support for 800 MHz rebanding.
R07.71.00	Latest XTS 3000™ and ASTRO Digital Saber™ host firmware release. 03/2007.
R08.00.00 – R11.01.02	ASTRO Digital Spectra VHF 146-174 "K" range: When the PTT is pressed and the transmit LED is lit, the unit acts like it is keyed up but does not transmit any RF power. SRN1325
R09.50.00-R11.06.02	ASTRO Digital Spectra™ is slow to unmute in scan or has poor sensitivity in scan when in priority scan

R09.50.00-R11.06.02 cont…	mode, with 12.5 KHz and 25 KHz channels mixed in scan list, and receiving weak signals. SRN1354
R09.60.04	Highest firmware version that installs on 512K ASTRO Digital Spectra™ vocons.
R11.01.01	Transmit Audio Gain Control (AGC) is introduced. This is the most significant enhancement to digital audio on ASTRO digital systems ever implemented. SRN1370 (April 2002)
R11.01.01 – R11.07.00	ASTRO Digital Spectra™ trunked priority talkgroup scan problem. (missed calls) SRN1330.Support for Soft-ID decode in ASTRO Digital Spectra™. ASTRO Digital Spectra™ equipped with DVP-XL may experience missed words. SRN1368
R11.08.00 and earlier	ASTRO Digital Spectra™ radios that are receiving with PL codes 4B- 146.2 Hz, 5Z- 151.4 Hz, 5A- 156.7 Hz, 5B- 162.2 Hz AND on a 12.5 KHz channel may not unmute. SRN1357
	ASTRO Digital Spectra™ used with Vehicular Repeater System (VRS) and ASTRO Digital Spectra™consolette with Option L146 does not operate correctly with Remote Mode Change/Steer Functionality. SRN1374
R11.12.00-R11.14.00	ASTRO Digital Spectra™. Radio re-affiliates every few seconds when in talkgroup scan. SRN1433.

DSP Firmware Version	**Notes**
05.xx.xx	This major release supports VSELP only.
06.xx.xx	This was the first DSP release for IMBE™ operation. It does not support subscriber AGC, and is the most inferior sounding IMBE™ codec. Anyone still using release 6 needs to upgrade immediately. Reproduced audio during packet-loss is extremely robotic sounding.
07.xx.xx	Some minor improvement over the audio characteristics of IMBE™ DSP release 6. As of 07.03.09 it supports subscriber AGC, if used with host firmware R07.01.01 or higher, with subscriber

07.xx.xx continued…	AGC enabled in codeplug. Reproduced audio during packet-loss is quiet and at times muted.
08.xx.xx	A major improvement in audio tone for both analog and digital (IMBE™) audio recovery. When used with subscriber AGC, all levels are balanced. All ASTRO™ product users are encouraged to upgrade to DSP release 8. Current version is 08.03.03.

ASTRO25 Radio Firmware	Notes	Enhancement/Change
Host R04.00.00 & DSP R04.00.00 (11/10/2003)	Trunked integrated voice and data is introduced.	New feature.
	Trunked OTAR is introduced.	New feature.
	Additional 3600 CC trunking features have been added.	New feature.
	Additional APCO P25 conventional features have been added to portable and mobile radios.	New feature.
	Fireground polling, evacuation and channel announcement features introduced.	New feature.
	Advanced Digital Privacy (ADP) is a new digital encryption algorithm being introduced.	New feature.
	MT1500™ portable radio introduced.	New model.
	XTS 1500™ portable radio introduced.	New model.
	Change in functionality of rekey request for trunked OTAR.	Enhancement.
	Portable subscriber unit ignores ABC toggle switch changes at power-up.	Issue update.

Host R04.00.00 & DSP R04.00.00 continued…	Subscriber is slow to unmute (3-5 sec.) upon channel change to an active talkgroup.	Issue update.
	Subscriber unit occasionally switches sites after cycling power of mode change.	Issue update.
	Subscriber unit stays on SmartZone™ site when user selects a SmartNet™ talkgroup.	Issue update.
	ASTRO Digital Spectra Plus™ dual control-head initial volume is not set properly after turning ignition on.	Issue update.
	Subscriber does not transmit if the PTT button is pressed during emergency alarm retries on a revert channel.	Issue update.
	Subscriber can unmute to a second subscriber when in Private Call II call.	Issue update.
	"KEYFAIL" is flashed too quickly on the subscriber when scan is enabled.	Issue update.
	Alert tone not heard while exiting scan when a page is received.	Issue update.
	Invalid radio set Identifier may be displayed on the Key Variable Loader (KVL) display.	Known problem.
	ASTRO Digital Spectra Plus™ doesn't de-affiliate at power-off from 9600 trunking system if configured with siren and DEK.	Known problem.
	CPS now supports macro record and playback.	Enhancement.

Host R04.00.00 & DSP R04.00.00 continued…	CPS now supports the Advanced System Key (ASK).	Enhancement.
	CPS now supports feature-level security.	Enhancement.
	CPS now allows the 12.5 KHz offset frequencies.	Issue update.
	CPS now allows the re-use of deleted sector ID's within the fireground accountability feature.	Issue update.
	CPS now supports USB adaptor for FLASHkeys.	Issue update.
	CPS incompatibility with other software.	Known problem.
	CPS problems when other serial communication software is open.	Known problem.
	CPS problem with French version of Windows.	Known problem.
	CPS problem closing dialog box.	Known problem.
Host R04.00.01 & DSP R04.00.01 (1/26/2004)	Test-code added to allow field screening for bad eepot component.	Enhancement.
Host R04.50.00 & DSP R04.50.00 (6/3/2004)	Introducing the Imbalanced Coverage Indication feature.	New feature.
	Conventional vote-scan operation is now supported.	New feature.
	Conventional data-scan is now supported.	New feature.
	Conventional vote-scan can now display the voted channel.	Enhancement.

Host R04.50.00 & DSP R04.50.00 continued…	Rekey request in conventional data-scan has been enhanced to send the request on the designated data-channel.	Enhancement.
	Problem with multi-key subscribers scanning a scan-list with mixed analog and digital members.	Issue update.
	Problems with various smart-PTT settings and telephone interconnect in conventional mode.	Issue update.
	Audio-level changes several times when an XTS 5000™ is inserted into an XTVA during a call.	Issue update.
	Radios leave a good Type II trunking site and go out of range.	Issue update.
	Radios appear stuck on “SITE XX” Radio leaves its preferred site and does not return.	Issue update.
	Subscriber will stay on incorrect control channel, display “OUT OF RANGE”, and not hunt for the correct control channel.	Issue update.
	Sel-Call decode does not work in conventional-scan.	Issue update.
	Subscriber will not re-affiliate after going out-of-range and coming back in-range.	Issue update.
	Changing emergency short press duration has no effect.	Issue update.
	DTMF not sent on busy channel; DTMF not sent during dial-tone when smart PTT is set to “Inhibit on carrier.”	Issue update.

Host R04.50.00 & DSP R04.50.00 continued…	Portable radios with the commander microphone can experience large volume changes if radio volume control moved.	Issue update.
	CPS now supports alternate table view.	Enhancement.
	CPS now supports Frequency pick-lists for dialogs.	Enhancement.
	CPS now supports channel-announcement feature.	Enhancement.
	CPS now supports remote programming.	Enhancement.
	CPS incompatibility with other software.	Known problem.
	CPS problems when other serial communication software is open.	Known problem.
	CPS problem with French version of Windows.	Known problem.
	CPS problem closing dialog box.	Known problem.
	CPS feature-access setup issue.	Known problem.
Host R04.51.00 & DSP R04.50.00 (6/30/2004)	XTL 5000™ and ASTRO Spectra Plus™ do not route audio to both stations in DCH setup when only one DEK is attached.	Issue update.
Host R04.51.01 & DSP R04.50.00 (7/7/2004)	Bad String in French Native Language Display on XTL 5000™.	Issue update.
Host R04.80.00 & DSP R04.80.00 (8/27/2004)	Fireground RF Modem introduced.	New feature.

Host R04.80.00 & DSP R04.80.00 continued…	An inhibited XTL 5000™ intermittently becomes partially re-enabled if powered on while the automobile is started.	Issue update.
	XTL 5000™ PTT does not work unless the rear control-head is selected as primary.	Issue update.
	When in poor-coverage, radio sometimes emits a continuous talk-prohibit tone until power is cycled.	Issue update.
	View OTAR IDs button added in CPS.	Enhancement.
	Channel announcement feature added in FLASHport™.	Enhancement.
	CPS generates invalid fields when adding a new trunking personality.	Known problem.
	CPS incompatibility with other software.	Known problem.
	CPS problems when other serial communication software is open.	Known problem.
	CPS problem with French version of Windows.	Known problem.
	CPS problem closing dialog box.	Known problem.
	CPS feature-access setup issue.	Known problem.
Host R04.80.01 & DSP R04.80.00 (9/30/2004)	Radio sometimes ignores grant for emergency hot mic call if another call is in progress on emergency talkgroup.	Issue update.
	XTS 5000™ with commander mic has no volume-control after power-up until the radio has unmuted once.	Issue update.

Host R04.80.01 & DSP R04.80.00 continued…	XTS 5000™ will not pass audio on a system-wide call.	Issue update.
	Evacuation-tone not always sounded at full volume.	Issue update.
Host R04.80.02 & DSP R04.80.00 (10/13/2004)	ASTRO Spectra Plus™ consolette non-priority indication is not selectable when in scan-list programming.	Issue update.
Host R05.00.00 & DSP R05.00.00 (12/6/2004)	Introduction of the XTS 2500™ model 1.5.	New model.
	Introduction of the XTL 5000™ VHF high-power mobile.	New model.
	Additional 3600 CC trunking features have been added.	New feature.
	Additional APCO P25 conventional features have been added.	New feature.
	APCO 25 emergency alarm receive-indicator supported.	New feature.
	Conventional talkgroup 0000 now supported.	New feature.
	Support for inhibit on status-symbols added.	New feature.
	Emergency via silent-audio now supported.	New feature.
	Analog flat-audio now supported.	New feature.
	The XTL 5000™ now offers the capability of a fireground RF modem on 700 MHz/380 MHz bands.	Enhancement.

Host R05.00.00 & DSP R05.00.00 continued…	6.x user may hear static or crackling noises during silent periods while receiving a digital call at full volume.	Issue update.
	6.x subscriber will emit six tones while sending a call-alert.	Issue update.
	CPS now supports clone express.	New feature.
	CPS now supports incremental installs.	New feature.
	CPS now supports channel pick-list.	New feature.
	CPS now supports remote-programming via Internet.	New feature.
	CPS Advanced System Key enhanced.	Enhancement.
	CPS feature-level security expanded.	Enhancement.
	CPS tables now support fill up/down.	Enhancement.
	CPS now supports PDA applications.	Enhancement.
	CPS now supports codeplug-alias.	Enhancement.
	All software options now viewable by name in CPS.	Enhancement.
	CPS Advanced System Key issue.	Known problem.
	CPS Window style issue.	Known problem.
	CPS incompatibility with other software.	Known problem.

Host R05.00.00 & DSP R05.00.00 continued…	CPS problems when other serial communication software is open.	Known problem.
	CPS problem with French version of Windows.	Known problem.
	CPS problem closing dialog box.	Known problem.
Host R05.00.01 & DSP R05.00.00 (1/13/2005)	XTS 5000™ with commander mic has no volume-control after power-up until the radio has unmuted once.	Issue update.
Host R05.01.00 & DSP R05.01.00 (3/15/2005)	UHF high power XTL 5000™ introduced.	New model.
	XTS 5000™ PTT during data-message causes radio to key voice on data-channel.	Issue update.
	Radio resets after many rekey requests without power cycle.	Issue update.
	Zone/mode change while in transmit on data-channel may not land on correct mode.	Issue update.
	Inhibited-subscriber doesn't always uninhibit by sending an enable command through the KMF.	Issue update.
	XTL 5000™ W3 control-head display contrast not restored after selective-inhibit is cancelled.	Issue update.
	Portable transmit audio ramps up to desired volume over 2-3 seconds when talk-permit tone enabled and mic AGC is in use.	Issue update.
	Data-services stop working.	Issue update.

Host R05.01.00 & DSP R05.01.00 continued…	Conventional voting-scan does not vote the strongest channel.	Issue update.
	16th talkgroup in a personality doesn't work.	Known problem.
	Hard key-zeroize in silent-emergency causes tone to sound.	Known problem.
Host R05.01.01 & DSP R05.01.00 (4/14/2005)	Subscriber transmits DTMF digits at 8 KHz deviation.	Issue update.
	16th talkgroup in a personality doesn't work.	Known problem.
	Hard key-zeroize in silent-emergency causes tone to sound.	Known problem.
	Proper code-detect feature does not work correctly on subscriber with SecureNet™.	Known problem.
	Subscriber radio-alias display is overridden by failsoft indication.	Known problem.
	Scan cannot be enabled through subscriber menu selection.	Known problem.
	DTMF "Hot keypad" does not work while subscriber is in scan mode.	Known problem.

It's important to note pages 32-41 reference ASTRO25™ firmware. ASTRO25™ firmware is applicable to ASTRO25™-family radios.

The ASTRO25™ firmware change-log was obtained through an Internet PDF file which originally appeared on the BatBoard Internet discussion forum. Detailed and accurate information past firmware release R05.01.00 is not available.

It cannot be stressed enough how important it is to keep your host and DSP firmware up-to-date. There have been tremendous improvements in the audio quality of ASTRO™ digital (IMBE™) transmissions since the first IMBE™ DSP codec was released in 1996. Some major law-enforcement agencies are still using host and DSP firmware combinations dated from 1995-1997. The tone of reproduced audio using DSP firmware version 6 and no subscriber AGC is terrible. Motorola Inc. is to be commended for vastly improving the audio characteristics of their digital radios, but they haven't made enough of an effort to distribute new firmware upgrade packages to their customers at no charge.

Getting the latest firmware is highly recommended, but without the proper configuration of the CSD (codeplug), the audio may still be inferior.

Subscriber AGC controls the audio gain of the transmitted audio. When enabled, it addresses many issues which contribute to terrible audio on analog and digital transmissions. Loud-talkers have their audio balanced, while quiet-talkers have their audio levels brought up. A side-effect of AGC is the increase of background noise which may be present in the audio of quiet-talkers. Users of any radio-system should be properly educated in the correct use of their radios; this is much more effective than subscriber AGC. Optimizing radio-configuration and educating end-users make for a superior system.

Below are examples of how digital radios should be configured for the best-sounding transmitted audio. Your mileage may vary; these are Motorola Inc. recommended settings.

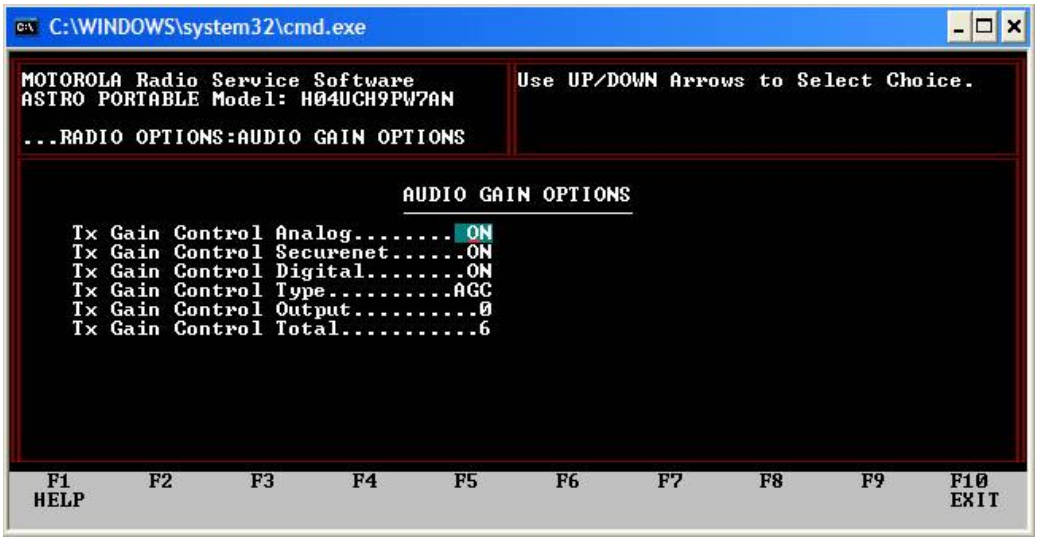

Figure 9.1 Recommended settings for optimized subscriber AGC operation in ASTRO™ RSS.

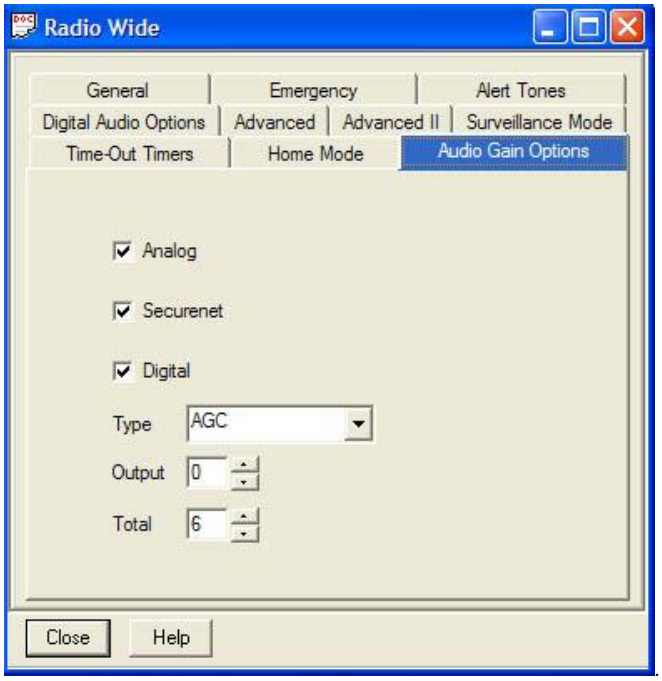

Figure 9.2 Recommended settings for optimized subscriber AGC operation in ASTRO™ CPS.

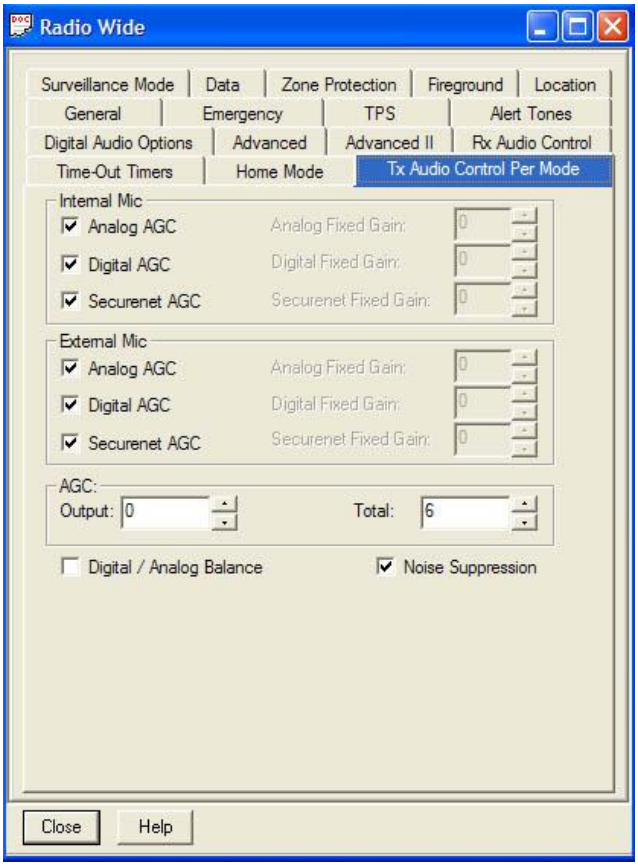

Figure 9.3 Recommended settings for optimized subscriber AGC operation in ASTRO25™ CPS.

It’s hard to believe, but those simple configuration options and current firmware make a world of difference. The bottom line is if you’re a systems administrator and are just learning about this information now through the guide, Motorola Inc. has not educated you well in their product and its optimal performance. You must keep up with Service Release Notices (SRNs) and other technical documentation which is routinely released by Motorola Inc. to address these and other technical issues. Take pride in what you do.

FLASHport™ Technology

FLASHport™ is simply a fancy name which means “upgrade”. By upgrading, you may add features (FLASHport™ options) and/or update the host and DSP firmware in a radio. This is accomplished by putting the radio into bootstrap mode and communicating with the flash ROMs and EEPROM.

In older ASTRO™-series radios, a Smart Radio Interface Box (SRIB), a flash/programming cable and an i-button were required hardware for this procedure. On the newer ASTRO25™-series platform, a simple flash/programming cable is all that’s needed; Motorola Inc. did away with the RIB hardware.

All Motorola Inc. ASTRO™ and ASTRO25™ radios contain a “flashcode”. This is a 13-digit hexadecimal number which represents options enabled in the radio codeplug. It looks like this example:

599108-1C5E00-1

FLASHCODE	**5**	**9**	**9**	**1**	**0**	**8**	**-**	**1**	**C**	**5**	**E**	**0**	**0**	**-**	**1**
POSITION	**12**	**11**	**10**	**9**	**8**	**7**	**-**	**6**	**5**	**4**	**3**	**2**	**1**	**-**	**CHECKSUM**

Figure 10.1 A chart which breaks down the FLASHport™ address positions.

There are really only 12-digits in the flashcode, as the last digit indicates the checksum. Each position of the flashcode could be a hexadecimal digit from 0-F.

For each FLASHport™ digit position, there are four possible FLASHport™ options which could be represented through the binary weight of B1, B2, B4 and B8.

Take position 12 for example. The flashcode binary weight is 5. This means it has two FLASHport™ options installed: The options of weight B1 and B4. Those are:

B4 G806/Q806 ASTRO™ Digital Operation (CAI)
B1 G14/H114 Enhanced Digital ID Display

Position 11 has a binary weight of 9. This means options B8 and B1 are installed. These options are:

B8 G298/Q498 Hardware Mutlikey Encrytpion with OTAR
B1 G101/H101 Repeater Access

It is important to note Motorola Inc. uses the FLASHport™ system for other radio platforms and some options are not compatible with ASTRO™ and ASTRO25™ product platforms.

The following table is a complete list of known FLASHport™ options. There may be several undocumented options, or options which differ between product platforms. Some ASTRO™ and ASTRO25™ FLASHport™ options are exclusive to each others’ product-family.

FLASHport™ Feature Chart – ASTRO™/ASTRO25™ Options

POSITION	WEIGHT	OPTIONS
12	**1**	G806/Q806 ASTRO Digital Operation
	2 (N/A)	
	4	G114/H14 Enhanced Digital ID Display
	8	H14/H44 ASTRO Data
11	**1**	G101/H101 Repeater Access
	2	Q52 Federal Government FPP (ASTRO25 only)
	4	H869/W969 Hardware Multikey Encryption
	8	G298/Q498 Hardware Multikey Encryption with OTAR
10	**1**	G170/H43 Trunked Radio Remote Monitor/Radio Trace
	2 (N/A)	
	4	G474 Multi-radio Software (ASTRO25 mobiles only)
	8	G683/H46 Trunked One-touch Status Message
9	**1**	H39 Selective Radio Inhibit
	2	W12 RF Pre-amp (ASTRO25 mobiles only)
	4 (N/A)	
	8 (N/A)	
8	**1**	Q883 3600/9600 Interopability (ASTRO25 portables only)
	2	Q319 Enable RF Modem (ASTRO25 mobiles only)
	4	G791 XTL 1500 Enhanced Software Capabilities
	8	G996 Over-the-air Provisioning (ASTRO25)
7	**1**	G48/H35 Conventional Systems Operation
	2	H02 Encrypted Tactical Inhibit (ASTRO25 portables only)
	4	G50/H37 SmartNet Systems Operation
	8	G51/H38 SmartZone Systems Operation
6	**1**	G857 FDNY RX/TX Emerg. Tone Set. (ASTRO25)
	2 (N/A)	
	4	H04 Conventional Tactical Rekey (ASTRO25, H07 Software Multi-key (ASTRO)
	8	H29 Software Single-key Encryption (ASTRO portables only)
5	**1**	Q354 Over The Air Channel Steering
	2	Q353 Over The Air Channel Reassignment
	4	G352/Q352 Soft-ID
	8	G351/Q351 MODAT
4	**1**	Q947/W947 Packet Data Interface
	2	G241/Q241 Analog-only Operation
	4	G858 HPD Operation (ASTRO25 mobiles only)
	8 (N/A)	
3	**1**	Q53 FCC FPP and Radio Programming (ASTRO25 portables only)
	2	G387/Q387 Conventional Voting Scan
	4	G173/Q173 SmartZone Omnilink Multi-zone Operation
	8	G182/Q182 Radio Control Protocol
2	**1**	G789/Q575 3600bps Analog/Digital Trunking (ASTRO25 only? Unconfirmed..)
	2	G440 GPS Operation (ASTRO25 Mobiles only) W995 NJSP Zone Operation
	4	W357 Channel Scan with VRS (ASTRO/ASTRO25 mobiles only)
	8	Q361/Q361 ASTRO25 9600bps Trunking Operation
1	**1**	Q445 Fireground Accountability Software (ASTRO25 portables only)
	2	Q446 Channel Announcement (ASTRO25 portables only)
	4	G193/Q667 Advanced Digital Privacy (ADP) (ASTRO25)
	8	G788/Q574 9600bps Trunking (ASTRO25? Unconfirmed)

Figure 10.2 FLASHport™ option chart. (Source: http://www.akardam.net/moto/tools/decode3.pl)

To calculate an entire flashcode by hand can be time-consuming. Several hobbyists have written online flashcode decoders which convert a flashcode into human-readable options displayed in text format. Other hobbyists have written small executable programs which does the same task offline. Unfortunately the stand-alone offline decoder is no longer available for download. Here are useful links:

http://www.radioreference.com/modules.php?name=Flash

http://www.akardam.net/moto/tools/decode3.pl

Hardware Hacking

There are two product-families of digital-capable radios: The ASTRO™ and ASTRO25™ series. The hardware hacking section of this guide applies only to ASTRO™-series radios. These are the Motorola Inc. ASTRO Digital Saber™, the ASTRO Digital Spectra™ and the XTS 3000™.

The ASTRO Digital Saber™ and the XTS 3000™ share the same host (ROS) and DSP firmware builds. The ASTRO Digital Spectra™ has its own host firmware build, but shares the same DSP firmware as the portable radios.

As stated much earlier in this guide, there are two vocon-sizes for the ASTRO Digital Saber™ and ASTRO Digital Spectra™: 512K and 1M. The 512K vocons use three 256K flash ROMs. Two ROMs (256K x2) hold the 512K host ROS firmware and the remaining 256K ROM holds the DSP firmware. The same 256K flash ROM is used to store DSP firmware on the Motorola Inc. XTS 3000™ vocoder board.

The 256K flash ROMs are made by Intel or AMD. This varies on a radio-to-radio basis, and is not critical for operation. They are the Intel 28F020, AMD AM28F020 and AM29F002NBB chips, all in TSOP-32 packages. The AM29F series chip features a software write-lock—which is not activated or used in ASTRO™ products.

1M ASTRO Digital Saber™ and ASTRO Digital Spectra™ vocons utilize a 1M flash ROM to store host ROS firmware. Motorola Inc. chose to use the Intel 28F800B5B, 28F800CVB and Micron MT28F800B5B flash ROMs in a TSOP-48 package.

In the XTS 3000™, the controller holds a 1M flash ROM in a TSOP-40 package. Motorola Inc. uses either a TE28F008* flash ROM or the more popular Micron MT28F008B5B ROM.

These various flash ROMs may be read or written to with a chip programmer such as those made by Willem or Phyton Inc., in conjunction with TSOP-32, TSOP-40 and TSOP-48 adapters. Proper care must be exercised when removing/installing TSOP chips to the boards. DO NOT attempt to experiment with chip removal unless you are an experienced and qualified technician.

Figure 11.1 Qualified technician “BSA” prepares to perform maintenance on his ASTOR radio. Subject hasn’t showered in three days and is not photogenic. It’s believed he was packing at least seven cheeseburgers at the time, with the risk of cheeseburger-gas contamination.

Many hobbyists may not be aware the same host ROS and DSP firmware code is shared among the ASTRO™ portable radio-family. Host ROS and DSP firmware may be cloned from an XTS 3000™ and written to a ASTRO Digital Saber™, or vise-versa.

The ASTRO Digital Spectra™ host ROS firmware is not cross-platform-compatible with the ASTRO Digital Saber™ or XTS 3000™.

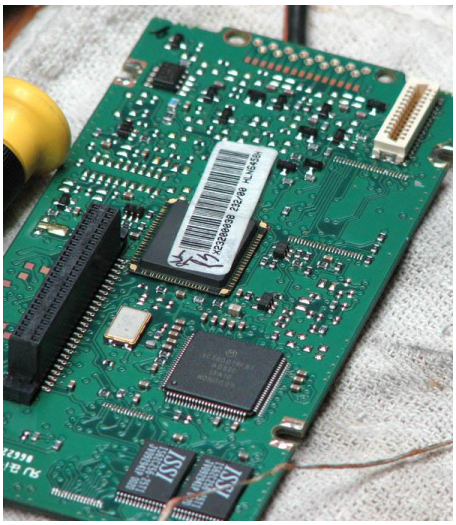

Figure 11.2 A Motorola Inc. ASTRO Digital Spectra™ vocon is shown with the host and DSP flash ROMs removed. This vocon was fortunate enough to receive a free firmware update. It was transformed from VSELP to IMBE™ through donor firmware cloned from another ASTRO Digital Spectra™ which had recently been flashed with the latest firmware builds.

DSP firmware is the same among the ASTRO Digital Saber™, ASTRO Digital Spectra™ and XTS 3000™. For example: The DSP flash ROM from an ASTRO Digital Spectra™ is read with appropriate hardware and saved to a file. The firmware can then be written to a DSP flash ROM and installed to an XTS 3000™.

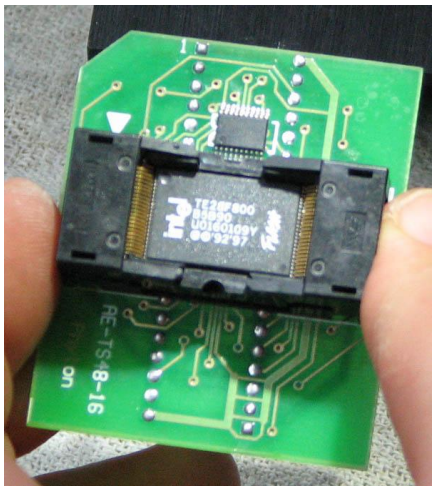

Figure 11.3 A flash ROM from an ASTRO Digital Spectra™ is shown seated in a TSOP-48 adapter in preparation for a firmware upgrade. The firmware write-time to the chip is typically less than one minute.

The ASTRO™ platform uses a 32K x8 EEPROM to store the radio-codeplug in. The same chip—an Atmel 28C256E, is used in the ASTRO Digital Saber™, ASTRO Digital Spectra™ and the XTS 3000™. It is fitted in a TSOP-28 package.

Normally hobbyists use leaked copies of Motorola Inc. Lab-tool or Depot software to manipulate codeplug options such as band-split, serial number or FLASHport™ options. However there are times when a radio-codeplug is so corrupted, the radio will not longer communicate with the computer and appear to be dead. There are even occasions where the radio displays fail or error codes not documented in the service manual. In these instances, it's necessary to pull the EEPROM from the vocon or controller board(s) and manually repair the corrupt data.

Depending on the software you may choose for communicating with your chip programming hardware, it will have an option for loading s-record format files. If you have a known-to-be-good previously-saved s-record, you may load it and write it to the EEPROM, then install it back to the board. Your corrupt codeplug problem will be rectified.

Figure 11.4 A leaked photograph showing the inside of the Motorola Inc. CGISS Mexican Depot (MexiPot). Why send your radio to Mexico when you can work on it yourself?

The *Guide to ASTRO™ Digital Radios* does not provide links or files which may contain Motorola Inc. intellectual property. With this said, the firmware could be sitting right in front of you, installed in a radio that just arrived back from the Mexico depot. Get your SMD rework station out and fire up your programming computer…30 minutes later your useless eBay VSELP radio could be flashed with the latest and greatest firmware.

There are some other interesting points to note about the ASTRO™ host ROS firmware. Over the years there's been discussion about the ASTRO™ product-family supporting the Multiple Private Line (MPL) feature. There's no reference in RSS or CPS to this sought-after feature, but there's reference to it in the host ROS firmware as a soft-menu item. This applies to both the mobile and portable host ROS firmware builds.

```
0007BB60 4620 5241 4E47 4500 4E4F 2043 4F4D 4D53 F RANGE.NO COMMS
0007BB70 0000 4341 4C4C 0043 4841 4E00 4552 4153 ..CALL.CHAN.ERAS
0007BB80 0047 5250 0049 4E44 5800 4B45 5900 4D50 .GRP.INDX.KEY.MP
0007BB90 4C00 4D53 4700 4D55 5445 0050 5357 4400 L.MSG.MUTE.PSWD.
```

Figure 11.5 An illustration which highlights the MPL feature in ASTRO Digital Spectra™ host ROS firmware. This feature is also referenced in the ASTRO Digital Saber™ and XTS 3000™ host ROS builds. (Host ROS R11.70.00 referenced in this illustration example)

Another issue which has been discussed is the support or lack of, for certain encryption algorithms. The ASTRO Digital Spectra™ and ASTRO Digital Saber™ and XTS 3000™ support DES-XL, DES, DVI-XL, DVP-XL, DES-OFB, HAYSTACK, AES-256 and DVI-SP. DES-OFB and AES-256 are ASTRO™ CAI-only encryption algorithms.

Figure 11.6 Contrary to incorrect information posted on a certain Internet discussion forum, the ASTRO™ products do support the AES-256 Type 3 encryption algorithm. Featured in the photo illustration is an XTS 3000™ with a DES-OFB/DES-XL/AES-256 triple-algorithm UCM module installed. This algorithm is also referenced in both the ASTRO™ portable and mobile host ROS firmware builds.

```
0008E4E0 06DF 0000 0100 D944 5350 0020 0045 4D43 .......DSP. .EMC
0008E4F0 2020 0035 3132 4B00 314D 4547 0055 4E4B   .512K.1MEG.UNK
0008E500 4E57 4E00 464C 5348 4344 004B 4731 2020 NWN.FLSHCD.KG1
0008E510 004B 4732 2020 004B 4733 2020 0044 5650 .KG2  .KG3  .DVP
0008E520 0044 4553 2D58 4C00 4445 5300 4456 492D .DES-XL.DES.DVI-
0008E530 584C 0044 5650 2D58 4C00 4445 532D 4F46 XL.DVP-XL.DES-OF
0008E540 4200 4841 5953 5443 4B00 4145 532D 3235 B.HAYSTCK.AES-25
0008E550 3600 4456 492D 5350 004E 4F4E 4500 554E 6.DVI-SP.NONE.UN
0008E560 4B4E 574E 004E 4F4E 4500 FFFF FFFF FFFF KNWN.NONE.......
```

Figure 11.7 An illustration which details the encryption algorithms supported in ASTRO™ portable and mobile host ROS firmware releases. (As of R07.71.00 and R11.70.00. Hexadecimal addresses from host ROS R07.71.00 used in this illustration example)

It is believed HAYSTACK is a Type 1 algorithm for ASTRO™ CAI and DVI-SP is a modified variant of DVI-XL, which works in ASTRO™ CAI mode for export-customers. (These details are unconfirmed)

A useful feature which could be used in combination with surveillance accessories is the voice-activated transmit (VOX) feature, and ultra-sensitive VOX operation. These features are referenced in

the host ROS firmware as the “VOX ON” and “VOX OFF” soft menus. “WHISPER ON” and “WHISPER OFF” soft-menus also exist—however they are not referenced in the RSS or CPS software releases. These are possibly SP features for certain customers.

Figure 11.8 An illustration which highlights the VOX and high-sensitivity WHISPER soft-menu features, which aren’t seen anywhere in RSS or CPS programming screens.

Another miscellaneous but noteworthy firmware mention is the ASTRO™ Portable ASTRO25™ trunking firmware for the ASTRO Digital Saber™ and XTS 3000™. This is major version number R06.xx.xx series firmware, and is used only in conjunction with ASTRO25™/9600bps trunking systems.

The Motorola Inc. XTS 3000™ has a signal-meter which is usually not active in the upper-right display. However, with version R06.xx.xx host firmware installed, the signal-meter works for 3600 and 9600bps trunking systems.

As of host firmware version R06.22.00, there’s no support for AES-256 or triple-encryption-algorithm modules. Only the first two algorithms are displayed during SERVICE test mode. This limitation applies only to this major firmware revision (R06.xx.xx) and not R07.xx.xx releases.

Figure 11.9 A Motorola Inc. XTS 3000 with R06.xx.xx host firmware installed. Note the signal meter in the upper-right display.

As of the publication of this guide (August 2007), the latest IMBE™/CAI host and DSP firmware builds for ASTRO™ and ASTRO25™ products are as follows:

ASTRO Digital Spectra™	**ASTRO Digital Saber™, XTS 3000™**
Host ROS: **R11.70.00** DSP: **08.03.03**	Host ROS: **R07.71.00** (3600bps turnking) Host ROS: **R06.71.00** (9600bps trunking) DSP: **08.03.03**

ASTRO25™ Mobile	**ASTRO25™ Portable**
Host ROS: **R10.00.00** DSP: **R10.00.00**	Host ROS: **R10.00.00** DSP: **R10.00.00**

Guidelines For Buying & Selling ASTRO™/ASTRO25™ Kit

Over the last five years, eBay has become the primary source to find new and used ASTRO™/ASTRO25™ kit at reasonable prices. Some sellers do an excellent job when listing their products for sale, stating all critical information in their auctions.

Whether you're buying or selling ASTRO™/ASTRO25™ on eBay or a for-sale forum of an Internet discussion board, you must know/list the following information:

- The host firmware (ROS) installed in the radio;
- The DSP firmware installed in the radio;
- The revision of the DSP firmware (A,I,M or N);
- The flashcode installed in the radio;
- The size of the vocon/controller ROM (512K or 1M. Larger if ASTRO25™);
- The band-split of the radio (H04UCH9PW7AN for example);
- The encryption module firmware, if installed;
- Encryption algorithms, if installed;
- Last version of RSS/CPS radio was programmed with (not critical);

This information is easily obtained by putting the radio into SERVICE mode by powering it on, and pressing the ".." button five times within the first 10 seconds, or by pressing the HOME key (mobiles) five times within the first 10 seconds upon power-up. If using a W3 hand-held control-head mobile setup, it's the lower-most option-button on the right side of the control-head.

Depending on the host ROS firmware installed in the radio, certain fields may not display. If this is the case, you must state this in your auction.

ASTRO25™ products do not have a DSP revision—just a version. You do not need to ask this question when purchasing a radio. The flashcode determines whether the radio will transmit in IMBE™ mode.

Finally, if a deal looks too good to be true, it probably is. There are a lot of thieves in this hobby. Only deal with credible (positive feedback) or other established persons from Internet discussion forums. Someone who wants $1000 for an XTS 3000™ that signed up a week ago, is not credible.

Radio Programming: Software and Hardware Part Numbers

ASTRO™ Portables (ASTRO Digital Saber™, XTS 3000™):

RVN4100 (RSS MS-DOS software. No longer sold.)
RVN4182 (CPS; runs in Windows environment.)
RKN4046A ASTRO Digital Saber™ programming cable
RKN4035D XTS 3000™ programming cable
RLN4008B RIB Programming interface (required)

ASTRO™ Mobile (ASTRO Digital Spectra™):

RVN4100 (RSS MS-DOS software. No longer sold.)
RVN4183 (CPS; runs in Windows environment.)
3080369B73 Low-power ASTRO Digital Spectra programming cable
0180300B10 High-power ASTRO Digital Spectra programming cable
RLN4008B RIB Programming interface (required)

ASTRO25™ Portables (XTS 1500™, XTS 2500™, XTS 4000™, XTS 5000™, PR 1500™ and MT 1500™)

RVN4181 CPS Programming software
RKN4105 USB Programming cable
RKN4106 Serial Programming cable
NKN1029A USB Programming cable, XTS 4000™
NKN1027A Serial Programming cable, XTS 4000™

ASTRO25™ Mobiles (XTL 5000™, Digital Spectra Plus™, XTL 1500™, XTL 2500™)

RVN4185 CPS Programming software
HKN6155 Serial programming cable (Low-power)
HKN6183 Serial programming cable (High-power)
HKN6184 USB programming cable

ASTRO™/ASTRO25™ Encryption Hardware

Detailed encryption capabilities of the ASTRO™ and ASTRO25™ family radios are not outlined in the *Guide to ASTRO™ Radios*, however an excellent encryption primer has already been written by **batdude** and is most helpful in building a foundation of knowledge in this area. It is available for download here (link working as of 8/12/2007):

http://members.aol.com/batlabsdotcom/encryption.pdf

Change Log

The *Guide to ASTRO™ Digital Radios* has undergone several changes since the time of a short "FAQ" post on the BatBoard Internet Discussion Forum in October 2003.

A more detailed, but highly disorganized website was erected in 2005, but I've since taken it offline. This was referred to as release 2.0.

This guide will now be presented in PDF format, and a change log will list what's new or updated in each forthcoming release. Unlike Motorola Inc., I believe it's important to tell your users what has changed since you last messed with the code.