PROGRAMMING AND OPERATION INSTRUCTION MANUAL

MODEL 712

R-D-S 'RADIODATA' ENCODER

Radio Data System

Revision 2
(Automatic Parsing)
Firmware Rev. 1.0.4
Effective with 712 S/N 406

INOVONICS
INCORPORATED

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R-D-S
RADIO DATA SYSTEM 'RADIODATA' ENCODER

December, 2005

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Section I

INTRODUCTION

MODEL 712 PRODUCT DESCRIPTION

The "Radio Data System" The Radio Data System allows the FM broadcaster to transmit certain digital data along with his regular audio programming. Packets of data transmitted on a low-level subcarrier identify the station and its particular broadcasting 'format,' allow for transmission of song information, advertising and other text messages, and perform additional ID, control and housekeeping chores.

RDS vs. RBDS The Radio Data System was developed in Europe and is abbreviated RDS there. The first US implementation of RDS differed sufficiently from the European standard to warrant its being renamed the Radio *Broadcast* Data System, or RBDS. Differences between the two standards have been reconciled and minimized over the years, yet RBDS prevails as the US designation. For the sake of clarity and simplicity, the more generic and established term RDS will be used throughout this Manual.

General Inovonics' 712 is a complete, 'full-function' digital data encoder for quickly and easily implementing RDS at any FM radio station. In addition to static IDs, traffic and other 'flags,' The 712 supports dynamic data for sending song titles, advertising messages and specialized "in-house" applications to the listener's radio.

Features Leading features of the Inovonics 712 include:

- "Static" data quickly programmed or updated with a Windows® PC or ASCII terminal. ASCII standardized interface supports "dynamic" functions.

- Works with popular hard-disk automation systems to transmit song titles, contests, billboards, scrolling advertisements, etc.

- Scrolling messages are automatically 'parsed,' or broken into 8-character word groups for transmission. An alternative "Safe Scroll" mode reduces the distraction associated with dynamic displays in automobiles.

- Loop-through or 'sidechain' operation with any exciter/stereo generator combination.

- Operates with third-party hardware and software for increased functionality.

- Simple to install and easy to use!

Standards Supported:
European CENELEC and United States NRSC.

RDS Applications Supported:
PI, PS, PTY, TP, TA, RT, AF, DI, M/S, FFG. (A detailed explanation of these applications begins on Page 7.)

Operating Modes:

(1) Loop-Through:
In loop-through operation, the RDS subcarrier is internally mixed with the MPX input and the combined signal is delivered to the RDS or MPX Output. The encoder has unity gain in the loop-through mode and accepts a maximum level of 6 volts peak-to-peak corresponding to ±75kHz carrier deviation.

(2) Sidechain:
In sidechain operation, only the RDS subcarrier appears at the RDS or MPX Output. The monitored MPX (or TTL sync) is used solely to syn-chronize the 57kHz RDS subcarrier with the 19kHz stereo pilot.

Pilot or MPX Input:
An unbalanced, bridging BNC input that accepts either the composite/multiplex (MPX) signal or 19kHz TTL-level pilot sync from the stereo generator.

RDS or MPX Output:
An unbalanced, low-impedance BNC output to feed a wideband input of the FM exciter.

RDS Injection Level:
Continuously adjustable between zero and 2 volts peak-to-peak.

Serial Data Port:
RS-232 port (DB-9) for static pro-gramming and dynamic messaging. 2400, 4800, 9600, 19200, 38400, 57600 or 115000 baud; 8, N, 1, plain-text ASCII protocol.

TA Switching:
The temporary TA flag is set either by a software command or with a contact closure through a rear-panel BNC connector.

Power Requirements:
105–130VAC or 210–255VAC, 50/60Hz; 10W.

Size and Shipping Weight:
1¾"H x 19"W x 7"D (1U); 7 lbs.

BLOCK DIAGRAM

Figure 1, below, is a simplified Block Diagram of the Model 712. Because of the all-digital, minimalist-discrete-component nature of encoder circuitry, we have not provided schematic diagrams of the Model 712 in this Manual. As they say on the back of TV sets:

> NO USER-SERVICEABLE COMPONENTS INSIDE. REFER ALL SERVICING TO QUALIFIED TECHNICAL PERSONNEL.

Nonetheless, Inovonics does, of course, support the Model 712 to the technical n^{th} degree, and will provide detailed service information upon request, including sources for all replaceable parts and realistically-priced factory replacements for firmware-proprietary integrated circuits.
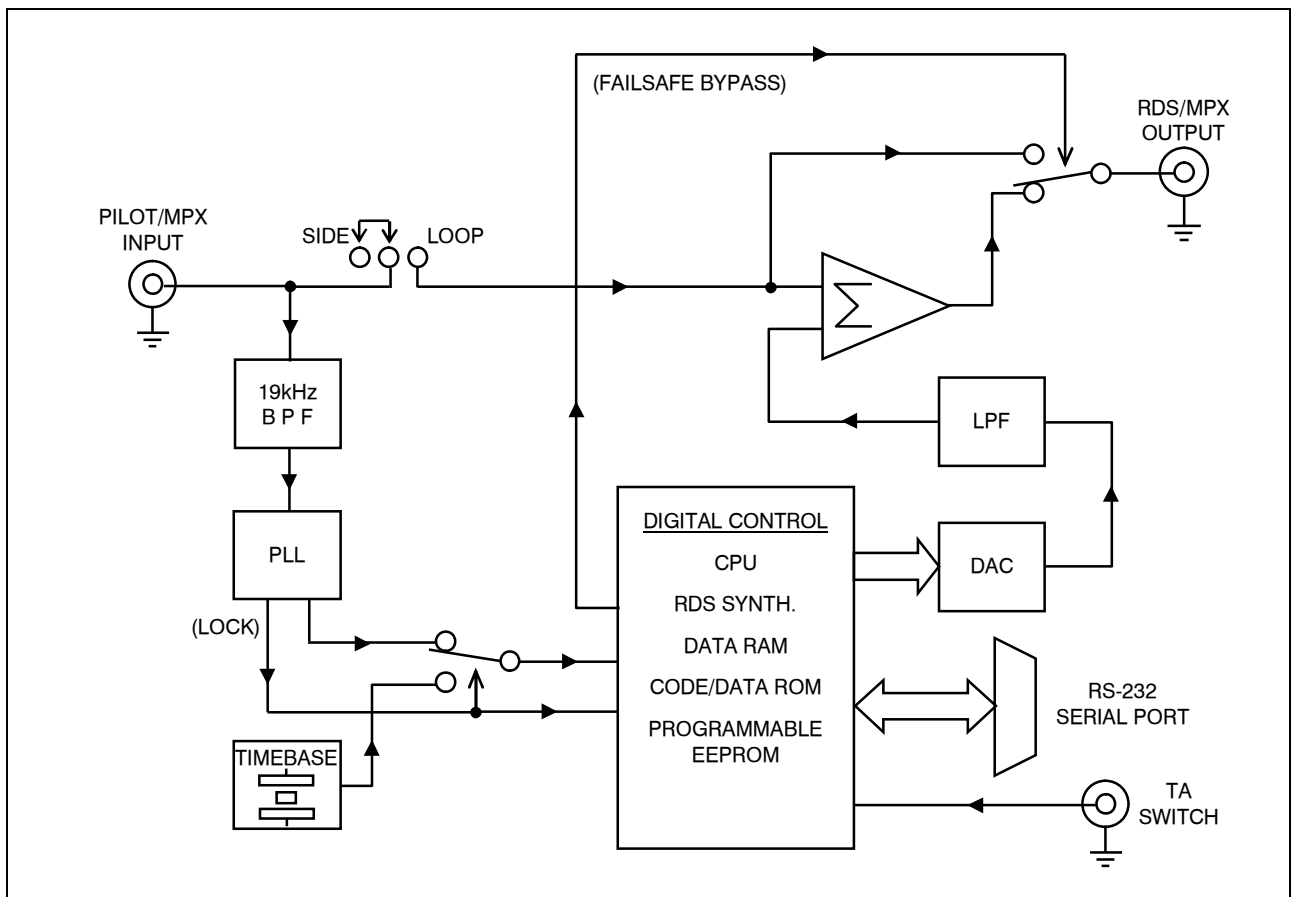
Figure 1 – Block Diagram, Model 712 RDS Encoder

Section II

THE RADIO DATA SYSTEM

RDS: EUROPE vs. AMERICA

The European Broadcasting Union (EBU) and its member countries originated the concept of "Radio Data" transmission. The European RDS specification, CENELEC Standard EN50067, was first published in 1984, and was revised in 1986, 1990, 1991 and 1992.

European RDS has grown in use following initial adoption of the Standard. RDS is nearly universal throughout Europe; it is almost impossible to find a European FM broadcasting station that does *not* carry a radio data subcarrier.

The popularity of RDS in Europe is very much in contrast with initial reluctance on the part of US broadcasters to embrace this technology. This can be ascribed to material differences in broadcasting practices.

Almost without exception, FM broadcasting in the United States is 'detached' and independent; that is, each station originates its own programming. One exception might be America's National Public Radio, though for most of the broadcast day even NPR stations originate, or at least schedule, their own programs.

Much of European broadcasting is similar to the concept of network radio that was common in the US prior to the 1950s. In Europe, a central program originator may have many transmitting facilities of modest power situated throughout the country. The European disposition toward lower-power transmitters can be found on the 'local radio' level as well, with relay (re-broadcast) repeater transmitters at several different frequencies to blanket a designated service area.

The European concept of a *service area* equates to the US broadcaster's *market*. The subtle difference between these designations further characterizes broadcasting practices and ethics. RDS benefits the European broadcaster through almost an altruistic endeavor to be of *service* to his listeners. The US broadcaster is *marketing* his programming, and is primarily interested in how he can create additional revenue from RDS.

THE RDS SYSTEM

RDS is a digital data channel transmitted as a low-level subcarrier above the range of the composite stereo program signal in the FM baseband. The data transmission (baud) rate is comparatively low,

yet it is quite robust because of redundancy and error correction routines.

It is not within the scope of this Manual to cover the details of RDS subcarrier coding and modulation. For this the reader is directed to the Specification appropriate to his location, either the CENELEC EN50067 Specification for Europe, or the United States NRSC Specification. It is assumed that the user has some familiarity with the concept of RDS, since the balance of this Manual will deal with specific implication of RDS implemented with the Inovonics Model 712.

ADDRESSING THE MODEL 712 ENCODER

Many applications, such as Radio Paging, navigational assistance, roadside message billboards, radios which print and eject money-saving coupons, stock market updates, etc. all require continuous, on-line access to the RDS encoder by one or more service providers. Generally, these applications are the ones that promise additional revenue to the station. The Model 712 offers these capabilities and is directly addressed by simple ASCII commands from a computer or automation system.

The Model 712 does *not* provide TCP/IP network connectivity to enable online control via a Local Area Network or the Internet. Inovonics does offer another RDS encoder, the Model 713, which does provide a direct network connection. However, third-party hardware and appropriate software may be used with the 712 to offer TCP/IP connectivity.

Particularly in Europe, RDS encoders may be linked with one another for network support applications. The UECP, or Universal Encoder Communication Protocol was developed by CENELEC to support this form of operation. The 712 does *not* conform to the UECP.

RDS APPLICATIONS SUPPORTED BY THE MODEL 712

The following is an alphabetical listing of RDS applications that are fully supported by the Model 712. The standardized RDS application abbreviation is followed by an expansion of the application name and a short explanation of the function.

AF **List of Alternative Frequencies:** A "network" broadcaster, or one using low-power rebroadcast transmitters to fill holes in his coverage area, can include a list of all frequencies where the identical program can be heard simultaneously. Upscale RDS receivers constantly search for the best signal that carries the very same program. When a stronger signal is found, the radio re-tunes with no noticeable interruption. The principal utility of this RDS function

is with European radio networks and US stations with 'translators.'

DI   **Decoder Information:** This is one of several 'flags' that convey yes/no or other very basic data. This particular flag tells the receiver whether the broadcast is monaural, or is being transmitted in any of several methods of stereo or binaural broadcasting. This is a rather esoteric and little-used function, and only monaural and stereo modes are supported by the Model 712.

FFG   **Free Format Groups:** Included in the Model 712 is a method of transmitting proprietary data within a legitimate RDS group. This is a special use of the encoder for non-standard applications. Additional notes can be found on Page 37.

M/S   **Music / Speech Switch:** This flag simply indicates whether music or speech is the primary broadcast programming. The purpose of this function is not well explained in the respective Standards; hence it comes as no surprise that it is not widely used.

PI   **Program Identification:** This block of data identifies the broadcast station with a hexadecimal numerical code, which becomes the "digital signature" of the station. The code is assigned by the broadcasting authority in most countries, but in the US (only!) it can be calculated from a numerical encoding of station call letters. The receiver processes the PI code to assist automatic tuning features (station memories), and to prevent false switching to alternative frequencies that might be shared by broadcasters in nearby regions.

PS   **Program Service Name:** This is the station's "street name" that will appear on the receiver faceplate display. The PS can be up to eight characters in length (including spaces) and can be as simple as the station's call letters (KWOW or KWOW FM) or a slogan (NEWSTALK or LIVE 95). The Program Service Name is automatically displayed, even on automobile receivers, so it is meant to remain 'static.' Because of driving safety considerations, broadcasters are discouraged from making the PS 'dynamic'; that is, to send long messages in successive 8-character frames. As a matter of fact, it is a violation of both the CENELEC and the NRSC standards to flash or scroll the PS display. Nevertheless, this nefarious practice has become very common, both in the US and abroad.

PTY   **Program Type:** The PTY data flag identifies the station format from a collection of pre-defined categories. Many RDS receivers are able to seek the listener's preferred format automatically. This means that a car radio can switch from a fading station to a stronger one that carries the same *variety* of music, though not the very same program, as provided by AF switching. The PTY function of RDS helps a broadcaster catch 'transient audience' share. A listing of the PTY categories is given on Page 32.

Under some programming circumstances, the PTY identifier may be made 'dynamic,' changing between categories for a station that "dayparts" (changes its format for specific time periods). The PTY

code is not meant to change from song to song or to accommodate a top-of-the-hour newscast, however.

RT   **RadioText:** This is a 64-character block of plain text that the listener can select for visual display on the faceplate of the radio. This function is generally not available on automobile receivers for safety considerations, which has precipitated the frowned-upon practice of scrolling the PS field instead. Most radios have limited alphanumeric display capability, so the 64 characters 'march' across the front panel, much akin to those annoying LED advertising signs found in airport buses or fast food emporia. Like the scrolling PS implementation, RadioText can announce song titles and performers, run special promotions or contests, or display sponsors' messages.

TA   **Traffic Announcement:** This is a *temporary* flag added to the RDS data stream *only* as a traffic bulletin is being aired. Some RDS car radios can be set to search for traffic bulletins among various TP stations (see **TP** below) while tuned to a listener's preferred program, or even while playing a CD or tape. As soon as any TP station broadcasts a traffic bulletin, the receiver *temporarily* switches-over to receive it. When the bulletin is finished, the receiver switches back to the original program, CD or tape.

TP   **Traffic Program Identification:** The TP flag identifies the station as one that routinely broadcasts traffic bulletins for motorists as part of its normal, everyday programming. When the TP flag is displayed on the receiver faceplate, the radio is searching for traffic announcements. The radio keeps track of TP stations offering this service to speed up the search-and-switch process.

Section III

ENCODER INSTALLATION

UNPACKING AND INSPECTION

As soon as the equipment is received, inspect carefully for any shipping damage. If damage is suspected, notify the carrier at once, and then contact Inovonics.

We recommend retaining the original shipping carton and packing materials, just in case return or reshipment becomes necessary. If returned for Warranty repair, shipping damage sustained as a result of improper packing for return *may invalidate the Warranty!*

IT IS VERY IMPORTANT that the Warranty Registration Card found at the front of this Manual be completed and returned. Not only does this assure coverage of the equipment under terms of the Warranty, and provide a means of tracing lost or stolen gear, but also the user will automatically receive specific SERVICE OR MODIFICATION INSTRUCTIONS should these be forthcoming.

MOUNTING

Rack Requirement   The Model 712 mounts in a standard 19-inch equipment rack and requires only 1¾ inches (1U) of vertical rack space. We recommend plastic or fiber washers to protect the painted finish around the mounting holes.

Heat Dissipation   Consuming less power than a pet-grooming hair clipper, the 712 itself generates negligible heat. The unit is specified for operation within an ambient temperature range extending from freezing to 120°F/50°C. But because adjacent, less efficient equipment may radiate substantial heat, be sure that the equipment rack is adequately ventilated to keep its internal temperature below the specified maximum ambient.

AC (MAINS) POWER

Fuseholder   The fuseholder is at the far left of the front panel. Apply downward pressure and pull the cap outward to access the 5mm mains fuse. Note that the cap has space for a spare fuse as well. The cap is reseated by reversing the removal process. This fuse also serves as a

front-panel emergency power disconnect for the Model 712.

Mains Voltage Selector Unless specifically ordered for export shipment, the Model 712 is set at the factory for operation from 115V, 50/60Hz AC mains. This can be confirmed by checking the designation next to the mains connector on the rear panel. The *inappropriate* voltage and fuse value will have been crossed out at the factory with a black marker.

To change the mains voltage, first remove the top cover of the unit. A clearly marked slide switch is next to the AC mains connector on the encoder circuit board. *With power disconnected*, use a small screwdriver to set the switch for 115VAC or 230VAC operation.

Be sure to install the appropriate fuse listed on the rear panel. You can remove the factory strikethrough with a (doubtless, carcinogenic) solvent and then cross out the inappropriate marking with an indelible felt pen.

Power Cord The detachable IEC-type power cord supplied with the encoder is fitted with a North-American-standard male plug. The individual cord conductors may be color-coded in either of two ways:

1) In accordance with US standards:

BLACK = AC "HOT"   WHITE = AC NEUTRAL
GREEN = EARTH GROUND

2) To European CEE standards:

BROWN = AC "HOT"   BLUE = AC NEUTRAL
GRN/YEL = EARTH GROUND

RADIO FREQUENCY INTERFERENCE (R F I)

Location Although it is natural for the 712 to be installed alongside high-power transmitters, please practice reasonable care and common sense in locating the unit away from *abnormally* high RF fields.

Ground Loops Because the unbalanced PILOT OR MPX INPUT and the RDS OR MPX OUTPUT of the Model 712 are chassis-ground-referenced, a mains frequency or RF ground loop could be formed between the input or output cable shield grounds and the AC power cord ground. A 'ground-lifting' AC adapter may well remedy such a situation, though the chassis somehow must be returned to earth ground for safety. Generally, being screwed-down in the equipment rack will satisfy the safety requirement.

SELECTION OF OPERATING MODES

Sidechain Mode Configured for sidechain operation, the rear-panel PILOT OR MPX INPUT connector simply bridges (monitors) the output of the stereo generator to derive timing information from the 19kHz stereo pilot. Alternatively, a TTL-level 19kHz sync squarewave may be applied to this input. We do not recommend this, however, because the

phase relationship between the synchronizing squarewave and the 19kHz pilot component in the composite, multiplex output of the stereo generator may not be assured.

In sidechain operation the RDS OR MPX OUTPUT will contain *only* the RDS subcarrier, the composite/MPX signal is *not* routed through the 712. This operating mode will insure best multiplex signal integrity and assure uninterrupted program transmission in the event of a catastrophic encoder failure (never happens!). As delivered, the 712 is configured for sidechain operation.

Referring to the jumper installation drawing, Figure 2, below, locate the 3-terminal jumper strip, located just behind the rear-panel RDS OR MPX OUTPUT connector on the Model 712 circuit board. The shorting shunt is positioned to the *left* for sidechain operation, as shown in the upper example of Figure 2.

Loop-Through Mode   When the Model 712 is jumpered for loop-through operation, the RDS subcarrier is internally combined with the composite/MPX signal. This means that the RDS OR MPX OUTPUT *will include* the composite/MPX program signal (at unity gain) with the RDS subcarrier added.

The lower illustration in Figure 2, below, shows the position of the shorting shunt, toward the *right*, for loop-through operation.
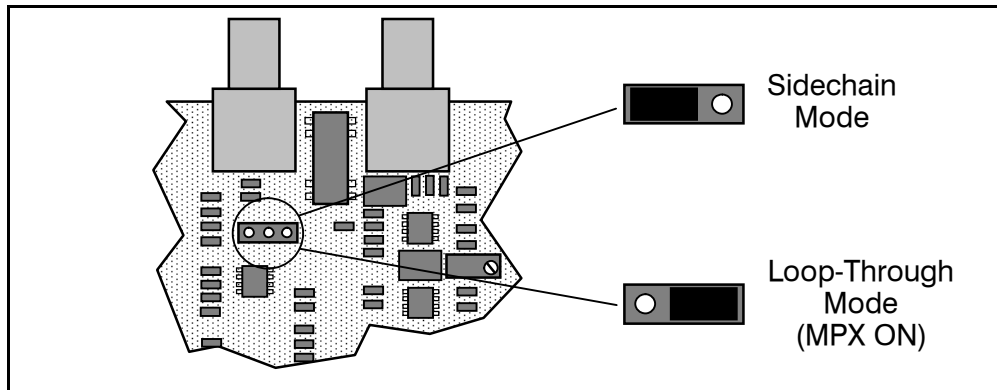
Figure 2 – Encoder Mode Jumpering

IMPORTANT: The 712 encoder must be properly configured for the desired operating mode: sidechain or loop-through. See the preceding instructions to confirm that the encoder circuit board is properly jumpered before connecting the Model 712 to other air-chain equipment.

ALSO: Test the encoder with its controlling interface (computer, terminal, automation, etc.) *before* it is placed in the air chain. This will ensure that communication with the encoder can be established and that the encoder is properly initialized.

Sidechain Mode (preferred)

Attach a BNC 'T' adapter to the composite/MPX output of the stereo generator as shown in Figure 3, below. Connect one side of the 'T' directly to a wideband (composite/ MPX) input of the FM exciter and the other side to the PILOT OR MPX INPUT of the Model 712. (This is only a bridging 'sync' connection when the circuit board has been jumpered for sidechain operation and in no way affects the composite/MPX signal.)

If the stereo generator has a dedicated 19kHz TTL-level output designated for RDS encoder sync, you *may* connect this to the encoder PILOT OR MPX INPUT. We do not recommend this, however, as a dedicated 19kHz sync output may not have an accurate phase relationship with the stereo pilot.

Cable the RDS OR MPX OUTPUT of the encoder to a second wideband (subcarrier) input of the FM exciter.
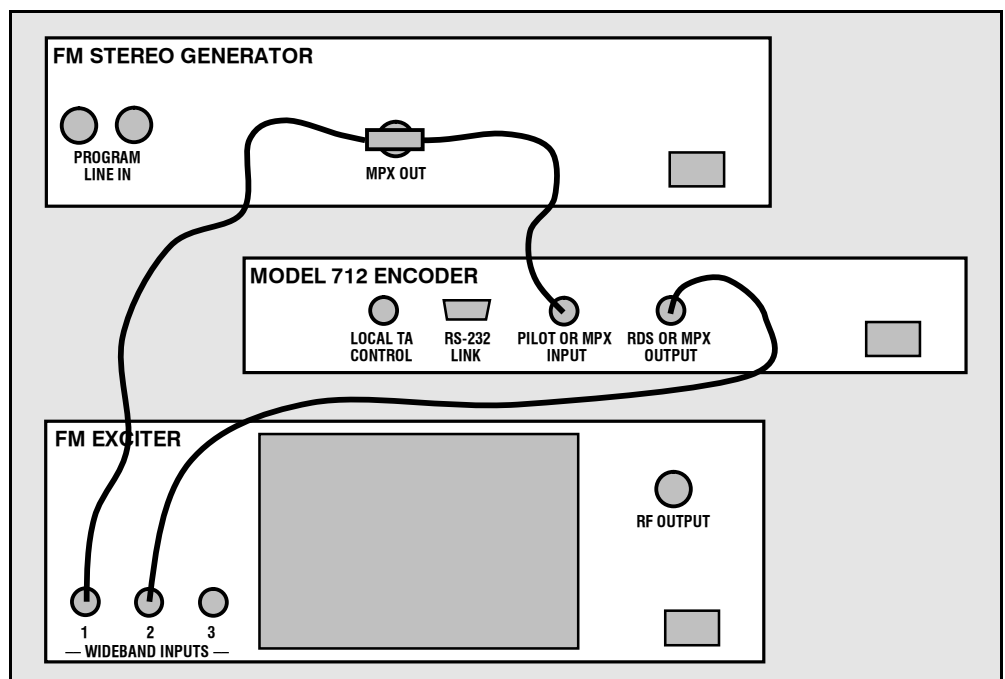
Figure 3 – 'Sidechain' Encoder Connection

Loop-Through Mode In the loop-through mode, the output of the stereo generator is cabled directly to the PILOT OR MPX INPUT of the Model 712 as shown in Figure 4, below. Connect the RDS OR MPX OUTPUT of the encoder to a composite/MPX wideband input of the FM exciter. When internally jumpered for loop-through operation, the composite/MPX signal *passes through* the encoder with unity gain, and with the RDS subcarrier added.
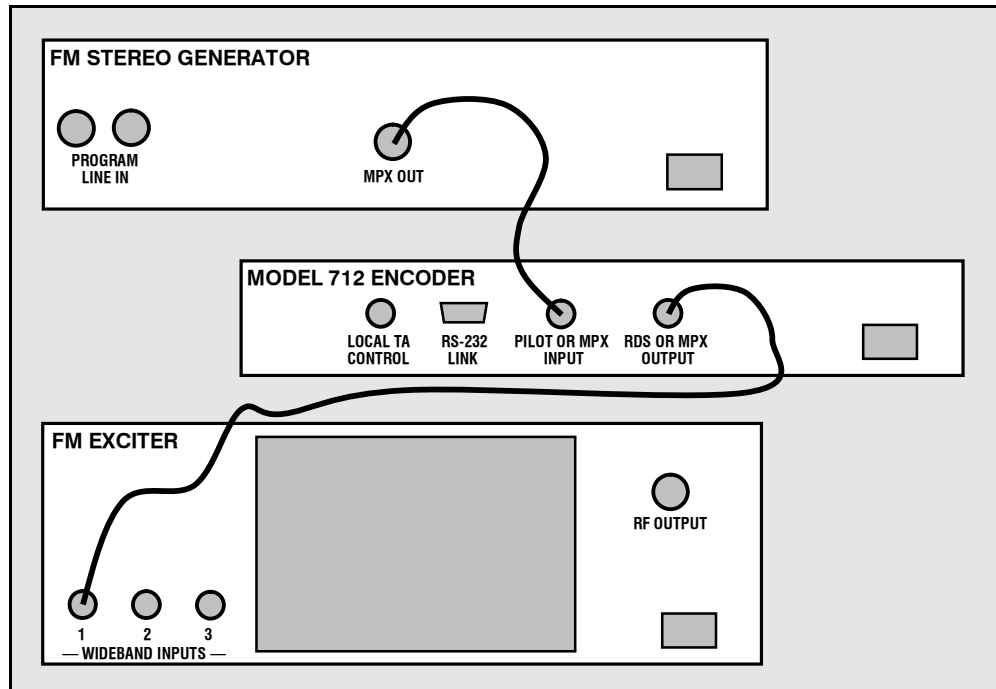
Figure 4 – Loop-Through Encoder Connection

Manually Activating the TA Flag The Travel Announcement feature is a temporary command. This flag *must* coincide with the actual voice warning of a traffic condition. The encoder includes a provision to access this flag with a manual switch closure, which will doubtless prove faster, more convenient and more reliable than software control of the TA function.

A run of single-conductor shielded cable may be taken from the TA CONTROL BNC connector on the rear panel of the encoder to a normally open *momentary* (spring-return!) pushbutton switch located conveniently at the announcer's operating position.

The TA flag will be transmitted as long as the switch is held down. *It is important that this alert is active only for the duration of a traffic announcement.* The TA flag must be *turned off* immediately after completing the verbal traffic warning.

DATA INTERCONNECTION

The rear-panel RS232 SERIAL DATA INTERCONNECT DB-9 port is addressed in simple ASCII text for programming the various static RDS IDs and 'flags,' and for uploading Radio Text. The Windows®

programming software provided with the Model 712 on CD-ROM automatically formats static data with simple, on-screen entry. This software may also be downloaded from the Inovonics Website. For direct connection with automation, communication syntax is explained in Section IV, with advanced programming instructions beginning on Page 25.

Interconnect Cable

When connecting the 712 encoder to a computer for static programming, or to station automation for dynamic messaging, a 'straight-through,' pin-for-pin DB-9 extension should be used. This cable pinout is diagrammed in Figure 5A at the bottom of the page.

Computer or Terminal Requirements

Although the Windows® RDS Data-Entry Software affords the easiest method of inputting static RDS data, the encoder may also be addressed with any computer running a "terminal emulation" program (eg: *HyperTerminal,* normally supplied with *Microsoft* Windows®), or with a simple "dumb" terminal that has an RS-232 interface. The encoder can accommodate several baud rates, but the factory default is 9600 baud. Set the terminal (or terminal program) for: 9600-baud / 8 data bits / no parity / one stop bit (9600,8,N,1).

Using either the Windows® interface or an ASCII terminal, static PS and other IDs, flags and the alternative frequency list are uploaded into non-volatile encoder memory. If dynamic RadioText is not used, a slogan, phone number or advertising message can be entered as a simple static message. Once this has been done, the encoder may be disconnected from the computer, relocated to another operating point, or reconnected to an alternative data source for dynamic messaging. This may be a hard-disk-based station automation system that provides song title and artist, plus ads or station promos. The automation system must be configured to the encoder's baud rate and programmed to deliver dynamic data in proper syntax as explained by the advanced instructions in Section IV.

Modem Link

A modem link also may be used for addressing the encoder from a remote location. When properly configured, a modem link will appear 'transparent,' as if the encoder were connected directly to the controlling system. Figure 5B shows proper pin connections for the cable used to connect the Model 712 to a conventional external modem. The three conductors shown are the only ones required.
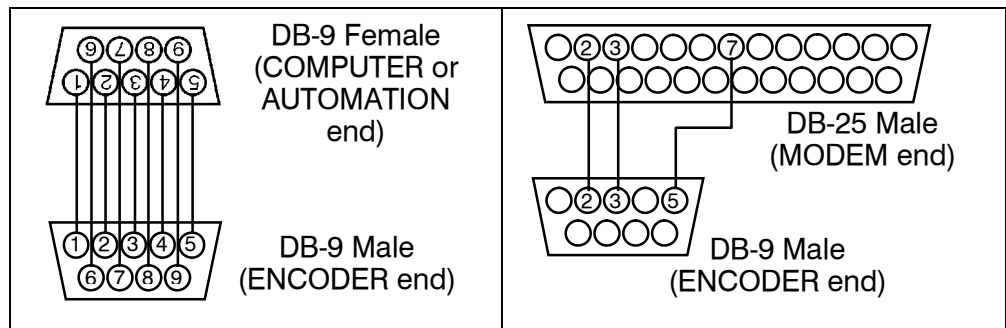
Figure 5A
Computer or Automation Cable

Figure 5B
Modem Cable

Section IV

PROGRAMMING AND OPERATION

FRONT PANEL APPOINTMENTS

Six front-panel ENCODER STATUS indicators monitor Model 712 vital signs.

PWR. ON	This green LED glows whenever primary power is present. If this indicator is off, the encoder will have switched into the failsafe Bypass mode. In the loop-through encoder mode (only), Bypass connects the PILOT OR MPX INPUT directly to the RDS OR MPX OUTPUT.
PILOT LOCK	This LED lights when the encoder has locked to the 19kHz stereo pilot signal from the stereo generator, either in the sidechain or the loop-through mode of encoder operation.
FREE RUN	When no 19kHz pilot is present at the PILOT OR MPX INPUT, the encoder defaults to a crystal-controlled internal timebase. This enables RDS transmissions with monaural programming. The FREE RUN LED shows that the encoder has defaulted to its internal timebase.
RS-232 ACTIVITY	As the encoder is being addressed, either by a computer or terminal for static programming, or by station automation for uploading of song titles or advertising, this LED shows 2-way activity of the serial interface.
RDS DATA	This LED flashes as RDS data is being transmitted, indicating that the encoder is operating normally. Even when no dynamic data is being sent, the various RDS groups of static identifiers are updated continually.
TA FLAG	Whenever the TA flag is raised, either with a software command or a switch closure, this LED flashes. **Remember:** the TA flag is supposed to be only temporary. It should be turned off when the announcement ends.

In addition to the LED status indicators, the front panel also contains:

FUSE / DISCONNECT	The front-panel fuseholder also provides a means of disconnecting AC mains power in an emergency. Push the fuseholder cap down and pull it away from the panel to interrupt power.

INJECTION
LEVEL ADJUST

RDS injection level (subcarrier modulation) is set with this multiturn trim control. A detailed procedure for setting injection level follows.

SUBCARRIER INJECTION LEVEL

The front-panel INJECTION LEVEL ADJUST potentiometer sets the level of the RDS subcarrier. This is a 15-turn potentiometer to allow the required adjustment resolution.

In the *sidechain* mode of operation, the RDS subcarrier is the only signal that appears at the rear-panel RDS OR MPX OUTPUT connector. Because some exciters require a high signal level at auxiliary wideband (SCA) inputs, the RDS signal has been made adjustable to any value between zero and 2 volts, peak-to-peak.

In *loop-through* operation of the encoder, the composite/MPX program signal that is fed to the PILOT OR MPX INPUT appears with unity gain at the RDS OR MPX OUTPUT. A typical peak-to-peak level of the Composite/MPX program signal is 3 volts. The same 0-2V RDS subcarrier level range is available in this mode, so obviously the INJECTION LEVEL ADJUST control will be closer to the counterclockwise end of its travel to give a level of 0.1 volts p-p, which would correspond to the typical 3% to 4% RDS injection.

Setting Subcarrier Amplitude

Injection level is best set with a modulation monitor that includes a subcarrier measurement utility. Alternatively, a basic mod-monitor can be used alone, but program modulation and the stereo pilot must be turned off to resolve the low RDS injection level.

NOTE: If using a mod-monitor that does *not* have separate subcarrier measurement capability, keep in mind that mod-monitors are *peak-responding* for total modulation readings near 100% modulation, but may be *average-responding* for low-level measurements on other readout scales. Because the RDS subcarrier is a complex, suppressed-carrier double-sideband signal, an *average* reading of 3% RDS injection can represent a level that is substantially higher when measured peak-to-peak. It is the *peak* level that is of concern in broadcasting.

Perhaps a better means of setting injection when a subcarrier monitor is not available is simply to bridge the input of the exciter with an oscilloscope using a BNC "T" adapter. With a normal program input, the peak-to-peak value of the composite/MPX signal can be noted. Write this figure down and then turn off program and pilot modulation (but do not *disconnect* the stereo generator). Set the peak-to-peak value of the RDS subcarrier to about 3% of the measured composite/MPX level. When the program signal is returned to normal, the mod-monitor should indicate a 3% increase in total modulation, though this may be difficult to resolve near the 100% mark. Readjust the output level of the *stereo generator* to fine-tune the final total-mod figure.

In the United States, the FCC permits an extra 5% modulation for each subcarrier, with total modulation not to exceed 110% even with two or more subcarriers. Consult the FCC regulations to be certain on this matter.

Subcarrier Phase   In the interest of maintaining greatest program modulation efficiency, the 57kHz RDS subcarrier should be in *quadrature* with the 19kHz stereo pilot. Both in-phase and quadrature relationships between the stereo pilot and RDS subcarrier are shown in Figures 6 and 7, respectively. Note that a quadrature relationship (Figure 7) yields a slightly lower peak level, which allows the greatest carrier modulation by the program audio signal.
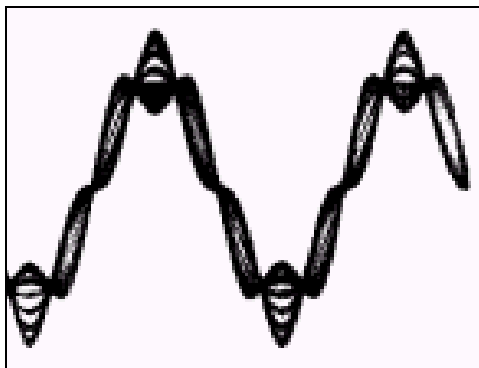
Figure 6 – Subcarrier In-Phase   **Figure 7 –** Subcarrier In Quadrature
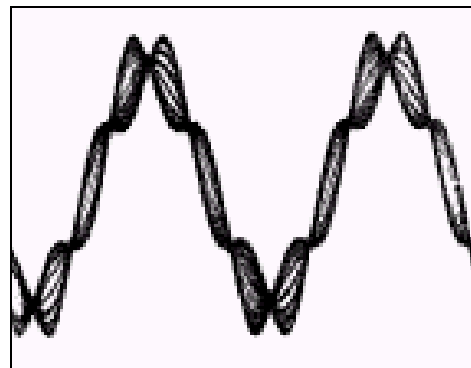
The Model 712 is skillfully and carefully aligned at the factory to ensure that the subcarrier is in quadrature with the stereo pilot, whether the encoder is used in the sidechain or in the loop-through operating mode. Although some stereo generators supply a pilot-sync reference for RDS (usually a TTL-level squarewave), this reference may or may not be in exact phase with the actual stereo pilot component of the composite/MPX signal. For this reason we recommend using the composite/MPX signal for synchronization. In the sidechain mode, the Model 712 simply bridges the output of the stereo generator and does not load or otherwise compromise the composite/MPX signal.

PROGRAMMING OPTIONS

Developed as a fully 'interactive' RDS encoder, the 712 can interconnect directly with station automation to transmit dynamic messaging to the receiver; for example, song title and artist information or air personality ID. Station automation communicates with the Model 712 through an RS-232 serial data interface.

The data stream from the automation system must be formatted properly for communication with the 712 encoder. Commands require proper preambles, or headers, so that the 712 interprets dynamic data as valid commands.

In addition to dynamic messaging, there is a certain amount of obligatory, repetitive *static* information that is broadcast continuously in the RDS data stream. These are IDs and 'flags' that tell the receiver 'who is sending what, and how.' For all practical purposes, this information is fixed, and is programmed into the non-volatile memory of the Model 712 before it is connected to station automation for dynamic messaging.

Simplified Windows® Data-Entry Software

To help get RDS on-air quickly and painlessly, a very simple and intuitive Windows® interface has been included on the CD-ROM that comes with the Model 712 encoder. This can be used by anyone to set the static IDs and flags, and even to program default entries into the dynamic messaging fields.

Advanced Programming 'Tutorial'

A 'tutorial' on programming the encoder begins on Page 25 and goes into some detail on how commands are formatted and sent as different groups, or 'strings,' of ASCII characters. To stress the importance and to impart full understanding of the syntax of characters that need to be sent, the tutorial has been written for the more experienced programmer. It is hoped that the detailed instructions for 'manually' addressing the encoder, as if from a 'dumb terminal,' will give a sufficient understanding of how commands from station automation must be formatted.

LOADING AND RUNNING THE SIMPLIFIED WINDOWS® SOFTWARE

Installing the Software

Insert the supplied CD. This software has an 'autorun' utility, therefore: click Start, then My Computer, and then double-click the CD Drive (D:). Double click the file: setup.exe to launch the Wizard (shown here) that will guide you through the several installation steps. Unless you have a specific reason to make changes, simply accept the default recommendations in each step by selecting Next> every time.

A normal installation will place an icon on your computer Desktop. Double-clicking the icon will start the data-entry software.

The data-entry screen is largely self-explanatory. Before entering any data, it is important to select the proper encoder operating mode. For North America (US, Canada and Mexico), the button indicated by the arrow should be toggled to read: RBDS. For the rest of the world, it should be set to indicate: RDS. This is important both for setting the PI code and to make sure that the proper PTY group is selected.

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Using ALL-CAPS   Because many RDS radios cannot display a full set of ASCII characters, the use of mixed (capitals and lowercase) letters can result in a very bizarre or completely unreadable message. Thus this Windows® data-entry software forces the use of all-capital letters.

PI Code Calculator   The PI code is your station's 'digital address.' It is a hexadecimal code that is assigned by an appropriate broadcasting authority in most countries, but in the United States PI is numerically calculated from the station's callsign. (An in-depth discussion of the mathematical calculation appears in the NRSC RBDS Standard.)

A PI calculator for US 'K' and 'W' callsigns (US only!) is built into the Model 712 software. Simply enter call letters into the Call box and click the left-facing arrow. The hexadecimal code will automatically be entered in the Code box. If the hexadecimal code for a US station is known, you may enter it under Code, and then click the right-facing arrow to confirm a proper call letter match.

In all other countries the appropriate broadcasting authority is responsible for assigning PI codes, which are then entered directly into the Code box. *NOTE:* Canadian and Mexican codes should *never* bring up US-look-alike call letters when 'tested' by clicking the right-facing arrow! When in doubt: 1) consult the broadcasting authority, 2) check the latest published RDS Specification, or 3) log onto the primary RDS information website: **www.rds.org.uk** for help.

The illustration below shows the data entry screen filled-in for a typical US rock station. Each of the entries will be detailed individually, with references to Manual page numbers that further explain the discussed RDS function.

PI   As explained above, software automatically calculates the PI Code for US stations; otherwise the hexadecimal PI code assigned by the broadcasting authority must be entered manually in the (Code) PI field.

PTY   Program Type identifies the station's programming format from a list. There are two lists, one for the European RDS system and one

for the American RBDS specification, hence the button that toggles between RBDS and RDS. With the proper RDS/RBDS setting, choose the station format from the drop-down list. Refer to Page 32 for a breakdown of the PTY lists and their differences.

PS   The 8-character PS field is for the "street name" of the station. This will appear on the radio faceplate whenever a dynamic, scrolling-PS message is *not* being transmitted. PS is introduced on Page 8.

PARSE   Revision 2 of the Windows® software offers the user a built-in utility to 'parse' messages automatically when dynamic messaging is enabled (see DPSS).

'Parsing' Defined   Parsing is used in the "block" mode of message transmission, the more popular 'grouped-word' method, and refers to the breaking-down of messages into meaningful segments for efficient display on the 8-character alphanumeric readout common to all RDS receivers. Once parsing options are set, this encoder function is valid for any scrolling-PS message, whether it is entered into the static DPS register, or received as ASCII text from station automation.

Very short words are sent together in groups. For instance, *THIS IS* constitutes seven characters that can be sent as a group. The same would hold true for *OF THE* or *NOW HERE*. Longer words, up to and including 8 characters, are sent individually: *WARNING* or *DOUGHNUT* or *BICYCLE*. The Model 712 can either center words that are sent individually on the radio display or left-justify them. This will be covered along with the function of the PARSE button.

Words that exceed the available 8 characters are 'sidestepped' through two or more consecutive displays. Examples: *EMERGENC* followed by *MERGENCY*, or *SUPERMAR* followed by *UPERMARK* and *PER-MARKE* and *ERMARKET*. This method of splitting words gives a good sense of continuity and readability.

"Safe Scrolling" Explained   Clicking on the PARSE button will show a drop-down menu of the numbers 0 through 9. With 0 or 9 selected, parsing action will be just as described. 0 centers word groups and 9 left-justifies them. Other choices are for variations of what we call our "Safe Scrolling" message display mode.

We developed Safe Scrolling because of our concern over distracted car drivers. When viewing a message in the block mode (complete words or groups of words), a driver must pay close attention to the radio display or risk missing part of the message. Although the message may be repeated over and over, the driver may tune in at the end of a song, and in finding out who sang the number could easily rear-end the car in front.

Safe Scrolling 'marches' the message across the display screen one character at a time, not unlike soldiers passing a reviewing stand. A message requires a much longer transmission time in this mode, but a glance at the radio display every ten to fifteen seconds still allows the driver to get the full message without missing words.

Setting PARSE to 1 will scroll the message one character at a time, as just described. Other numbers also safe-scroll the message, but at 2, 3, 4, and up to 8 characters at a time. Selecting 9 will automatically parse, as previously described, but text will be left-justified rather than centered on the display. 2 through 8 may be useful in some special RDS applications, but 0 and 1 are the primary PARSE selections. To recap: 0 will enable the more-popular, auto-parsed, centered block mode and 1 the Safe Scrolling, letter-by-letter option.

DPSS   The speed of dynamic PS messaging is set here, or dynamic PS messaging can be turned off entirely. When OFF is selected, the dynamic PS message remains in the non-volatile encoder memory, but only the 8-character default static "street name" typed into the PS field will be displayed on the receiver faceplate.

Setting the speed at 1 will result in the slowest refresh rate of the 'block' message, or slowest Safe Scrolling. 9 is the fastest speed, but many RDS radios may not display the message properly at high speed settings. The display *should* be stable with any radio at a speed setting of 7 or lower.

DRTS   RadioText is the separate 64-character message that may be displayed on some radios when the listener pushes an INFO or TEXT button. Many automobile receivers will not permit RadioText display, hence the popularity of dynamic, scrolling-PS despite rules and cautions against its use. RadioText is sent as a single, 64-character message, so it generally needs to be refreshed less frequently in the normal RDS transmission cycle.

DRTS sets this RadioText transmission refresh rate. As a *static* RadioText message is not generally called upon to convey dynamic advertising or song-title information like the scrolling-PS function, a setting of 3 should be adequate. Higher settings may interact with other functions and compromise the stability of any scrolling-PS messages.

When DRTS is set to OFF, the RadioText message will not be transmitted. It will remain on the software screen and in the encoder firmware memory, however.

MS   Select MUSIC or SPEECH as the primary station format (see Page 8).

TA   The TA flag is to be sent only for critical traffic-related announcements, and then only while the announcement is being broadcast. We fervently recommend using only direct-connected, hardware-switch-activation of the TA flag, as described on Page 14.

However, as the 712 encoder may be some distance from the studio and addressed by a serial (or modem) connection, provision has been made to set the TA flag with a software command. Selecting ON from the drop-down TA menu will set the flag, which will remain on until reset by selecting and sending OFF, or until the TA function times-out, if the timeout function has been programmed using a terminal or terminal emulation program (see Page 34).

TP   Set this to YES only if your station regularly broadcasts traffic advisories and will activate the TA flag for critical announcements. This is clarified on Page 9.

DI   This is generally set for STEREO, unless the station has all-monaural programming and does *not* transmit the stereo pilot signal, in which case MONO may be selected. DI is discussed in further depth on Page 8.

DPS   Up to 64 characters of information may be entered in the Dynamic PS messaging field. This can be set either to 'parse' (see Page 21), or to scroll one character at a time. Both the European CENELEC and the American NRSC specifications for RDS/RBDS operation expressly forbid 'Dynamic PS'. Nonetheless, dynamic messaging is flaunted in the face of these august agencies and is currently practiced worldwide.

Manual Parsing   The tic marks above the DPS entry field are useful in manually formatting dynamic, scrolling-PS messages that are not automatically parsed; that is, broken into sensible groups by Model 712 Revision 2 software. The following illustration shows how one can manually format a scrolling PS message for optimum readability. This same illustration may prove valuable when it comes to deciding how to format non-parsed messages within station automation software.

NOTE: In this illustration, the menu that drops-down from the PARSE button would be set to 8, meaning that the full eight characters available on the radio faceplate would be sent as a group at each transmission interval. Again, the automatic parsing function of the Model 712 Encoder is *not* called into play for this illustration.

When simply *scrolled* one character at a time (PARSE = 1), the message shown in the example could be read easily, although it would take about a minute for all characters to march sequentially across the receiver faceplate. Alternatively, automatic parsing (PARSE = 0) would break the message into independently-meaningful groups with much faster message throughput.

But as it is typed in the Windows® screen example on Page 20, and with PARSE set to 8 (corresponding to the limit of the receiver display), the message would show up something like this:

```
LISTEN T    O BRET A    ND CHET
IN THE M    ORNING -     THEY AR
E HILLAR    IOUS
```

By altering the text slightly and forcing the message to break into standalone clusters of eight characters, 'block' transmission of essentially the same message would be far more readable. Here is an example of how the message could be formatted:

```
|.......|.......|.......|.......|.......|.......|.......|.......|
DPS  LISTEN TO BRET AND CHET IN THE MORNING THEY ARE A LAUGH RIOT
```
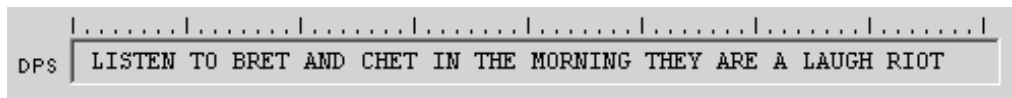
Each sequentially-displayed 8-character 'screen' would break at the major tic marks and display on the radio faceplate as shown below:

```
| L | I | S | T | E | N |   |   |      | T | O |   | B | R | E | T |      | A | N | D |   | C | H | E | T |

|   | I | N |   | T | H | E |   |      | M | O | R | N | I | N | G |      | T | H | E | Y |   | A | R | E |

|   | A |   | L | A | U | G | H |      |   | R | I | O | T |   |   |   |
```

Keep in mind that enabling the Model 712 parsing utility (PARSE=0) will automatically perform this word-breaking function in encoder firmware. This illustration simply shows how parsing *may* be implemented manually. Additional discussion of dynamic PS modes and formatting may be found under advanced programming notes on Pages 25 through 40.

TEXT   The 64-character RadioText buffer holds a static message that can be called up for viewing on home RDS receivers and on some auto radios. Please see the previous discussion on Page 9.

The entire 64-character RadioText message is transmitted as a block. If so equipped, the *receiver* will buffer RadioText and display it as a scrolling message automatically, hence there is no need to observe word breaks or perform other message formatting tasks.

SPEED   This refers to COM port serial communications with the encoder. See additional information on Pages 15 and 30.

ECHO   The Model 712 can be set either to echo RS-232 programming commands back to the computer or automation system, or not. The option is not important when using the supplied Windows® software, but may have implication when addressing the encoder from a 'dumb terminal' or with station automation.

AF1   Rebroadcast 'translators' or stations on a network may air the very
through   same program on multiple frequencies. Only when the program is
AF9   heard at the same time (synchronously) at different dial settings is the associated frequency considered a true "alternative frequency."

NOTE: When AFs are listed, the station's primary frequency *must* also be in the list. AF frequencies are selected from a drop-down menu associated with each AF button.

Sending Data   Once all information is entered into the various fields, clicking the
to the Encoder   Send To Encoder button will upload all RDS data to the Model 712. As data is received by the Model 712, the RS-232 ACTIVITY indicator on the front panel will flash.

Data transfer takes about 3 seconds, and a progress bar is shown at the bottom of the window.

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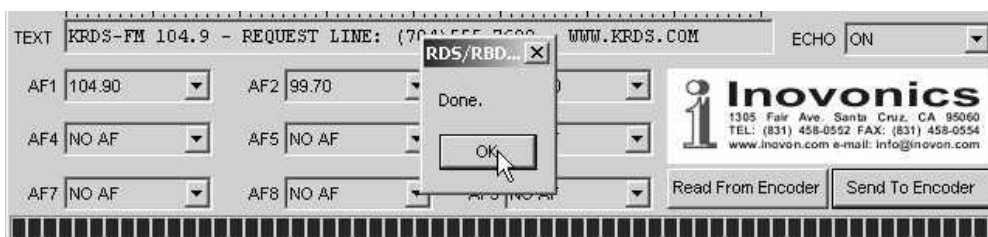
Done. is displayed when completed. If transfer is *not* successful for any reason, an error message will be shown. The Done. message box must be cleared before further data can be entered.

Entering data via the Windows® software automatically initiates a "Save" command, ensuring that the entry will remain in non-volatile memory within the 712 encoder. This means that if the encoder loses AC mains power, the most recently Windows®-entered data will be transmitted when power is restored. Even if the encoder is controlled by station automation, a default set of data should be uploaded to the Model 712 using the Windows® software utility so that something meaningful will be transmitted immediately following a power outage.

Reading Data From the Encoder

In a situation where the RS-232 data link is lost, once communication has been reestablished data may be read from the encoder to verify what is currently being broadcast. Clicking on Read From Encoder will copy all entries from the encoder buffer to the software screen.

The data resident in the Model 712 encoder memory may be downloaded back onto the software screen without interrupting RDS transmission. This feature is useful for updating only certain fields of RDS data being transmitted without having to re-enter everything. Download by clicking Read From Encoder, make changes in any of the fields, and then upload the revised file back to the encoder with a Send To Encoder command.

File Management

All the RDS programming information on a filled-in data entry screen may be also saved locally on the computer as a file. This is useful when various programming segments throughout the broadcast day have dedicated RDS messaging, or when messaging needs to be replaced within a programming segment with updated advertising or station promo information.

Data on the screen may be saved as a file before, after, or instead of sending information to the encoder. Clicking in the menu bar on File→Save As will prompt you for a location and name for the file, which will have an .ino extension. The file may be named in keeping with its content and stored on the computer Desktop, or in a folder created and set aside for this purpose. To import a saved .ino file onto the screen, click on File→Open and browse to the directory and folder where the .ino file has been saved. Double-click the file to bring the RDS programming information onto the screen where it then can be sent to the Model 712 encoder with a Send To Encoder command.

ADVANCED PROGRAMMING - TERMINAL CONFIGURATION

Configuration of the terminal, computer or automation system obviously will depend on the connected hardware and its resident firmware. For simplicity of illustration, encoder programming instructions here reference *HyperTerminal*, the terminal emulation pro-

gram by Hilgraeve, Inc., developed for Microsoft and supplied with the Windows® operating system. It is hoped that programming instructions based on terminal emulation will help the programmer better understand what ASCII syntax the encoder requires without regard to the specific equipment that sends programming commands.

When using *HyperTerminal*, it's best first to upgrade to the latest version. Download this at no charge from www.hilgraeve.com. The more current product seems to run more smoothly and has text editing features not found in earlier versions.

NOTE: Disconnect the encoder or leave it turned off until the computer or terminal has been configured. Also, be sure to quit the Model 712 Windows® data-entry program before addressing the encoder with *HyperTerminal*.

HyperTerminal is started under Windows® with the command routine: Start→Programs→Accessories→Communications→ HyperTerminal. Double-click: HyperTrm.exe. This brings up the main *HyperTerminal* screen with a Connection Description window for naming your encoder communications program (below, left). Type RDS and click OK. This opens a Connect To window (below, right).
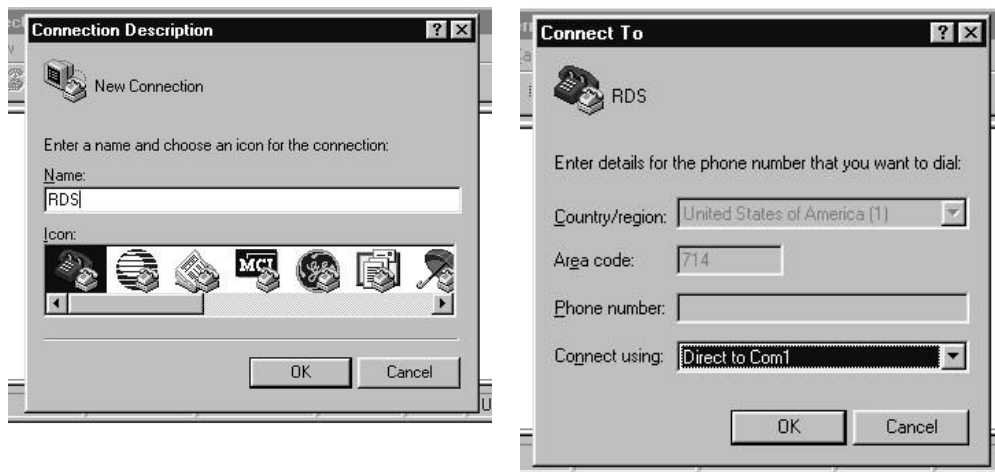
Click Connect Using **and select** Direct to Com1, **unless there is a reason to use another serial COM port. Click** OK.

The next window that appears shows COM1 Properties. **Here you set the communications parameters as follows:** Bits per second: 9600, Data bits: 8, Parity: None, Stop bits: 1, **Flow** control: None. **Check your settings against the picture at the top of the next page. Click** OK **to close all boxes and to clear the** *HyperTerminal* **data entry screen.**

At the top of the *HyperTerminal* data entry screen, click File→Properties→Settings. Check to make sure that the default settings agree with the screen capture on the left, below.

Click the ASCII Setup button. On the next screen, check the box: Send line ends with line feeds, as shown at the right, below. Then close all boxes. This leaves the main *HyperTerminal* window open for data entry.
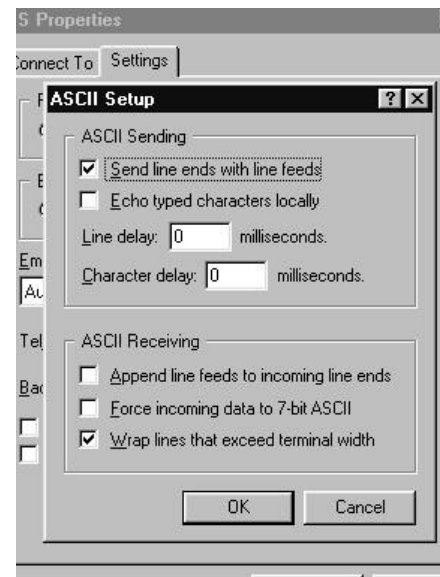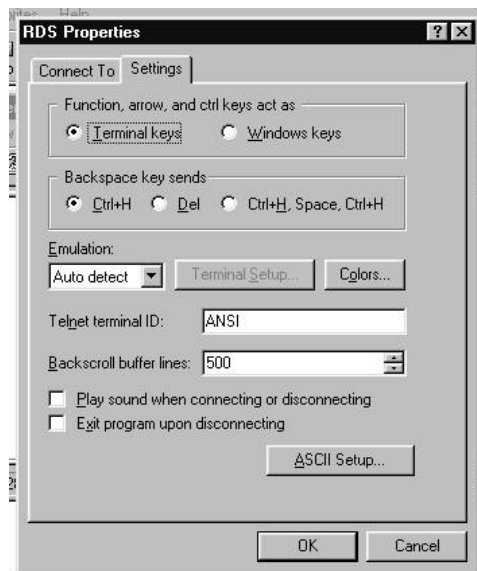
If you experience trouble communicating with the Model 712, there's a quick and easy check to verify that the computer and the terminal program are functioning normally. With pins 2 and 3 of the DB-9 connector shorted with a screwdriver, whatever is typed on the keyboard should appear on the screen.

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Connect and Turn-On

NOW connect the computer to the encoder's RS-232 LINK port and apply AC power to the encoder. The HyperTerminal screen should show the word "Ready" as the encoder is powered up, as shown in the first screen shot on the right.

Next, type: ??↵ (two question marks followed by Enter). This will cause the encoder to send back the contents of all ID, flag and message registers, which, as shown on the far right, are either default factory settings or empty. This double question mark can be used at any time to make the encoder 'spill its guts.' This exercise does not interrupt or interfere with encoder operation.
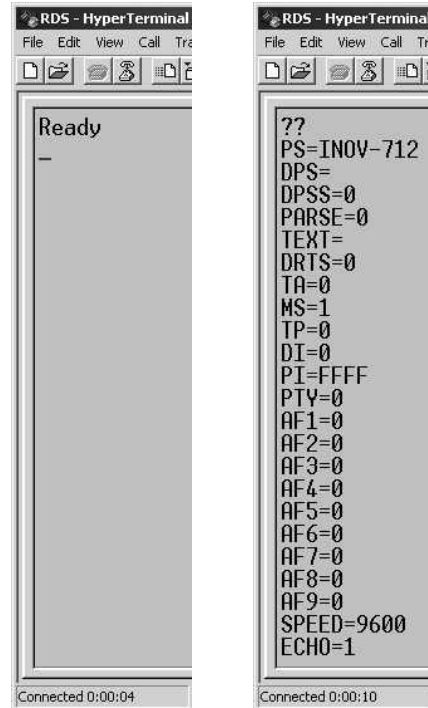
Any single parameter in a register can be interrogated independently. Simply type the register designation followed by a single question mark. A response shown at the right for the typed command: PI?↵.

PROGRAMMING SYNTAX

How to Type

In these programming instructions the *exact* ASCII syntax to be entered on the keyboard will be given in the font used in this example: TEXT=HELLO↵ . Specifically, the word TEXT, the equal sign and the word HELLO would be typed, followed immediately by pressing the Enter key. We will use ↵ as the symbol for Enter.

Take time to type deliberately and slowly. Even at 9600 baud, some delays are inherent in the communications between the computer and the encoder. One characteristic of typing too quickly will be the omission of line feeds in responses returned from the encoder.

Using ALL CAPS

Programming commands should be typed in ALL CAPS (capital letters) and messages should be kept as simple as possible. Though the encoder will accept lowercase letters and all ASCII punctuation in the PS and RT fields, some RDS radios have limited character sets and may display ambiguous lowercase characters or gibberish. To assure readability, keep the keyboard Caps Lock key engaged and avoid fancy punctuation. 'Smileys' are not a good idea.

Correcting Mistakes

Under *HyperTerminal*, use the Enter key to drop to a new line, if required, and use either the Backspace key or the keyboard's directional arrows to navigate within a text entry. Overtyping an entry

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will automatically replace the previous characters. What is shown on the screen before the Enter key is pressed is what will be sent to the encoder.

Echo Your computer screen will display what has been "echoed" by the encoder as data is entered. Each character typed on the keyboard will be sent to the encoder, which will turn it back around to be shown on the monitor screen. This round trip gives continuous confirmation of 2-way communications.

The return data path is not essential, however. The Model 712 will accept programming commands on a receive-only basis. For example, a studio-transmitter radio link (STL) may include 1-way data transmission that could be used to address the encoder.

If double characters appear when typing, your *terminal* or computer has been configured for local echo. Rather than defeating the echo function of the encoder, local echo should be turned off. This is usually a software command in the terminal or terminal program. Local echo may be used with a 1-way link.

The Model 712 has been set to echo as the factory default. The command to turn echo off is `ECHO=0↵` . To turn echo back on again, type `ECHO=1 ↵` .

Validity Symbols The Model 712 ignores ASCII inputs that do not conform to proper formatting rules. This is an important feature when the encoder is connected full-time to station automation. When a valid command is accepted by the encoder, it returns `OK` to the computer screen. If a data input is properly formatted, but is ambiguous or otherwise not accurate, the screen will display `NO`. Examples of valid and invalid commands are shown below. Follow programming instructions *exactly* to ensure that commands will be accepted.

Valid speed, 9600 baud ⟶ `SPEED=9600` `OK`

Invalid speed, 3000 baud ⟶ `SPEED=3000` `NO`

Valid Traffic Announcement commands, TA=1 and TA=0 ⟶ `TA=1` `OK` `TA=0` `OK`

Invalid TA=6 ⟶ `TA=6` `NO`

Valid hexadecimal PI value ⟶ `PI=4A2D` `OK`

Invalid call-letters substitution ⟶ `PI=KWAV` `NO`

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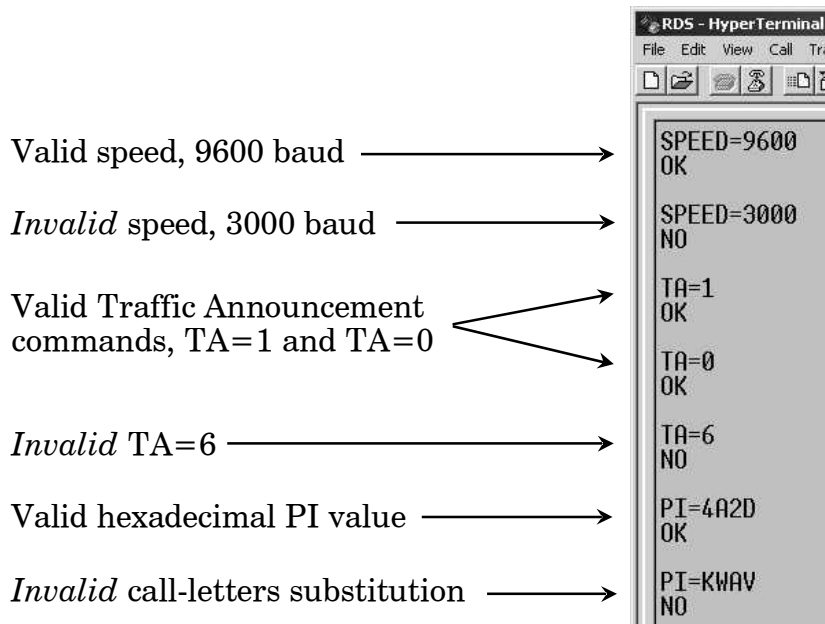
ENCODER COMMUNICATIONS SETTINGS

Basic encoder communications settings have been preset at the factory at default values. Communications commands must use proper syntax, as described above, and preferably typed in ALL CAPS for reasons already given.

Communication Speed
The encoder defaults to 9600, 8, N, 1 ASCII communications. To change just the baud rate to 2400, for example, type: SPEED=2400↵. Acceptable baud rates are 2400, 4800, 9600, 19200, 38400, 57600 or 115200. The Model 712 may be addressed at the highest, 115200 baud speed, but the trifling amount of data that is ever uploaded to the encoder really makes the highest speed a matter of overkill. Even the modest default 9600 baud setting is lightning fast for encoder programming, and may prove far more dependable, especially with long data cable runs. The lowest baud-rate settings are useful when the encoder is addressed via a dial-up modem or a slow data channel that is part of an STL radio link.

Echo
As recommended earlier, the encoder should echo the keyboard commands, rather than having the terminal echo locally. ECHO=1↵ enables encoder echo, ECHO=0↵ turns it off.

ENCODER HOUSEKEEPING COMMANDS

Register Interrogation
Typing: ??↵ (two question marks followed by Enter) returns the status of all flag and ID settings and the contents of static message buffers to the screen. This was illustrated on Page 28.

Encoder Initialization
The "initialize" command is invoked by typing: INIT↵. This is used to reestablish encoder operation in the unlikely event of an internal firmware 'crash,' or to restore temporary factory defaults. INIT↵ erases all user programming that has been 'saved' in non-volatile memory. (See **Saving Presets**, below, for using the SAVE↵ command for retaining data entered.) INIT↵ is an emergency recovery command only. It is *not necessary* to execute INIT↵ prior to updating any encoder programming.

Saving Presets
Once the RDS parameters have been set-up, or after any updates have been made, type: SAVE↵ to write data to non-volatile memory. The SAVE↵ command may be executed at any time during the data entry process to protect everything entered to that point, and executed again when all entry is complete.

Encoder Reset
Typing: RESET↵ initiates a 'hardware reset' equivalent to turning the encoder off and back on again. This reset command does *not* clear the registers of programming commands that have been saved as described above.

Firmware Version
Type: REV↵ for a display of the encoder's firmware version. This has importance in determining whether differences exist between Model 712 encoders purchased at different times.

STATIC DATA PROGRAMMING

The following instructions detail a 'hard way' of programming the various IDs, flags, and static text messages. Only the abbreviations of the functions are given. Refer to Pages 7 through 9 for in-depth parameter descriptions.

NOTE: This programming is most easily accomplished using the Windows® data-entry software supplied with the encoder. See Page 19. However, if a Windows® computer and the Model 712 software is not available at the encoder location, the following instructions may be followed when programming with an ASCII terminal.

PI Calculation In Europe and in some other parts of the world, an appropriate bureaucracy assigns the PI code for RDS transmissions. PI is a hexadecimal number that becomes the station 'digital address.' In the US the PI code is mathematically calculated from the station's call letters using a formula published in the US RBDS Standard. This is a copious process, that's why we built a calculator into the Windows® software supplied with the Model 712.

The manual PI calculation method shown here is valid only for four-letter calls. Three-letter calls have been preassigned. These are published in the RBDS Standard.

For the manual method, each letter of the alphabet is assigned a number value according to the following list:

A	0	H	7	O	14	V	21
B	1	I	8	P	15	W	22
C	2	J	9	Q	16	X	23
D	3	K	10	R	17	Y	24
E	4	L	11	S	18	Z	25
F	5	M	12	T	19		
G	6	N	13	U	20		

Now follow these simple(?) steps to calculate the PI. Here we have provided an example for Radio Station KWAV.

1) Take the number value of the *fourth letter* of your call and write it at the top of a column.   V=21   21

2) Take the number value of the *third letter* of your call, multiply it by 26 and add it to the column.   A=0 (X 26)   0

3) Take the number value of the *second letter* of your call, multiply it by 676 and add it to the column.   W=22 (X 676)   14872

4) If your call begins with a K, add 4096 to the column. If it begins with a W, add 21672.   K (add 4096)   4096

5) Add the column up.   18989

This gives a *decimal* number value for your call letters, which now

has to be converted to *hexadecimal* for the PI entry.

The easiest way to convert from decimal to hexadecimal is with the Windows® accessory calculator. Bring the calculator up with the sequence: Start→Programs→Accessories→Calculator. Then select: View→Scientific and verify that the Dec (Decimal) box is checked. Enter your decimal sum with the keyboard keypad as shown below.
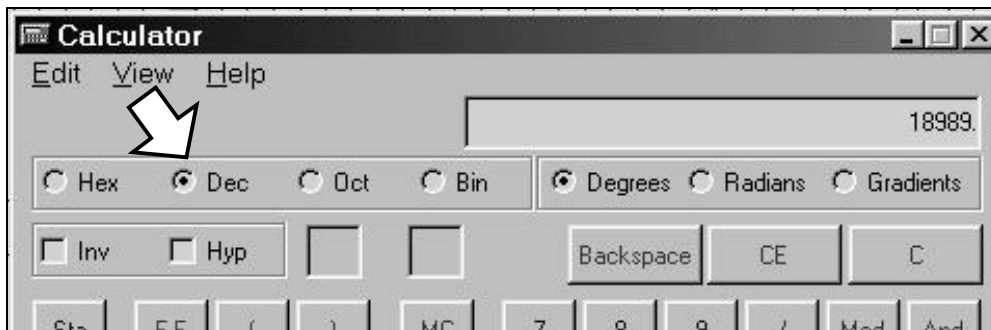
Next check the Hex box. The hexadecimal value will be displayed on the calculator as shown below.
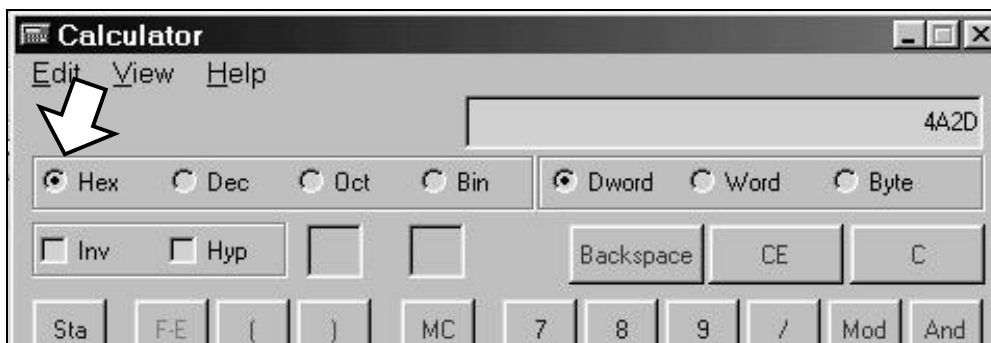
The hexadecimal conversion shown in the example is 4A2D. This is an *alphanumeric* value containing both letters and numbers. Some PI codes may contain only numbers, but all will have four characters. Our four-character example is entered by typing: PI=4A2D↵.

PS   The Program Service Name is your station's "Street Name." This may be simply the call letters, KBAD or KBAD-FM or a slogan such as LIVE 105. Up to 8 characters (including spaces) may be accommodated. Enter by typing: PS=xxxxxxxx↵, where x represents the entry in capital letters. (A discussion and instructions for scrolling PS begin on Page 37.)

PTY   "Program Type" indicates the station format. The listings shown on the next page were assigned by the NRSC in the United States and by CENELEC for the rest of the world. *Be sure to select your format from the proper list!*

The numbers in the <u>PTY</u> column indicate the categories listed in the appropriate standards. Enter this number into the encoder's PTY field by typing: PTY=n↵ or PTY=nn↵, where n or nn is the number shown in the <u>PTY</u> column on the following page.

PTY	US (NRSC)	EUROPE (CENELEC)
0	None	None
1	News	News
2	Information	Current Affairs
3	Sports	Information
4	Talk	Sports
5	Rock Music	Education
6	Classic Rock Music	Drama
7	Adult Hit Music	Culture
8	Soft Rock Music	Science
9	Top 40 Music	Varied
10	Country Music	Pop Music
11	Oldies Music	Rock Music
12	Soft Music	Easy Listening Music
13	Nostalgia Music	Light Classics Music
14	Jazz	Serious Classics Music
15	Classical Music	Other Music
16	Rhythm and Blues Music	Weather
17	Soft R and B Music	Finance
18	Foreign Language	Children's Programs
19	Religious Music	Social Affairs
20	Religious Talk	Religion
21	Personality	Phone-In
22	Public Non-Commercial	Travel
23	College	Leisure
24	(unassigned)	Jazz Music
25	(unassigned)	Country Music
26	(unassigned)	National Music
27	(unassigned)	Oldies Music
28	(unassigned)	Folk Music
29	Weather	Documentary
30	Emergency Test	Alarm Test
31	Emergency!	Alarm!

NOTE: PTY codes 30 and 31 are reserved for *true emergency and emergency test situations only*. Consult the appropriate Standards Group for using these PTY codes.

Also please take care in coding the PTY identifier, as the categories can be ambiguous. For instance, what if yours is a college station that relays NPR programming? How about Rock and Top 40 crossovers? Just what can Cultural possibly pertain to in the 21st Century? Would Serious Classics dare to include Stravinsky or Bartok? For clarifications on these and other burning questions, refer to the appropriate RBDS or RDS Standard, or put your question directly to the Standards Group. We regret that Inovonics is not certified to answer such questions.

The PTY identifier can be made into a semi-dynamic function. It can be changed from one entry to another if your station "dayparts" (alters formats during specific, *extended* periods). The PTY should

not change from song to song or to accommodate a 5-minute news-cast, however.

TP If yours is a station that transmits travel advisory updates on a regular basis, type: TP=1↵. If you do *not* broadcast travel information, type: TP=0↵.

TA The Travel Announcement flag can be software-activated by typing: TA=1↵, but *must* be turned off by typing TA=0↵ *immediately* when the announcement ends. TA is most easily and safely activated with a hard-wired switch closure at the announcer's position (see Page 14). Leave the software command set at TA=0↵ and use the switch!

TA Timeout A safety feature has been built into the Model 712 to guard against an extended software-activated TA flag. Say, for example, that the TA flag was activated by the software command: TA=1↵, and the data link was suddenly lost. No TA=0↵ command would be received, and the TA flag would remain raised indefinitely. As this is not a good thing, an automatic timeout option has been included for *software-activated* TA flags.

Timeout can be set between 1 and 9 minutes. To enable this feature, type: TATIME=m↵, with the value of m (minutes) between 1 and 9. This will automatically reset the TA flag to TA=0 after the programmed time has elapsed.

As received, this timeout feature is disabled. Type: TATIME?↵. A zero returned from the encoder shows that the feature is turned off. Once set, the feature can again be disabled by typing: TATIME=0↵.

NOTE: The timeout should not be used to define the actual period that the TA flag is raised. The TA flag *must* be reset to zero immediately following a traffic announcement. Again, it's best to use the manual switch option for this command as described on Page 14.

AF As many as 9 'alternative frequencies' may be entered in to the Model 712. These are optional frequencies that carry the *very same program* as the main channel as in a network or translator situation.

Alternative frequencies are actually transmitted as special AF *channel numbers*. The RDS receiver logs these channel values and uses them in the process of finding a stronger signal of the identical program, either from another station on a network or from a rebroadcast translator.

The Model 712 has nine registers for alternative frequencies. Each register must have a numerical value assigned and entered into it. Any register that is *not* used for an alternative frequency must have a 0 (zero) value inserted. The factory default is a zero in all registers.

Alternative frequency channels begin with Channel 1 at 87.6MHz, and go in 100kHz increments up to Channel 204 at 107.9MHz. The table on the next page converts frequency to AF channel numbers.

MHz	CHAN	MHz	CHAN	MHz	CHAN	MHz	CHAN
87.6	1	92.7	52	97.8	103	102.9	154
87.7	2	92.8	53	97.9	104	103.0	155
87.8	3	93.9	54	98.0	105	103.1	156
87.9	4	93.0	55	98.1	106	103.2	157
88.0	5	93.1	56	98.2	107	103.3	158
88.1	6	93.2	57	98.3	108	103.4	159
88.2	7	93.3	58	98.4	109	103.5	160
88.3	8	93.4	59	98.5	110	103.6	161
88.4	9	93.5	60	98.6	111	103.7	162
88.5	10	93.6	61	98.7	112	103.8	163
88.6	11	93.7	62	98.8	113	103.9	164
88.7	12	93.8	63	98.9	114	104.0	165
88.8	13	93.9	64	99.0	115	104.1	166
88.9	14	94.0	65	99.1	116	104.2	167
89.0	15	94.1	66	99.2	117	104.3	168
89.1	16	94.2	67	99.3	118	104.4	169
89.2	17	94.3	68	99.4	119	104.5	170
89.3	18	94.4	69	99.5	120	104.6	171
89.4	19	94.5	70	99.6	121	104.7	172
89.5	20	94.6	71	99.7	122	104.8	173
89.6	21	94.7	72	99.8	123	104.9	174
89.7	22	94.8	73	99.9	124	105.0	175
89.8	23	94.9	74	100.0	125	105.1	176
89.9	24	95.0	75	100.1	126	105.2	177
90.0	25	95.1	76	100.2	127	105.3	178
90.1	26	95.2	77	100.3	128	105.4	179
90.2	27	95.3	78	100.4	129	105.5	180
90.3	28	95.4	79	100.5	130	105.6	181
90.4	29	95.5	80	100.6	131	105.7	182
90.5	30	95.6	81	100.7	132	105.8	183
90.6	31	95.7	82	100.8	133	105.9	184
90.7	32	95.8	83	100.9	134	106.0	185
90.8	33	95.9	84	101.0	135	106.1	186
90.9	34	96.0	85	101.1	136	106.2	187
91.0	35	96.1	86	101.2	137	106.3	188
91.1	36	96.2	87	101.3	138	106.4	189
91.2	37	96.3	88	101.4	139	106.5	190
91.3	38	96.4	89	101.5	140	106.6	191
91.4	39	96.5	90	101.6	141	106.7	192
91.5	40	96.6	91	101.7	142	106.8	193
91.6	41	96.7	92	101.8	143	106.9	194
91.7	42	96.8	93	101.9	144	107.0	195
91.8	43	96.9	94	102.0	145	107.1	196
91.9	44	97.0	95	102.1	146	107.2	197
92.0	45	97.1	96	102.2	147	107.3	198
92.1	46	97.2	97	102.3	148	107.4	199
92.2	47	97.3	98	102.4	149	107.5	200
92.3	48	97.4	99	102.5	150	107.6	201
92.4	49	97.5	100	102.6	151	107.7	202
92.5	50	97.6	101	102.7	152	107.8	203
92.6	51	97.7	102	102.8	153	107.9	204

To enter the alternative frequency of 98.1MHz into register one, type: AF1=106↵. To enter the alternative frequency of 107.7MHz into register two, type: AF2=202↵. Enter a value into all nine reg-

isters. If only a couple of alternative frequencies are entered be sure to type a ⊠ (zero) into all unused registers.

NOTE: The alternative frequency utility requires that the station's *main frequency* be entered into one of the registers, whether that station has translators or not. Be sure to enter the primary frequency of the station into one of the registers, and enter zeroes into unused registers.

DI Though this identifier is not presently used to any great extent, to be on the safe side type: `DI=1↵` if you are a *stereo* station, and type: `DI=0↵` if you broadcast only in monaural.

M/S The utility of this flag also is obscure. Nevertheless, it is recommended to type: `MS=0↵` if your broadcast day is primarily speech, such as All-News or Talk Radio, and type: `MS=1↵` if music makes up the bulk of your programming.

RT RadioText is the static message that appears on the radio faceplate when called up by the listener. This is not to be confused with the PS field, which can be either static or dynamic. Some stations make RadioText a dynamic function, changing the message at intervals to promote an upcoming broadcast, to announce results of a contest, or to send advertising messages. We recommend that you program a default RadioText message into static memory and initiate a `SAVE↵` command. This will ensure that the RadioText field will not be empty following a power outage or loss of the data link.

To enter the static RadioText type: `TEXT=`$x_1 x_2 x_3$ . . . x_{64}`↵`, with x representing up to 64 *uppercase* characters, including spaces; a RadioText message may be shorter than 64 characters, however.

Even with a default message saved in non-volatile memory, Radio-Text is updated simply by entering new data. This may be done manually from a computer or terminal, or automatically by station automation for messages that change during the day. When connecting the encoder's RS-232 SERIAL DATA INTERCONNECT port to the automation system, be sure that the system is configured for the proper data rate and programmed to give the `TEXT=`. . . header when sending data.

RadioText Rate Generally, RadioText is updated less frequently than IDs and flags to keep from slowing-down the radio's search for formats, traffic information and alternative frequencies. The tradeoff is that text messages are sent and updated less frequently. There will always be a tradeoff between RadioText throughput and speed of other RDS functions, including AF-seek and either static or scrolling PS displays.

The RadioText update rate is programmed by typing: `DRTS=n↵`, with n a number between 1 and 9, corresponding to a refresh rate between slow and fast, respectively. Keeping the throughput tradeoff in mind, unless RadioText is being used for contests or for other quasi-dynamic activities, it is best to use a lower number. A rate of 1, 2 or 3 will make little difference in the speed of other RDS functions.

NOTE: RadioText can be turned off entirely by typing: DRTS=0↵. A zero value in this field turns the RadioText message off, but does not delete any saved message from memory.

Free Format Group
The encoder can transmit two unspecified data groups for in-house remote control, restricted paging or similar proprietary applications. This feature can be static, with the same data transmitted repeatedly, or controlled by an external application as a dynamic function.

The two "free data" groups are known as the 'G' and 'H' groups. Each contains three hexadecimal ASCII blocks of data. To enter data into these groups, type: G=bbbbccccdddd↵ and/or: H=bbbbccccdddd↵. The blocks represented by bbbb, cccc and dddd are the RDS B, C and D data blocks. Certain hexadecimal values in these blocks may already be in use for RDS functions supported by the 712 encoder. Consult the applicable RBDS or RDS Standard for more information on how these data can be used.

Saving Entries
Once all data have been entered, execute a SAVE↵ command to write your entries to non-volatile memory. Data held in non-volatile memory is loaded into working memory following a power-up or a RESET↵ command. Saving to non-volatile memory is a good precautionary measure and does not limit dynamic operation.

SCROLLING DISPLAYS AND DYNAMIC ENCODER OPERATION

Safety Considerations
The concept of scrolling text messages on the dashboard of a car, in plain view of the driver, continues to be the subject of discussion and debate within the broadcast community and with transportation safety agencies. It should be a matter of common-sense concern to the responsible broadcaster as well.

Inovonics takes a cautionary, conservative view of dynamic message displays in plain view of an automobile driver. The CENELEC and NRSC standards groups have expressly forbidden this practice for good reason. Proponents argue that GPS and other navigational aids in cars pose a similar and equal hazard, even though these displays are often more of a 'heads-up' display than the faceplate of a dash-mounted radio. Indeed, propping a paperback mystery novel on the car's steering wheel is more 'heads-up' than the radio faceplate, but do these scrolling display proponents condone reading while driving, we wonder? It is our recommendation to relegate visual readouts to display only essential information, and in a manner that poses the least distraction.

RadioText
RadioText is transmitted as a 64-character block of data. The presentation of this display has been left to receiver manufacturers. Some home receivers can actually show the entire message at once, whereas other radios must scroll the message in a limited window. A good number of auto radios simply do not support RadioText, and others require the operator to press a TEXT or INFO button to enable the display. A few car radios actually disable the RT readout

when the car is moving.

Dynamic PS   When the CENELEC and NRSC standards for RDS/RBDS were initially drafted, scrolling text in the PS field was absolutely forbidden. Despite this edict, not to mention the inferences of common sense, the refresh rate of the PS field makes message scrolling not only possible but also tempting. Early implementers of RDS discovered the means by which this could be done, and encoder manufacturers rose to the occasion with accommodating hardware. Now third-party 'data consolidators' provide message formatting services on a subscription basis to broadcasters, fitting messages into the 8-character PS field by calling on Internet connections and links to libraries of song titles, weather forecasts, stock quotes and ads.

'Block' Transmission   The quickest and most popular PS messaging format is "block" transmission. Rather than scrolling the message across the receiver faceplate like so many marching soldiers, the message is formatted into 8-character blocks of text. Song title and artist information is sent on sequential 8-character screens like this:

```
  F I R S T        C U T   I S          T H E
D E E P E S T      S H E R Y L          C R O W
```

This gives the information in six screens. With a typical refresh rate of two seconds per screen, this same information could be repeated several times during the song, and even interspersed with a preview of the next selection, advertising, or a station ID and promo.

The main drawback to the block method of messaging is that a message in this format must be watched almost continuously to avoid missing part of the text. If the message can be counted on to repeat, a missed portion could be caught next time around. But if a lot of information is flying along at a good clip, the data-deprived driver could easily be distracted.

True 'Scrolling'   The Model 712 can be programmed to send dynamic PS messages by the block method if text is properly formatted, either by the built-in 'parsing' utility, or manually, as discussed on Page 23. In the interest of safety, however, Inovonics has developed an alternative technique that more closely fits the description of "scrolling-PS," very much like soldiers marching past a reviewing stand. This alternative is not nearly as fast as the block transmission method, but is far safer. Here is how the same song and title would look:

```
  F I R S T   C     F I R S T   C U     I R S T   C U T
R S T   C U T       S T   C U T   I     T   C U T   I S
  C U T   I S       C U T   I S   T     U T   I S   T H
T   I S   T H E       I S   T H E       I S   T H E   D
S   T H E   D E       T H E   D E E     T H E   D E E P
H E   D E E P E     E   D E E P E S       D E E P E S T
```

```
[D][E][E][P][E][S][T][ ]    [E][E][P][E][S][T][ ][C]    [E][P][E][S][T][ ][C][H]

[P][E][S][T][ ][C][H][E]    [E][S][T][ ][C][H][E][R]    [S][T][ ][S][H][E][R][Y]

[T][ ][S][H][E][R][Y][L]    [ ][S][H][E][R][Y][L][ ]    [S][H][E][R][Y][L][ ][C]

[H][E][R][Y][L][ ][C][R]    [E][R][Y][L][ ][C][R][O]    [R][Y][L][ ][C][R][O][W]
```

This safer method has taken 30 screens to show the same information that the block method displayed in 6 screens. That's a full minute versus 12 seconds by the block method. Clearly the throughput is far less with true scrolling, but the display requires only the occasional glance to capture the entire message. True scrolling does not accommodate the 'channel surfer' well, however; a scrolled message may not repeat if tuned-in in the middle of a song.

Selecting the Dynamic Mode

To activate the 'scrolling' mode of dynamic PS messaging, type: PARSE=1↵. For the 'block' mode, type: PARSE=0↵.

Enabling Dynamic PS and Setting the Refresh Rate

The transmission rate for successive frames of PS data can be adjusted between a nominal 'fast' and 'slow.' For block text transmission, a slower setting would be a wise choice, as each block of the message would stay on the radio's 8-character display long enough to be seen by an occasional casual glance.

In the case of scrolling text, a faster setting would be in order, as the message inherently takes longer to display in its entirety.

To *enable* dynamic PS messaging, type: DPSS=n↵, where n is a number between 1 and 9; 1 being the slowest update of the PS field, and 9 being the fastest. Type: DPSS=0↵ to turn dynamic PS messaging *off*. Entering a zero value will transmit the saved static message in the PS field.

Some radios cannot process fast updates in the PS field. A fast setting for scrolling text could display only gibberish on some radios.

Entering Dynamic PS Text

Dynamic PS messages are held in encoder memory as 64-character (maximum) text strings. In the 'block' mode, and with the automatic parsing utility enabled (PARSE=0), short words are consolidated and longer ones 'sidestepped' to fit successive 8-character display screens. If the safer 'scrolling' PS mode is used (PARSE=1), the message will just slowly march across the radio display.

Enter text as all-caps by typing: DPS=$x_1 x_2 x_3 \ldots x_{64}$↵, x representing up to 64 capital characters as shown here:

x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}
F	I	R	S	T		C	U	T		I	S		T	H	E		D	E	E	P	E

x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}	x_{41}	x_{42}	x_{43}	x_{44}
S	T		S	H	E	R	Y	L		C	R	O	W								

x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}	x_{61}	x_{62}	x_{63}	x_{64}

Note that, in this case, text is entered without need for special formatting, perhaps just as it comes from station automation.

Note also that there is sufficient space available to add further information such as ON KWAY or ON A&M RECORDS. If no text is entered in the blank, trailing fields, the message will begin repeating from the beginning.

Section IV

APPENDIX

TABULATED LISTING OF ENCODER COMMANDS AND PROMPTS

PARAMETER	COMMAND	DATA ENTRY
Program Identification	PI=	4 digit HEX number (station "digital address")
Program Service Name	PS=	8 (max) ASCII characters (station "street name")
Dynamic PS	DPS=	64 (max) ASCII characters (for messaging in PS field)
Dynamic PS Speed	DPSS=	0 to 9 (0 = OFF, 1 = slow, 9 = fastest)
Dynamic PS Method	PARSE=	0 to 9 (0 = Auto-Parse, centered, 1 to 8 = 'Safe Scrolling,' 9= Auto-Parse, left-justified)
Program Type	PTY=	1 or 2 digit number (describes station format)
Traffic Program	TP=	0 or 1 (0 = no, 1 = yes)
Traffic Alert	TA=	0 or 1 (0 = flag off, 1 = flag on)
Software TA Timeout	TATIME=	0 to 9 (0 = function off, 1-9 = minutes to timeout)
Alternative Frequencies	AF1=	0 to 204 (0 = blank; 1 to 204 = "channel" in 100kHz increments, 87.6MHz to 107.9MHz)
	AF2=	
	AF3=	
	AF4=	
	AF5=	
	AF6=	
	AF7=	
	AF8=	
	AF9=	
Decoder Information	DI=	1 digit HEX number (defines mono or 2-channel mode)
M/S	MS=	0 or 1 (0 = speech-only, 1 = music)
RadioText	TEXT=	64 (max) ASCII characters
Dynamic RadioText Speed	DRTS=	0 to 9 (0 = RadioText off; 1 to 9 = update rate, slow to fast)
RS-232 Serial Baud Rate	SPEED=	2400 or 4800 or 9600 or 115200
Command Echo	ECHO=	0 or 1 (0 = echo off, 1 = echo on)

	COMMAND	SPECIAL COMMANDS
	?	Followed by command without equal sign returns status of encoder memory for that parameter; eg.: AF3?.
	??	Returns all data in encoder memory.
	REV	Returns firmware revision number.
	SAVE	Saves all uploaded commands to non-volatile RAM.
	RESET	Resets the encoder as if AC power were cycled off and on.
	INIT	Initializes the encoder to all factory defaults.
RESPONSE	**MEANING**	
OK	Command received by encoder properly formatted and understood.	
NO	Command properly formatted but data not understood.	
(NONE)	Data sent is ignored by the Model 712.	

INOVONICS WARRANTY

I TERMS OF SALE: Inovonics products are sold with an understanding of "full satisfaction"; that is, full credit or refund will be issued for products sold as new if returned to the point of purchase within 30 days following their receipt, provided that they are returned complete and in an "as received" condition.

II CONDITIONS OF WARRANTY: The following terms apply unless amended *in writing* by Inovonics, Inc.

A. The Warranty Registration Card supplied with this product *must* be completed and returned to Inovonics within 10 days of delivery.

B. This Warranty applies only to products sold "as new." It is extended only to the original end-user and may not be transferred or assigned without prior written approval by Inovonics.

C. This Warranty does not apply to damage caused by misuse, abuse, accident or neglect. This Warranty is voided by unauthorized attempts at repair or modification, or if the serial identification label has been removed or altered.

III TERMS OF WARRANTY: Inovonics, Inc. products are warranted to be free from defects in materials and workmanship.

A. Any discrepancies noted within ONE YEAR of the date of delivery will be repaired free of charge, or the equipment will be replaced with a new or remanufactured product at Inovonics' option.

B. Parts and labor for factory repair required after the one-year Warranty period will be billed at prevailing prices and rates.

IV RETURNING GOODS FOR FACTORY REPAIR:

A. Equipment will not be accepted for Warranty or other repair without a Return Authorization (RA) number issued by Inovonics prior to its return. An RA number may be obtained by calling the factory. The number should be prominently marked on the outside of the shipping carton.

B. Equipment must be shipped prepaid to Inovonics. Shipping charges will be reimbursed for valid Warranty claims. Damage sustained as a result of improper packing for return to the factory is not covered under terms of the Warranty and may occasion additional charges.

Revised Feb. 2003