

**PROGRAMMING AND OPERATION
INSTRUCTION MANUAL**

MODEL 720

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



—— USER'S RECORD ——
Model 720 – Serial No. _____
Date Purchased _____
Warranty Card Mailed? — <input type="checkbox"/>

PROGRAMMING AND OPERATION INSTRUCTION MANUAL

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'RADIODATA' ENCODER

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Section I

INTRODUCTION

MODEL 720 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 functions.

General Inovonics’ 720 is the company’s third-generation ‘full-function’ dynamic RadioData encoder capable of scrolling song titles and other information on the RDS radio faceplate. All of the important static IDs, traffic and other ‘flags’ are of course supported, as well as specialized “in-house” applications.

The front-panel LCD screen, built-in diagnostics and safeguards offered for the first time in the Model 720, allow for near-foolproof RDS implementation at any FM radio station. Every step has been taken to guarantee simple, straightforward and safe operation.

Features Leading features of the Inovonics 720 include:

- Front-panel LCD screen and built-in diagnostics, both in encoder firmware and software.
- “Static” data quickly programmed or updated with any Windows[®] PC using a serial or USB connection.
- Works with popular hard-disk automation systems to transmit song titles, contests, billboard updates, scrolling advertisements, etc.
- A unique “No Headers” mode supports unformatted streaming text feeds.
- Scrolling messages are automatically ‘parsed,’ or broken into 8-character word groups for transmission, or can be scrolled one character at a time.
- 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; contains no trans-fats!

MODEL 720 TECHNICAL SPECIFICATIONS

Standards Supported:

European CENELEC and United States NRSC.

RDS Applications Supported:

PI, PS, PTY, TP, TA, RT, AF, DI, M/S, RAW. (A detailed explanation of these applications begins on Page 8.)

Operating Modes:

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 $\pm 75\text{kHz}$ carrier deviation.

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 synchronize 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. In the absence of a 19kHz signal, the 720 reverts to an internal crystal time-base.

RDS or MPX Output:

An unbalanced, 75-ohm (BNC) output to feed a wideband input of the FM exciter.

RDS Injection Level:

Subcarrier level is continuously adjustable from the front panel from zero to 3V p-p. The LCD screen gives both bargraph and voltage readouts.

Serial Data Port:

A rear-panel RS-232 port (DB9) accepts static encoder programming and dynamic messaging from station automation. The 720 accommodates all common data rates between 1200 and 115,200 baud. 720 software features an automatic port and data rate ID utility to simplify initial connection and setup.

USB Port:

A front-panel USB port gives quick and easy access for encoder setup. All static messaging may be quickly set with a laptop PC.

TA Switching:

The temporary TA flag is set either by a software command or with a contact closure through a rear-panel terminal strip. The 720 incorporates a programmable TA-timeout utility to preclude TA flag violations.

Supplied Software:

Model 720 software runs on any Windows® PC for either USB or serial (COM) port operation. The software is intuitive, self-guiding and contains numerous pop-up and other Help files.

Power Requirements:

105–130VAC (0.250A Fuse) or
210–255VAC (0.125A Fuse),
50/60Hz; 10W.

Size and Shipping Weight:

1 $\frac{3}{4}$ "H x 19"W x 8"D (1U); 7 lbs.

BLOCK DIAGRAM

Figure 1 is a simplified Block Diagram of the Model 720. A full set of schematics may be found in the Appendix, Section VII, and accompanying circuit descriptions begin on Page 37.

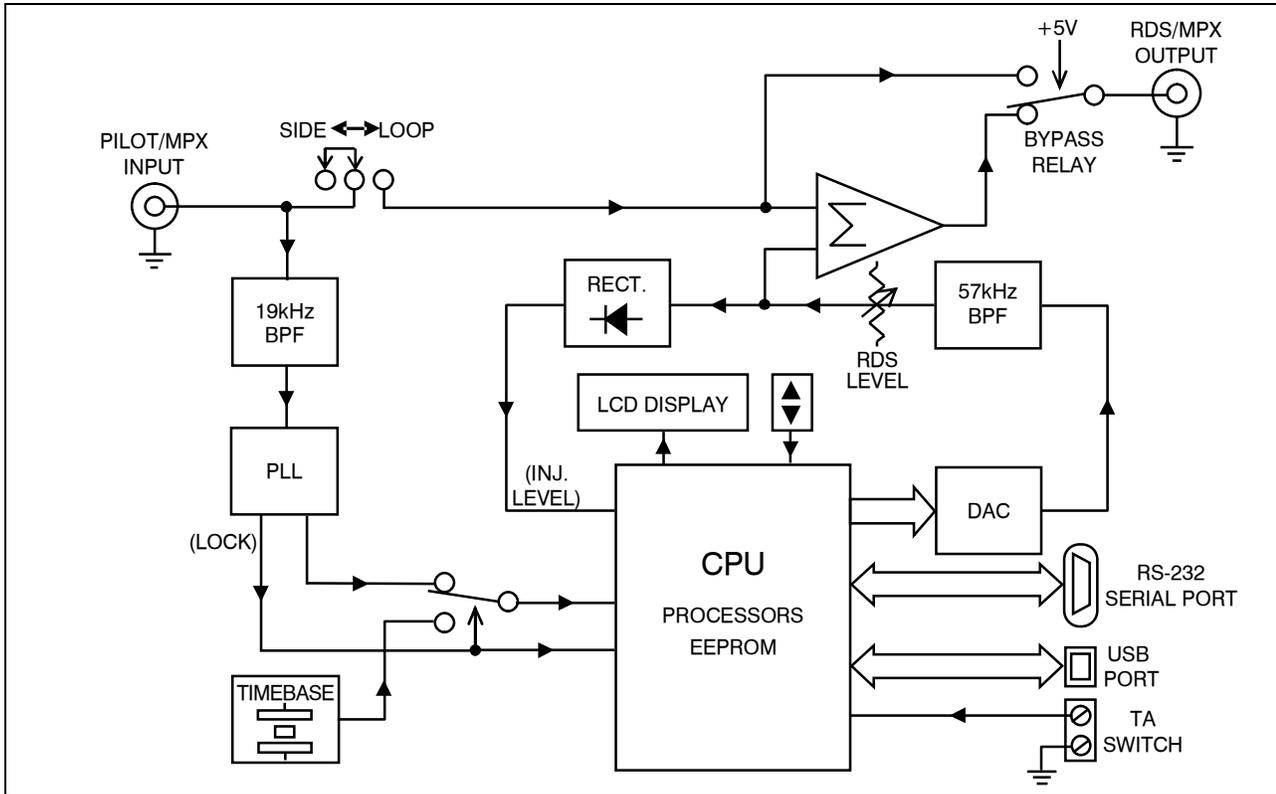


Figure 1 – Block Diagram, Model 720 RDS Encoder

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 transshipment becomes necessary. If returned for Warranty repair, shipping damage sustained as a result of improper packing for return *may invalidate the Warranty!*

IT IS IMPORTANT to complete and return the Warranty Registration Card that accompanies this manual, or the Warranty registered on the Company's Website, www.inovon.com. This assures coverage of the equipment under terms of the Warranty, provides a means of tracing lost or stolen gear, and adds the user to a database to receive specific service instructions or software/firmware updates when issued.

Section II

THE RADIO DATA SYSTEM

THE SYSTEM DEFINED

RDS is a digital data channel transmitted as a low-level subcarrier above the range of the composite stereo program signal in the FM broadcast baseband. The data transmission (baud) rate is comparatively low, yet it is quite robust because of redundancy and error correction routines. The injection level of the 57kHz RDS subcarrier is a relatively low 3% to 4%, thus it does not rob the broadcaster of significant program audio modulation.

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 720 Encoder.

In particular, the explanations of the various messaging and house-keeping functions afforded by RDS will help the reader become more familiar with what the system has to offer and how it can be used to the broadcaster's greatest advantage. These explanations begin on Page 8.

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 rapidly grew 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 RadioData 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, although 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 feed 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.

**RDS vs. RBDS
or "What's in
a Name?"**

As the Radio Data System was developed in Europe, it is understandable that it 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 to differentiate it from its European counterpart. 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.

RDS APPLICATIONS SUPPORTED BY THE MODEL 720

The following is an alphabetical listing of RDS applications that are fully supported by the Model 720. 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 broadcasting network, or an individual broadcaster using low-power rebroadcast transmitters ('translators') 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 to it with no audible interruption. The principal utility of this RDS function is with European radio networks and US stations with translators. The 720 can hold as many as 25 Alternative Frequencies.
- DI** **Decoder Information:** This is one of several 'flags' that convey yes/no or other very basic data. This particular flag is meant to tell 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 con-

ventional stereo transmissions are supported by the Model 720.

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 understood. In general, only all-news or talk-radio stations would fly the Speech flag.

PI Program Identification: This block of data identifies the broadcast station with a hexadecimal numerical code that represents the “digital signature” of the station. 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. The code is assigned by the broadcasting authority in most countries, but in the US and in Canada it can be calculated from a numerical encoding of station call letters. Model 720 software does this automatically as described on Page 16.

PS Program Service Name: This is the station’s “street name” that might typically 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 was meant to remain ‘static.’

Because of driving safety considerations, broadcasters have, from the start, been discouraged from making the PS ‘dynamic’; that is, to send long messages in a succession of 8-character frames. As a matter of note, it remains a violation of both the CENELEC and the NRSC standards to flash or scroll the PS display. Nevertheless, this nefarious practice of ‘Scrolling-PS’ has become very common, both in the US and abroad. The Model 720 has various modes for message scrolling that offer a safe alternative to the static PS display. These are described beginning on Page 18.

PTY Program Type: The PTY data flag identifies the station format from a list of pre-assigned 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, although not the very same program. The PTY function of RDS helps a broadcaster catch a certain ‘transient audience’ share... a long-distance truck driver for instance. Two distinct lists, one for RDS and the other for RBDS, remain a major disparity between the two systems. A listing of all PTY categories is given in the Appendix.

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.

RAW **Raw Data Entry:** The Model 720 provides a method of transmitting proprietary ‘hidden’ data within legitimate RDS groups. This is a special use of the encoder for non-standard applications. Additional notes can be found on Page 26.

RT **Radio Text:** This is a 64-character block of plain text that the listener is able to select for visual display on only some radios. Radio Text should not be confused with scrolling-PS, however, they are two separate and distinct messaging utilities that are available simultaneously.

The Radio Text function is not often available on automobile receivers for legacy safety considerations. This has precipitated the frowned-upon practice of instead scrolling the PS field for song titles and other ‘dynamic’ messages. Radio Text has become relegated to the display of more ‘static’ information, such as the station’s call-in phone number or Web address.

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 MP3. 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 MP3.

The ‘takeover’ nature of the TA function has spawned numerous abuses, mostly in a misguided and evil attempt to ‘steal’ listeners. A naughty broadcaster might tease a listener he has just ‘grabbed’ by mentioning some hot pop star interview that’s up next on his station as he goes into his traffic update. Or he might simply leave the TA flag on inadvertently (or not!). The Model 720 incorporates a TA countdown timer that limits the traffic announcement to a user-programmed maximum number of seconds.

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 logo 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-switchover process.

COMMUNICATING WITH THE MODEL 720 ENCODER

The 720 may be addressed either by an RS-232 serial link or through the front-panel USB port. Either port may be used for initial setup of the static flag and message registers, and Model 720 software serves both methods with an intuitive data-entry screen and self-guided help. This process is covered in Section III.

Scrolling song titles require interconnection with station automation. Some RDS applications require continuous, on-line access to

the RDS encoder by outside service providers. The Model 720 offers these capabilities so long as it can be directly addressed through its serial port by simple ASCII commands from a computer or automation system.

The Model 720 does *not* provide onboard TCP/IP network connectivity to enable online control via a Local Area Network or the Internet. Inovonics does offer RDS encoders that do provide a direct network connection. However, a third-party IP-to-serial converter functioning as a telnet server may be used with the 720 to offer TCP/IP connectivity.

Early RDS deployment in Europe included a provision to link RDS encoders 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 720 does *not* conform to the UECP.

Section III

SOFTWARE INSTALLATION AND FIRMWARE SETUP

NOTE: It is important to pre-program Model 720 firmware before the encoder is placed in the air chain. Firmware refers to the message and ‘flag’ registers that are non-volatile memory inside the unit itself. ‘Default’ register settings and messages are programmed-in at the factory as part of the final checkout process. Although benign in nature and intent, factory defaults could prove a source of confusion or embarrassment if allowed to air in lieu of settings and messages appropriate to the installation.

For this reason, Section III is presented ahead of instructions for installing and using the unit. We recommend ‘tabletop familiarization’ with the 720 before bolting it into the rack.

INSTALLING THE SOFTWARE

Install Software First!

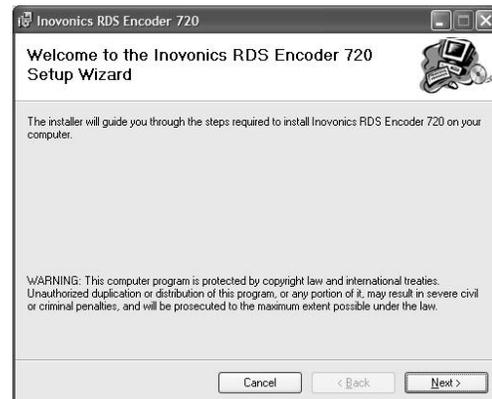
The provided software runs on any Windows® computer running Microsoft’s Windows XP or later operating system. Software should be installed on the computer *before* the computer is connected to the 720 Encoder. The same software is used for either USB or serial connection between the computer and the Model 720.

Microsoft ‘dot-NET’ Framework

720 software utilizes components of Microsoft’s ‘dot-NET’ framework. This utility has been distributed through routine Microsoft XP updates and should be resident on any well-maintained PC. If software installation pauses because dot-NET files are not found on the computer, dot-NET has been supplied on the 720 software CD-ROM or may be download directly from the Microsoft Website.

Insert the CD-ROM into the computer’s appropriate drive. The disc has an auto-run utility that will start the Windows Installer. If auto-run does not initiate the installation, open the file for the CD drive and double-click the setup.exe icon.

The image shown at the right should appear on your screen in short order. This is the 720 Setup Wizard that will guide you through software installation. For a typical installation, simply continue to click Next> until the program has been completely in-



stalled, then click Close to exit the Setup Wizard.

Software installation will place a shortcut on the computer Desktop. Do try to resist the overwhelming temptation to double-click the icon at this time. We sincerely recommend first installing the USB driver, whether or not the encoder's USB port will be your primary means of addressing the unit.



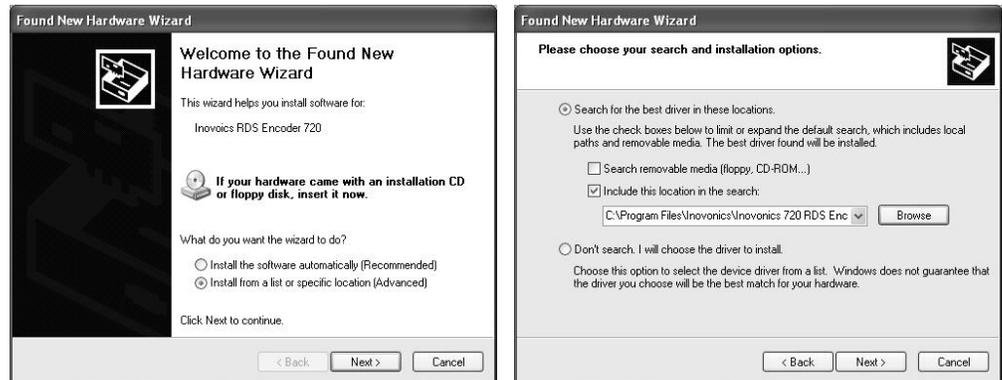
Installing the USB Driver

At this time, power-up the Model 720 and connect it to the computer using the USB cable provided.

Windows® will post a message that new hardware has been found. Next, the Found New Hardware Wizard will start and guide you through the installation step.



On the initial 'Welcome' screen (below, left), check the box Install from a list or specific location (Advanced), and then click Next.



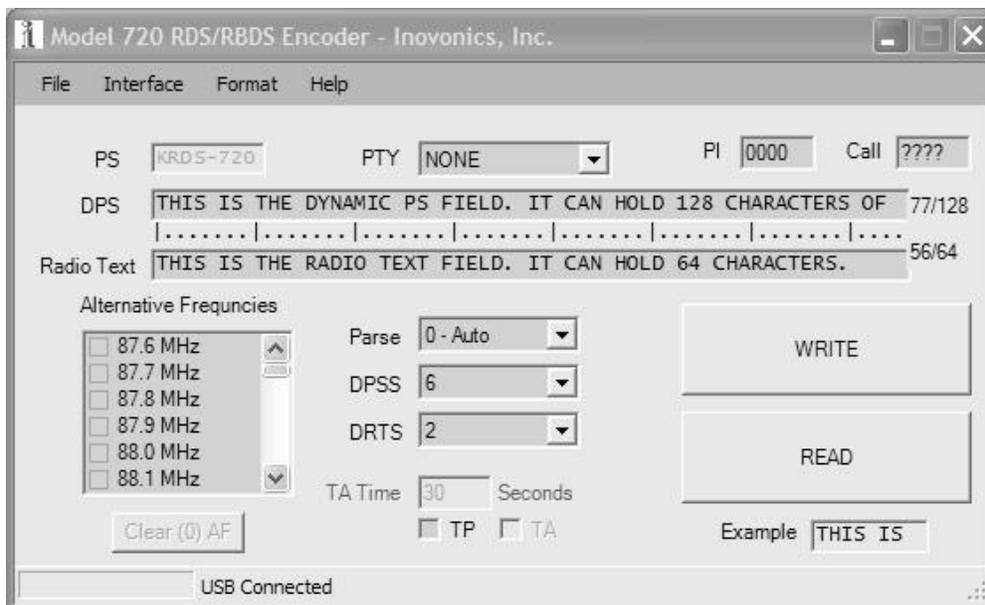
Continue to click Next until installation reaches the window shown on the right. Highlight the driver on the CD-ROM drive named: C:\Program Files\Inovonics RDS Encoder 720\USB Drivers as shown, and then click Next once again. When driver installation completes, the final screen will prompt you to click Finish. At this point you will see another notification, this time advising that the new hardware is installed and ready to use.



RUNNING THE SOFTWARE

NOTE: Even if you have no intention of programming the encoder through the USB port in everyday operation, we recommend that you familiarize yourself with the static data entry procedure of encoder programming using the USB connection. If you have followed this manual's sequence of encoder setup, the computer should be connected to the USB port at this time. A procedure for establishing serial (COM) port communications between the computer and the encoder begins on Page 22.

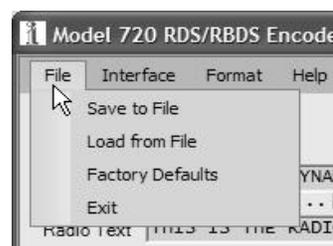
With the computer and encoder USB ports connected, double-click the Model 720 Desktop icon. This should bring up the data-entry window shown below. Check first at the bottom of the window that the words USB Connected are displayed as indicated in the illustration. This verifies communication between the computer and the encoder.



Data Entry The following steps will show how data is entered into the various RDS fields. As these fields are updated, all information is first held by the software program on the computer, and then transferred to the encoder with a WRITE button command.

THE MENU BAR

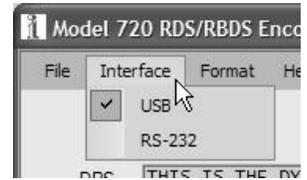
Click File at the top of the window. This brings down a sub-menu that allows the user to save programming setups *from* the encoder to a small file on the computer, or to load setups from a file on the computer *to* the encoder.



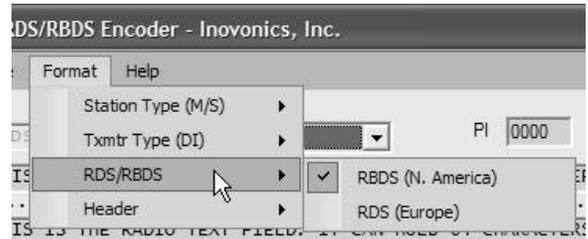
Files will be assigned a .rds extension. The 720 file utility is useful for distributing a common encoder setup among stations in a network, or for easily changing non-dynamic scrolling-PS or Radio Text messages without having to type them in each time. .rds files may be kept in a folder created for them using the usual Windows® file-making rules and procedures.

This menu tab also allows the user to reset the encoder to Factory Defaults. Executing this command actually re-initializes the encoder with factory settings, purging all setup options programmed by the user from the non-volatile encoder memory.

The next menu item, Interface, shows at a glance whether the software and encoder are set to communicate via the front-panel USB port or the serial (COM) port. The USB box will be checked at this time. Clicking RS-232 will bring up a port-assignment utility that is explained on Page 22.



Clicking Format opens a number of programming options, many of which are pertinent to the station's RDS presence. These must be set properly and will be discussed individually here.



RDS/RBDS

This is important! This selection essentially switches the Model 720 between North American and European operating modes, selecting the proper PTY list and enabling the built-in PI calculator for US and Canadian call letters. Set this to RBDS in the US, Canada and Mexico, and to RDS for the rest of the world.

**Station Type:
the M/S Switch**

This RDS flag is set to Music for the preponderance of today's FM broadcasting. It would be set to Speech for an all-news or all-talk format, even allowing for jingles and promo ditties.

**Txmtr Type:
the DI Switch**

Set this to Stereo unless all transmissions are monaural. The 720 does not support the other, somewhat esoteric (and lost in history) DI options originally included in the CENELEC specification.

Header

An important feature of the 720, and one that sets it apart from earlier models and most competitive products, is the ability to transmit scrolling-PS messages from raw, unformatted ASCII text. In the preferred mode of operation, scrolling-PS messages are preceded by the special 'header' DPS=. This prepares the encoder to format and send the following text string to appear on the RDS radio faceplate.

Satellite-delivery music services and some station automation equipment are able to output only raw, unformatted song title and artist information to accompany the audio programming. In these instances, sending the encoder properly-formatted data with the appropriate headers would require either an additional computer routine or use of a third-party 'data consolidator' to perform off-site data formatting.

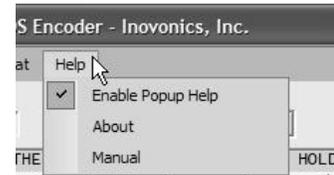
When the Format and Header selection is set to Yes (Normal Operation), the Model 720 responds only to scrolling-PS messaging that is preceded by the required DPS= message header. When set to NO (Satellite Streaming), all ASCII text received via the serial (COM) port will be 'parsed' by the 720 and sent out as a scrolling-PS message.

Needless to say, this software selection should be operated in the Yes (Normal Operation) mode except in those special installations that utilize unformatted streaming text. This mode keeps the encoder

under stable control by station automation and prevents automation system ‘housekeeping’ commands from popping up on RDS radios. Once the encoder is set to the No (Satellite Streaming) mode and is receiving streamed text, the 720 parses and shows everything that comes along. A special ‘escape’ sequence is needed to get it out of this mode via the serial connection; this is explained on Page 26. The USB port may always be used to reset the encoder.

The Help Menu

The Help selection on the Menu Bar lets the user turn on or off the Help ‘balloons’ that pop up for a short time when hovering-over various areas of the data-entry screen with the mouse cursor. In About you can determine the version of software that’s being used, and hyperlinks will take you to the Inovonics Website or facilitate the composition of testy letters to our Tech Support department. A PDF of this manual loads when you click Manual.



PI AND PTY CODES

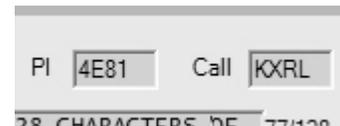
PI Code and the Calculator

As discussed on Page 9, the PI code identifies your station with a unique digital address. In many parts of the world this code is assigned by the national broadcasting authority or a regional standards group.

NOTE: A valid PI code is essential to proper RDS *system* operation. RDS radios may actually *tune away* from a station transmitting RDS data groups that do not include a valid PI code.

When the Model 720 is operated in the European RDS mode, the 4-character, hexadecimal PI code is typed directly into the PI box. Note that the box marked Call is grayed-out in the RDS mode. In the US and Canada, however, the PI code is derived from station call letters using a somewhat complex mathematical formula that gives a certain weighting to each letter in the station’s call. The US and Canadian formulae are different, of course, and there is considerable room for error when manually calculating the hex value from call letters. We have not included these formulae here, but interested parties can refer to the appropriate Standard for a full and somewhat confusing explanation of how the PI is actually calculated.

Model 720 software contains a nifty built-in calculator that makes PI code entry entirely automatic in North America. When the encoder is in the RBDS mode, US or Canadian call letters may be typed directly in the Call box. As soon as valid call letters are entered, the corresponding hex code will magically appear in the PI box. US and Canadian calls must begin with K, W or C.



NOTE: The 720 software calculator will not respond to call letters assigned in countries other than the US and Canada.

PTY Format Identifier

The PTY (Program Type) code identifies the station's programming format from lists that have been compiled as part of the RadioData standards. There are two lists, one for the European RDS system and one for the North American RBDS specification. The two lists are shown side-by-side in the Appendix.

The appropriate PTY list is automatically loaded when the 720 is set for the proper operating mode (RDS or RBDS) as explained previously in the Menu Bar discussion. With the proper encoder mode set, choose the station format from the drop-down list.

Take care in choosing the PTY identifier as 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 this less-gracious day and age? Would Serious Classics dare to include Stravinsky, Bartok or Arthur Fiedler? For clarifications on these and other burning questions, refer to the appropriate RBDS or RDS Standard, or put your question directly to the appropriate Standards Group. We regret that the Inovonics Tech Dept. is not certified to fathom such conundrums.

The PTY identifier can assume a semi-dynamic function in that it is permitted to change from one format category to another if the station "dayparts," or alters formats during specific, *extended* segments of the broadcast day. The PTY should not change from song to song or to accommodate a 5-minute newscast.

NOTE: The PTY codes relating to emergencies are reserved for *true emergency and emergency test situations only*. Consult the appropriate Standards group before even thinking about airing these PTY codes.

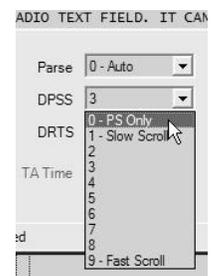
THE PS FIELD - STATIC AND SCROLLING

Static PS

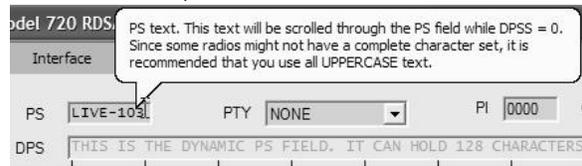
PS, or Program Service Name, was initially included in the RDS specifications simply to display a fixed station identifier on the RDS radio faceplate. As of this writing, anything other than a static display is still discouraged, although the scrolling of song titles and even advertising messages has become universal practice on all continents.

The 720 has two PS memory registers. One holds a fixed, 8-character station-ID or station "street name," and the second is a 128-character buffer register to hold a longer message for scrolling across the radio faceplate. Clicking on the DPSS (Dynamic PS Speed) box will drop a menu. At this time, click 0-PS Only.

This action will 'open' the PS box so that an 8-character station ID may be entered. If Pop-Up Help is turned on, then hovering over this area will display the helpful hint of using uppercase text when entering this information. We



heartily recommend using all-caps for this short-form PS entry, as well as for the scrolling-PS (DPS) field, and even for Radio Text. Some RDS radios are not able to display lowercase characters at all, or may show gibberish when lowercase characters are received.

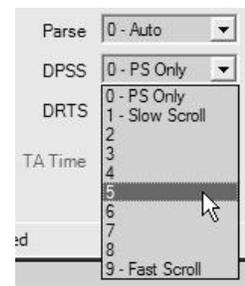


Scrolling-PS

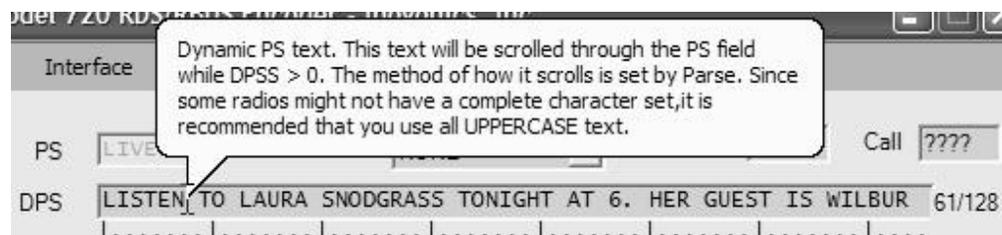
The Dynamic PS (DPS) register can hold up to 128 characters of text, which can be made to scroll across the RDS radio faceplate in a manner and at a rate determined by software settings.

An entry typed into the DPS field will be entered into non-volatile encoder memory once the WRITE button has sent it to the 720. This allows programming the encoder at the studio and then relocating it to the transmitter site. Left undisturbed, the encoder will scroll the same message endlessly.

To enter text manually, it is first necessary to set the DPSS box to a 'speed' setting that opens the DPS field and sets it up for transmission. Click DPSS and select a scrolling speed about midway down the list. The 720 can perform very rapid *transmission* of the scrolling-PS message, but some radios cannot keep up with a really fast scroll. We recommend a '6' as a top scrolling speed.



The field will now be open for data entry. Hovering over the DPS field will pop up a Help balloon with hints and reminders. Place your cursor in the box, clear what's there, and type in your text. The character counter to the right of the field shows the number of characters entered out of the 128-character maximum.



In 'online' dynamic operation, the encoder is addressed by station automation through the serial (COM) port. Each data transfer of up to 128 characters will clear the contents of the DPS register and replace it with the new song title or other information, which then repeats until new data are received. What is manually typed into the register at this time will be saved until new data is sent to the encoder, either by re-typing manually for a USB upload or by being replaced by data from the serial port.

Parsing

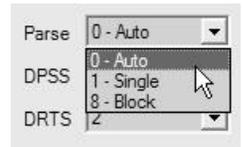
Parsing is the encoder's 'smart' mode of message transmission. Parsing breaks messages down into meaningful character groups for efficient display on the 8-character alphanumeric readout common to all RDS receivers. Once the parsing options are set, the parsing

function is valid for any scrolling-PS message, whether it is manually typed and sent to the DPS register or received as ASCII text from station automation.

Parsing sends short words together. *THIS IS* consists of seven characters that would be sent as a group; the same holds true for *OF THE* or *NOW HERE*. Longer words, up to and including 8 characters, are sent individually: *WARNING* or *DOUGHNUT* or *BICYCLE*.

Words that exceed 8 characters are ‘sidestepped’ at a slightly faster refresh rate through two or more consecutive displays. Examples are *EMERGENC* followed by *MERGENCY*, or *SUPERMAR* followed by *UPERMARK* and *PERMARKE* and *ERMARKET*. This method of splitting words gives a good sense of continuity and readability.

The 720 affords three parsing options. These are selected with a drop-down menu in the Parse box. The method just described is the most popular and is selected by clicking 0-Auto in the box.



The other two options select either Single, or what we call our “safe scrolling” method explained below, or 8-character Block transmission that simply presents the incoming DPS text string as a succession of 8-character blocks without the ‘smart’ division into word groups. Hovering over this area brings up a Help balloon with this same information.

“Safe Scrolling”

We developed ‘Safe Scrolling’ because of our concern over distracted automobile drivers. When viewing a message composed of 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 trying to find out who sang the number might run the risk of rear-ending another car.

Safe Scrolling ‘marches’ the message across the display screen one character at a time, just like soldiers passing a reviewing stand. Any message would require 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 any words.

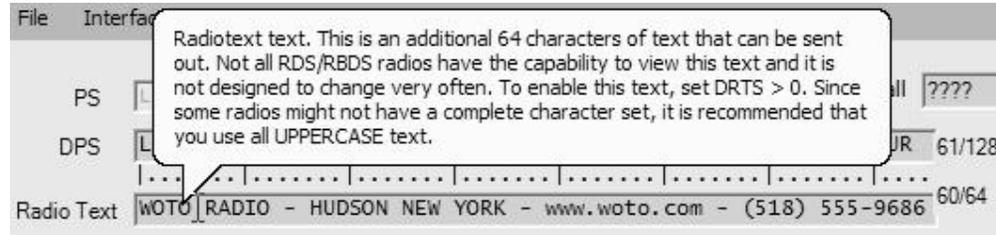
RADIO TEXT

Radio Text is a separate 64-character message that is transmitted to the radio as a complete message; that is, it is not parsed by the 720 Encoder. The Radio Text message is held in buffer memory within the RDS receiver, and then scrolled or otherwise displayed in a manner determined by the receiver manufacturer.

Some automobile receivers do not display Radio Text, others may require the listener to press an INFO or TEXT button to see the Radio Text message. Radio Text is meant to be a static message, perhaps with station contact information or a general station promo

slogan. It may be entered manually and updated only when the information changes.

Click into the Radio Text field, clear what's there and type in your message. The character counter to the right of the field shows the number of characters entered out of the maximum of 64. Note that hovering over the field will bring up a Help balloon.

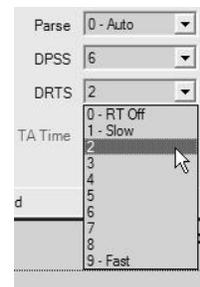


Although we extend our recommendation of using uppercase characters for this field, receivers with Radio Text capability are usually higher-end radios that have a better chance of showing lowercase characters properly.

**DRTS
Radio Text
Speed**

Although Radio Text is sent to the receiver as a complete message and not parsed by the encoder, the repetition rate at which the Radio Text message group is refreshed is a user-defined variable.

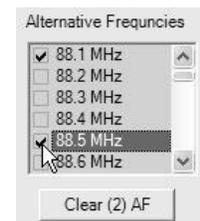
Once a station is tuned-in, the time interval before Radio Text is initially displayed will depend on how frequently this RDS data group is transmitted. Because Radio Text is a static message generally relegated to 'secondary' information, the refresh rate does not need to be very high. On the DRTS (Dynamic Radio Text Speed) scale of 1 to 9, a setting of 2 or 3 is usually quite adequate. Keep in mind that with a faster refresh rate Radio Text will monopolize transmission resources and compromise the speed of scrolling-PS messaging.



The DRTS drop-down menu can also be set to zero. This turns Radio Text off completely and grays-out the text entry field.

ALTERNATIVE FREQUENCIES

As mentioned on Page 8, the 720 accommodates as many as 25 'Alternative Frequencies,' the maximum number supported by the RDS/RBDS specification. These are other dial locations where the very same program can be heard at the very same time (in sync!). The RDS radio hunts for the strongest signal that carries the program and seamlessly switches to it. This feature is used by European radio networks and by any independent station that have rebroadcast 'translators' for extending coverage to areas where the main signal cannot be received well.



Enter your Alternative frequencies by checking a box

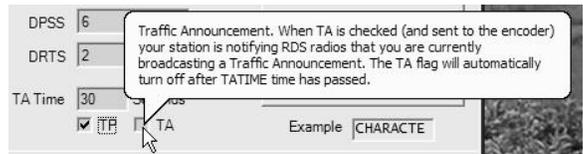
for every dial location that carries the program. Always include the main transmitter frequency, otherwise the RDS radio will not switch back when required. A button below the Alternative Frequencies box allows all checks to be cleared at once.

TRAFFIC ALERTS

The TP / TA function is a useful provision of the RadioData System, but one with a potential for abuse. TP / TA is detailed on Page 10, including an explanation of how the utility can be abused and the safeguards built into the Model 720 to prevent this.

In order for a station to air TA (Traffic Alert) messages, it must first be listed as a TP (Traffic Program) station; that is, a station that routinely includes traffic updates in the normal programming schedule. RDS radios keep track of TP stations and ‘look’ for a TA flag only from among those stations.

If your station does air routine traffic announcements, check the TP box. This will then permit the encoder to send TA flags on demand.

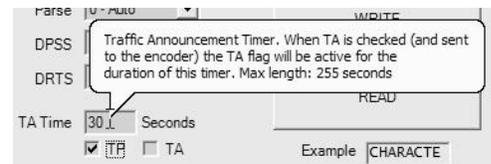


In keeping with RDS and RBDS regulations, the TA flag is to be sent only for critical traffic-related announcements, and then only for the actual duration of the accompanying voice message. We recommend using only the direct-connected, hardware-switch-activation of the TA flag described on Page 32. However, as the encoder may be installed 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.

Nevertheless, the TA box on the 720 software screen may be checked to initiate a TA flag. The flag is then transmitted immediately when the WRITE button is clicked. To clear the flag when the announcement is finished, uncheck the TA box and click WRITE once again.

TA Time

The 720 is equipped with a built-in timer that limits the maximum period for TA-flag transmission. This guards against a short-circuit in a hardwired TA installation, or in the event that a second software command is not received at the end the TA announcement. TA may be set to time out after a period of up to 255 seconds, with the 30-second factory-default value a typical setting. The TA timeout is set in the TA Time box, and a Help balloon gives additional hints.

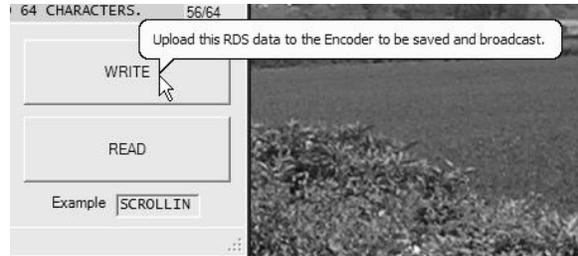


Once the TA has timed-out, the TA function resets and has to be re-initiated to proceed with another announcement.

WRITING TO AND READING FROM THE ENCODER

When using the 720 software program to address the encoder from a computer, once any single or series of RDS parameters have been set and any text entered, it is then necessary to click **WRITE** to send the data to the encoder. The data will be transferred to non-volatile memory within the Model 720 at that time.

Keep in mind that when the **WRITE** button is clicked, the entire contents of the software screen will be re-sent to the encoder.



Similarly, clicking: **READ** will download the contents of the 720 Encoder memory back to the software where it can be read or saved as a .rds file.

ADDRESSING THE 720 WITH A SERIAL LINK

The following tutorial will give instructions on serial connection with the 720 encoder. The software detailed in the USB discussion is the same used for serial communication. As previously recommended, initial setup is easiest with a USB link.

Serial Connection

If currently connected, disconnect the USB cable from the encoder. Using the DB9 serial cable provided, connect the computer to the Model 720.

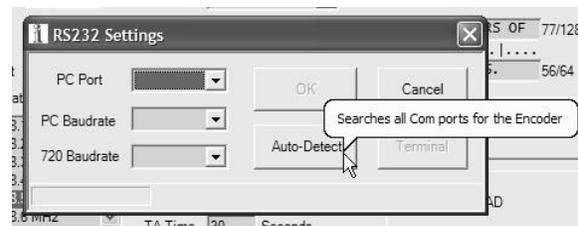
In the Menu Bar, click **Interface** and then **RS-232**. This will bring up a box labeled **RS232 Settings**. In this box the baud rate of the computer and encoder ports may be set manually using drop-down menus, or a handy built-in utility will automatically determine settings.

Changing Baud Rates

When changing the baud rate of the encoder, keep in mind that the 720 will not respond to an improper incoming baud rate. You will have to know what baud rate the 720 is set to, establish communications at that rate, and then reset the computer baud rate if this is the aim. The USB connection can always be used to reset the encoder's baud rate, or the built-in **Auto-Detect** utility can be used.

Auto-Detect

Clicking **Auto-Detect** will start a software utility that will interrogate all computer COM ports, determine which one is connected to the 720 Encoder, and set the computer's baud rate to match the encoder. A valid connection will be confirmed by a notification at the bottom of the window, first showing **Found**, and then listing the port and its speed



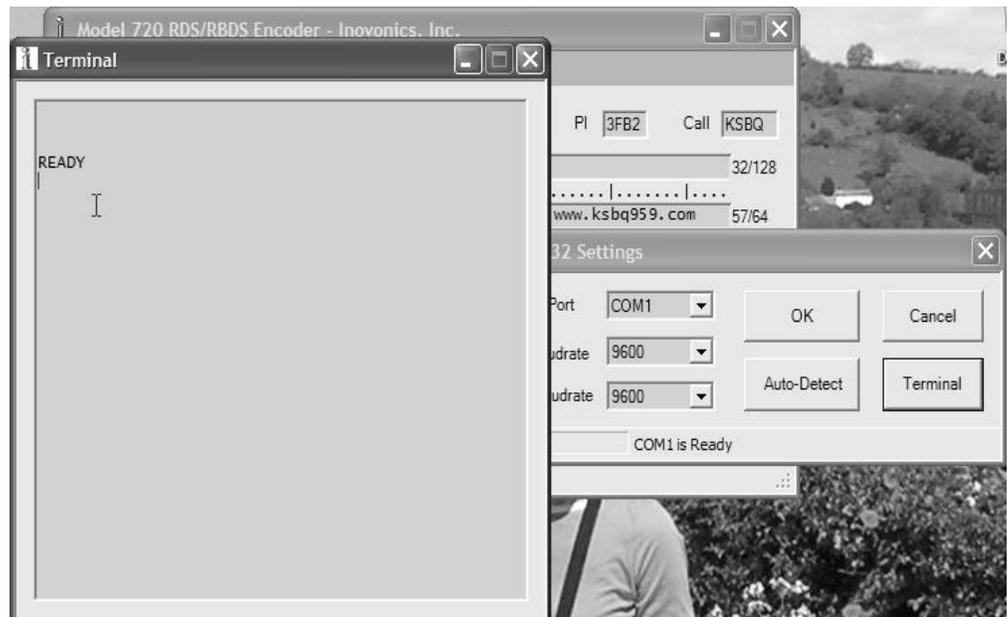
**Dual
Addressability**

At this point COM port communication is established. Data entry using the Windows® software may be done in exactly the same manner as already has been described for the USB connection.

With the 720 connected to station automation via the serial port, a computer may still be plugged into the front-panel USB port to give simultaneous, dual connectivity. This permits the easy editing of static messages and flags without taking the encoder offline. The 720 will respond to whichever control source is currently sending data, whether this is a WRITE command from the Windows® software or individual register entries preceded by proper headers from station automation or a terminal, discussed next.

THE SOFTWARE TERMINAL UTILITY

With a 2-way serial connection between the computer and encoder, first check that the encoder is set to the normal header mode. In the Menu Bar, click Format and hover over Header. See that Yes (Normal Operation) is checked. Next click Interface and then RS-232 to reopen the RS232 Settings box. Click Terminal to bring up the data-entry box shown here. Hit the keyboard Enter key and the word READY will appear, confirming communication with the encoder.



Next type ??↵ (two question marks followed by Enter). This will interrogate the encoder and send back the contents of all ID, flag and message registers. An example of this interrogation is shown at the top of the next page. The double question mark can be used at any time to make the encoder 'spill its guts.' The exercise does not interrupt or interfere with encoder operation.



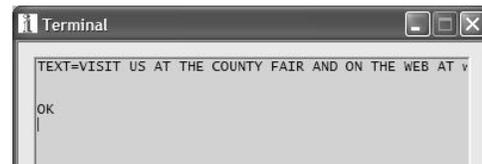
The displayed syntax includes ‘register designation’ headers appropriate to each entry. Any single register may be interrogated by typing its header and a single question mark. For example, type SPEED?↵ to request a confirmation that the encoder port speed is indeed set to 9600 baud.



**Updating
Registers
Using the
Terminal Utility**

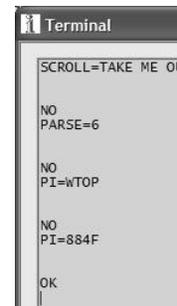
In these programming instructions the *exact* ASCII syntax to be entered on the keyboard will be given in the font used in the following example for the Radio Text field: TEXT=VISIT US AT THE COUNTY FAIR AND ON THE WEB AT www.wtop989.com↵. Specifically, the word TEXT followed by the equal sign and the message to be sent, followed by the Enter key. The symbol ↵ denotes the Enter key.

The illustration here shows this Radio Text field entry. Note that the terminal utility does not word-wrap the text, but each character will be seen as it is entered. When the Enter key is pressed after the text has been typed-in, the reply OK indicates that data has been received and saved in encoder RAM. Note that the ‘answerback’ response is always a couple of lines below the entry.



The terminal utility is not intended for use as a text editor, in that typing errors are not easily corrected in this window. If you make a mistake, just press Enter and start over. Your mistake will be sent and saved in 720 memory, but if you update the error promptly it’s doubtful that anything untoward will be noticed. This illustrates the advisability of using the 720 software, rather than the terminal utility, for entering text.

If improper syntax or an invalid entry is made, the encoder will respond back with a NO. This is shown for a number of improper entries here. The last entry was an attempt to set the PI register by simply typing-in call letters. This won’t work. The 720 PI calculator is in the software routine, which is not available when



communicating directly with the encoder using the terminal utility. When a proper hex-value PI code is entered, however, the response is OK.

Updating the AF List Using Headers

To keep the Model 720 backward-compatible with Inovonics' earlier encoder models, the Alternative Frequency list (AF) may be entered in either of two ways when using the terminal utility.

- 1) Enter the frequency directly in MHz. Example: AF1=95.9↵ and AF2=97.1↵ . Up to 25 Alternative frequencies may be entered in this manner. To clear the example second entry from the AF list, for example, type AF2=0↵ . The 720 will resort the list, so AF 'slot' numbers may change. Do a ?? ↵ inquiry to view the updated list.
- 2) Enter the Alternative Frequency by direct entry of the *channel number* assignments listed in the RDS and RBDS Standards. Channel numbers are tabulated in the Appendix. An example entry would be AF1=114↵ for 98.9MHz.

All AF entries may be cleared by sending AF0=0 to the encoder.

Saving to Non-Volatile Memory

Messages and commands sent to the Model 720 as ASCII text strings with headers are saved only in encoder RAM (Random Access Memory). *In the event of a power failure, this information will be lost!* In contrast, encoder programming using the Windows® software is automatically followed by a SAVE↵ command that transfers it to non-volatile encoder memory. This further emphasizes the desirability of using 720 software for setting the various RDS registers to protect their contents.

Losing dynamic data should not be a worry, however, as the only messaging-with-headers generally streamed to the encoder is scrolling-PS song titles or similar temporary data that is ordinarily updated on a continuous basis. However, when using the terminal utility or other means of serially-addressing the encoder without the 720 software, following any command or message with SAVE↵ will transfer all data from the encoder's RAM to non-volatile EEPROM memory.

AUTOMATION SYNTAX REQUIREMENTS

Generally, the Dynamic PS (DPS) field will be the only one addressed by station automation for sending song title and artist, station promo or similar information. In normal operation using headers, a typical automation command might be DPS=FLY ME TO THE MOON BY FRANK SINATRA↵ . Inovonics has collaborated with most of the automation system vendors to make sure that the 720 and other Inovonics encoders are compatible with all popular systems.

The use of headers allows the encoder to ignore commands that are not properly formatted. This way housekeeping or other miscellaneous data streamed by the automation system will not appear on RDS radio displays.

‘No Header’ Operation When the 720 is configured for ‘no header’ operation, everything in the serial data stream that is sent to the encoder will be parsed and will appear as a scrolling-PS message on RDS radios, contingent upon appropriate settings in the Parse and DPSS fields. This can be tested by setting the 720 for this mode (click Format, then Header, and check No (Satellite Streaming)). Once in this mode, bring up the terminal utility and type your text into the box. On an Enter command, the typed-in data will be sent, parsed and transmitted.

To escape from the ‘no header’ mode, press the keyboard Escape key three times and then press Enter. The screen will show READY, indicating that it is back in the Yes (Normal Operation) mode.

One-Way Data Transmission A return data path is not essential for encoder programming using the terminal utility or any other direct RS-232 data connection. The Model 720 is able to accept programming commands on a strictly receive-only basis; this is useful, for example, if a studio-transmitter radio link (STL) includes only a one-way data path to the transmitter site. Keep in mind, however, that commands will not ‘echo’ back a response. Using the supplied Windows® software always requires a 2-way link.

Data Echo The 720 ‘echoes’ incoming data. What comes up in the terminal utility window is actually coming back from the encoder. With one-way transmission, text or commands typed into the terminal window will not be visible but will nevertheless be sent to the encoder. Again, use of the supplied software requires a 2-way link.

THE ‘FREE FORMAT’ GROUPS

Under the RDS and RBDS Standards, the RadioData system is able to transmit unspecified data groups for in-house remote control, restricted paging or similar proprietary applications. These data can be static, with the same information transmitted repeatedly, or controlled by an external application as a dynamic function.

Certain “free data” groups are specified in the RDS and RBDS Standards. The Model 720 addresses these as a generic ‘RAW’ data group consisting of three hexadecimal ASCII blocks (or packets) of hexadecimal values; that is, three groups of four hexadecimal characters, which comes out to 3 x 16 bits. To enter data into these groups, send: RAW=bbbbccccdddd↵. The blocks represented by bbbb, cccc and dddd are the RDS/RBDS B, C and D data packets, which are described in the relevant Standard.

Certain hexadecimal values in RDS/RBDS packets are already in use for RDS functions supported by the 720 encoder. Group A, for instance, which precedes packets in the RAW group, contains the PI code, which is programmed into encoder memory. But other groups can be altered on a temporary basis without compromising functions that regularly depend on data in these groups.

An example of a user-developed command is RAW=4000170C65B0. This command would ‘sneak’ data into the RDS stream indicating the current date and time, a function not otherwise supported by the 720 Encoder. The necessary checksums are automatically handled by the 720. Consult the applicable RBDS or RDS Standard for more information on using RAW data commands.

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 23. Registers may also be interrogated individually using the same cited instructions.
Encoder Initialization	<p>The “initialize” command is invoked by typing: INIT↵. This is an emergency recover command used to reestablish encoder operation in the unlikely event of an internal firmware ‘crash.’ An INIT↵ command is not required to clear registers before updating encoder programming. Typing INIT↵ erases all user programming that has been ‘saved’ in non-volatile memory and restores the encoder to factory defaults.</p> <p>To save an existing encoder setup, use the READ button in the Windows® software to save an .rds file (see Page 22).</p>
Saving to Non-Volatile Memory	RDS parameters are transferred from RAM to non-volatile EEPROM with a SAVE↵ command. This is done automatically when using the supplied Windows® software.
Encoder Reset	Typing RESET↵ performs a ‘soft restart’ equivalent to powering the encoder down and back up again. This reset command does <i>not</i> clear the registers of programming commands that have been saved with a SAVE↵ command.
Firmware Version	Type REV↵ for a display of the encoder’s firmware version. This has importance in determining whether differences exist between Model 720 encoders purchased at different times.
Communication Speed	The factory default for encoder speed is 9600 baud. To change the baud rate to 2400, for example, type SPEED=2400↵. Acceptable baud rates are 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200. The 720 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 supreme overkill. Even the default 9600 baud setting is lightning fast for encoder programming. Modest baud rates may prove far more dependable, especially with long data cable runs. The lowest baud-rate settings are useful when the encoder is addressed using a dial-up modem or a slow data channel that is part of an STL radio link.

Section IV

ENCODER INSTALLATION

MOUNTING

Rack Requirement The Model 720 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 an electric pencil sharpener, the 720 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 re-seated by reversing the removal process. This fuse also serves as a front-panel emergency power disconnect for the Model 720.

Mains Voltage Selector Unless specifically ordered for export shipment, the 720 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 right behind 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 some, probably 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 (RFI)

- Location** Although it is expected that the 720 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 input and output of the Model 720 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, although the chassis must somehow 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 the output of the stereo generator, monitoring the composite/MPX signal 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 of possible phase ambiguities between the synchronizing squarewave and the 19kHz pilot component in the composite, multiplex output of the stereo generator.

In sidechain operation the encoder's RDS OR MPX OUTPUT will contain *only* the RDS subcarrier; the composite/MPX signal is *not* routed through the 720. This operating mode will insure multiplex signal integrity and assure uninterrupted program transmission in the event of a catastrophic encoder failure (never happens!). As delivered, the 720 is configured for sidechain operation.

Referring Figure 2, locate the 3-terminal jumper strip, situated just behind the rear-panel RDS OR MPX OUTPUT connector on the circuit board. The shorting shunt is positioned to the *right* for sidechain operation.

- Loop-Through Mode** With the Model 720 jumpered for loop-through operation (shorting shunt to the *left*), the RDS subcarrier is internally combined with the composite/MPX signal and the RDS OR MPX OUTPUT *will include* the composite/MPX program signal at unity gain. The 720 provides a relay bypass of the composite/MPX signal in the event of power loss.

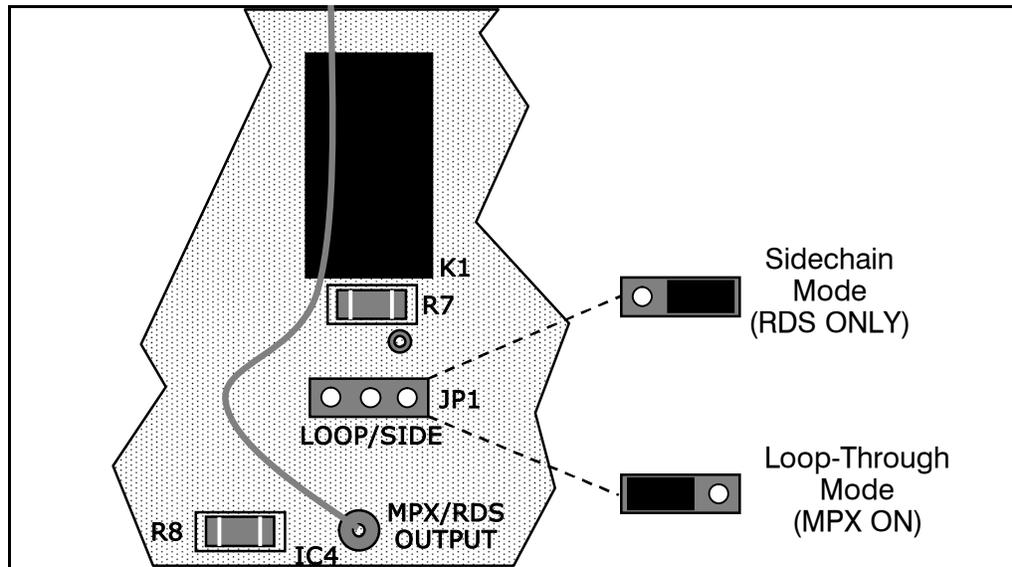


Figure 2 – Encoder Mode Jumpering

JP3 JP3 is included to facilitate any future firmware updates. Instructions for this procedure will accompany any updates issued. Header connector J5 is used only for initial factory programming of the 720.

CONNECTING THE MODEL 720

IMPORTANT: The 720 encoder must be properly configured for the desired operating mode: sidechain or loop-through. Consult Figure 2 to confirm that the encoder circuit board is properly jumpered before connecting the Model 720 to other air-chain equipment.

ALSO: Be sure that encoder firmware has been programmed according to the instructions in Section III.

Sidechain Mode (Preferred)

Using a BNC ‘T’ adapter at the composite/MPX output of the stereo generator, 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 720 as shown in Figure 3. This is only a bridging ‘sync’ connection with the circuit board jumpered for sidechain operation and does not affect the composite/MPX signal.

Using a Separate Sync Source

If the stereo generator has a dedicated 19kHz RDS sync’ output, you *may* connect this to the encoder PILOT OR MPX INPUT for sidechain operation. We do not recommend this, however, as this output may not have an accurate phase relationship with the stereo pilot in the composite/MPX output signal.

Cable the RDS OR MPX OUTPUT of the encoder to a second wideband (subcarrier) input of the FM exciter.

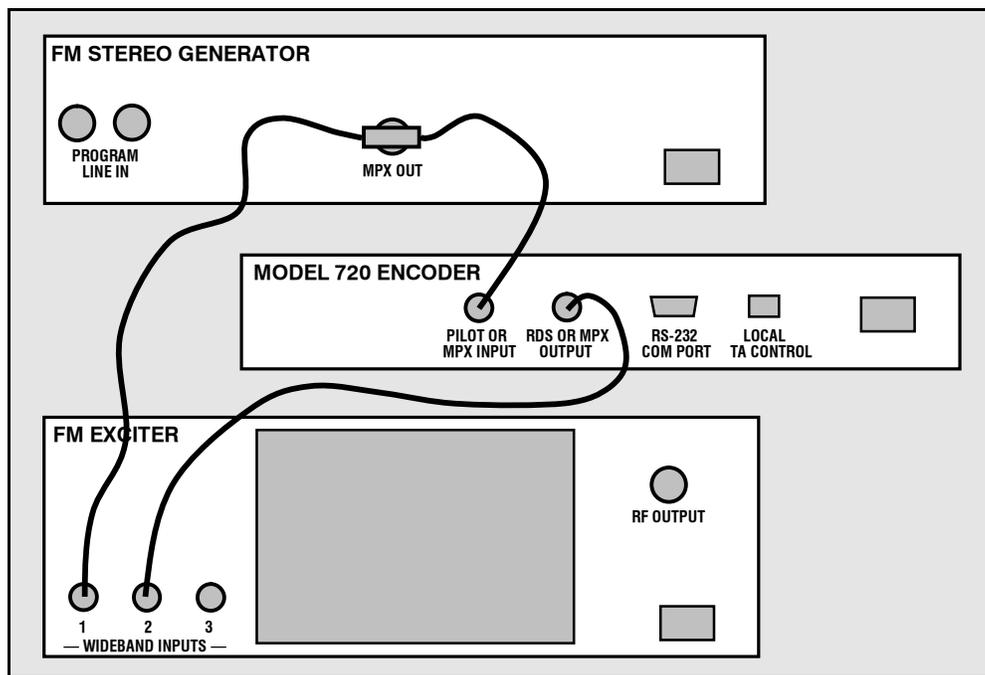


Figure 3 – ‘Sidechain’ Encoder Connection

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 720 as shown in Figure 4. 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 with the RDS subcarrier added, or routed directly through the encoder by the bypass relay in the event of encoder power loss.

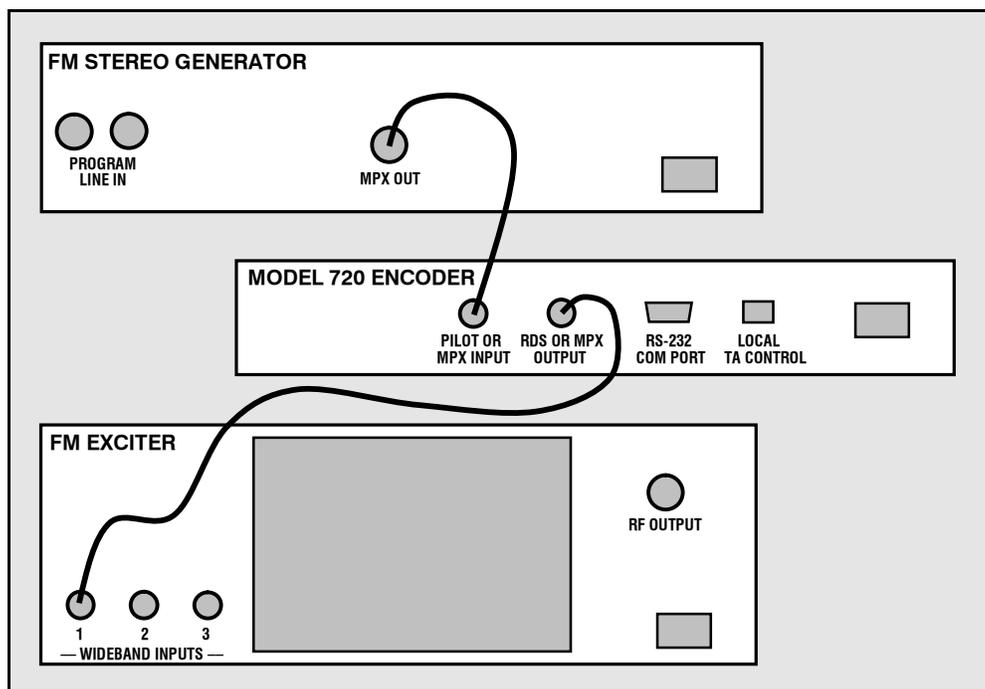


Figure 4 – Loop-Through Encoder Connection

Composite STL If a composite STL is used between the studio and the transmitter site, the 720 encoder may be kept at the studio for direct connection with station automation. Figures 3 and 4 still apply, with the STL transmitter taking the place of the FM exciter.

Manual Activation of the TA Flag The Traffic Announcement feature is a temporary command. This flag *must* coincide with the actual voice warning of a notable 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 cable may be taken from the LOCAL TA CONTROL terminal strip 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 screw-terminal part of this connector unplugs from the rear panel to make connection easier. A twisted pair is acceptable for a short run, but anything more than about 20 feet should probably be a shielded (coax) cable; shield grounded, of course.

The TA flag will be transmitted for 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 should be *turned off immediately* after completing the verbal traffic warning, which should be automatic if a spring-return switch is used.

The 720 does incorporate a down-counting TA timer to prevent a continuous switch closure from signaling a permanent TA flag. This timer is user-programmed for a specified time in seconds, after which the TA flag is automatically turned off until the switch is opened and then closed again. Programming of this timer is covered on page 21.

DATA INTERCONNECTION

For dynamic operation of the 720, the rear-panel RS-232 SERIAL DATA INTERCONNECT port is addressed in simple ASCII text. The primary utility of this port is to connect with station automation for uploading scrolling-PS and Radio Text messages. Communication syntax for direct connection with automation is explained beginning on Page 24 and in the Appendix.

The various RDS flags and other static data should already have been programmed per the instructions in Section III.

Interconnect Cables When the 720 is connected to a computer for static programming, the front-panel USB port is by far the most convenient means, and a suitable cable has been included with the encoder. Serial-port connection with station automation for dynamic messaging requires a 'straight-through,' pin-for-pin DB9 extension cable, and a short one comes with the 720. Serial cable pinout is diagrammed in Figure 5A.

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 computer or automation system. Figure 5B shows proper pin connections for the cable used to connect the Model 720 to a conventional external modem. The three conductors shown are the only ones actually required in this case.

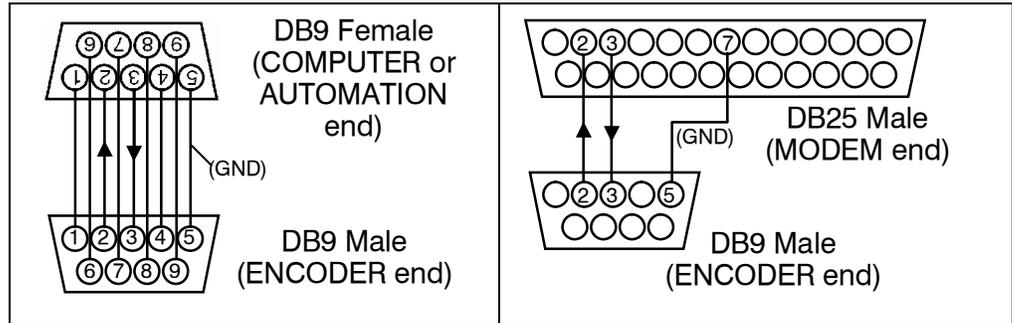


Figure 5A
Computer or Automation Cable

Figure 5B
Modem Cable

Cables Made In-House

Occasionally there is a need to make a data cable in-house; to connect the Encoder to the data output of an STL receiver, for instance. Figure 5C illustrates that only three connections are actually required for the encoder’s RS-232 interface. A cable like the one depicted can be made easily and will work just as well as a “serial extension cord” with all nine conductors connected.

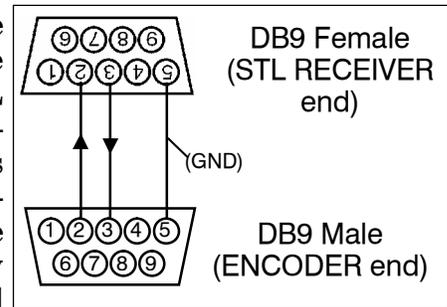


Figure 5C
Housemade Cable

Computer or Terminal Requirements

Although the supplied Windows® software and front-panel USB port afford the easiest method of entering static RDS data, the encoder may also be addressed serially using the terminal-emulation program that is part of the 720 software package (see Page 23). A simple “dumb” RS-232 terminal and, of course, station automation may also address the encoder directly. The encoder can accommodate multiple baud rates, but the factory default is 9600 baud. Set terminal or automation for: 9600-baud / 8 data bits / no parity / one stop bit (9600,8,N,1).

Section V

ENCODER OPERATION

THE FRONT PANEL LCD DISPLAY

The Inovonics 720 Encoder is nominally ‘menu driven,’ which in this case simply means that contents of internal data registers, plus data-on-the-fly and a readout of the subcarrier voltage level, may be viewed on the front-panel LCD display using the ▲ (up) and ▼(down) buttons to cycle through a number of different screens. It is comforting to know that no changes to the data registers can be made with these front-panel buttons; the USB and serial ports are the only means of updating the data to be transmitted.

The following listing explains the contents of each LCD screen.

SCREEN NUMBER	WHAT IS DISPLAYED
01	This is the STATUS: screen. It shows whether the encoder is locked to the stereo pilot or is running from the internal crystal timebase. SENDING PS> < displays what is actually being seen on the listener’s radio faceplate. When a TA flag is sent, TA FLAG ON is also displayed in this area as a flashing alarm.
02	DATA: shows incoming commands ‘on the fly.’ This is useful for verifying communications between the computer or automation and the encoder, and to read the commands to check that they are valid. When incoming commands are sent using the supplied software, the contents of all registers are updated whether or not changes have been made. Incoming programming will include spaces and ‘carriage returns,’ or ↵ symbols, necessary parts of the text strings.
03	DPS= displays the contents of the scrolling-PS buffer.
04	PARSE: indicates the parsing mode, along with a legend describing which DPS Method is programmed.
05	PS: displays the ‘short form’ Program Service name programmed into 720 memory and whether its transmission is enabled or disabled per the DPSS setting.
06	DPSS: shows the scrolling-PS speed setting, along with a legend describing the options.
07	TEXT: displays the contents of the Radio Text buffer.
08	DRTS: shows the Radio Text refresh rate, along with a descriptive legend.
09	PI: indicates the hex value of the station’s PI code. For North American RBDS operation, the station’s CALL LETTERS: will also be displayed here.
10	PTY: displays the code number of the station’s Program Type, or format, along with a matching (DESCRIPTION) from the appropriate RDS or RBDS list.
11	MS: the setting of the Music/Speech switch, with legend.
12	DI: Decoder Information, mono or stereo transmissions.

13	TP: whether or not the station carries traffic information programming as part of its broadcast schedule.
14	TA: shows whether the Traffic Alert is ON or OFF; this is also indicated on the 01 STATUS: screen. Displays TA: N/A when TP is off (TP: 0).
15	TATIME: indicates the number of seconds programmed for the automatic TA timeout function.
16	HEADER: shows whether the 720 is set for the normal header mode for scrolling-PS, or set to accept unformatted text.
17	SPEED: the setting of the encoder's RS-232 baud rate.
18 (and up)	AF1: Screen 18 and successive screens show any Alternative Frequencies (or NONE) programmed into the 720 encoder.
(Final Screen)	The 'bottom' LCD screen indicates RDS LEVEL: , the actual peak-to-peak voltage of the RDS subcarrier at the output of the Model 720. A bargraph representation is also shown.

SETTING THE SUBCARRIER INJECTION LEVEL

The front-panel INJECTION LEVEL ADJUST potentiometer sets the level of the RDS subcarrier. This is a 15-turn potentiometer to yield the required adjustment resolution. The 720 design has included a measurement utility to display the peak-to-peak amplitude of the RDS subcarrier on the LCD screen. By scrolling down the LCD menu to the very last screen, the peak-to-peak amplitude of the subcarrier is displayed directly in peak-to-peak volts.

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 3 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. The level of the composite/MPX program signal will typically be in the 3- to 5-volt p-p range. The same 0-3V RDS subcarrier level capability of the 720 is available in the loop-through mode as well, so obviously the INJECTION LEVEL ADJUST control will be closer to the counterclockwise end of its travel to give a level in the 0.16 volt p-p range corresponding 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 without a separate subcarrier measurement capability, keep in mind that mod-monitors are *peak-responding* for total modulation readings near 100%, but may be *average-responding* for low-level measurements. Because the RDS subcarrier is a complex waveform, an *average* reading of 3% RDS injection can represent a level that is substantially higher when measured peak-to-peak. The *peak* level is of concern in broadcasting.

**The Built-In
On-Screen
RDS Level
Display**

If the peak-to-peak level of the composite/MPX for 100% carrier deviation is known, the RDS level may be set with reasonable accuracy using the built-in subcarrier measurement utility of the 720. The composite/MPX is easily measured by bridging the input of the exciter with an oscilloscope using a BNC “T” adapter. Monitoring normal program material that has passed through a typical audio processor, the 100%-modulation value will be apparent on the ‘scope. Take this figure and multiply it by 3 to 4 percent, and then set the front-panel INJECTION LEVEL ADJUST control to the calculated value. For example, if the composite/MPX level is 4V p-p at 100% modulation, set the RDS level to $4 \times .035$, or 0.14V p-p for 3.5% injection.

In the United States, the FCC permits an extra 5% modulation for each added FM subcarrier, with total modulation not to exceed 110% with two or more subcarriers. Consult current local regulations regarding this matter.

Subcarrier Phase

According to the RDS and RDBS Specifications, the 57kHz RDS subcarrier may be either in phase or in quadrature with the 19kHz stereo pilot. Both phase relationships are shown in Figures 6 and 7, respectively. Note that the quadrature relationship in Figure 7 yields a slightly lower peak level, which suggests the possibility of marginally greater carrier modulation by the program audio signal.

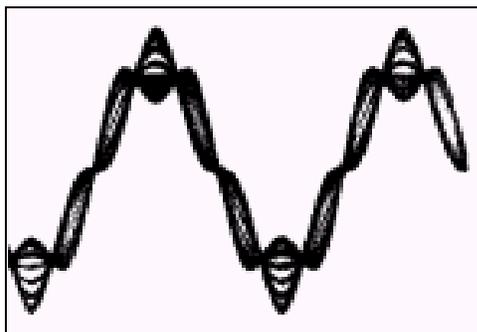


Figure 6 – Subcarrier In Phase

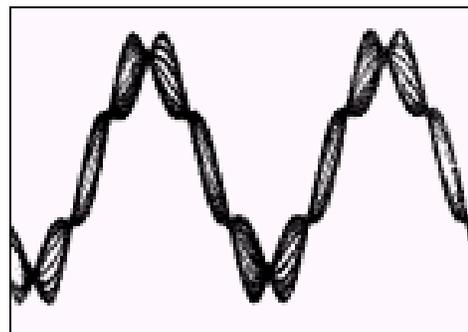


Figure 7 – Subcarrier In Quadrature

The Model 720 is skillfully and meticulously aligned at the factory to ensure that the subcarrier is in phase with the stereo pilot, whether the encoder is used in the sidechain or in the loop-through operating mode. Although some stereo generators are equipped to 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 in the composite/MPX signal. For this reason we recommend using the composite/MPX signal for synchronization. In the sidechain mode, the Model 720 simply bridges the output of the stereo generator and does not load or otherwise compromise the composite/MPX signal.

Section VI

CIRCUIT DESCRIPTIONS

INTRODUCTION

This Section details the circuitry of the Inovonics Model 720 RDS/RBDS RadioData Encoder. Circuit descriptions refer to the two pages of Schematic Diagrams contained in the Appendix, Section VII.

Component Annotation

Schematics for the 720 may appear to have component reference designations assigned in a somewhat haphazard manner, but this is not really the case at all. Rather than annotate the schematic in a logical sequence, we have instead elected to designate the actual components on the main circuit board in a top-to-bottom and left-to-right manner, following the physical placement of the parts. It is our expectation that this will simplify any necessary troubleshooting, as the physical component can be located quickly following analysis of the schematic.

Stereo Pilot Recovery

A sample of the composite/MPX signal is filtered by the ‘biquad’ band-pass configuration of op-amps IC8B, IC9A and IC9B to recover the 19kHz stereo pilot. Trimmer adjustment R49 is used to fine-tune the phase of the recovered pilot signal. PLL IC10 lends further filtering action and squares-up the 19kHz waveform, as well as providing logic to indicate pilot lock.

IC11 is a second PLL that includes frequency-divider IC12 in its loop. The output of IC11 is a 114kHz squarewave, a six-times multiplication of the stereo pilot. This is a clocking frequency at twice the RDS subcarrier rate that is used by digital processing stages to generate the RDS subcarrier.

RDS Waveform Synthesis

IC7 is a ‘PIC,’ a simple form of microprocessor with onboard memory. The function of this data processing block is to synthesize the double-sideband, suppressed-carrier RDS waveform. The PIC has an on-board crystal oscillator to establish an internal master clock that is an exact multiple of the RDS subcarrier. Thus IC7 is able to ‘free-run’ with sufficient precision to generate the subcarrier if lock with the stereo pilot is not obtained.

Subcarrier waveforms are sent as parallel data to the resistor ‘ladder’ comprising resistors R25 through R40. This ladder performs the D/A conversion for digital synthesis of the RDS subcarrier.

Band-Pass Filter	<p>The segmented RDS waveform from the D/A resistor ladder is passed through dual band-pass filter stages, IC6B and IC6A. This 57kHz filter removes higher-order distortion components inherent to the digital-synthesis process.</p> <p>R3 is the front-panel INJECTION LEVEL ADJUST control that determines the magnitude of the RDS subcarrier at the encoder output. The adjusted level is rectified by IC5A and IC5B. Peak-weighted DC from this rectifier becomes the basis for front-panel digital read-out of RDS LEVEL: in volts on the LCD display.</p>
RDS Signal Combining and Output Stage	<p>IC4A is the encoder output driver stage. With JP1 jumpered as shown for SIDE (sidechain) mode, only the level-adjusted RDS subcarrier will be passed at unity gain to the rear-panel connector.</p> <p>With JP1 jumpered for LOOP (loop through) operation, the composite/MPX signal applied to the rear-panel PILOT OR MPX INPUT connector is passed through this stage at unity gain and will appear combined with the RDS subcarrier at the output. Relay K1 provides a failsafe bypass path for the composite/MPX signal in the loop-through operating mode if encoder power is lost.</p>
Encoder Data Formatting	<p>IC13 is a second ‘PIC’ microprocessor that is responsible for receiving and formatting all incoming RDS data. IC13 is able to interface directly with the encoder’s USB port, and RS-232 interface chip IC3 performs level conversion for the 2-way serial data (COM) port.</p> <p>IC13 also addresses the front-panel LCD display and receives up/down menu commands from the panel buttons. The hardwire TA command is also processed by this PIC. IC13 is interconnected with the RDS waveform generator, IC7, and provision has been included for updating the firmware in IC13 through the encoder’s USB port.</p>
Power Supply	<p>IC1 and IC2 are linear voltage-regulator ICs that supply $\pm 5\text{VDC}$ to encoder circuitry. The power transformer has dual primary windings for operation from 115V and 230V AC mains.</p>

Section VII

APPENDIX

This section of the Model 720 Manual contains Certain Tabulated Items, Parts Listings, Schematic Diagrams and an explanation of Inovonics' Most Generous Warranty Policy.

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=	128 (max) ASCII characters (for scrolling messages in the PS field)
Dynamic PS Speed	DPSS=	(0 = OFF, 1 = slow (to) 9 = fastest)
Dynamic PS Method	PARSE=	(0 = Auto-Parse, 1 = Single ('Safe Scrolling') 8 = Block
Program Type	PTY=	1 or 2 digit number to describe station format.
Traffic Program	TP=	(0 = no, 1 = yes)
Traffic Alert	TA=	(0 = flag off, 1 = flag on)
Software TA Timeout	TATIME=	(1 to 255 seconds to timeout)
Alternative Frequencies	AF1=	(0 = NONE; 1 to 204 = "channel" in 100kHz increments, 87.6MHz to 107.9MHz); Frequency in MHz may also be entered directly.
Decoder Information	DI=	(0 = Mono, 1 = Stereo)
M/S	MS=	(0 = Speech-Only, 1 = Music)
Radio Text	TEXT=	64 (max) ASCII characters
Dynamic Radio Text Speed	DRTS=	(0 = Radio Text off; 1 = slow (to) 9 = fast
RS-232 Serial Baud Rate	SPEED=	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
	COMMAND	SPECIAL COMMANDS
	?	Following a header returns status of encoder memory for that specific parameter; eg.: DI?.
	??	Returns all data in encoder memory.
	REV	Returns firmware revision number.
	SAVE	Saves encoder RAM to non-volatile EEPROM.
	RESET	Resets the encoder as if AC power were cycled off and back on.
	INIT	Initializes the encoder to all factory defaults.
RESPONSE	MEANING	
OK	The command is properly formatted and has been received and executed by the encoder.	
NO	Incoming data is not properly formatted and has not been executed by the encoder	
(NONE)	Data sent is ignored by the Model 720.	

US AND EUROPEAN PTY LISTINGS

<u>PTY</u>	<u>US (NRSC) 'RBDS'</u>	<u>EUROPE (CENELEC) 'RDS'</u>
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!

ALTERNATIVE FREQUENCY CHANNEL NUMBERS

<u>MHz</u>	<u>CHAN</u>	<u>MHz</u>	<u>CHAN</u>	<u>MHz</u>	<u>CHAN</u>	<u>MHz</u>	<u>CHAN</u>
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

COMPONENT PARTS LIST

NOTE: The majority of components used in the Inovonics 720 RDS/RBDS RadioData Encoder are surface-mounted parts, which are very difficult to remove and replace in the field. We therefore recommend returning the unit to the factory should repair become necessary.

Not all components with schematic reference designations may be individually listed, and component descriptions may or may not specify a particular manufacturer or vendor. When no manufacturer is called out, the term (open) advises that any manufacturer's product carrying the given part number (or the same description in the case of a generic part) is acceptable.

Should you need to order a part that is not listed here, call, write, fax or e-mail the factory with a brief description of what it is that you need. We'll then do our very best to figure out what to send you... maybe a nice surprise!

C1,2	Capacitor, Y-class Ceramic Disc, .0047 μ F, 440VAC; Murata/Erie DE7150 F 472M VA1-KC
C3,4	Capacitor, Electrolytic, radial leads, 2200 μ F, 35V "snap-in"; Digi-Key P7 466-ND
C5-13,15,16,23-25,29,30,32,33,38,42,43	Capacitor, Monolithic Ceramic, 0.1 μ F, 50V, SMD 0603; (open)
C14,31,37	Capacitor, Monolithic Ceramic, 2.2 μ F, 25V, SMD 0805; (open)
C17,18,19,20,36	Capacitor, Monolithic Ceramic, 0.001 μ F, 50V SMD 0603; (open)
C21,22,39,40	Capacitor, Monolithic Ceramic, 22pF, 50V SMD 0603; (open)
C26	Capacitor, Monolithic Ceramic, 0.01 μ F, 50V SMD 0603; (open)
C27, 28	Capacitor, Polypropolyne, 0.0022 μ F, 50V; Wima FKP2 series
C34	Capacitor, Monolithic Ceramic, 0.0033 μ F, 50V SMD 0603; (open)
C41	Capacitor, Monolithic Ceramic, 0.47 μ F, 50V SMD 0603 (open)
CR1	Diode, Bridge Rectifier; Digi-Key DF005SDI-ND
CR2,3	Diode, Silicon Signal, SOD-123; (open) 1N4148W
F601	Fuseholder; Littlefuse 0286067 (The fuse itself is a 5mm X 20mm normal "fast blow" type; value to match the specification stated on the rear panel.)
IC1	Integrated Cct., DPAK-3; (open) 78M05
IC2	Integrated Cct., DPAK-3; (open) 79M05
IC3	Integrated Cct., DIP; (open) MAX232N

IC4,5	Integrated Cct., 8SOIC; (open) OP279
IC6,8,9	Integrated Cct., 8SOIC; (open) LF353
IC7,13	Integrated Cct.; Microchip 18F4550 'PIC' (<i>Requires factory programming, available only from Inovonics</i>)
IC10	Integrated Cct., 8SOIC; (open) LM567CM
IC11	Integrated Cct., 16SOIC; (open) CD4046BTD
IC12	Integrated Cct., 16SOP; (open) CD4018BNSR
J1	Connector, AC Mains; Switchcraft EAC303
J2	Connector, USB; Digi-Key ED90064-ND
J3	Connector, 2-position 'Barrier'; Digi-Key 277-1011-ND Plug-In Terminal Block is Digi-Key 277-1106-ND
J4	Connector, DB9 Female, PC-Mount; (open)
J601,602	Connector, BNC Bulkhead; Mouser 523-31-221-75RFX
K1	Relay, DPDT; Mouser 653-G5V-2-DC5
PD1,2,3	ESD Protection Diode; Digi-Key 568-4027-1-ND
Q1	Transistor, NPN, SOT23; Digi-Key MMBT5551-7DICT-ND

Except as noted by reference designation, **all resistors** used in the 720 are surface-mounted SMD 0603 size, 1% tolerance, value specified on the schematic.

R7,55	Resistor, Surface-Mounted Metal Film 1206 size, 1/4W, 18-ohm, 1%; (open)
Y1	Crystal, 4.332Mz; Digi-Key 478-4342-1-ND
Y2	Crystal, 20MHz; Digi-Key X439-ND
LCD DISPLAY	2 X 40 Alphanumeric; Optrex C-51850NFQJ-LW-AAN

PARTS SUPPLIERS

Inovonics strives to maintain factory stock of all parts used in the products we manufacture. A large proportion of the components in the 720 is 'generic' and may be obtained from a wide variety of sources.

A few parts are more-or-less proprietary. These may either be: 1) manufactured specifically for Inovonics, 2) purchased directly from a manufacturer that sells only in production quantities, or 3) may require pre-installation service such as programming.

Inovonics does not depend on parts sales to fatten our coffers. We do not impose a minimum charge for parts, and in some cases we will elect to supply small parts at no charge, rather than generate the necessary paperwork. Always check with the factory, we may well prove the best source for the exact replacement.

The electronic component distributors listed below have proven themselves reputable suppliers for small quantities of component

parts for broadcasters and other commercial or professional users. Nearly any semiconductor, IC, capacitor, resistor or connector used in the Model 720 will be available from one or more of these firms. Each supplier maintains a Website and publishes a full-line printed catalog, which is free for the asking. Minimum-order restrictions may apply, and export orders may be somewhat problematical.

Mouser Electronics

www.mouser.com — 1(800) 346-6873

Digi-Key Corporation

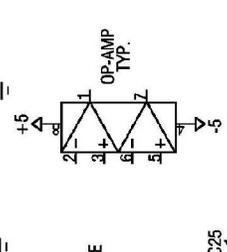
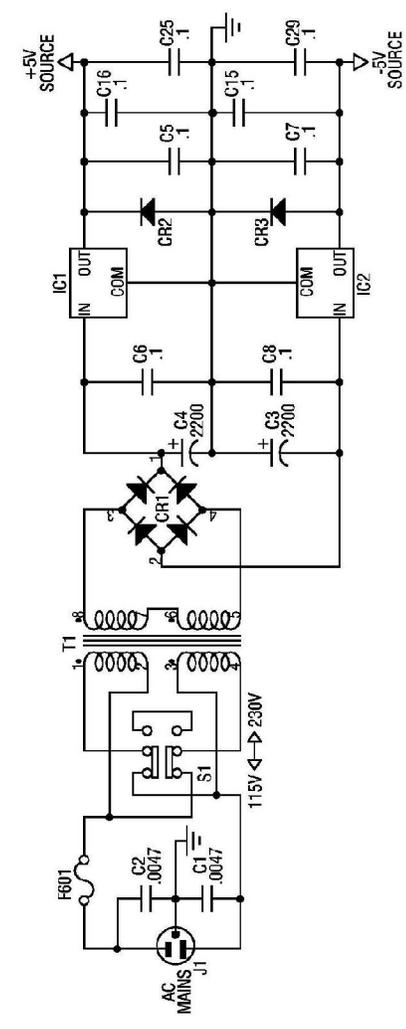
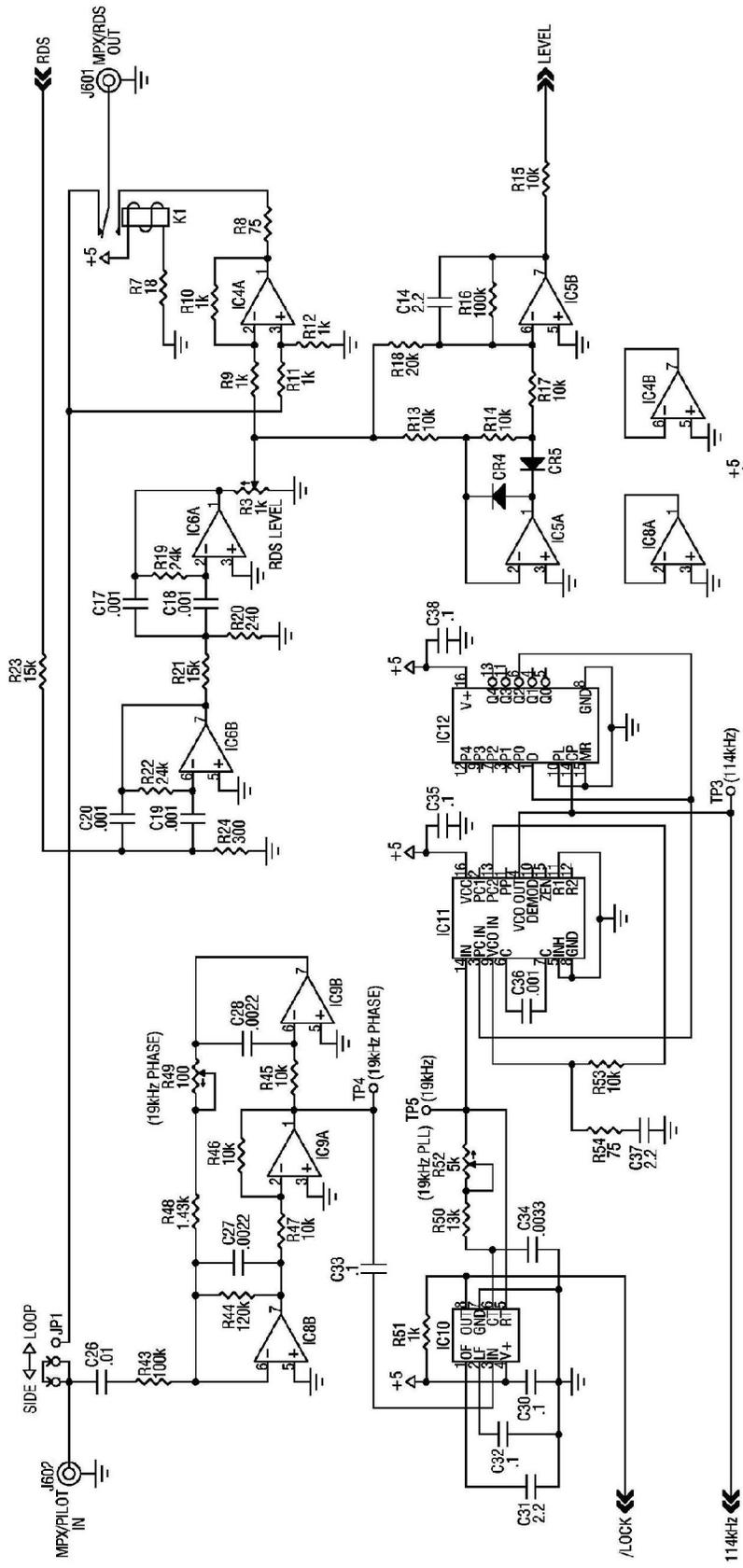
www.digikey.com — 1-(800) 344-4539

Future-Active Industrial Electronics

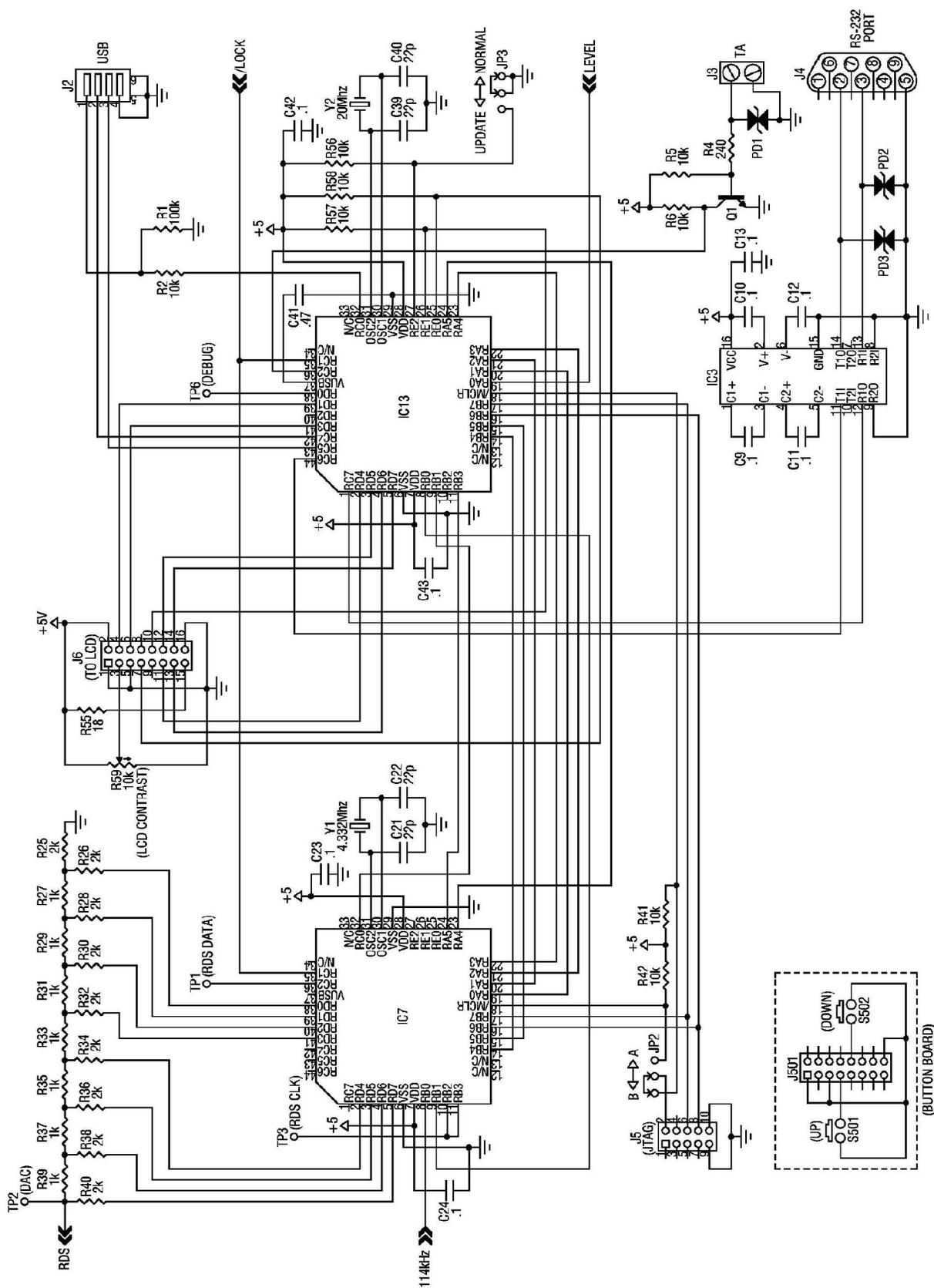
www.future-active.com — 1-(800) 655-0006

Allied Electronics

www.alliedelec.com — 1-(800) 433-5700



SCHEMATIC DIAGRAM	
INOVONICS 720 RDS/RBDS ENCODER	
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NOTES AND DOODLES:



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.

