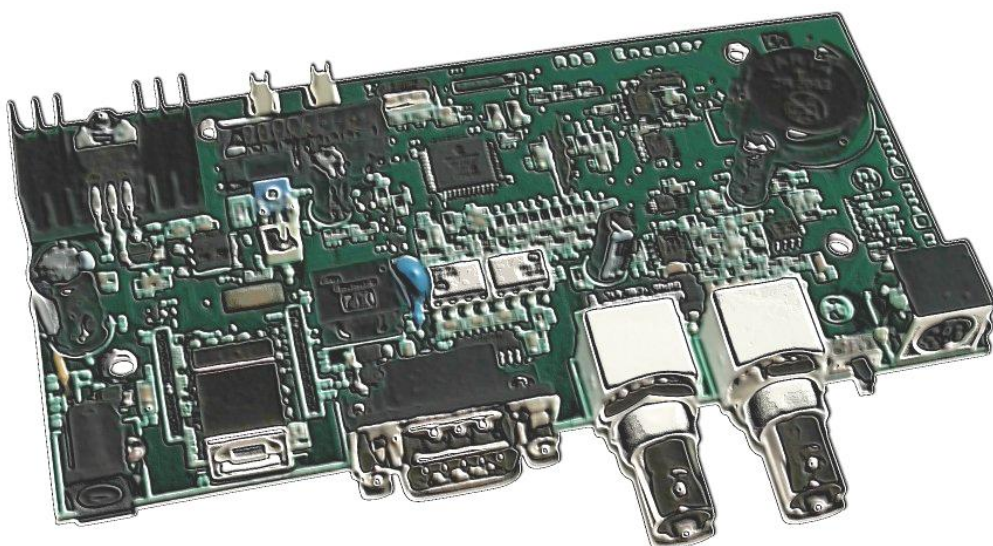




# P232U RDS Encoder Technical Manual

Firmware version 2.2e  
HW revision P264U



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# 1 Introduction

The P232U RDS Encoder is well suited for the vast majority of radio stations which use serial data channel (PC serial port, satellite link, serial over Ethernet) for the RDS content distribution. An independent USB communication port provides a simple way for local connection and configuration. The RDS encoder supports both dynamic and static operation.

This RDS encoder is characterized by proven concept, easy installation, great price and unsurpassed text processing capabilities. It maintains support for all RDS services and data formats that are commonly used. The device is equipped with standard analogue interface for seamless integration into the broadcast chain and interchangeability with other brand products.

Some features are unique: output data monitoring down to the bit level, direct conversion of XML tagging data to Radiotext Plus, port multiplication thru Windows control software and several others. Due to support of additional RDS2 data-stream, the P232U is ready for future enhancements of the FM broadcast standards.

## 1.1 Main Highlights

- Fully dynamic stand-alone FM broadcast RDS encoder with two independent communication ports
- Optically isolated RS-232 port, USB port
- Control interface supports all common communication protocols, incl. ASCII and UECP
- Text features include dynamic PS, parsing, scrolling, tagging, fixed messages and scheduling
- Excellent compatibility with broadcast automation systems
- Two switchable subcarrier configurations (RDS or RDS2) \*)
- Simply to use

\*) Only models sold since 2021. Current receivers may not fully support the RDS2.

## 1.2 Other Features

- Direct digital RDS signal synthesis; compliant with EN 50067 / IEC 62106
- Six switchable program sets (with optional PSN setting)
- Bypass relay, high reliability
- Switchable MPX loopthrough mode (Loop/Side)
- Internal real-time clock incl. backup battery
- Compatible with rest of the P132 family and with P164



CE conformance notice:

This device complies with the requirements of the EEC Council CE marking and EMC directives.  
Harmonized standards applied: EN 55032, EN 55024.

**Please read this manual and familiarize yourself with the controls before attempting to use this equipment.**

Where not otherwise indicated, any information mentioned in relation to the **RDS** (Radio Data System) applies in full also to the **RBDS** (Radio Broadcast Data System).

The equipment has been thoroughly tested and found to be in proper operating condition when shipped. The manufacturer is not liable for any damages, including but not limited to, lost profits, lost savings, or other incidental or consequential damages arising out of the use of this product.

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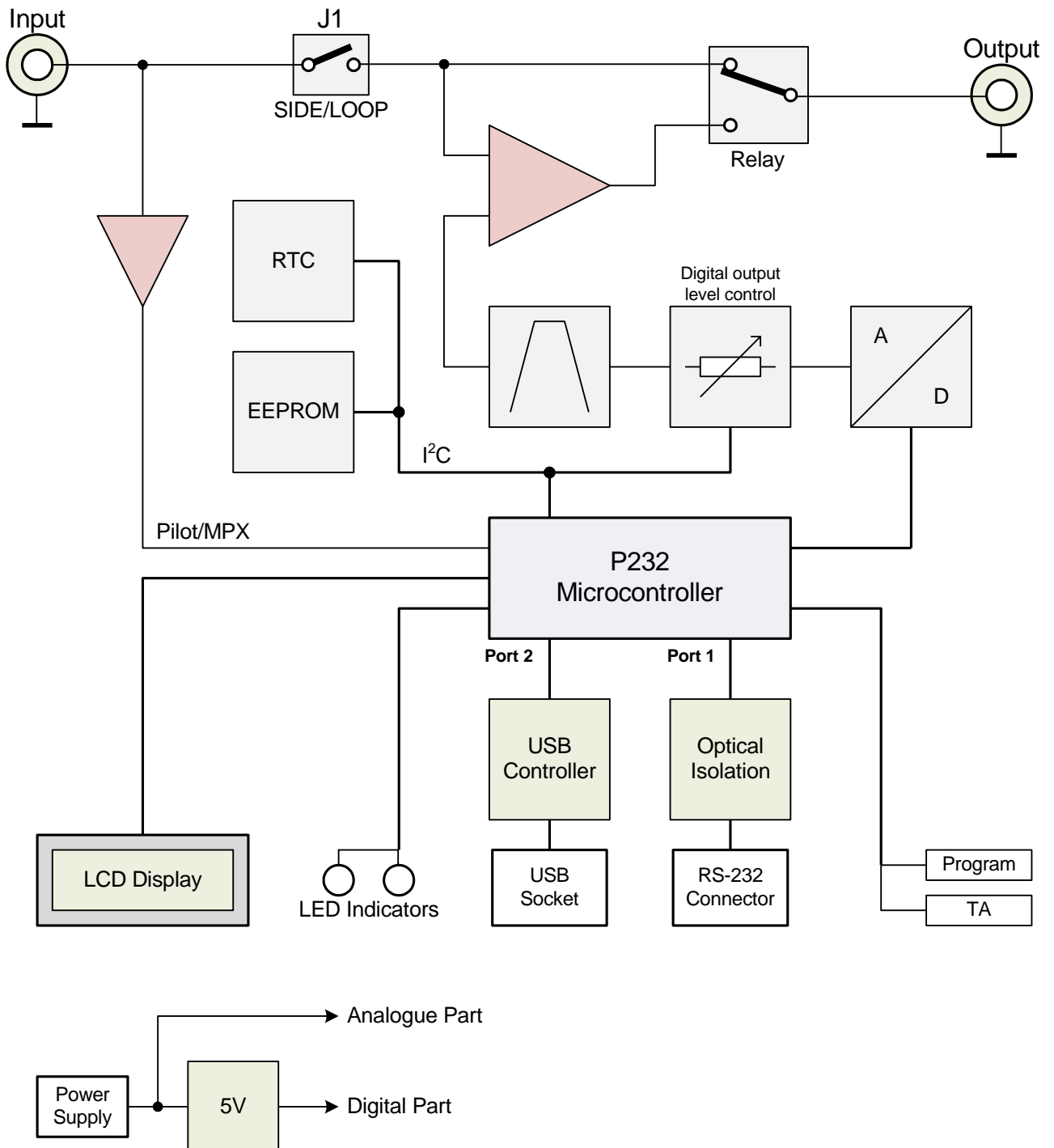


## 2 Technical Specifications

Parameter	Condition	Value
<b>General</b>		
Supply voltage		12 V DC stabilized
Supply current		250 mA (incl. optional LCD backlight)
Signal connectors		unbalanced BNC
Data connectors		1x RS-232 (referenced as <b>Port 1</b> ) 1x USB (referenced as <b>Port 2</b> )
Serial communication speed		Port 1: software switchable 1200, 2400, 4800, 9600, 19200 bps Port 2: fixed at 19200 bps
Serial communication mode		1 stop bit, 8 data bits, no parity, (no flow control), ASCII or UECP (SPB 490)
TA switching		software or external switch
TA/EON1TA input		TTL with 10 k $\Omega$ pull-up, level or falling edge activated
Program sets		6
Program set switching		ASCII command, UECP command or external switch
Program switch input		TTL with 10 k $\Omega$ pull-up, level controlled
RDS Services directly supported		PI, PS, PTY, TP, AF, TA, DI, M/S, RT, RT+ TMC, EON, PTYN, ECC, LIC, TDC, IH, CT, ODA
<b>RDS signal</b>		
Subcarrier configuration (switchable)	RDS	57 kHz
	RDS2	57 kHz and 66.5 kHz (only the HW revision 'P264U')
Subcarrier bandwidth		$\pm 2.4$ kHz (50 dBc)
Output level adjust		0.0 to 4.0 V p-p ( $\pm 20$ %) in 256 steps
Phase shift adjust	stereo transmission	Full range, in 9.5 deg. steps
<b>Audio/MPX/Pilot input</b>		
Recommended load impedance	mono	< 10 k $\Omega$
	stereo MPX	< 2 k $\Omega$
Recommended MPX voltage		1.6 - 8.0 V p-p
Passthrough voltage gain	2 Hz - 100 kHz	1 (0 dB)
Pilot tone level		min. 150 mV p-p
- recommended FM deviation		6.8 kHz
Pilot PLL capture range		8 Hz
Pilot frequency required	stereo broadcast	19000 Hz $\pm 2$ Hz
<b>Output</b>		
Output impedance		100 $\Omega$
Recommended load impedance		> 70 $\Omega$ , < 1 nF, no DC offset
Max. output voltage (RDS + MPX)		9.0 V p-p
Recommended RDS level		3 - 11 % of MPX

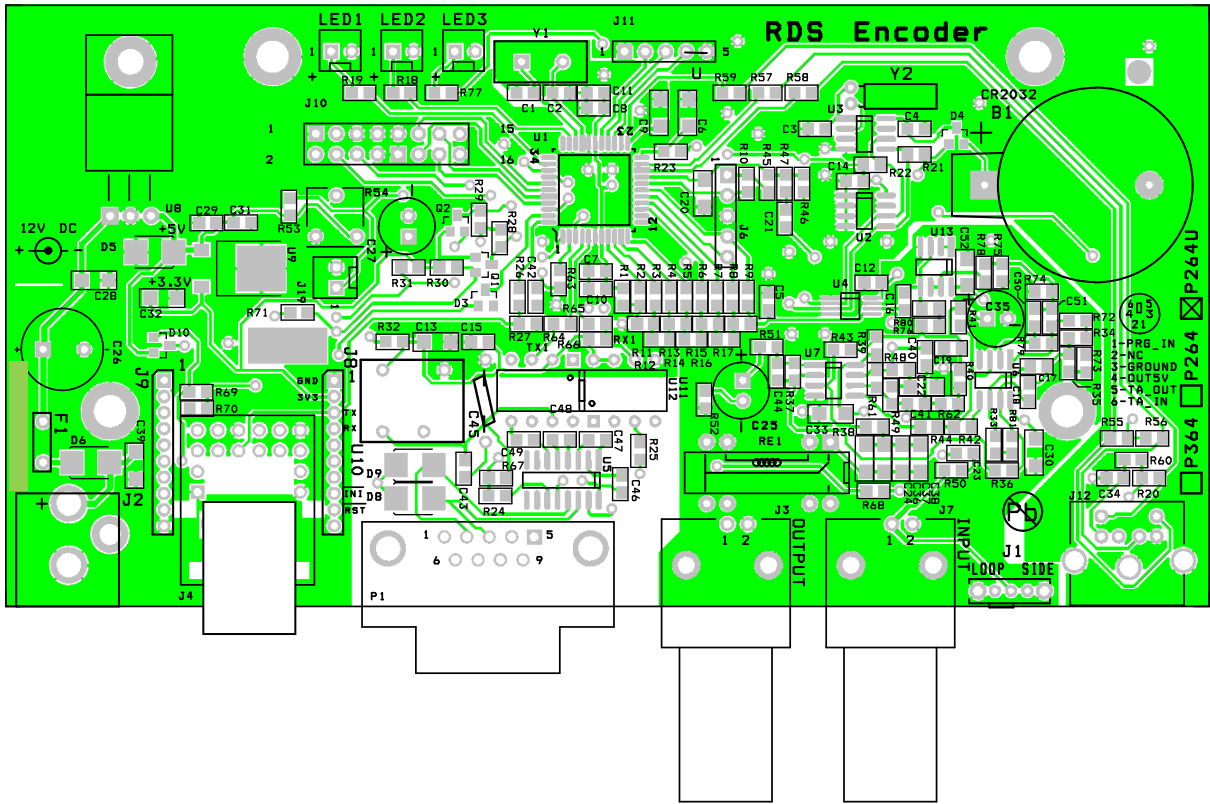
Notes: *p-p - peak-to-peak value*  
The unit can operate with mono transmitter as well.

## 2.1 Block Diagram



### 3 Physical Description

#### 3.1 Board Layout



#### 3.2 Connectors

**J2** - 12 V power supply connector (2.1 mm)  
Central pin is positive (+)

**J3** - Output

**P1** - Port 1 RS-232 connector (DB9 male)  
See section 6 for pin diagram.

**J4** - Port 2 USB connector (B type)

**J7** - Pilot or MPX input

**J12** - Logical control inputs

- 1: Program switch input
- 2: (not connected)
- 3: Ground
- 4: 5V output (max. 50 mA)
- 5: TA output
- 6: TA/EON1TA switch input

**J19** - 5 V Output for LCD backlight

- 1: +5V
- 2: Ground

**J10** - Optional LCD display output (HD44780)

1	GND	9	GND
2	+5V	10	GND
3	V0	11	DB4
4	RS	12	DB5
5	GND	13	DB6
6	E	14	DB7
7	GND	15	+5V BKLT
8	GND	16	GND

#### 3.3 Adjustable Elements

**J1** - MPX loopthrough switch

**R54** - LCD contrast trimmer

#### 3.4 LED Indicators

**LED1** - Operation / Receive data / Error

**LED2** - Pilot tone indication / Firmware update

**LED3** - TA (blinking) / RDS2

**B1** - Lithium battery 3 V for real time backup. Estimated endurance is 10 years. Replace by CR2032 type.

*Note: EEPROM memory which is used for RDS data storage does not require any voltage to hold the data.*

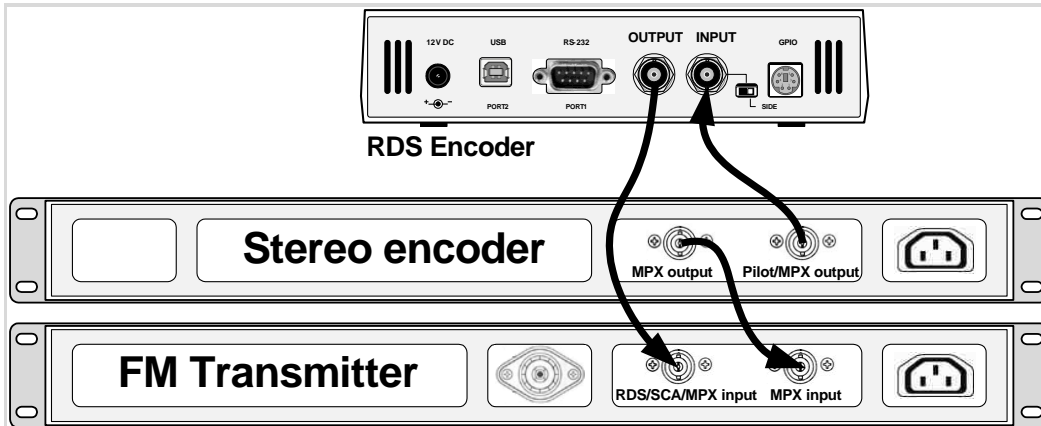
## 4 Installation and Setting-up

### 4.1 Connection

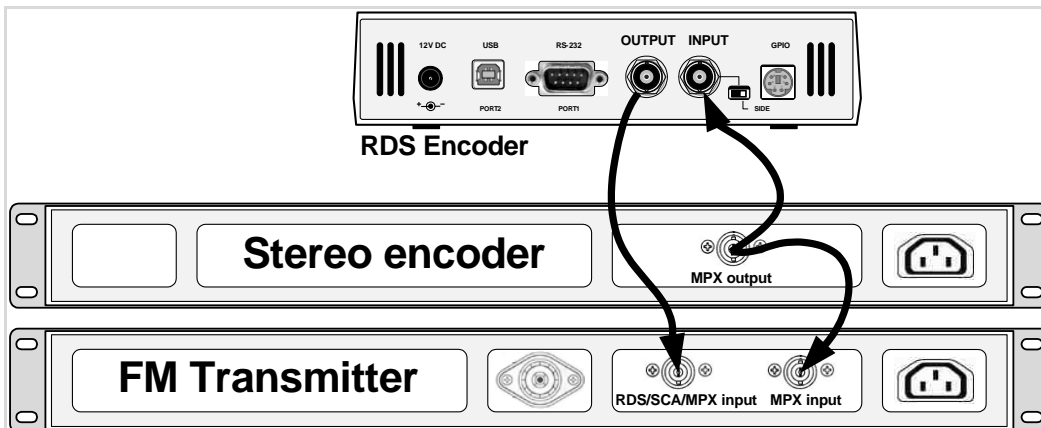
Basic rules:

- The RDS signal must be fed into modulation input (added to MPX signal if stereo encoder is used).
- If stereo encoder is used, one of its outputs (MPX or pilot tone) should be fed into the RDS encoder input to meet the synchronization requirement.

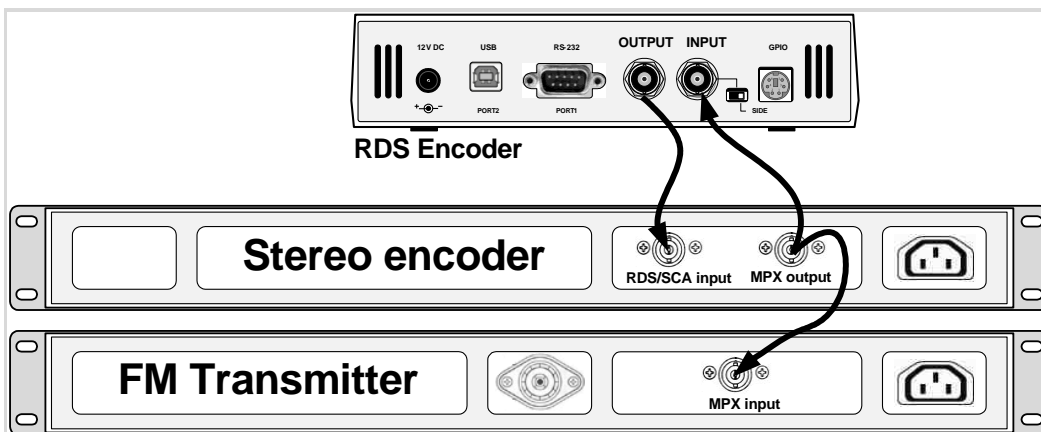
Following figures show various situations and corresponding methods of connection:



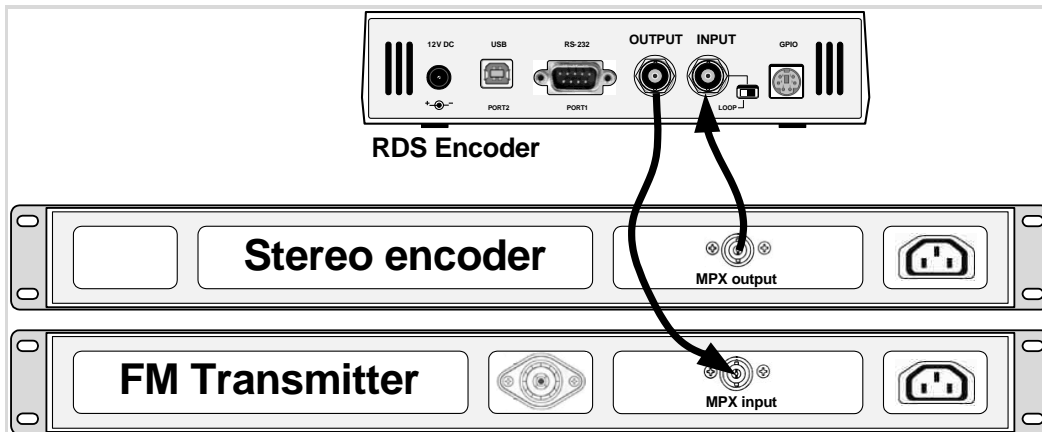
Separate stereo encoder - default connection.



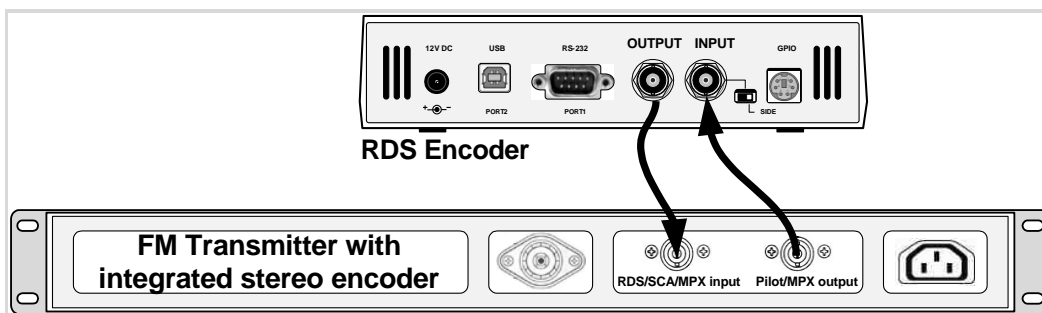
Stereo encoder with only one MPX output provided.



FM transmitter with only one MPX input provided.



Both stereo encoder and FM transmitter with only one MPX connector provided - loopthrough mode. It is recommended not to use this mode if any of the other connections are possible.



FM transmitter with integrated stereo encoder.

In case of **mono** transmission (no stereo encoder used) the RDS encoder input may be left unconnected (since there is no need of external synchronization) or it may be used for the audio signal injection in the case that the FM transmitter has only one input connector.

## 4.2 Controls on the Board

### 4.2.1 Adjustable elements

Due to completely DSP-based solution there's no adjustable element on the board affecting the RDS or MPX signal.

### 4.2.2 J1 - MPX loopthrough switch

Set the switch to LOOP position only if you want to pass the input signal to the output of the RDS encoder (loopthrough mode). **In all other cases the switch must be set to SIDE position!**

## 4.3 Power Supply

The RDS encoder can be supplied from any power supply, which delivers a stabilized voltage of 12 V DC and a current of at least 300 mA and no more than 2 A. The RDS encoder has built-in polarity protection. The central conductor of the power supply connector is positive (+).

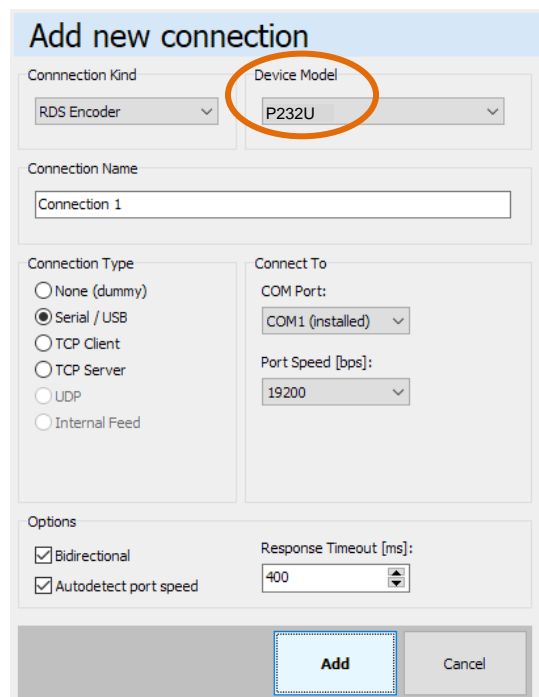
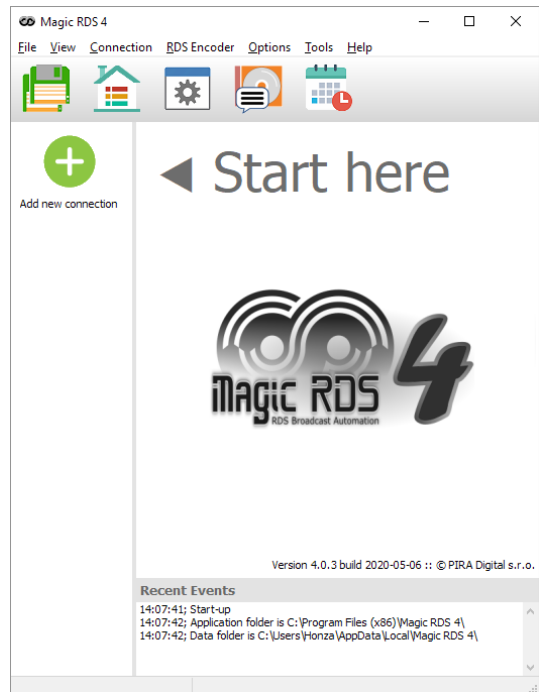
*Note: After first power-up the RDS encoder will start to generate the RDS signal with factory default values (PS: \* RDS \*, PI: FFFF). There is no need to configure anything to turn on the RDS subcarrier.*



## 4.4 Windows control software - First steps

To configure the RDS encoder before first use, you may use either the USB (Port 2) or RS-232 (Port 1).

1. Install the Windows control software called 'Magic RDS 4', run the setup exe file and go through the simple installation wizard.
2. In the case of USB connection install the USB driver now.  
*TIP: Latest operating systems already come with the USB driver included.*
3. Make sure the RDS encoder is connected and powered, all connectors are seated completely.
4. Run the Magic RDS software using Windows Start button.
5. Double-click on the 'Add new connection' icon.
6. Select your device model (P232U). Choose the Serial/USB connection and select the COM port the RDS encoder is connected to.  
*Note: You may find/change the assigned COM port number in Windows Control Panels - System - (Hardware) - Device Manager.*
7. Finally click on the Add button. You should see "Connected" or "Opened" in the Recent Events box. Now you are ready. The settings are saved automatically.
8. Configure the basic RDS settings. Especially check the pages **RDS Content - Program** and **Device Setup - Analog Control**.
9. To change the setting, click on the Test button first. Then, to make that setting permanent, click on the Apply button.
10. The Recent Events box and status bar at the bottom of the window show whether the data was sent successfully. If an error is shown, check the connection to the RDS encoder, its power supply and whether a correct COM port is selected in the connection setup.
11. Follow the Magic RDS help for further details, tools and configuration options.



*Note: The RDS encoder contains two types of memory. These are marked as RAM and EEPROM. Like any other computing system the RAM holds all operational data which are also used for transmission whilst the EEPROM is used for the data storage during power-off. By default the button Test will fill the RAM only. The Apply or Store button saves the data into EEPROM. If the user forgets to store the data into EEPROM, that settings will be lost when the power is disconnected.*

## 4.5 Level and Phase Adjustment

### 4.5.1 RDS signal output level



**Important note:** There is no universal setting for the RDS level. Due to various input sensitivity of different FM broadcast equipment it is absolutely necessary to check and adjust the RDS level during the installation!

The correct level should be between 2 and 11 % of the audio multiplex signal, measured by oscilloscope in peak-to-peak values on the modulator input. Recommended value is such that results in 3 kHz deviation of the FM carrier. Don't forget that the maximum total FM carrier deviation with RDS and MPX signal is 75 kHz. It is much easier to use any FM broadcast analyzer for setting the RDS level precisely.

Adjusting higher RDS level results in better RDS reception in areas covered with weak signal. This is especially important if using scrolling PS or sending a lot of text information or graphics. However consider following aspects before adjusting higher RDS level:

- the MPX (audio) level must be decreased a little to meet the overall FM deviation limit,
- automatic tuning using alternative frequencies (AF) will appear slower – the receiver will rate the signal reception as good although there may be a subjective reason for tuning to another frequency.

Allowed deviation range of the FM carrier caused by **RDS/RBDS** is **1.0 to 7.5 kHz**.  
The overall peak frequency deviation shall not exceed **75 kHz**.

#### Example

Typical sensitivity of the transmitter's composite (MPX) input is 3.5 volts peak-to-peak for 100 percent deviation. In such a case, the recommended RDS signal level is approximately  $3500 \times 3.0 / 75 = 140 \text{ mVpp}$ .

If using SCA input on the transmitter, take into account that there may be a fixed or variable signal attenuation on this input so the RDS signal level needs to be increased adequately, up to +20 dB (10 times higher) than calculated.

### 4.5.1 Adjusting the RDS output level

The RDS level can be adjusted after establishing a connection to the encoder, using one of these two methods:

#### In the Windows software

The control is available in section Device Setup, page Analog Control.

Enter the RDS level directly in mVpp unit and click on the Test button. Or check the 'Track' box and adjust the level as desired. Finally confirm by the Apply button.

#### In terminal, using ASCII command **LEVEL=**

The P232U RDS encoder allows direct adjusting of the RDS level in 256 steps, in range 0 to 255, by assigning a corresponding value to the LEVEL parameter. Each step represents approx. 15.6 mV increase.

Desired step count can be calculated as

$$LEVEL = \left( 256 \times \frac{\text{Output RDS level}}{4000} \right) - 1$$

Current output RDS level (in **mV p-p**) can be calculated as

$$\text{Output RDS level} = \frac{LEVEL + 1}{256} \times 4000$$

### 4.5.2 RDS2 signal output level

The RDS level adjustment is valid for both the RDS and RDS2 subcarrier configurations.

In the RDS2 configuration, the output level value is a sum of two subcarriers, 57 kHz and 66.5 kHz. Amplitude ratio between these subcarriers is 10:11. The subcarriers are phase-aligned to achieve optimal overall FM deviation.

When enabling the RDS2, signal level of stream 0 (57 kHz) drops to approx. a half of the original (RDS) level and may require to be re-adjusted according to the broadcaster needs.

No special equipment is needed for the RDS2 signal level adjustment. For instance, if conventional FM analyzer shows 2.7 kHz FM deviation for the RDS, the upper subcarrier now has 3.0 kHz. Various experiments have shown that this is near the optimal value, for seamless RDS2 file reception at majority of the covered area.

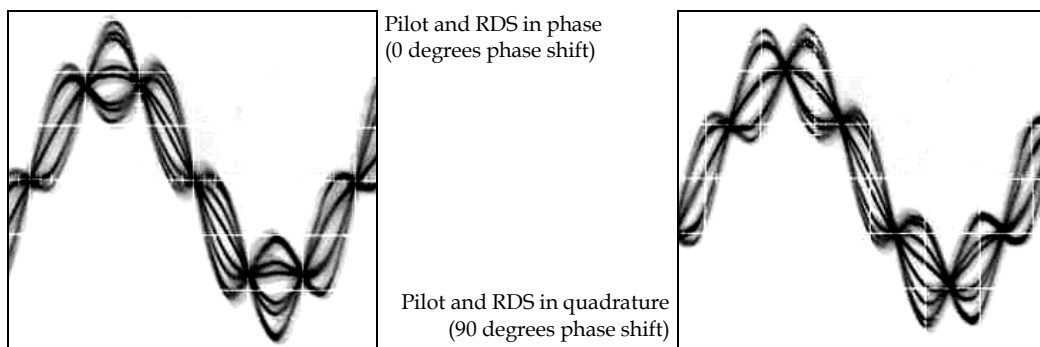
### 4.5.3 Phase adjustment for stereo transmission

The phase adjustment between RDS subcarrier and pilot tone is an optional procedure applicable for stereo transmission (for mono there's nothing to adjust). The adjustment is made using the Windows control software or using the `PHASE=` command. Make sure the external synchronization is enabled (check the command `EXTSYNC` or the item 'Subcarrier reference source' on the Analog Control card in the Windows control software, it must be set to Auto).

From factory the phase shift is already adjusted so user may skip this chapter.

1. Fetch pilot or MPX signal to the RDS encoder. The PILOT LED will indicate that the pilot tone is present.
  2. Adjust right phase shift (0 or 90 degrees phase shift between 19 kHz pilot tone and 57 kHz RDS subcarrier, measured on transmitter input, see the oscillograms). The phase adjustment would be difficult without an oscilloscope or specialized measuring instrument.
- Some experiments performed in the field show that the conditions of RDS reception are not too much affected by the phase criterion. However, similar experiments have shown that right phase shift adjust offers a better behaviour of audio receivers, and notably the residues of audio intermodulation which can sometimes be observed, but with the aid of professional instruments only.
- Conclusion:** *The phase adjustment is only optional and you may skip this step. Make sure the pilot tone is indicated on the RDS encoder by the PILOT LED.*

#### Oscillograms



Measuring conditions: Two-channel analogue oscilloscope, CH1: pilot (or MPX without audio), CH2: RDS output, trigger source: CH1, vertical function: CH1+CH2, horizontal: 5  $\mu$ s/div.

## 4.6 Setting Basic RDS Data

Before getting on-air with the RDS signal, you will need to decide on the settings to be used. The following RDS services must be set as the first. Use the Windows control software and its GUI. For more experienced users or those without a Windows PC, any terminal application can be used (see section 6).

*Note: When attempting to set-up a unit that was already placed in operation before, the user should clear the encoder first. In the Windows control software, go to Device Setup – Special – Initialize.*

### 4.6.1 PI (Program Identification)

This is very important information that enables the receiver to distinguish between countries, areas in which the same program is transmitted, and the identification of the program itself. The code is not intended for direct display and is assigned to each individual radio program, to enable it to be distinguished from all other programs. The PI code consists of four characters (hexadecimal numbers).

The first character identifies country:

0	<i>Cannot be assigned.</i>	8	CR, SR, GA, GM, NE, SC, PS, BG, NL, PT, IR, PH, CN
1	AI, BO, GT, CM, NA, SL, DE, GR, MA, ME, MD, KI, KW, LA	9	CU, PA, UY, GN, BI, TD, AL, DK, LI, LV, SI, SA, NZ, JP, PG
2	AG, CO, HN, CF, LR, ZW, DZ, CY, CZ, IE, EE, BT, QA, TH	A	AR, DM, KN, ZA, AC, GW, MU, AT, GI, IS, LB, AM, AF, SB, SG
3	EC, JM, AW, DJ, GH, MZ, EH, AD, SM, PL, TR, KG, BD, KH, TO	B	BR, DO, LC, MX, BF, BW, CD, HU, IQ, MC, AZ, UZ, MM, BN, MV, YE
4	FK, MQ, MG, MR, UG, AO, IL, CH, VA, MK, PK, WS	C	BM, CL, SV, VC, CG, KM, CI, SD, MT, GB, LT, HR, GE, CN, LK, ID
5	BB, GE, MS, ML, ST, SZ, RW, IT, JO, SK, TJ, FJ, IN	D	AN, GD, HT, MX, TG, TZ, DE, LY, RS, KZ, KP, TW, AE
6	BZ, PY, TT, AO, CV, KE, LS, BE, FI, SY, UA, OM, MO	E	GP, TC, VE, MX, BJ, ET, ZM, ES, RO, SE, TM, BH, KR, NP, FM
7	KY, NI, PE, GQ, SN, SO, RU, LU, TN, KS, NR, VN	F	GL, BS, GY, VG, PM, NW, NG, ER, EG, FR, NO, BY, BA, MY, HK, VU, MN

*Note: AU, CA and US are not included in the table above due to specific rules in the PI assign.*

The second character identifies program type in terms of area coverage:

0	Local	Local program transmitted via a single transmitter only during the whole transmitting time.
1	International	The same program is also transmitted in other countries.
2	National	The same program is transmitted throughout the country.
3	Supra-regional	The same program is transmitted throughout a large part of the country.
4 to F	Regional	The program is available only in one location or region over one or more frequencies, and there exists no definition of its frontiers.

The third and fourth characters are used to clearly identify different stations within the area of coverage.

*Important note: Meaning of some PI digits may be different for US RBDS.*

*Important note: If the station has only one transmitter, second PI digit must be zero (x0xx).*

*Important note: Factory default PI value is FFFF and it's needed to change it as soon as possible to avoid the situation that two different stations with common area of coverage have the same PI. For each station in the same location the unique PI must be assigned. Stations that carry different program must be unambiguously identified by the last two PI digits. In other case they are recognized as one station by car radios, regardless of any other service settings. If the broadcaster hasn't received the 4-digit PI from the authority, he must choose such number that is not in conflict with other stations in the location.*

#### 4.6.2 PS (Program Service name)

The PS name is max. 8 character long radio station name that will be shown most of the time on the radio display. Advanced use of the PS (Dynamic/Scrolling PS) is discussed later.

#### 4.6.3 PTY (Program Type)

The PTY code defines the type of the programme broadcast within 31 possibilities. See chapter 7.2 for a complete list. This code could be used for search tuning.

*Important note: PTY number 1 (News) should never be left on all the time. Use PTY number 3 (Info) for this purpose.*

#### 4.6.4 TP (Traffic Program)

This is a flag to indicate that the tuned program carries traffic announcements. The TP flag should only be set on programs which dynamically switch on the TA identification during traffic announcements. The flag shall be taken into account during automatic search tuning.

#### 4.6.5 MS (Music/Speech)

This is a two-state signal to provide information on whether music or speech is being broadcast. The signal would permit receivers to be equipped with two separate volume controls, one for music and one for speech, so that the listener could adjust the balance between them to suit his individual listening habits.

#### 4.6.6 AF (Alternative Frequencies)

The Alternative Frequencies are used to tell receivers what frequencies they can receive the radio station on. This facility is particularly useful in the case of car and portable radios. For this to work, each transmitter must have RDS with the same PI code.

*Important note: If second PI digit is set to zero (x0xx), this indicates that the station has only one transmitter and the AF list is ignored on most receivers.*

*For complete RDS service description visit the website, section Support.*

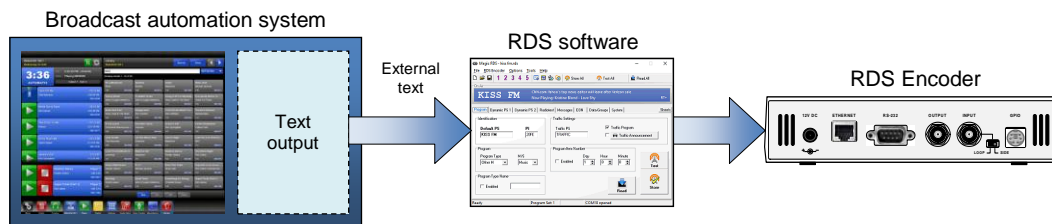
## 5 RDS Services and Features

### 5.1 Broadcast Automation System Link-up

To send dynamic data via the RDS it's very useful to link the RDS encoder with your broadcast automation system. This results in a possibility of sending commercials, current song information, program announcements and other kind of information. All broadcast systems can be linked with the P232U. The link may be either indirect or direct.

#### 5.1.1 Indirect Link

In this configuration, the broadcast automation system does not communicate directly in the RDS encoder's language but rather it updates the text information in a specific file on the disk. That file is periodically read and processed by the RDS encoder's control software.

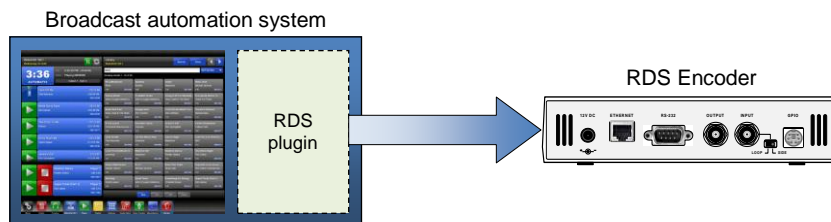


Default Windows control software for the P232U RDS encoder is the **Magic RDS 4**. This application including documentation, tutorials and examples of use can be downloaded from the Website, at the product page. The text processing is accessible through menu item Tools – External text sources.

Since probably hundreds of automation systems are used around the world and new versions are released often, information in this manual cannot be full-scale. For information about how to configure the broadcast automation system text output please follow its documentation or contact the software vendor.

#### 5.1.2 Direct Link

In this configuration, the broadcast automation system drives the RDS encoder directly via its communication port, either physical or virtual.



### Physical port connection setup procedure

1. For the present turn off the RDS encoder support in the broadcast automation system.
2. Connect the RDS encoder and configure all basic parameters like PI, default PS, text setup, enable appropriate text services (usually Radiotext 1). Use the Windows control software or a terminal application. **Store** all setting into EEPROM. Exit the Windows control software or the terminal.
3. Find out the baudrate (speed) that is used by the broadcast automation system for communicating with the RDS encoder. Configure the connection parameters, using Device setup dialogue box or a terminal.
4. Turn on the RDS encoder support in the broadcast automation system.

**Important note: By default only one software application can access one communication port at the same time!**

For detailed information about how to control the RDS encoder contact your broadcast software vendor.

## Data format

The P232U RDS encoder supports several formats (protocols) for input data and it's designed to be compatible with all broadcast automation software which allows direct RDS encoder control.

The support includes:

- ASCII commands
- UECP protocol (format given by UECP specification)
- X-Command (described later in this chapter)

Basic data format for ASCII command is as follows:

Prefix (ASCII command): RT1=  
Terminating character↵ : <CR> (Carriage return). <CR><LF> accepted as well.

Example:

```
RT1=Now Playing: Julia Michaels - Issues↵
```

See section 7 for complete list of all ASCII commands.

## Compatibility commands

To reach the best possible compatibility with broadcast automation systems, the P232U includes a special set of compatibility commands. In the systems where the P232U is not directly supported (or the system is older version) the user may try to select another RDS encoder model to send text messages. Where possible, set the communication as unidirectional.

Command	Translated to
TEXT=	RT1=
DPS=	DPS1=
PS_SCROLL=	DPS1ENQ=

## Radiotext Plus (RT+ tagging)

The RT+ feature is designed to let the listener take additional benefit from the Radiotext service by enabling receivers to offer direct access to specific elements of Radiotext. Typically the RT+ feature supports song artist and song title elements. These elements anyway carried in the Radiotext, are identified by their class type, length and location within the Radiotext. The receiver must be equipped with the RT+ function (also called "tagging") to take advantage of this feature.

The RDS encoder includes full support for the RT+ and its handling is highly automated. For direct use your broadcast automation system must support X-Command or the RT+ function either by means of user defined groups or by the command RTP= (see section 7.7 for more details). In other cases the Windows control software used in the indirect link configuration can provide the RT+ service.

## X-Command for RDS encoders

The X-Command is the newest and preferred method how to forward text information (incl. tagging) from the broadcast automation system to the RDS encoder. It is based on simplified markup language. The X-Command is fully supported by the P232U RDS Encoder.

Example:

```
XCMD=<rds><item><dest>3</dest><text>Now Playing: <artist>Julia Michaels</artist> -  
<title>Issues</title></text></item></rds>↵
```

For more details follow the information in the document 'X-Command for RDS Encoders'.

## 5.2 Dynamic PS Text

Standard RDS enabled receiver disposes of 8-character LCD display but we usually need to show pile of information and commercials. So small display on the one hand and so much demands on the other hand. The P232U solves it by unique system of text messages showing. Although Radiotext service is defined in the RDS standard, this service is not present some receivers (especially older car radios) and has some other limitations. According to the broadcasters needs, the PS service - one of the basic RDS services supported by all receivers - can be usually used to give sequential information. This has become known as 'Dynamic PS' or 'Scrolling PS'.

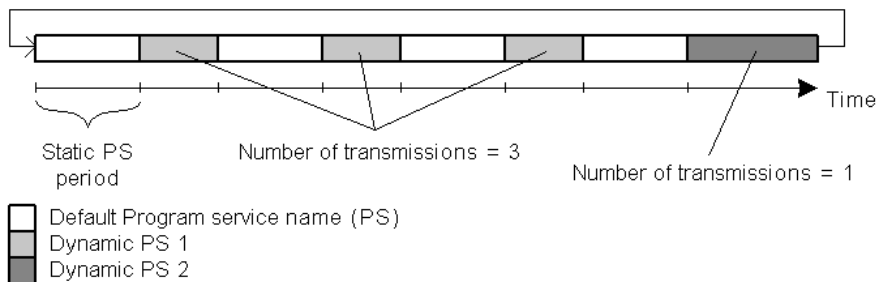
**Note: Using the dynamic PS is restricted in some countries and it's fully prohibited by the RDS standard! The manufacturer is not responsible for incompetent use of this feature. Some receivers may not display the dynamic PS properly for reasons that lie entirely on their side. Never provide traffic information inside the Dynamic PS text!**

The P232U RDS encoder offers advanced implementation of the Dynamic PS service. Basic text message length is up to 255 characters (mode independent). Two varieties of the Dynamic PS are present: Dynamic PS 1 (DPS1) and Dynamic PS 2 (DPS2). Both varieties are configurable independently from each other.

Basic configurable parameters are:

- Text content/text source
- Display mode
- Label period or scrolling speed
- Number of transmissions

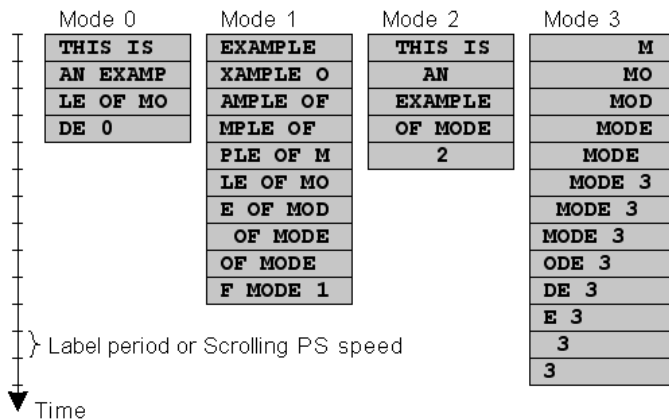
Example of full dynamic PS use:



The number of transmissions is specified for each Dynamic PS text. The Static PS period (delay between text loops) specifies the time between two repeats of the Dynamic PS text loops. Default PS is displayed during this time.

Four display modes are provided. The mode is switchable 'on the fly', without need to re-enter the text message.

- Mode 0 - Scrolling by 8 characters
- Mode 1 - Scrolling by 1 character
- Mode 2 - Word alignment scrolling (see also SETFEAT command for further options)
- Mode 3 - Scrolling by 1 character, text separated by spaces at begin and end



Additional differences exist between Dynamic PS 1 and Dynamic PS 2 (see sections 7.2 and 7.9). In general the DPS1 should be used if on-line connection is available between your studio and the RDS encoder while the DPS2 should be used if the RDS encoder is placed on a site without on-line connection providing set of fixed messages.



### 5.3 Alternative Frequencies

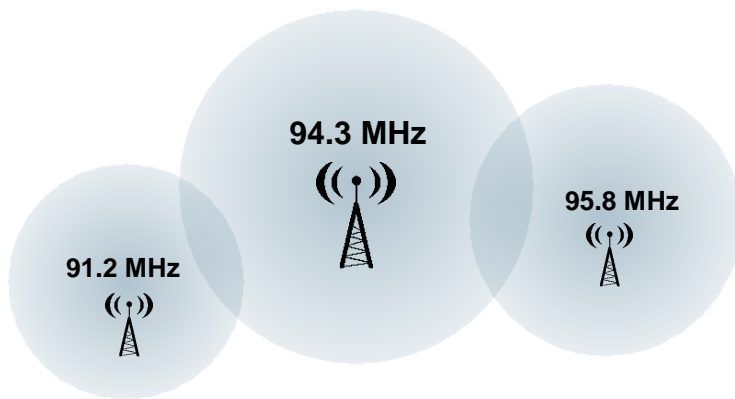
The list of alternative frequencies gives information on the various transmitters broadcasting the same program in the same or adjacent reception areas. It allows switching to another frequency of the same station when leaving the current frequency coverage. This facility is particularly useful in the case of car and portable radios.

*Important note: If second PI digit is set to zero (x0xx), this indicates that the station has only one transmitter and the AF list is ignored on most receivers.*

Ideally the AF list should only comprise frequencies of neighboring transmitters or repeaters. Entire AF set should be as tiny as possible to allow the receiver to find the strongest frequency quickly. This will improve the listener's experience. Thus there should be more RDS encoders using individual AF sets within larger networks.

Two methods of AF transmitting are possible:

- AF method A is used for stations carrying the same program on all their transmitters. The list may contain up to 25 frequencies.
- AF method B is used for larger lists or when splitting areas or different programs are broadcast.



#### 5.3.1 Method A

This is a default method recommended for most of stations.

To establish a common list of AF-A using a terminal:

*Note: Requires only one RDS encoder for entire network (common STL or one main transmitter and two repeaters). The list must contain all frequencies on which the signal from the RDS encoder is carried.*

AF=94 . 3 , 95 . 8 , 91 . 2	Enter the list
*AF	Store the list

To establish a separate list of AF-A for each transmitter:

*Note: Requires separate RDS encoder for each transmitter.*

*Note: All RDS encoders must be using the same PI (Program Identification).*

91.2 MHz:

AF=94 . 3	Enter the list
*AF	Store the list

94.3 MHz:

AF=95 . 8 , 91 . 2	Enter the list
*AF	Store the list

95.8 MHz:

AF=94 . 3	Enter the list
*AF	Store the list

### 5.3.2 Method B

Total capacity: up to 8 lists, up to 12 AF pairs each

Method B AF coding is a more complex method that is used where the number of AFs used by a transmitter and its associated repeater stations exceed 25, or where it is required to indicate frequencies which belong to different regions which at times carry different programs.

More than one transmitter or associated repeaters of the station broadcast the same set of different AF lists in sequence. Total number of AF lists used within entire network is in general identical to the number of transmitters and repeater stations in the network so as to provide a unique list for each transmitting station. In this method the alternative frequencies are individually addressed by transmitting the tuning frequency paired with one alternative frequency. Each list starts with the tuning frequency for which the list is valid, e.g. 94 . 3. All remaining pairs (up to 12) give the tuning frequency together with a valid AF.

For the transmission of the frequency pairs within one block the following convention is used. They are generally transmitted in ascending order ( $F1 < F2$ ), e.g. 94 . 3, 95 . 8 or 91 . 2, 94 . 3. In special cases they are transmitted in descending order, if they belong to different regions, or carry from time to time different programs. If you use the Windows control software, this assures right order automatically.

**To establish a common set of AF-B lists using a terminal:**

*Note: For illustration purpose only. If the network contains only a few frequencies like in this example, the method A is more effective.*

AF=A	Switch to method A to allow editing of the AF lists
AF=94 . 3, 94 . 3, 95 . 8, 91 . 2, 94 . 3	Enter the first list for 94.3 MHz
*AF=1	Store the list
AF=95 . 8, 94 . 3, 95 . 8	Enter the second list for 95.8 MHz
*AF=2	Store the list
AF=91 . 2, 91 . 2, 94 . 3	Enter the third list for 91.2 MHz
*AF=3	Store the list
AF=	Terminate the set of AF lists
*AF=4	Store the termination
AF=B	Switch back to method B - start cycling through the lists
*AF	Store the method setting

**To read the set of AF-B lists:**

AF	Read the AF method being used (A/B)
AF=A	Switch to method A to allow reading of the AF lists
AF=1	Load the first list
AF	Read the list
AF=2	Load the second list
AF	Read the list
AF=3	Load the third list
AF	Read the list
AF=4	Load the fourth list
AF	Read the list, no AF here, terminating
AF=B	Switch back to method B

**Notes:**

*If the number of AFs of a station is larger than 12, the list must be split into two or more lists. These lists are transmitted directly one after the other.*

*Broadcasters using splitting of a network during certain hours of the day should use AF method B, and not AF method A. The lists should be static, i.e. the AFs included in the list, carrying a different program during certain hours of the day, shall be signaled by transmitting in the descending order ( $F1 > F2$ ). Their PI shall differ in the second digit of the code (using regional variant 4 to F) and may also be static. Switching the second digit of the PI to 1, 2 or 3 informs the receiver that now even AFs transmitted in descending order carry the same program and the receiver may use them for switching.*

## 5.4 Enhanced Other Networks information (EON) control

The EON feature is used to update the information stored in a receiver about program services other than the one received. Alternative frequencies, the PS name, Traffic Program and Traffic Announcement identification as well as Program Type and Program Item Number information can be transmitted for each other service. The relation to the corresponding program is established by means of the relevant Program Identification (PI).

The EON is especially useful for linking two or more stations of the same owner. Most of EON featured receivers gives priority to stations linked by EON when seek function is activated. Since the P232U can store four EON links, up to 5 stations can be linked together.

Station that doesn't carry traffic announcements can refer to a station that does. This situation is described below. For more information see appropriate section in the List of Commands or in the Magic RDS control software help.

### 5.4.1 Traffic Program and Traffic Announcement codes

The coding to be used is as follows:

Traffic Program (TP)	Traffic Announcement (TA)	Applications
0	0	This program does not carry traffic announcements nor does it refer, via EON, to a program that does.
0	1	This program carries EON information about another program that gives traffic information.
1	0	This program carries traffic announcements but none are being broadcast at present and may also carry EON information about other traffic announcements.
1	1	A traffic announcement is being broadcast on this program at present.

Station which uses the code TP=0, TA=1 must refer to at least one program service which carries traffic information, and has the flag TP=1. When a particular program service begins a traffic announcement, the station that cross-references this service via the EON feature will broadcast a switch signal by setting the appropriate EON TA flag to 1. The EON TA flags can be controlled by software for all four EON links in the P232U. The first EON link TA flag can be also controlled by external TA/EON1TA switch.

The situation described is illustrated on the example below:

### 5.4.2 Example

Kiss FM is a small station that doesn't carry traffic announcements but refers via EON to City Radio, which is regional station of the same owner that carries the traffic announcements. If the Kiss FM listener has activated the EON feature on his receiver, he will be automatically tuned to City Radio for the duration of traffic announcements.

#### Station 1: Kiss FM

PI=20F1  
PS=KISS FM  
TP=0, TA=1  
Frequency: 90.2 MHz

#### **Station 1 EON Data:**

EON1PI=2501  
EON1PS=CITY  
EON1TA=(controlled by external switch)  
EON1AF=93.7

#### Station 2: City Radio

PI=2501  
PS=CITY  
TP=1, TA=(controlled by external switch)  
Frequencies: 93.7 and 106.2 MHz  
(only 93.7 can be received in the area covered by Kiss FM)

Both TA/EON1TA switch connectors can be wired together and controlled by only one switch or device if the transmitters of 90.2 and 93.7 MHz are placed on the same site.

## 5.5 Weekly Scheduling

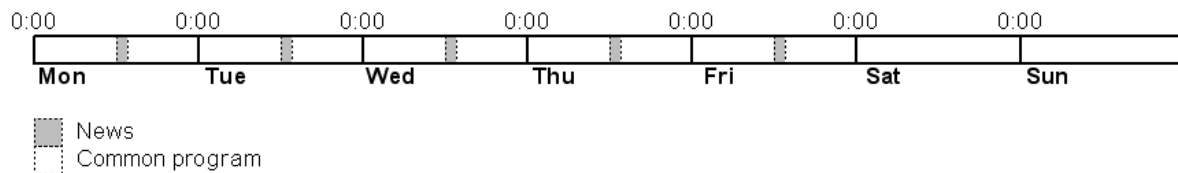
This feature allows scheduling of text messages, program type names, RDS encoder settings and any other commands in hourly, daily and weekly program. The scheduling is provided directly by the P232U unit. Once set, it works with no more support from PC or control application. This is especially useful when the RDS encoder is placed on remote site. For local connection, consider the Magic RDS 4 Task scheduler feature.

### 5.5.1 Key features

- The scheduling feature is fully implemented in the P232U unit and works independently
- Almost any RDS service or control command can be scheduled
- Up to 48 scheduling items
- Each item may contain any combination of days in week, up to 12 times (a wildcard is supported on the hour place), program type (PTY) information and any from more than 60 commands

### 5.5.2 First steps

Let's say that our radio station called 'PRO 88' broadcasts news from Monday to Friday at midday. The news duration is 40 minutes. During the news the PS is set to 'HOT NEWS' and the PTY is set to 1 (News). In common program the PTY is set to 3 (Info).



#### Scheduling item 01:

Days: Monday, Tuesday, Wednesday, Thursday, Friday  
 Times: 12:00  
 PTY: 1 (News)  
 Command: PS=HOT NEWS

#### Scheduling item 02:

Days: Monday, Tuesday, Wednesday, Thursday, Friday  
 Times: 12:40  
 PTY: 3 (Info)  
 Command: PS=PRO 88

### 5.5.3 Text messages scheduling

Although it's possible to change directly the Dynamic PS and Radiotext (using an appropriate command, for example `RT2=The best music in the city`), the maximum text length is limited since maximum command length in each Scheduling item is 35 characters. For longer texts you may use indirect method based on the bank of Messages:

1. Store the text as a Fixed Text Message, for example Message 01.
2. In the Scheduling call the message number, for example `RT2MSG=1` or `DPS2MSG=1` or `XCMD=<rds><msg>1</msg></rds>`.

The Windows control application provides easy GUI for this case.

### 5.5.4 Troubleshooting

If the scheduling doesn't work as expected, check the following points:

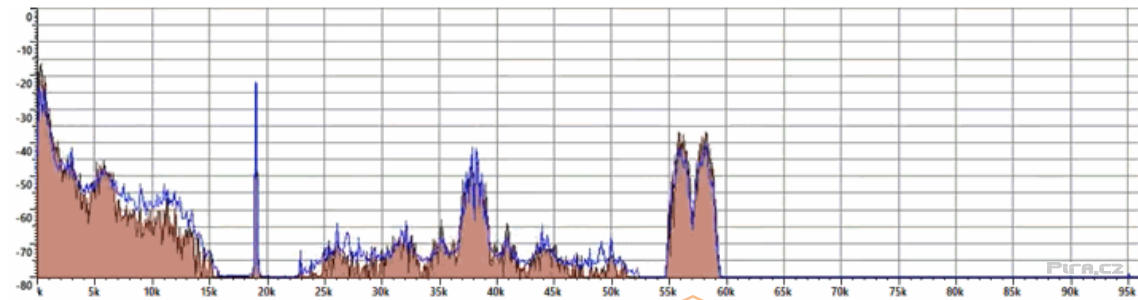
- Scheduling enabled?
- Date and Time actual?
- Commands typed right?

## 5.6 RDS2 Subcarrier Configuration and Station Logo

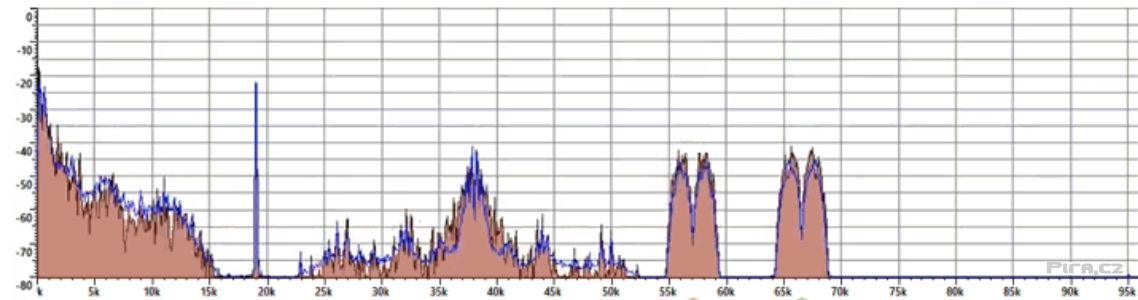
### 5.6.1 Enabling the additional RDS2 data-stream

The subcarrier configuration is controlled by ASCII command `RDSGEN=` (see section 7). In the Window control software, the RDS2 subcarrier configuration can be enabled in Device Setup – Analog Control – RDS Generator.

Two options are available, keeping balance between costs, occupied bandwidth, achievable modulation levels, transfer rate and reliability of data reception under various conditions.



MPX Spectrum - Original RDS (default option)



MPX Spectrum - Original RDS and additional RDS2 data-stream

When the RDS2 is enabled, an additional stream 1 will appear in the MPX spectrum at 66.5 kHz subcarrier. Content of the basic stream 0 at 57 kHz subcarrier remains unchanged, providing all original RDS features and full backward compatibility.

***Please keep on mind: Current receivers may not fully support the RDS2.  
In some countries, enabling the RDS2 may violate with broadcast license specifications!  
The RDS2 subcarrier configuration is available only to models sold since 2021 (marking 'P264U' on the board).***

### 5.6.2 RDS2 Modes of Operation

The RDS2 mode of operation is controlled by ASCII command `RDS2MOD=` (see section 7). In the Window control software, the RDS2 mode of operation can be changed in RDS Content – System – Miscellaneous.

Content of the stream 1 can be controlled partially or fully by an external application, which provide the data coded into the RDS2 group format. All modes of operation allow external applications to send the RDS2 content using the ASCII command `G=`. The mode of operation effectively determines a default (idle state) content of stream 1:

Mode	Designation	Description
0	Tunneling	The stream 1 is effectively a duplicate of the basic stream 0. This is a default setting.
1	RDS2 Buffer / Station Logo	Internal RDS2 Buffer (see the command <code>STORE</code> ) is periodically sent in stream 1.

The modes of operation may be enhanced in future, depending on possible RDS2 expansion.

### 5.6.3 Setup Procedure for the Station Logo Broadcast

The station logo is encoded according to the latest IEC 62106 standard:

Supported format for the logo image is PNG (preferred) or JPG. Recommended logo file size is about 3 kB.

The image aspect ratio is 1:1 (square) or 4:3. The actual number of pixels is not important because the receiver can resize the station logo by applying its aspect ratio.

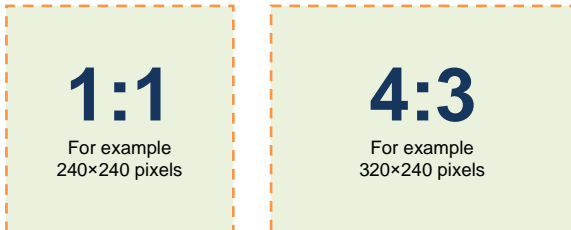


Image aspect ratios supported by receivers for the station logo

Various graphic tools can be used for optimizing the logo file according to the IEC 62106 specs. The resolution and number of colors can be reduced, as well as overall image complexity, to achieve smallest file size possible.



Setup for the station logo in the Magic RDS 4. The Magic RDS version must be 4.1.8 or later.



1. In the Magic RDS 4, go to Device Setup – Station Logo.
2. Click on the Load button and select the logo file.
3. Click on the Apply button to store the logo.  
The logo is now saved in the RDS encoder's non-volatile memory and ready for cyclic transmission.
4. Enable the RDS2 subcarrier configuration (section 5.6.1). Adjust correct RDS level (section 4.5.2).
5. Set the RDS2 mode to 1 (section 5.6.2).
6. Click on the RDS Spy button to verify the logo reception (View – File Receiver).

## 6 Communication Ports

### 6.1 Overview

For configuration and control requirements this RDS encoder is equipped with two communication ports. These ports include individual buffers and work in complete independence, i.e. both ports can be used at one time by different applications.

The port overview is given in following table:

Physical plug	Port reference	Port type	Description and purpose
 RS-232	<b>Port 1</b>	Physical	This port is dedicated especially for local PC connection or for connection with satellite receiver or Ethernet to RS-232 adapter. The port is accessible from the computer using COMx name, where x is the port number assigned in the operating system. The port baudrate is configurable in range 1200-19200 bps.
 USB	<b>Port 2</b>	Physical	This port is dedicated especially for local configuration and diagnostics. It is accessible like any standard serial RS-232 port from the computer, using COMx name, where x is the port number assigned in operating system. Virtual COM Port driver ensures compatibility with all software although the connection is physically realized via USB cable.

Both ports are universal so they accept complete set of ASCII commands, a connection from the Windows control software and UECP records (depending on setup).

Since some situations require more communications ports or there may be a need to address more RDS encoders in larger networks, the P232U RDS Encoder's control software provides a unique port multiplication features, called Bridges and Virtual Ports. In such case the broadcast automation system connects to the Windows control software.

#### 6.1.1 RS-232 connector pin diagram (Port 1)

To comply with UECP specification (SPB 490), the RS-232 interface is designed as a DTE (Data Terminating Equipment) and therefore the connector is a male type 9-pin.

Pin number	Meaning	Note
1	DCD	No internal connection
2	<b>RxD</b>	<b>Receive data input (to the RDS encoder)</b>
3	<b>TxD</b>	<b>Transmit data output (from the RDS encoder)</b>
4	DTR	Internally connected to pin 6
5	<b>GND</b>	<b>Ground</b>
6	DSR	Internally connected to pin 4
7	RTS	Internally connected to pin 8
8	CTS	Internally connected to pin 7
9	RI	No internal connection

For a connection to the computer or other DTE device, a crossed cable is required, usually known as null-modem cable or laplink cable.

## 6.2 Working with a Terminal Application

This section explains how to make the settings above from a terminal application.

All RDS encoder's settings and configuration incl. text messages etc. can be made from a terminal using a set of ASCII commands. (Any Windows GUI based application effectively does the same; it translates the user's data into the ASCII commands.)

1. In the case of USB connection install the USB driver now.
2. Make sure the RDS encoder is connected and powered, and all connectors are seated completely.
3. On the PC, run an application or program emulating or possessing an ASCII terminal. For example the Terminal in the Magic RDS 4 presents all the characteristics to easily communicate in ASCII mode with the RDS encoder.  
*Note: Latest Windows versions unfortunately no longer contain terminal application. That needs to be installed additionally from public resources. Suitable replacement for the Windows HyperTerminal is the PuTTY client that is available for free download at <http://www.putty.org>.*
4. For USB connection configure the communication parameters as follows:

Transmission speed	2400 bps (default, see note)
Data bits	8
Parity	None
Stop bits	1
Flow control	None

*Note: If the RDS encoder was previously in use, there may remain any speed from 1200, 2400, 4800, 9600 or 19200 bps. Actual speed is showed on the encoder's LCD display. The Magic RDS 4 detects the speed automatically.*

Once configured, the terminal can be used. To check if the hardware and logic configuration work as planned, type for example HELP and press <Enter> to display the list of all commands. If no or unknown characters are displayed on the screen, try again a second time, otherwise, check the following points:

- RDS encoder turned on?
- Cable used (does the LED1 indicate incoming characters?)
- Configuration of the terminal application

To display the commands entered at the keyboard on the screen, type the command ECHO=1 followed by <Enter>. If all characters written are displayed twice, type ECHO=0 and press <Enter>.

To store this parameter into a non-volatile EEPROM memory, type \*ECHO and press <Enter>.

To display actual parameter value, type ECHO and press <Enter>.

Now you made first steps with the RDS encoder command interpreter.



## 6.3 Command Interpreter

The RDS encoder command interpreter meets the following rules:

Any instruction sent to the RDS encoder must be **validated** by <Enter>. Before validating you may correct the characters by pressing <Backspace>.

There are several methods of use for the commands:

- Query or command without argument, ex. HELP  
*Shows the parameter value or performs the operation.*
- Command with argument, ex. ECHO=1  
*Assigns the value to the parameter.*
- Memory store command, ex. \*ALL  
*Stores the parameter value(s) into the non-volatile EEPROM memory.*
- Memory store command with argument, ex. \*MSG01=  
*Assigns the value to the parameter and stores it immediately into the non-volatile EEPROM memory.*

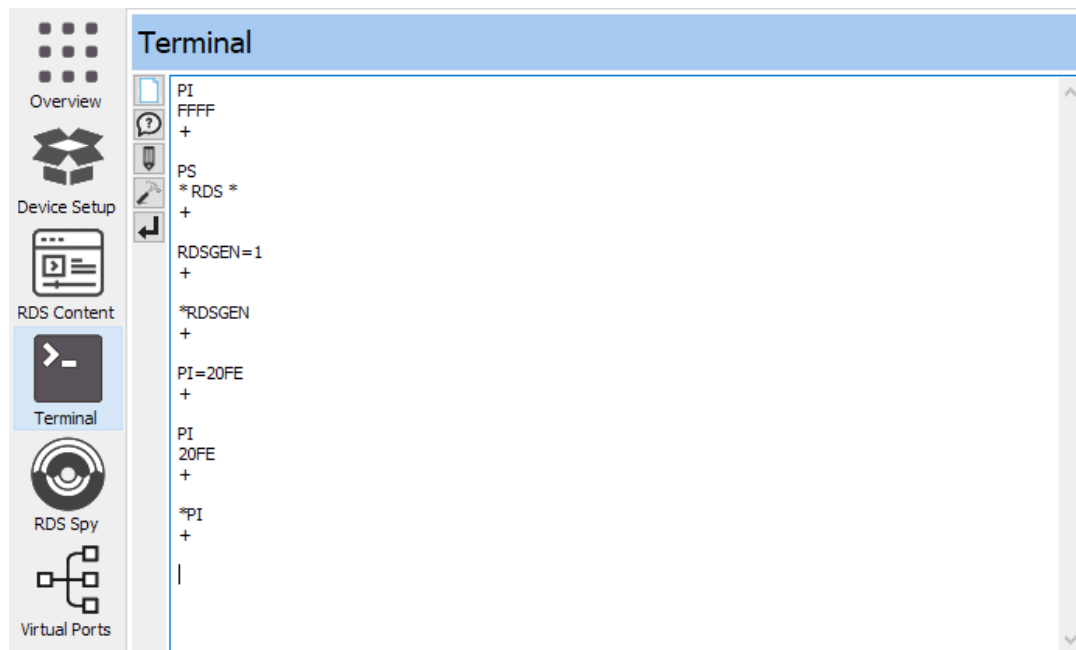
Not all methods are available for all commands, see Command Summary section.

Depending on the command processing success, several characters (followed by two pairs of carriage return and line feed characters) can be returned by the RDS encoder:

+	Command processed successfully
!	Unknown command
-	Invalid argument
/	Command processed partially

The command interpreter is not case sensitive. But it's recommended to write all commands in UPPER CASE to maintain backward compatibility with older firmware versions.

If you wish to retain change of any parameter value during power off, don't forget to store it into EEPROM memory!





A terminal built in the Magic RDS 4.

## 6.4 Additional Information

This additional information provides all details required for implementation of the P232U protocol into your application (broadcast automation system, messaging system, TMC data source etc.). Please see also the Annex 1 - Communication Protocol Implementation Flowcharts. Some source code examples are provided on the website.

### 6.4.1 Unidirectional or bidirectional - What is the difference?

The P232U supports both unidirectional and bidirectional communication modes. Nothing is required to be set, the mode of operation results only from the method of communication.

<p><b>Unidirectional</b> (backward channel from the RDS encoder is not present or the data from this channel is ignored)</p> 	<ul style="list-style-type: none"> <li>✓ Very simple to implement</li> <li>✓ Low cost data link</li> <li>× No direct feedback from the unit</li> </ul>
<p><b>Bidirectional</b> (both channels are used)</p> 	<ul style="list-style-type: none"> <li>✓ Reliable remote control</li> <li>× Backward channel may be hard to realize in some cases</li> <li>× Unsuitable for larger networks</li> </ul>

### 6.4.2 Command synchronization

Unidirectional communication:

If sending more commands in sequence, the execution times must be taken into consideration. In other case some commands may be discarded after internal buffer filling.

Command	Execution time
PS=, TPS=, DPSx=	up to 400 ms
G=	up to 200 ms
*ALL	200 ms
*EON, *DPSx, *MSGxx=	50 ms
Other store commands, SEN=	10 ms
All other commands	0 ms (typ.)

The times result from the EEPROM write cycle duration or from the requirement of internal synchronization with RDS data group order. Most of commands require no perceptible delay due to internal RX line buffering.

TX	P   S   =   P   R   O   _   8   8   ←	(execution time)	(next command may follow)
----	---------------------------------------	------------------	---------------------------

**Legend:**

TX - data sent to the RDS encoder, ← - CR (char. 13, <Enter>)



## 7 List of Commands

### 7.1 Command Summary

#### Basic:

AF	AF=	*AF	*AF=	Alternative Frequencies
AFCH	AFCH=	*AFCH		Alternative Frequency Channels
DI	DI=	*DI		Decoder Identification
DPS1	DPS1=	*DPS1		Dynamic PS 1
	DPS1ENQ=			Dynamic PS 1 Enqueue
DPS2	DPS2=	*DPS2		Dynamic PS 2
DPS1EN	DPS1EN=	*DPS1EN		Dynamic PS 1 Enable
DPS2EN	DPS2EN=	*DPS2EN		Dynamic PS 2 Enable
DPS1MOD	DPS1MOD=	*DPS1MOD		Dynamic PS 1 Mode
DPS2MOD	DPS2MOD=	*DPS2MOD		Dynamic PS 2 Mode
DPS1REP	DPS1REP=	*DPS1REP		Dynamic PS 1 Number of Repeating
DPS2REP	DPS2REP=	*DPS2REP		Dynamic PS 2 Number of Repeating
DTTMOUT	DTTMOUT=	*DTTMOUT		Default Text Timeout
EQTEXT1	EQTEXT1=	*EQTEXT1		Equal Text 1
LABPER	LABPER=	*LABPER		Label Period
MS	MS=	*MS		Music/Speech
PI	PI=	*PI		Program Identification
PS	PS=	*PS		Program Service name
PTY	PTY=	*PTY		Program Type number
PTYN	PTYN=	*PTYN		Program Type Name
PTYNEN	PTYNEN=	*PTYNEN		PTYN Enable
RT1	RT1=	*RT1		Radiotext 1
RT1EN	RT1EN=	*RT1EN		RT1 Enable
RT2	RT2=	*RT2		Radiotext 2
RT2EN	RT2EN=	*RT2EN		RT2 Enable
RTPER	RTPER=	*RTPER		Radiotext Switching Period
RTTYPE	RTTYPE=	*RTTYPE		Radiotext Type
RSTDPS	RSTDPS=	*RSTDPS		Restart Dynamic PS
SCRLSPD	SCRLSPD=	*SCRLSPD		Scrolling PS Speed
SPSPER	SPSPER=	*SPSPER		Static PS Period
TA	TA=	*TA		Traffic Announcement
TATMOUT	TATMOUT=	*TATMOUT		TA Timeout
TP	TP=	*TP		Traffic Program
TPS	TPS=	*TPS		Traffic PS
INIT				Initialization
		*ALL		Store All
HELP				Help

#### EON:

EONxAF	EONxAF=		EON x Frequencies
EONxAFCH	EONxAFCH=		EON x Frequency channels
EONxEN	EONxEN=		EON x Enable
EONxPI	EONxPI=		EON x Program Identification
EONxPS	EONxPS=		EON x Program Service name
EONxPSN	EONxPSN=		EON x Program Service Number
EONxPTY	EONxPTY=		EON x Program Type number
EONxTA	EONxTA=		EON x Traffic Announcement
EONxTP	EONxTP=		EON x Traffic Program
		*EON	Store all EON data into EEPROM

x is in range 1-4

*Note: Almost all commands have their equivalent in the Windows control software, accessible through its GUI.*

**Fixed messages:**

MSGxx		*MSGxx=	Text Message
MSGxxD		*MSGxxD=	Message Destination
MSGLIST			List of Messages
DPS2MSG	DPS2MSG=	*DPS2MSG	Dynamic PS 2 Message Number
RT2MSG	RT2MSG=	*RT2MSG	Radiotext 2 Message Number

xx is in decimal range 01-99

**Scheduling:**

SLIST			List of Scheduling Items
SxxC		*SxxC=	Scheduling Item Command
SxxD		*SxxD=	Scheduling Item Days
SxxP		*SxxP=	Scheduling Item PTY
SxxT		*SxxT=	Scheduling Item Times
SEN	SEN=	*SEN	Scheduling Enable

xx is in decimal range 01-48

**System:**

COMSPD	COMSPD=	*COMSPD	Port 1 Speed
CT	CT=	*CT	Clock Time and Date
DATE	DATE=		Date
ECHO	ECHO=	*ECHO	Terminal Echo
EXTSYNC	EXTSYNC=	*EXTSYNC	External Pilot Synchronization
LEVEL	LEVEL=	*LEVEL	RDS Signal Level
LTO	LTO=	*LTO	Local Time Offset
MJD	MJD=		Modified Julian Day
PHASE	PHASE=	*PHASE	RDS Signal Phase
PILOT			Pilot Tone Present
PSNMAIN	PSNMAIN=	*PSNMAIN	PSN of Main Program
RDS2MOD	RDS2MOD=	*RDS2MOD	RDS2 Mode of Operation
RDSGEN	RDSGEN=	*RDSGEN	RDS Generator
RESET			Reset
SETFEAT	SETFEAT=	*SETFEAT=	Special Features
SPEED	SPEED=	*SPEED	Port 1 Speed
STATUS			RDS Encoder Status
TIME	TIME=		Time
VER			Firmware Version

**Advanced:**

ADR		*ADR=	Encoder Address List
CC		*CC=	Conditional Command
	EAS=		Send EAS Text Message
	EASTIME=		Set EAS Timer
ECC	ECC=	*ECC	Extended Country Code
ECCEN	ECCEN=	*ECCEN	ECC and LIC Enable
	G=		Group
GRPSEQ	GRPSEQ=	*GRPSEQ	Group Sequence
LIC	LIC=	*LIC	Language Identification Code
PAC y, zz	PAC y, zz=	*PAC	Port Access Control
PROGRAM	PROGRAM=	*PROGRAM	Program Set Selection
PSW			PS Window
Rabbbb, cc			Read Memory
RTP	RTP=		Radiotext Plus Tagging Data
RTPRUN	RTPRUN=		Radiotext Plus Running Bit
	SETSPY=		Set RDS Monitoring Counter
SHORTRT	SHORTRT=	*SHORTRT	Short Radiotext
SITE		*SITE=	Site Address List
		*STORE=	Write to the non-volatile RDS2 Buffer
UDG1	UDG1=	*UDG1	User Defined Groups 1
UDG2	UDG2=	*UDG2	User Defined Groups 2
UECP	UECP=	*UECP	UECP Enable
	XCMD=		X-Command for RDS encoders

y is in range 0 to 2

zz is in range 00 to FF (hex)

## 7.2 Basic Commands

<b>AF</b>	<b>Alternative Frequencies</b>	<b>(87.6-107.9), A, B, (1-8)</b>
Current list of alternative frequencies in MHz representation in range of 87.6-107.9 MHz. Up to 25 items are allowed in the list.		
In addition this command switches between AF method A and B and allows working with different AF lists for the method B.		
For more details about the method B follow the section 5.3. From factory the AF method is set to A.		
AF=103.5, 98.0	Sets the alternative frequencies to 103.5 and 98.0 MHz (method A)	
AF	Shows current AF list. Returns "B" if method B is active.	
*AF	Stores the AF list into EEPROM (default space for method A)	
*AF=1	Stores the AF list into EEPROM (to a space used by method B)	
AF=87.5	Not allowed (87.5 MHz not defined in original RDS standard)	
AF=108.0	Not allowed (108.0 MHz not defined in original RDS standard)	
<b>AFCH</b>	<b>Alternative Frequency Channels</b>	<b>H (01-CC)</b>
Current list of alternative frequency channels in hexadecimal representation in range of 01-CC (87.6-107.9 MHz). Up to 25 items are allowed in the list.		
AFCH=01, 3B	Sets the alternative frequencies to 87.6 and 93.4 MHz	
AFCH=00	Not allowed (87.5 MHz not defined in original RDS standard)	
AFCH=CD	Not allowed (108.0 MHz not defined in original RDS standard)	
<b>DI</b>	<b>Decoder Identification</b>	<b>(0-15)</b>
Identification of the decoder to be used by the receiver.		
DI=1	Standard transmission - stereo.	
DI=0	Standard transmission - automatic stereo/mono set depending on pilot tone presence.	
<b>DPS1</b>	<b>Dynamic PS 1</b>	
Up to 255 characters long text message to be displayed on receiver instead of static PS name. Primarily used for song titles streaming etc.		
DPS1>Hello World	Sets the DPS1 text	
DPS1=	Clears the DPS1	
<b>DPS1EN</b>	<b>Dynamic PS 1 Enable</b>	<b>(0, 1)</b>
Enables (1) or disables (0) the Dynamic PS 1 text.		
DPS1EN=1	Enables the DPS1 text.	
<b>DPS2EN</b>	<b>Dynamic PS 2 Enable</b>	<b>(0, 1)</b>
Enables (1) or disables (0) the Dynamic PS 2 text.		
<b>DPS1ENQ</b>	<b>Dynamic PS 1 Enqueue</b>	
Advanced version of the DPS1 command. Places the text to a one level deep queue. New text will not be displayed on the receiver until old text reaches its end. Applies only to text length <128 characters.		
DPS1ENQ>Hello World	Sets the following DPS1 text	
<b>DPS2</b>	<b>Dynamic PS 2</b>	
Up to 255 characters long text message to be displayed on receiver instead of static PS name. Alternatively used in conjunction with <i>Messages Commands</i> .		
DPS2>Hello World	Sets the DPS2 text	
DPS2=	Clears the DPS2	
<b>DPS1MOD</b>	<b>Dynamic PS 1 Mode</b>	<b>(0-3)</b>
Display mode for the DPS1 text.		
0 - Scrolling by 8 characters		
1 - Scrolling by 1 character		
2 - Word alignment scrolling		
3 - Scrolling by 1 character, text separated by spaces at begin and end		
<b>Note: In mode 3 the maximum text length is limited to 240 characters.</b>		
DPS1MOD=3		

<b>DPS2MOD</b>	<b>Dynamic PS 2 Mode</b>	<b>(0-3)</b>
Display mode for the DPS2 text.		
0 - Scrolling by 8 characters		
1 - Scrolling by 1 character		
2 - Word alignment scrolling		
3 - Scrolling by 1 character, text separated by spaces at begin and end		
<i>Note: In mode 3 the maximum text length is limited to 240 characters.</i>		
DPS2MOD=3		
<b>DPS1REP</b>	<b>Dynamic PS 1 Number of Repeating</b>	<b>(0-127)[CLR]</b>
Specifies number of repeating for the DPS1 text message. Optionally the DPS1 text is then cleared.		
Without the optional CLR parameter specified the command has effect only if DPS2 is enabled.		
Number of repeating = number of transmissions - 1.		
DPS1REP=1		
DPS1REP=2, CLR		
<b>DPS2REP</b>	<b>Dynamic PS 2 Number of Repeating</b>	<b>(0-255)</b>
Specifies number of repeating for the DPS2 text message. Has effect only if DPS1 is enabled or if DPS2MSG value is AUTO.		
Number of repeating = number of transmissions - 1.		
DPS2REP=0		
<b>DTTMOUT</b>	<b>Default Text Timeout</b>	<b>(0-254)</b>
Specifies a timeout in minutes for Radiotext 1. If no RT1 has been received during the period, the RT1 text is replaced by default text.		
Default text means the RT1 text that is stored in EEPROM memory using *RT1. Following exceptions apply:		
For Program 1, if Message 91 contains a valid X-Command, it is launched on the Default Text timeout event.		
For Program 2, if Message 92 contains a valid X-Command, it is launched on the Default Text timeout event.		
1-254 - Timeout in minutes.		
0 - Function disabled.		
DTTMOUT=10		
<b>EQTEXT1</b>	<b>Equal Text 1</b>	<b>(0, 1)</b>
If set to 1, any update of Radiotext 1 via any port updates also Dynamic PS1 and vice versa. Applies also to UECP control. Has no effect for X-Command.		
EQTEXT1=1		
DPS1=Hello World		
RT1		
<b>LABPER</b>	<b>Label Period</b>	<b>(0-255)</b>
Label Period used in DPS Mode 0 and 2. Increasing the value by 1 increases the period by approx. 0.54 seconds (exact value depends on Group Sequence).		
LABPER=4                      Each label is displayed for about 2 seconds.		
<b>MS</b>	<b>Music/Speech</b>	<b>(0, 1)</b>
Music/Speech switch.		
MS=0	Speech program	
MS=1	Music program	
<b>PI</b>	<b>Program Identification</b>	<b>H (1000-FFFF)</b>
Identification code of the radio station. Always contains four hexadecimal digits.		
PI=20FE	OK	
PI=0F55	Not allowed (0 as first digit)	
<b>PS</b>	<b>Program Service name</b>	
Static name of radio station that is displayed on receiver. Max. 8 characters long.		
The PS= command requires additional processing time of up to 400 ms for internal synchronization with RDS group order.		
PS=KISS FM		



<b>PTY</b>	<b>Program Type number</b>	<b>(0-31)</b>
------------	----------------------------	---------------

An identification number to be transmitted with each program item, intended to specify the current Program Type within 31 possibilities.

Program type codes (Europe):

0 - (none)	16 - Weather
1 - News	17 - Finance
2 - Affairs	18 - Children
3 - Info	19 - Social Affairs
4 - Sport	20 - Religion
5 - Education	21 - Phone In
6 - Drama	22 - Travel
7 - Cultures	23 - Leisure
8 - Science	24 - Jazz Music
9 - Varied Speech	25 - Country Music
10 - Pop Music	26 - National Music
11 - Rock Music	27 - Oldies Music
12 - Easy Music	28 - Folk Music
13 - Light Classics Music	29 - Documentary
14 - Serious Classics	30 - Alarm Test
15 - Other Music	31 - Alarm

Program type codes (US RBDS):

0 - (none)	16 - Rhythm and Blues
1 - News	17 - Soft Rhythm and Blues
2 - Information	18 - Foreign Language
3 - Sports	19 - Religious Music
4 - Talk	20 - Religious Talk
5 - Rock	21 - Personality
6 - Classic Rock	22 - Public
7 - Adult Hits	23 - Leisure
8 - Soft Rock	24 - College
9 - Top 40	25 - (unassigned)
10 - Country	26 - (unassigned)
11 - Oldies	27 - (unassigned)
12 - Soft	28 - (unassigned)
13 - Nostalgia	29 - Weather
14 - Jazz	30 - Emergency Test
15 - Classical	31 - Emergency

PTY=10 Sets the Pop Music Program Type (EU)

<b>PTYN</b>	<b>Program Type Name</b>
-------------	--------------------------

Allows further description of the current Program Type, for example, when using the PTY code 4: SPORT, a PTYN of "Football" may be indicated to give more detail about that program.

PTYN=Football

<b>PTYNEN</b>	<b>PTYN Enable</b>	<b>(0, 1)</b>
---------------	--------------------	---------------

Enables (1) or disables (0) the PTYN service.

PTYNEN=1 Enables the PTYN service

<b>RT1</b>	<b>Radiotext 1</b>
------------	--------------------

Up to 64 characters long text message to be displayed on receiver in Radiotext format. Primarily used for song titles streaming, commercials etc.

RT1=Hello World

<b>RT1EN</b>	<b>RT1 Enable</b>	<b>(0, 1)</b>
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Enables (1) or disables (0) the Radiotext 1.

RT1EN=1 Enables the RT1

<b>RT2</b>	<b>Radiotext 2</b>	
Up to 64 characters long text message to be displayed on receiver in Radiotext format. Alternatively used in conjunction with <i>Messages Commands</i> .		
RT2=Hello World		
<b>RT2EN</b>	<b>RT2 Enable</b>	<b>(0, 1)</b>
Enables (1) or disables (0) the Radiotext 2.		
RT2EN=1	Enables the RT2	
<b>RTPER</b>	<b>Radiotext Switching Period</b>	<b>(0-255[:00-59])</b>
Specifies the time in minutes between two switching of the Radiotext. The switching can occur between RT1 and RT2 or between <i>messages</i> specified for RT2 (command RT2MSG=AUTO). Optionally, seconds may be specified as well.		
RTPER=3	Sets the period to 3 minutes	
RTPER=0 : 20	Sets the period to 20 seconds	
<b>RTTYPE</b>	<b>Radiotext Type</b>	<b>(0-3)</b>
Specifies Radiotext type for RT1 and RT2		
0 - A/A. Any Radiotext is always the same type.		
1 - A/B. RT1 is always type A, RT2 is always type B.		
2 - Automatic. Any change/update of the Radiotext causes the A/B flag to toggle. Default option. Required for proper RT+ function.		
3 - Same as 2 but also overrides UECP A/B flag control.		
The meaning of the RT type is: If the receiver detects a change in the A/B flag, then the whole Radiotext display is usually cleared and the newly received Radiotext message segments are written into the display. If the receiver detects no change in the A/B flag, then the received text segments or characters are written into the existing displayed message.		
RTTYPE=2		
<b>RSTDPS</b>	<b>Restart Dynamic PS</b>	<b>(0, 1)</b>
1 - When the Dynamic PS text is changed and no Dynamic PS is running, it will start immediately.		
0 - The SPSPER command drives the Dynamic PS start regardless of the fact that the Dynamic PS text was changed.		
<i>Changing a Dynamic PS text (1 or 2) that is currently running will always cause its restart. This rule does not apply to the DPS1ENQ command.</i>		
RSTDPS=1		
<b>SCRLSPD</b>	<b>Scrolling PS Speed</b>	<b>(0, 1)</b>
Sets high (1) or low (0) speed of scrolling PS transmission. Although setting high speed gives the result looking better, remember that on some receivers or under bad reception conditions the text may be unreadable. The reason is absolutely outside the RDS encoder and comes out from the fact that scrolling PS has never been included in RDS standard. Due to this the high speed is not recommended.		
SCRLSPD=1		
<b>SPSPER</b>	<b>Static PS Period</b>	<b>(0-255)</b>
Specifies the time between two repeats of the Dynamic PS text. Static PS (PS/TPS) is displayed during this time. Increasing the value by 1 increases the period by approx. 2.7 seconds (exact value depends on Group Sequence).		
If value 255 is set, the Dynamic PS will be displayed only once if changed. RSTDPS parameter must be set to 1 in this case.		
<i>If both DPS1 and DPS2 are enabled, the SPSPER cannot be zero (0).</i>		
SPSPER=4	Sets the period duration to about 11 seconds.	



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INIT	Initialization
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---

Sets most parameters and services in currently selected Program to their default values. Does not clear *Messages* and *Scheduling* items. Does not clear port and network settings. Apply for example if new blank EEPROM is placed on the board or if the RDS encoder was previously used for another station.

INIT	Initialize the program set that is currently selected.
*CC= PROGRAM=6 INIT	Complete initialization procedure. Replace the HH:MM with actual time and the DD.MM.YY with actual date.
*ALL PROGRAM=5 INIT	<b>Note: This initialization sequence must always be applied if new blank EEPROM is placed on the board in production process. Alternatively use the Windows control software: Device Setup - Special - Initialize.</b>
*ALL PROGRAM=4 INIT	
*ALL PROGRAM=3 INIT	
*ALL PROGRAM=2 INIT	
*ALL PROGRAM=1 INIT	
*ALL TIME=HH:MM DATE=DD.MM.YY	

---

ALL	Store All
-----	-----------

---

Stores all settings into the non-volatile EEPROM memory.

\*ALL

---

HELP	Help
------	------

---

Shows all commands available.

HELP

### 7.3 EON Commands

<b>EONxAF</b>	<b>EON x Frequencies</b>	<b>(87.6-107.9)</b>
List of Other Network frequencies that can be received in the area covered by linking station. Each item is in MHz representation in range of 87.6-107.9 MHz. Up to 25 items allowed.		
EON1AF=98.0, 99.3 Sets 98.0 and 99.3 MHz frequencies for Other Network 1		
<b>EONxAFCH</b>	<b>EON x Frequency channels</b>	<b>H (01-CC)</b>
List of Other Network frequency channels that can be received in the area covered by linking station. Each item is in hexadecimal representation in range of 01-CC (87.6-107.9 MHz). Up to 25 items allowed.		
EON1AFCH=01, 3B Sets 87.6 and 93.4 MHz frequencies for Other Network 1		
<b>EONxEN</b>	<b>EON x Enable</b>	<b>(0, 1)</b>
Enables (1) or disables (0) the link to the Other Network.		
EON1EN=1		
<b>EONxPI</b>	<b>EON x Program Identification</b>	<b>H (0000-FFFF)</b>
Identification code of the Other Network. Always contains four hexadecimal digits.		
EON1PI=24F1		
<b>EONxPS</b>	<b>EON x Program Service name</b>	
Program Service name of the Other Network.		
EON1PIN=12, 16, 40		
<b>EONxPSN</b>	<b>EON x Program Service Number</b>	<b>(1-255)</b>
Program Service Number assigned to the Other Network.		
Applies only if the operator requires changing of EON information via UECP.		
EON1PSN=1		
<b>EONxPTY</b>	<b>EON x Program Type number</b>	<b>(0-31)</b>
Program type number of the Other Network.		
EON1PTY=3		
<b>EONxTA</b>	<b>EON x Traffic Announcement</b>	<b>(0, 1)</b>
If set to 1, switches the receiver to corresponding Other Network for duration of the traffic announcement.		
Can't be set to 1 if:		
<ul style="list-style-type: none"> <li>▪ corresponding Other Network has TP=0</li> <li>▪ corresponding Other Network is not enabled</li> </ul>		
The EON1TA flag can be also controlled by external TA/EON1TA switch.		
<b>Note: Setting any EON TA to is also signaled to the receiver by a series of group type 14B.</b>		
EON1TA=1		
<b>EONxTP</b>	<b>EON x Traffic Program</b>	<b>(0, 1)</b>
Traffic Program flag of the Other Network.		
EON1TP=1		
<b>*EON</b>	<b>Store all EON data into EEPROM</b>	
Stores all EON data into EEPROM. TA flags are not stored.		
*EON		

x is in range 1-4

## 7.4 Messages Commands

These commands are provided for working with the bank of fixed text messages that is useful especially for offline operation of the RDS encoder or in conjunction with the scheduling feature. Using these commands you may enter the text messages and assign them to Radiotext, Dynamic PS or X-Command.

<b>MSGxx</b>	<b>Text Message</b>	
	Specifies the fixed message text. Since there is a place for 99 messages in the memory, the number xx must be in range 01-99. For Program 1, if Message 91 contains a valid X-Command, it is launched on the Default Text timeout event. For Program 2, if Message 92 contains a valid X-Command, it is launched on the Default Text timeout event. Same rule applies to Program 3 to 6.	
	*MSG01=Hello World	
<b>MSGxxD</b>	<b>Message Destination</b>	<b>(0-4)</b>
	Specifies the destination of the message used for automatic message switching. The number xx must be in range 01-99. 0 - Message not used for automatic switching 1 - DPS2 2 - RT2 3 - DPS2 and RT2 4 - X-Command Timer	
	*MSG01D=2	
<b>MSGLIST</b>	<b>List of Messages</b>	
	Shows all messages present in the memory and its destination. MSGLIST	
<b>DPS2MSG</b>	<b>Dynamic PS 2 Message Number</b>	<b>(0-99, AUTO)</b>
	0 - Default DPS2 text specified by DPS2 command or last DPS2MSG command is selected. 1-99 - The message of the number is selected for the DPS2. AUTO - Messages are selected automatically in ascending order. Only messages chosen by the MSGxxD command are selected.	
	DPS2MSG=AUTO	
<b>RT2MSG</b>	<b>Radiotext 2 Message Number</b>	<b>(0-99, AUTO)</b>
	0 - Default RT2 text specified by RT2 command or last RT2MSG command is selected. 1-99 - The message of the number is selected for the RT2. AUTO - Messages are selected automatically in ascending order. Only messages chosen by the MSGxxD command are selected.	
	RT2MSG=1	

xx is in decimal range 01-99



## 7.6 System Commands

<b>COMSPD</b>	<b>Port 1 Speed</b>	<b>(0-4)</b>
Specifies the Port 1 speed (baudrate).		
0 - 1200 bps		
1 - 2400 bps (default)		
2 - 4800 bps		
3 - 9600 bps		
4 - 19200 bps		
This command has the same effect as <i>SPEED</i> but the format of input is different.		
COMSPD=1		
<b>CT</b>	<b>Clock Time and Date</b>	<b>(0, 1)</b>
Enables (1) or disables (0) time and date transmission in CT format.		
CT=1		
<b>DATE</b>	<b>Date</b>	
Specifies the current date in DD.MM.YY format.		
DATE=30.11.05                      30 <sup>th</sup> of November 2005		
<b>ECHO</b>	<b>Terminal Echo</b>	<b>(0, 1)</b>
Determines if the RDS encoder sends an echo (1) of each character or not (0), that it receives via the port.		
ECHO=1		
<b>EXTSYNC</b>	<b>External Pilot Synchronization</b>	<b>(0, 1)</b>
0 - Forced internal clock source (for mono transmission)		
1 - Automatic external synchronization if pilot tone is present		
EXTSYNC=1		
<b>LEVEL</b>	<b>RDS Signal Level</b>	<b>(0-255)</b>
Sets the RDS signal level, directly affects the injection of the RDS signal into the FM transmitter.		
0 = minimum level, 255=maximum level.		
LEVEL=120		
<b>LTO</b>	<b>Local Time Offset</b>	<b>±(0-24)</b>
Specifies the offset between the local time and the universal time (UTC). Expressed in multiples of half-hours.		
LTO=+2		
<b>PHASE</b>	<b>RDS Signal Phase</b>	<b>(0-18)</b>
Fixes the relative phase shift between the pilot tone and the RDS signal.		
Changing the value by one results in 9.5 degrees phase shift change.		
The value serves only as a scale, it may not provide real phase shift value.		
PHASE=8		
<b>MJD</b>	<b>Modified Julian Day</b>	<b>H (00000-FFFFFF)</b>
Day, Month and Year coded as Modified Julian Day.		
To find D, M and Y from MJD:		
$Y' = \text{int} [ (\text{MJD} - 15\,078,2) / 365,25 ]$		
$M' = \text{int} \{ [ \text{MJD} - 14\,956,1 - \text{int} (Y' \times 365,25) ] / 30,6001 \}$		
$D = \text{MJD} - 14\,956 - \text{int} (Y' \times 365,25) - \text{int} (M' \times 30,6001)$		
If $M' = 14$ or $M' = 15$ , then $K = 1$ ; else $K = 0$		
$Y = Y' + K$		
$M = M' - 1 - K \times 12$		
To find MJD from D, M and Y:		
If $M = 1$ or $M = 2$ , then $L = 1$ ; else $L = 0$		
$\text{MJD} = 14\,956 + D + \text{int} [ (Y - L) \times 365,25 ] + \text{int} [ (M + 1 + L \times 12) \times 30,6001 ]$		
Y', M', K, L - intermediate variables.		
MJD=00D7CD                      18 <sup>th</sup> of February 2010		



<b>PILOT</b>	<b>Pilot Tone Present</b>	
Indicates if pilot tone is present (1) or not (0).		
PILOT		
<b>PSNMAIN</b>	<b>PSN of Main Program</b>	<b>(1-254)</b>
Specifies optional PSN (Program Service Number) for current Program set. This option has effect for UECP control only.		
PSNMAIN=1		
<b>RDS2MOD</b>	<b>RDS2 Mode of Operation</b>	<b>(0, 1)</b>
Controls the RDS generator and subcarrier configuration: 0: Tunneling - The stream 1 is effectively a duplicate of basic stream 0 (default). 1: RDS2 Buffer / Station Logo - The RDS2 Buffer (see command STORE) is periodically sent on stream 1. Other modes are currently undefined and should not be used. In all modes, the G command has higher priority when inserting user-defined RDS2 group to the stream 1.		
RDS2MOD=0		
<b>RDSGEN</b>	<b>RDS Generator</b>	<b>(0-2)</b>
Controls the RDS generator and subcarrier configuration: 0: RDS output disabled - no data goes from the RDS encoder's output. 1: RDS output enabled - single 57 kHz subcarrier (default). 2: RDS2 configuration enabled. Content of the upper subcarrier is given by the RDS2MOD and G commands. <i>Note: Disabling the RDS output has no effect on other functions.</i>		
RDSGEN=1		
<b>RESET</b>	<b>Reset</b>	
Provokes a hardware reset of the RDS encoder and is equivalent to an "off-on" cycle of the RDS encoder.		
RESET		
<b>SETFEAT</b>	<b>Special Features</b>	<b>H (0000-3FFF)</b>
This is a 16-bit Hex value bitmap which holds enabling bits for special RDS encoder features: Bit 0: Dynamic group sequence. If enabled (1), temporarily doubles the 2A group rate when the RT is changed. Bit 1: RT+ group type 11A/13A. Selects group type for RT+ service. Applies to RTP and XCMD commands. Bit 2: reserved, set as 0. Bit 3: X-Command Timer Message - resume (0) or reset (1). Bit 4: Enables scrolling of long words for Dynamic PS Mode 2 (Word parsing mode). Bit 5: Chooses between left alignment (0) and centering (1) for Dynamic PS Mode 2 (Word parsing mode). Bits 6 to 15: reserved, set as 0. <i>Note: The '*' prefix may be omitted for this command.</i>		
SETFEAT=0001	Enables dynamic group sequence, sets group type 11A for RT+	
SETFEAT=0003	Enables dynamic group sequence, sets group type 13A for RT+	
SETFEAT=0000	Factory default value	
<b>SPEED</b>	<b>Port 1 Speed</b>	<b>(1200, 2400, 4800, 9600, 19200)</b>
Specifies the port 1 speed (baudrate). This command has the same effect as COMSPD but the format of input is different.		
SPEED=2400		
<b>STATUS</b>	<b>RDS Encoder Status</b>	
Shows the most important operating values of the RDS encoder. You may also type ??.		
STATUS ??		
<b>TIME</b>	<b>Time</b>	<b>(00:00-23:59, 00:00:00-23:59:59)</b>
Specifies the current time in HH:MM format (sets the second counter to 00) or in HH:MM:SS format. The time value specified is a local time valid in the area of coverage.		
TIME=16:40 TIME=09:24:10		

<b>VER</b>	<b>Firmware Version</b>
Returns the firmware version that is currently present in the RDS encoder.	
VER	

## 7.7 Advanced Commands

<b>ADR</b>	<b>Encoder Address List</b>	<b>(0-63[,0-63])</b>
Up to two encoder address numbers in range 0 to 63, separated by comma. Applies to UECP control.		
*ADR=56		
*ADR=12, 35		

<b>CC</b>	<b>Conditional Command</b>
Executes specified command when specified condition occurs. Optional ELSE command supported.	

Syntax:

\*CC=[aa]bcc:dddddddd

\*CC=ELSE:eeeeeeee

where is:

aa - memory address pointer (00-FFF)

b - condition operator

< - lower than

> - greater than

= - equal

! - not equal

B - bit cc of [aa] is set (numbered from LSB to MSB)

cc - value to compare (00-FF) or bit number (00-07)

dddddddd - the command executed if the condition is matched

eeeeeeee - the command executed if the condition is not matched (optional)

Max. command length is 31 characters. Once the command is executed, next execution is stopped until the condition matching changes. In other words, the command is executed only at the condition matching change. Both numbers aa and cc are in hexadecimal representation. Only one CC item is allowed. Only commands from the second column of the Command Summary are allowed.

List of some applicable memory addresses:

13: PTY number (0-31)

15: number of DPS2 characters

28: Message counter (RT2)

29: Message counter (DPS2)

34: number of DPS1 characters

68: timer 0-8A, reset every minute

6A: one of the status bytes (bit 02 - DPS2 is running; bit 03 - DPS1 is running, bit 06 - external program switch)

71: Dynamic PS counter (points to the character that is currently transmitted on the first PS position)

76: static PS counter (0-SPSPER)

78: DPS number of repeats counter

8B: Group Sequence counter

C6: Scheduling item number waiting (0, 1-48)

CC: timer 0-FF, increased on each end of PS transmission (approx. once per 0.5 sec. by default)

E4: local hour (0-23)

E5: local minute (0-59)

To check visually what value is on each address, type MEM xx where xx is the address desired.

---

**Important note:** The CC is a very "strong" command. Due to a theoretical possibility of bad setting that may cause the unit stop responding (please don't ask for an example) the Conditional Command is not active after power-up for up to 30 seconds. This gives the user a time to type \*CC= to disable the Conditional Command before it becomes active.

---

*CC=[CC]B03:PS=RADIO *CC=ELSE:PS=PRO 88	Periodically switches the PS between 'RADIO' and 'PRO 88'.
*CC=[6A]B06:DPS2MSG=01 *CC=ELSE:DPS2MSG=02	If PROGRAM is set to 1 or 2, the external program switch will select a text Message for the Dynamic PS 2. (If PROGAM is set to 0, the status bit is always 0.)
PTYN=Football *CC=[13]=04:PTYNEN=1 *CC=ELSE:PTYNEN=0	Sets PTYN name to 'Football'. When PTY code 'Sport' is on-air, additional PTYN name is included.
*CC=[4E]B06:RT2EN=1 *CC=ELSE:RT2EN=0	Enables RT2 for the duration of traffic announcement (TA)
*CC=[E9]!01:COMSPD=1	Does not allow to set port 1 speed other than 2400 bps.
*CC=[E4]>0B:DPS2=Good afternoon *CC=ELSE:DPS2=Good morning	Different DPS2 text for hours in range 0-11 and 12-23. Scheduling feature can be used as well.
*CC=[71]<20:DPS1MOD=1 *CC=ELSE:DPS1MOD=2	Shows first part of DPS1 in mode 1, then switches to mode 2 for the rest of the text.
CC *CC=ELSE: *CC=	Shows actual CC settings. Disables the ELSE command. Completely disables the Conditional Command feature.

---

### EAS                      Send EAS Text Message

---

Activates the EAS (US Emergency Alert System) mode of operation:  
Loads the text message to Radiotext 1 and Dynamic PS 1. Sets PTY to 31 (Alert). Sets the EAS timer to 180 seconds.  
**Other commands changing the Radiotext or Dynamic PS are not accepted during the EAS session.**

---

EAS=Hurricane conditions are expected within your area

---

### EASTIME                  Set EAS Timer (0-999)

---

Number of seconds that the EAS text message should be transmitted. Typically, this command is sent **after** the EAS command. If the timer is set to 0 (or has been decremented to 0), then the RDS encoder will function in its normal mode of operation.

EASTIME=300	Extends the EAS mode duration to 5 minutes.
EASTIME=0	Immediately terminates the EAS mode of operation.

---

### ECC                                  Extended Country Code H (00-FF)

---

Uniquely determines the country in conjunction with the first digit of PI.

ECC=00	Unknown/not used/not applicable.
ECC=E2	

<b>ECCEEN</b>	<b>ECC and LIC Enable</b>	<b>(0, 1)</b>
Enables (1) or disables (0) the ECC and LIC features.		
ECCEEN=1		

<b>G</b>	<b>Send Group</b>	<b>H (000000000000-FFFFFFFF) or H (0000000000000000-FFFFFFFF)</b>
Orders the RDS encoder to send directly RDS or RDS2 groups whose contents are free. For RDS (stream 0), the Group content is in BBBBCCCCDDDD format where BBBB, CCCC and DDDD represent the contents of the block 2, block 3 and block 4 in hexadecimal expression. The block 1 has not been specified as it is always the PI programmed with the PI command. For more details about the group coding see section 10.3. For RDS2 (stream 1), the Group content is in AAAABBBBCCCCDDDD format where AAAA, BBBB, CCCC and DDDD represent the contents of the block 1, block 2, block 3 and block 4 in hexadecimal expression. The RDS encoder calculates CRC automatically. Using this command, the RDS transmission can then be partially or fully controlled by an external application. For full RDS stream control, 9600 bps or higher com. speed should be used. Next Group can follow after previous command success characters (+). Unlike the UECP control, the G buffer may not contain more than one group for each stream. The buffer is flushed as soon as possible (each stream has a maximum rate of 11.4 groups per second).		
G=380215D1A531	RDS group 3B containing 02 15D1 A531	
G=0000200F20202020	RDS2 group - tunneling a RT segment	

<b>GRPSEQ</b>	<b>Group Sequence</b>
Defines the RDS group sequence. Allows the user to control the group order and adjust repetition rate of individual RDS services. Max. 24 items are allowed. The services and groups are represented by following symbols:	
0	- Four groups 0A (MS, TA, DI, AF, one complete PS)
1	- Group 1A (ECC, LIC)
2	- Group 2A (RT)
A	- Group 10A (PTYN)
E	- Group 14A and 14B (EON)
X	- Group from UDG1
Y	- Group from UDG2
R	- Group 3A/11A (RT+)
U	- One group from the UECP buffer.
If the 'U' symbol is not present in the Group Sequence, any possible groups from the UECP buffer are transmitted as fast as possible, usually making a continuous sequence of groups until the UECP buffer flushes completely. This is a default configuration.	
Services, which are not placed in the sequence, are disabled regardless of their individual settings.	
Services, which are placed in the sequence and are disabled by their individual settings, are ignored (skipped).	
Inserting a nonsense string will result in the same effect as inserting a single 0.	
Inserting an unknown symbol will cause ignoring the rest of the string.	
It's a good practice to assure that at least one 0 is present in each consecutive 6 symbols. It is recommended not to place more than 4 same symbols consecutively.	
Take into consideration that RDS does not know anything like empty groups or delays between groups. There must be still some groups sent to the output.	
The GRPSEQ command does <b>not</b> affect: group 4A (CT), user groups inserted using the G command.	
GRPSEQ=02222	Four groups 0A followed by four groups 2A (very high Radiotext transmission rate), other services are disabled.
GRPSEQ=	Sets the groups sequence to default (022E1022EA022XYR).
GRPSEQ=022E10XXXX	High transmission rate of UDG2. PTYN and RT+ is disabled.
GRPSEQ=X	The RDS content is fully controlled via UDG1 (and possibly G command).

<b>LIC</b>	<b>Language Identification Code</b>	<b>H (00-FF)</b>
Enables a broadcaster to indicate the spoken language he is currently transmitting.		
LIC=00	Unknown/not applicable	
LIC=09	English	

<b>PAC</b>	<b>Port Access Control</b>
This command is described in the document 'P132 RDS Encoders - Communication Ports and Internet Functions'.	

---

<b>PROGRAM</b>	<b>Program Set Selection</b>	<b>(0-6)</b>
----------------	------------------------------	--------------

Selects the program set - copies the program data from EEPROM memory to operational memory. RDS services in selected program set are transmitted by the RDS encoder and can be modified and stored back into EEPROM memory. Six Program Sets are available in the device.

1 - Program set 1 is selected (default)

...

6 - Program set 6 is selected

0 - Program input on the board selects the program

**Note:** If PROGRAM is set to zero (0), most of store operations are not allowed to protect the data (since the destination in EEPROM is undefined in general).

---

PROGRAM=1

---

<b>PSW</b>	<b>PS Window</b>	
------------	------------------	--

Returns current Program Service name that is being sent by the RDS encoder. The value returned is an output of internal real-time RDS decoder so it's affected also by Dynamic PS and user defined groups.

---

PSW

---

<b>RTP</b>	<b>Radiotext Plus Tagging Data</b>	<b>(00-31; 00-31; 00-31; 00-31; 00-31; 00-15)</b>
------------	------------------------------------	---

Six 2-digit decimal numbers of RT+ tagging data in this order:

Tag 1 type, tag 1 start, tag 1 length, tag 2 type, tag 2 start, tag 2 length.

Start marker 00 means the first character in the Radiotext. Length marker gives the number of characters following the first character at the start position.

The tagging data must be associated with current Radiotext 1.

The tagging data are transmitted as groups 3A (RT+ ODA AID) and 11A (RT+ Tagging Data).

On each enter of the tagging data internal Toggle bit automatically changes its state from 0 to 1 or from 1 to 0.

First entering of the tagging data automatically enables the internal RT+ feature until power off or reset.

The RT+ is active only if symbol 'R' is present in the Group sequence.

If both tag 1 type and tag 2 type are set to 00, internal RT+ running bit is temporarily hold low until at least one valid tag type is entered.

**Note:** Consider using of the XCMD command.

---

RT1=Now playing: Novaspace - Time After Time

RTP=04,13,08,01,25,14

---

<b>RTPRUN</b>	<b>Radiotext Plus Running Bit</b>	<b>(0, 1, 2)</b>
---------------	-----------------------------------	------------------

0 - Bit set low (RT1 no longer contains RT+ data), automatically set to 1 on next RTP= entry.

1 - Bit set high (current RT1 contains RT+ data)

2 - Disable internal RT+ feature

This command is not required for common use since the running bit is set automatically.

---

RTPRUN=1

---

<b>SETSPY</b>	<b>Set RDS Monitoring Counter</b>	
---------------	-----------------------------------	--

This command is described in the document 'P132 RDS Encoders - Communication Ports and Internet Functions'.

---

---

<b>SHORTRT</b>	<b>Short Radiotext</b>	<b>(0, 1)</b>
----------------	------------------------	---------------

If enabled (1), all new inserted Radiotexts shorter than 60 characters will be followed by Carriage Return and the remaining spaces will be cut. Default value is 0.

SHORTRT=1

<b>SITE</b>	<b>Site List</b>	<b>(0-1023[,0-1023])</b>
-------------	------------------	--------------------------

Up to two site address numbers in range 0 to 1023, separated by comma. Applies to UECP control.

\*SITE=16

\*SITE=125,1022

<b>STORE</b>	<b>Write to the non-volatile RDS2 Buffer</b>
--------------	--

Syntax: \*STORE=aaaa,rds group(s)

**aaaa**: hexadecimal address in range B000 to EFFF. *Write to outside of this region may corrupt other RDS data.*

**rds group(s)**: array of hexadecimal byte values, each 8 bytes form one group. Max. length is 64 bytes.

End of the buffer: If the data does not fill entire 16KB region available, a special sequence of 8 bytes must be stored behind the last RDS group. This terminating sequence is 0000FFFF00FF0000.

See section 5.6.2 for details.

\*STORE=B000,0000FFFF00FF0000                      Clears the RDS2 buffer

<b>UDG1</b>	<b>User Defined Groups 1</b>
-------------	------------------------------

Specifies up to 8 groups in BBBBCCCCDDDD format, which are repeatedly transmitted in sequence by the RDS encoder. BBBB, CCCC and DDDD represent the contents of the block 2, block 3 and block 4 in hexadecimal expression. For more details about the group coding see section 10.3.

When entering new group(s), previous groups are removed from the UDG1 buffer.

UDG1=80001A961C97

Sets TMC group 8A containing 00 1A96 1C97

UDG1=

Clears the UDG1 groups

<b>UDG2</b>	<b>User Defined Groups 2</b>
-------------	------------------------------

Specifies up to 8 groups in BBBBCCCCDDDD format, which are repeatedly transmitted in sequence by the RDS encoder. BBBB, CCCC and DDDD represent the contents of the block 2, block 3 and block 4 in hexadecimal expression. For more details about the group coding see section 10.3.

When entering new group(s), previous groups are removed from the UDG2 buffer.

UDG2=380215D1A531,38058DB3B61E

Sets two UDG2 groups

UDG2=

Clears the UDG2 groups

<b>UECP</b>	<b>UECP Enable</b>	<b>(0, 1)</b>
-------------	--------------------	---------------

Enables (1) or disables (0) the UECP support for all ports. ASCII commands are accepted regardless of this value.

UECP=1

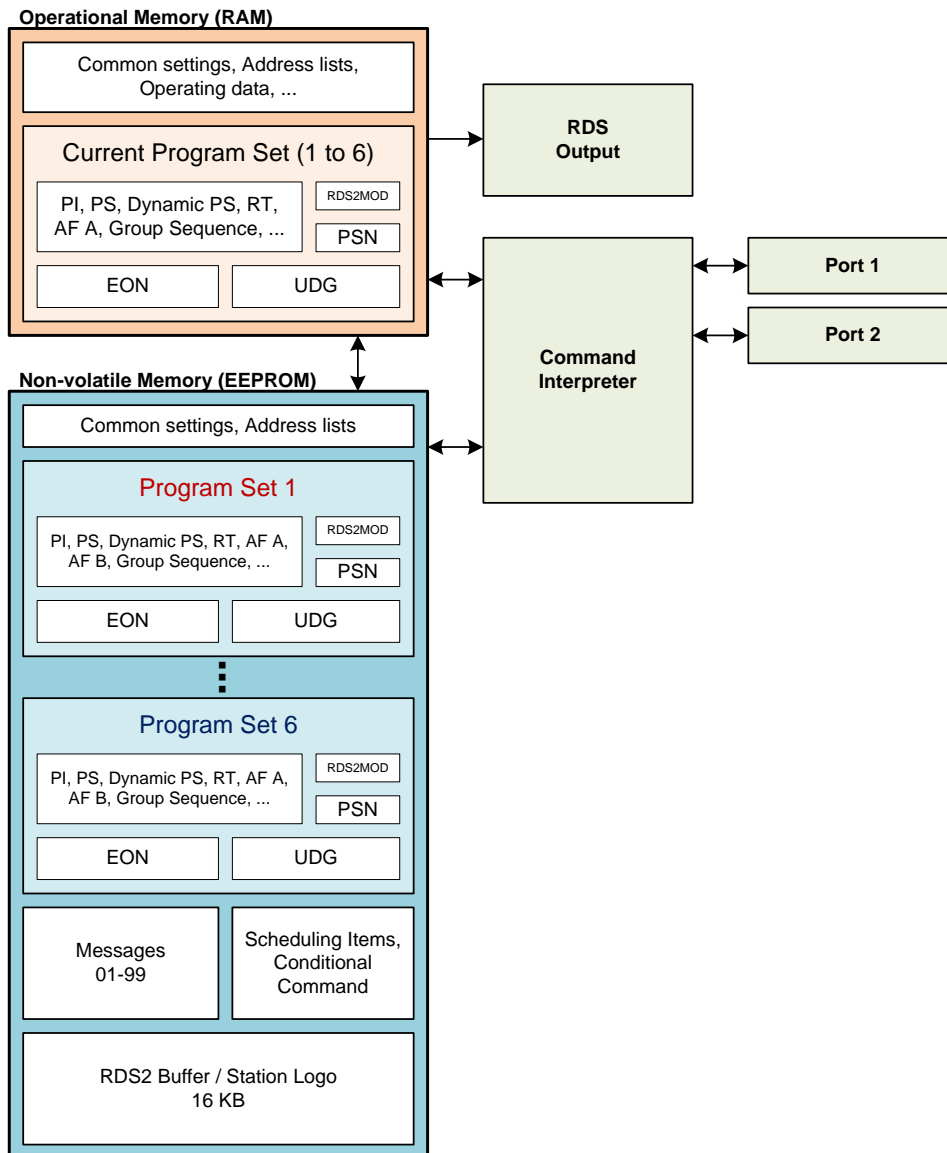
<b>XCMD</b>	<b>X-Command for RDS encoders</b>
-------------	-----------------------------------

This command is described in the document 'X-Command for RDS encoders'.

XCMD=<rds><item><dest>3</dest><text>Now playing: <artist>Raw Spirit</artist> -  
<title>Back In Town</title></text></item></rds>

Updates RT1 and RT+ with specified text and tags.

## 7.8 Memory Organization



## 7.9 Dynamic PS 1 and Dynamic PS 2 Summary

	Dynamic PS 1	Dynamic PS 2
Real time showing capability	yes, in mode 0 and 2	yes, in mode 0 and 2
Display modes available	4	4
Text queue available	yes	no
Max. text length	255	255
Max. queued text length	127	N/A
Removing redundant spaces from the text end	yes, in mode 2 and 3	no
Allows transmission of Messages	no	yes
Typically used for	Commercials, news and "on-air" texts	Fixed texts from the <i>Messages</i> bank

## 8 Further Features

### 8.1 Bypass Relay

The RDS encoder board includes a bypass relay providing an alternative way for the MPX signal on power supply failure (applies to loopthrough connection mode only).

### 8.2 LED Indication

Two LED diodes are used to indicate operating status of the RDS encoder:

	LED 1	LED 2	Status
Start-up	off	on	Initialization
	on	off	Firmware update in progress
Operation	. . . . .		Normal operation
	-----		An error occurred
	on		Receiving data on some port
		on	External pilot synchronization is active
		off	Internal clock source is selected
			-----

### 8.3 External Program Set Switch

External program switch input allows selecting one of two program sets by an external device. This device can be a simple switch or a device with digital output. The PROGRAM parameter must be set to 0 to enable this feature. The program input is level controlled, the switch shut-off or logical 1 selects the Program set 1, the switch closure or logical 0 selects the Program set 2.

Alternatively the switch input can be used for selecting a text message or for control of other RDS service or setting. For more details see chapter 7.7 - Conditional Command.

### 8.4 External TA/EON1TA Switch

External TA/EON1TA switch input allows you to control the Traffic Announcement parameter by an external device. This device can be a simple switch or a device with digital output. The TA input is level or edge activated, as specified by the TATMOUT command.

- If level controlled, the switch closure or logic 0 activates the TA (sets to 1). The switch shut-off or logic 1 deactivates the TA (sets to 0).
- If edge activated, a falling edge (logic 1 to logic 0 transition) activates the TA. Then the TA is deactivated after the duration specified by the TATMOUT command. Optionally a rising edge may deactivate the TA if occurs first.

The TATMOUT command doesn't affect the EON1TA switching. If EON1TA is controlled using the external switch, the control is always based on the level.

The switch function table:

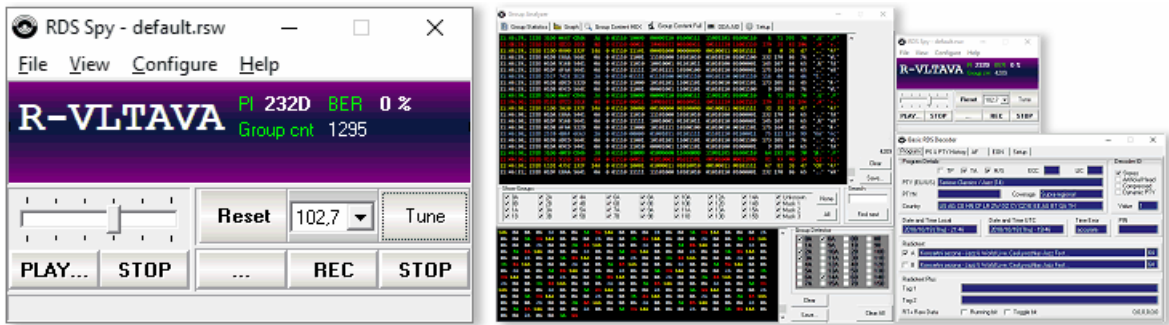
TP (local)	EON1 Enabled	Switch function
1	don't care	TA
0	1	EON1TA
0	0	Switch disabled



## 8.5 RDS Output Monitoring

Want to see or verify the RDS and RDS2 output data? The encoder supports direct complete RDS output monitoring on any communication port in real time using a desktop application. This unique feature allows complete RDS output analysis without need of a receiver or special equipment.

RDS data is provided as ASCII coded RDS groups in raw format at the RDS group rate (11.4 groups per second for each stream). The group content provided is equal to the group content being sent to output of the RDS encoder and being seen by listeners. This format of data is directly supported by some easy to use applications (for example freeware RDS Spy).



RDS Spy - Real-time freeware Radio Data System decoder and analyzer for Windows.

### 8.5.1 Monitoring the RDS Output Step-by-Step

1. For monitoring via Port 1, set the port speed to **19200 bps**.
2. In the Windows control software, select the device (connection) of interest.
3. Click on the RDS Spy button:



4. The real-time RDS content will appear immediately.

## 8.6 Showing Real Time in Dynamic PS

It's possible to show real time in Dynamic PS in mode 0 and 2. To show the time, the text must contain `%HH-MM%` string and this string must exactly fill the 8-character window. Then on each string occurrence place the real time will be displayed. The separator between hours and minutes is user selectable.

## 8.7 Real-Time Backup

A battery-powered RTC circuit provides real-time backup for case of mains power supply interruption or switch off. Use `TIME` and `DATE` commands to set the time and date information or simply use the Windows control software.

## 8.8 Firmware Upgrade

The RDS encoder has a firmware upgrade capability. This allows easily implementing of new features in future. When a new firmware version is released, special simple Windows application provides the firmware upgrade. The firmware upgrades are provided at no costs. Please refer to the website for more information.

## 8.9 Dynamic Group Sequence

The device supports Group sequence and its proprietary extension called 'Dynamic group sequence'. Whereas the Group sequence assigns fixed channel capacity (data rate) to each RDS service, the Dynamic group sequence temporarily changes this assignment to provide more capacity for prioritized RDS service.

In current implementation, if the Dynamic group sequence is enabled, it temporarily doubles the 2A group rate when the Radiotext changes. As the result, the Radiotext updates much faster on receivers, compared to conventional RDS encoders. In the rest of the time, the bandwidth reserved for other RDS services is kept unaffected, according to the Group sequence.

The Dynamic group sequence can be enabled by following methods:

In the Windows control software, go to Device Setup – Special – Special Features.

Or in the terminal, type `SETFEAT=+0001`

## 8.10 On-line Support

Not sure how to set-up the unit?  
Some RDS related feature is missing?

Feel free to contact us at <https://pira.cz/forum/> or via email.

***Important note: Before sending an email please make sure you have read entire content of this manual (incl. section 10.4), control software help file and also forum, F.A.Q. and tips on the website. Your question may be already answered in this extensive knowledge base.***

## 9 Universal Encoder Communication Protocol (UECP)

The UECP protocol (SPB 490) is an industrial standard for RDS encoder control to facilitate inter-working of various RDS devices and components regardless of the supplier. Due to rapid development of the field, the UECP typically does not handle specific functions and characteristics of particular RDS encoder model. Rather than this, it defines common interface for classic RDS services whereas other services have been set in advance using the way described on previous pages.

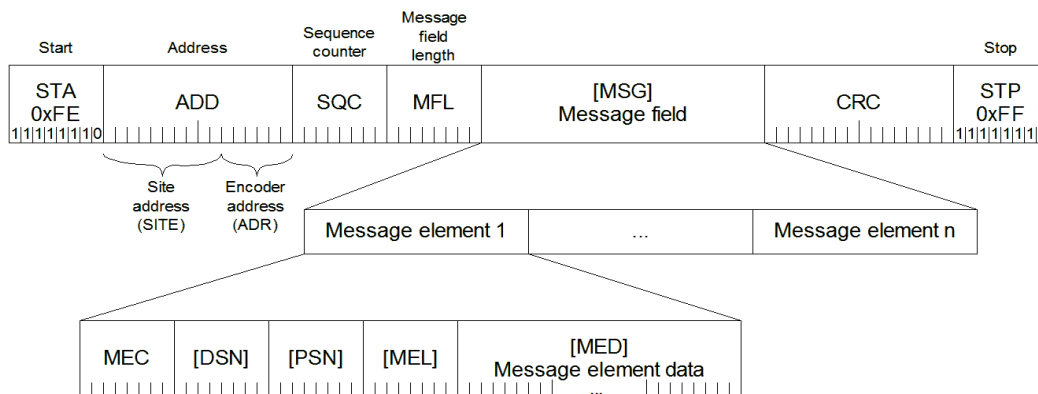
The UECP implementation in the P232U covers all commonly used services. Some UECP commands and functions that are obsolete, rarely used or not complying with the P232U concept, are not implemented.

### 9.1 UECP Implementation

#### 9.1.1 To turn-on the UECP support

1. Configure all RDS services and settings as desired.
2. Where required, configure the RDS Encoder address and Site address using the commands `*ADR=` and `*SITE=` or using the Windows control software (RDS Encoder – Device Setup).
3. Find out and set the right baudrate (speed) or network settings of the RDS encoder's port.
4. The UECP support is enabled by default. In other cases, type `UECP=1` and `*UECP` or use the Windows control software to turn-on the UECP support.

#### 9.1.2 General UECP frame (record) format



*Note: Read more information about the UECP in the document "SPB 490 Universal Encoder Communication Protocol" (published by RDS Forum).*

#### 9.1.3 UECP addressing

The address field of each UECP record comprises of two elements. These are:

- Site address, 0-1023 (most significant 10 bits)
- Encoder address, 0-63 (least significant 6 bits)

The RDS encoder incorporates two address lists; one of acceptable Site addresses (`SITE`) and the other of acceptable Encoder addresses (`ADR`). A UECP record is acceptable to a particular encoder only if the site address is contained within its site address list and the encoder address is contained within its encoder address list.

It is expected that many UECP commands will be sent to all encoders. For this reason a "global" address of 0 is defined for both the site and encoder addresses. Thus the address lists always consist of addresses defined by user and the "global" address of 0. Messages bearing the site address of 0 are deemed to be acceptable at all sites in the system. Messages bearing the encoder address of 0 are deemed to be acceptable by all encoders at sites specified by the accompanying site address.

### 9.1.4 The UECP implementation in the P232U

List of UECP commands accepted:

MEC	Meaning	Notes
01	PI	
02	PS	
03	TA/TP	
04	DI/PTYI	
05	MS	
07	PTY	
0A	RT	1
0D	Real time clock	
13	AF	
1C	Data set select	
24	Free-format group	3, 4
25	IH	3, 4
2D	Manufacturer specific command (X-Command)	
30	TMC	3, 5
40	ODA configuration and short message command	
42	ODA free-format group	3, 7
46	ODA data	3, 7

Special fields in the UECP frame:

Field	Handling
ADD	Site address 0-1023, Encoder address 0-63, note 2.
SQC	Sequence counter - if consecutive UECP records have the same SQC value, only the first correctly received record is applied. Except exists for records with SQC of 0x00 which are always accepted.
MFL	Message field length - In order to maintain overall robustness the MFL value must be exact, otherwise the UECP frame is considered as corrupted and it's discarded!
DSN	DSN must be 0 <u>or</u> 255 <u>or</u> equal to the number of current program set. Otherwise the command is discarded.
PSN	PSN must be 0 <u>or</u> equal to the PSNMAIN parameter of current program set <u>or</u> equal to any of the EON PSN in current program set. Otherwise the command is discarded.
CRC	If CRC does not match, the UECP frame is considered as corrupted and it's discarded.

Notes:

- 1) Capacity up to two Radiotexts.
- 2) The RDS encoder address list can contain up to three items for the Site address and up to seven items for the Encoder address. One of these items is always fixed to 0, the remaining items can be changed using the commands \*SITE= and \*ADR=.
- 3) Buffer size 16 groups (FIFO type), shared by all ODA data, IH, TMC and free-format Message elements. Number of repeats is assigned to each group in the FIFO buffer so one group occupies one position in the buffer regardless of number of repeats. See section 9.1.5.
- 4) Buffer configuration bit 5 ignored. Buffer configuration bit 6 meaning: 0 - no repeat, 1 - repeat the group one time, then clear.

- 5) Full support except the priority and buffer configuration. The encoder automatically assures at least 3-group long gap between any TMC groups in the data transmitted.
- 6) Timeout and buffer configuration ignored. Always inserts one group through the FIFO buffer.
- 7) Priority, mode and buffer configuration ignored. Always inserts one group through the FIFO buffer ("immediate" priority).

When the UECP is enabled, the RDS encoder accepts any mixture of ASCII commands and UECP records on the same communication port. The UECP communication is always unidirectional. There are no responses sent to the UECP records.

Any characters which follow the UECP start byte (0xFE) will be ignored by the ASCII command interpreter until one of the following conditions occurs:

- reception of the UECP stop byte (0xFF)
- reception of up to 260 characters
- port timeout (2 minutes)

For this reason take care not to send the UECP start byte within an ASCII command when the UECP is enabled.

### 9.1.5 UECP buffer for user-defined RDS groups

In order to simplify the RDS encoder's control and fit it to current applications, the device incorporates one global UECP buffer for all groups inserted via MEC 24, 25, 30, 42 and 46. This buffer is a FIFO type and its capacity is 16 groups.

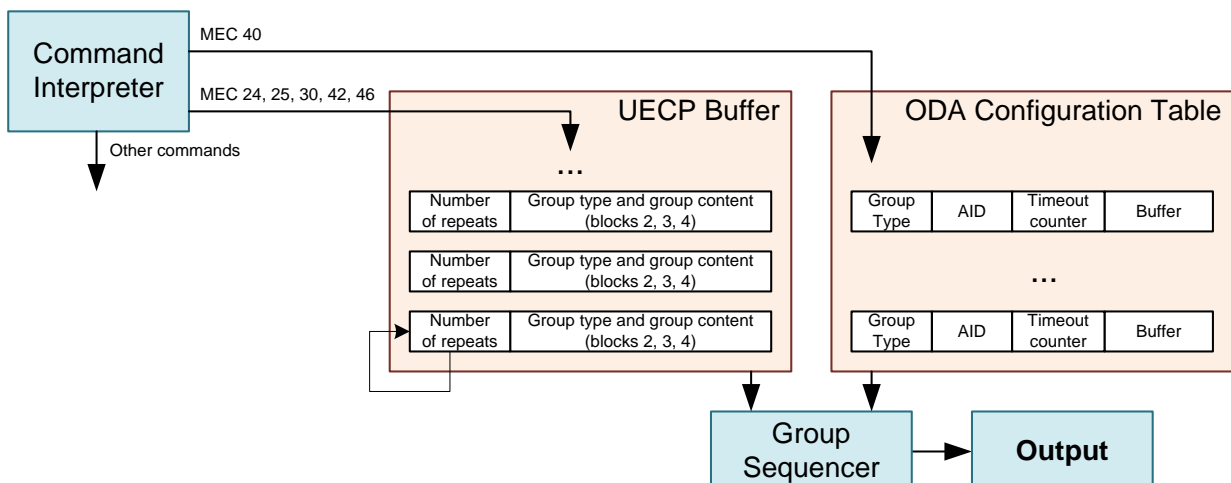
#### Transparent UECP buffer

If there's no symbol 'U' in the Group sequence, the UECP buffer is flushed into output stream as soon as possible, taking higher priority above any other group (excluding time groups 4A generated by the RDS encoder). This is a default configuration.

#### Batch UECP buffer

If there's at least one symbol 'U' present in the Group sequence, the buffer inserts one group into the output stream on the occurrence of the 'U' symbol. This makes a possibility to limit the speed of the buffer flushing but the groups may be delayed on the output.

The UECP buffer scheme is as follows (simplified):



*Note: The UECP buffer applies only to user-defined RDS groups inserted via UECP protocol. The UECP buffer has no meaning for other than those UECP MECs: 24, 25, 30, 42, 46 and 40 (single transmission).*

## 9.2 Traffic Message Channel (TMC) Application Notes

### 9.2.1 Basic requirements

The TMC service can work only if there is an application that we can call 'TMC data provider'. The TMC data provider collects all related information and translates it into RDS groups 8A type. The output from the TMC data provider is typically coded into UECP commands (MEC) 40 and 46 or into UECP command (MEC) 30. We will deal with the last case in following text.

Nowadays the TMC service is coded as an ODA application. Thus there must be ODA AID groups 3A transmitted in addition to the 8A groups. This can be done for example using the UECP MEC 40 or 24. The 3A groups typically carry fixed content so in some cases they can be inserted into the RDS encoder also one-time using the command UDG1= or UDG2=.

The Address and Site fields are optional. When the TMC data provider drives one RDS encoder only, these fields are usually set to zero. However there can be more RDS encoders connected with various Address and Site values. Each encoder will accept only the UECP records that match the Address and Site criteria. This configuration has been tested successfully simulating a network of more than 60 encoders (equivalent to full load of one 9600 bps channel).

### 9.2.2 Preparing for the TMC transmission

1. Configure all static parameters of the RDS encoder (PI, PS, CT etc.). Enable the UECP (UECP=1↵ \*UECP↵).
2. Where required, store the fixed 3A groups using the commands UDG1= or UDG2= (for example: UDG1=30100646CD46, 30104080CD46↵ \*UDG1↵).  
In this case make sure the UDG groups are included in the Group sequence (symbols X or Y).
3. Decide for the communication settings. Configure the RDS encoder and TMC data provider ports.
4. Configure the Site and Address values.

### 9.2.3 Application example

This application example shows TMC data and ODA AID information inserted by UECP commands 30 and 24.

Time	Group	UECP command	Comment
...			
9:27:58	<b>3A:</b> 8A 0646 CD46	FE 00 00 D0 07 24 06 10 06 46 CD 46 B9 68 FF	ODA AID variant 0
9:27:58	<b>8A:</b> 07 C801 4689	FE 00 00 D1 08 30 06 06 07 C8 01 46 89 94 54 FF	TMC 8A, two repeats
9:27:59	<b>8A:</b> 07 4984 6000	FE 00 00 D2 08 30 06 06 07 49 84 60 00 F2 5C FF	TMC 8A, two repeats
9:27:59	<b>3A:</b> 8A 4080 CD46	FE 00 00 D3 07 24 06 10 40 80 CD 46 49 7E FF	ODA AID variant 1
9:28:00	-	FE 00 00 D4 09 0D 0A 0C 10 09 1C 00 00 02 60 F3 FF	Encoder time adjust
9:28:00	<b>8A:</b> 01 883D 1A74	FE 00 00 D5 08 30 06 06 01 88 3D 1A 74 5F DC FF	TMC 8A, two repeats
9:28:00	<b>3A:</b> 8A 0646 CD46	FE 00 00 D6 07 24 06 10 06 46 CD 46 E3 E0 FF	ODA AID variant 0
9:28:01	<b>8A:</b> 02 8F50 15DD	FE 00 00 D7 08 30 06 06 02 8F 50 15 DD D3 6E FF	TMC 8A, two repeats
9:28:01	<b>8A:</b> 02 5404 ABD4	FE 00 00 D8 08 30 06 06 02 54 04 AB D4 1D E6 FF	TMC 8A, two repeats
9:28:01	<b>3A:</b> 8A 4080 CD46	FE 00 00 D9 07 24 06 10 40 80 CD 46 A6 E6 FF	ODA AID variant 1
9:28:02	<b>8A:</b> 05 497C 8000	FE 00 00 DA 08 30 06 06 05 49 7C 80 00 A6 D5 FF	TMC 8A, two repeats
...			

Notes:

- 1) Any RDS group inserted using the UECP elements 24, 25, 30, 40, 42 or 46 is put into the UECP buffer. See section 9.1.5 for more details. For TMC transmission it is recommended to leave the UECP buffer as transparent so the TMC data providing application has full control over the TMC transmission. The encoder automatically ensures at least 3-groups long gap between TMC groups.

## 10 Annexes

### 10.1 Character set and code-table conversions

The RDS system, as defined by the standards, does not support Unicode character set. Default character set (G0) used within the RDS system is limited to the characters provided in following EBU Latin code-table.

0x	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	@	P	`	p	á	â	ª	º	Á	Â	Ã	ã	
1	!	1	A	Q	a	q	à	ä	α	¹	À	Ä	Å	å
2	"	2	B	R	b	r	é	ê	©	²	É	Ê	Æ	æ
3	#	3	C	S	c	s	è	ë	‰	³	È	Ë	Œ	œ
4	◊	4	D	T	d	t	í	î	Ǧ	±	Í	Î	ÿ	ŵ
5	%	5	E	U	e	u	ì	ï	ě	İ	Ì	Ï	Ý	ý
6	&	6	F	V	f	v	ó	ô	ñ	´	Ó	Ô	Õ	õ
7	'	7	G	W	g	w	ò	ö	ö	ú	Ò	Ö	Ø	ø
8	(	8	H	X	h	x	ú	û	π	μ	Ú	Û	Ð	þ
9	)	9	I	Y	i	y	ù	ü	€	ı	Ù	Ü	Ɔ	ƞ
A	*	:	J	Z	j	z	Ñ	ñ	£	÷	Ř	ř	Ŕ	ŕ
B	+	;	K	[	k	{	Ç	ç	\$	°	Č	č	Ć	ć
C	,	<	L	\	l		Ş	ş	←	¼	Š	š	Ś	ś
D	-	=	M	]	m	}	β/Β	ğ	↑	½	Ž	ž	Ż	ż
E	.	>	N	^	n	~	ı	ı	→	¾	Đ	đ	Ʀ	Ƨ
F	/	?	O	_	o		IJ	ij	↓	§	Ł	ł	ð	

Basic set
Extended set

Example of use:

Character 'é' can be found in the table on coordinates 8, 2. Thus it converts to ASCII character 0x82 (HEX) or 130.

A conversion is required for all characters outside the basic set region. If you use MagicRDS control software, the characters are converted automatically between Windows ANSI coding and RDS character set. Setting for that feature can be made in Preferences - Local settings. Embedded internet functions are based on UTF-8 coding - conversion is made automatically inside the RDS encoder.

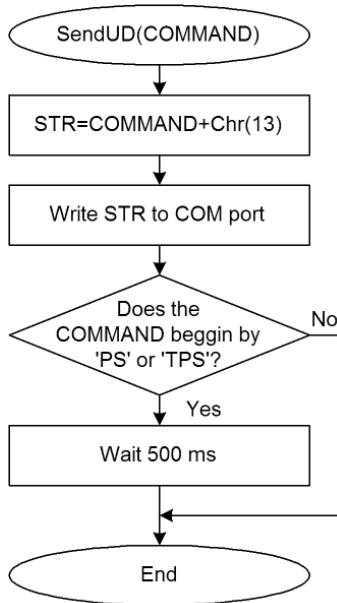
**Notes:**

- Many commercially available receivers use 14-segment LCD displays. These receivers are able to display only a limited part of the basic character set (green framed) and do not support the extended set at all. All lower-case characters are showed as upper-case.
- The EBU Latin basic set is compatible with most of other systems so conversion is not required for this region.
- Since many receivers contain no support for the extended character set, it is recommended to keep all characters in all text messages in the basic set region.
- Auxiliary code-tables (G1, G2) are not discussed in this manual as they are deprecated.

## 10.2 Communication Protocol Implementation Flowcharts

Following flowcharts allow the developer to implement the P232U ASCII protocol to any application easily.

### 10.2.1 Unidirectional Communication



Send command basic flowchart (unidirectional communication).

### 10.2.2 Bidirectional Communication

Confirm sequences definition:

```

CS1=Chr(13)+Chr(10)+' '+Chr(13)+Chr(10)+Chr(13)+Chr(10)
CS2=Chr(13)+Chr(10)+'!' +Chr(13)+Chr(10)+Chr(13)+Chr(10)
CS3=Chr(13)+Chr(10)+'-' +Chr(13)+Chr(10)+Chr(13)+Chr(10)
CS4=Chr(13)+Chr(10)+'/' +Chr(13)+Chr(10)+Chr(13)+Chr(10)
  
```

Variables used:

```

STR, REC, CS, COMMAND: string
ACCEPTED, ERROR: integer/boolean
TIME: time/float
  
```

Other values:

TIMEOUT: COM port timeout, usually  $\geq 400$  milliseconds

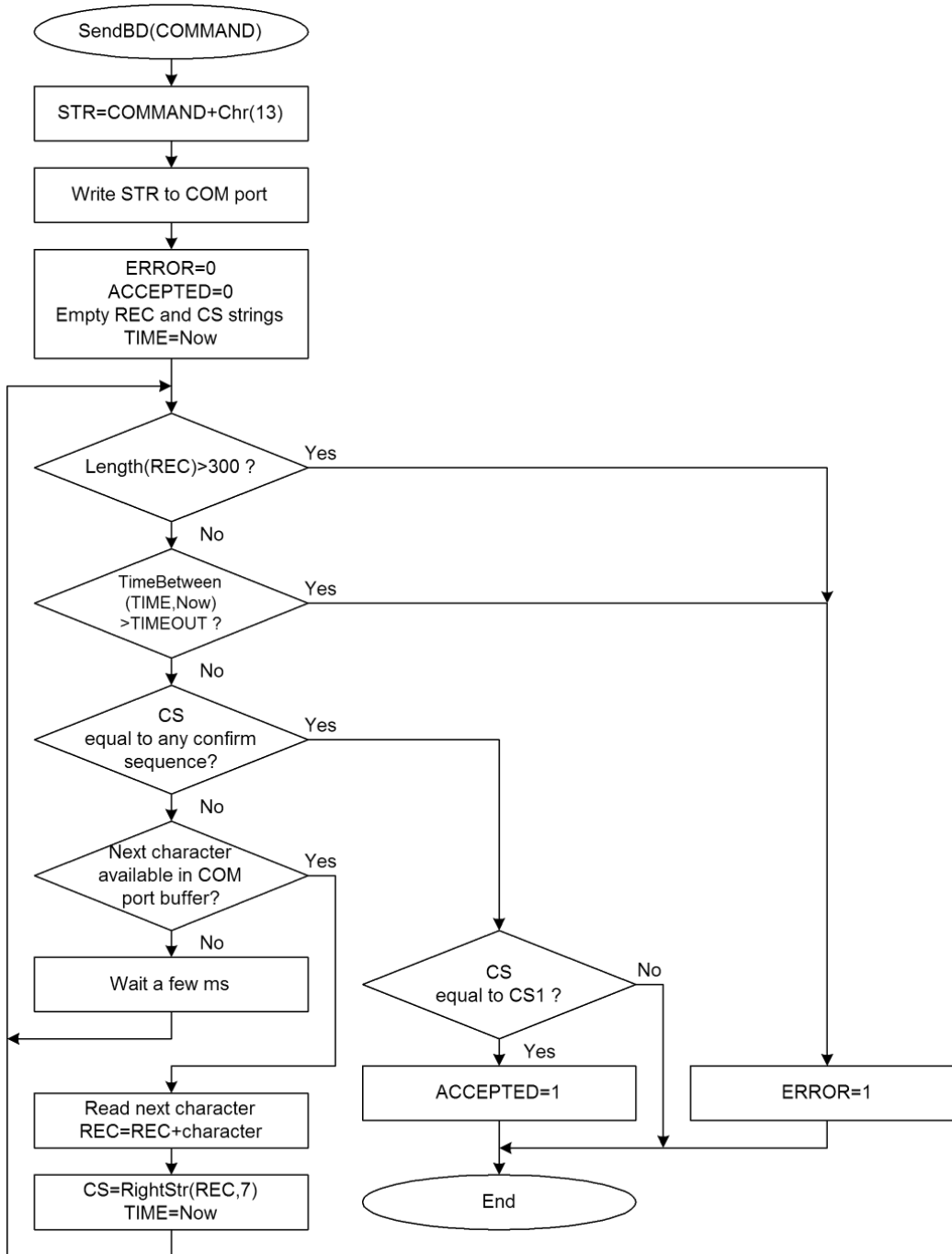
Calling examples:

```

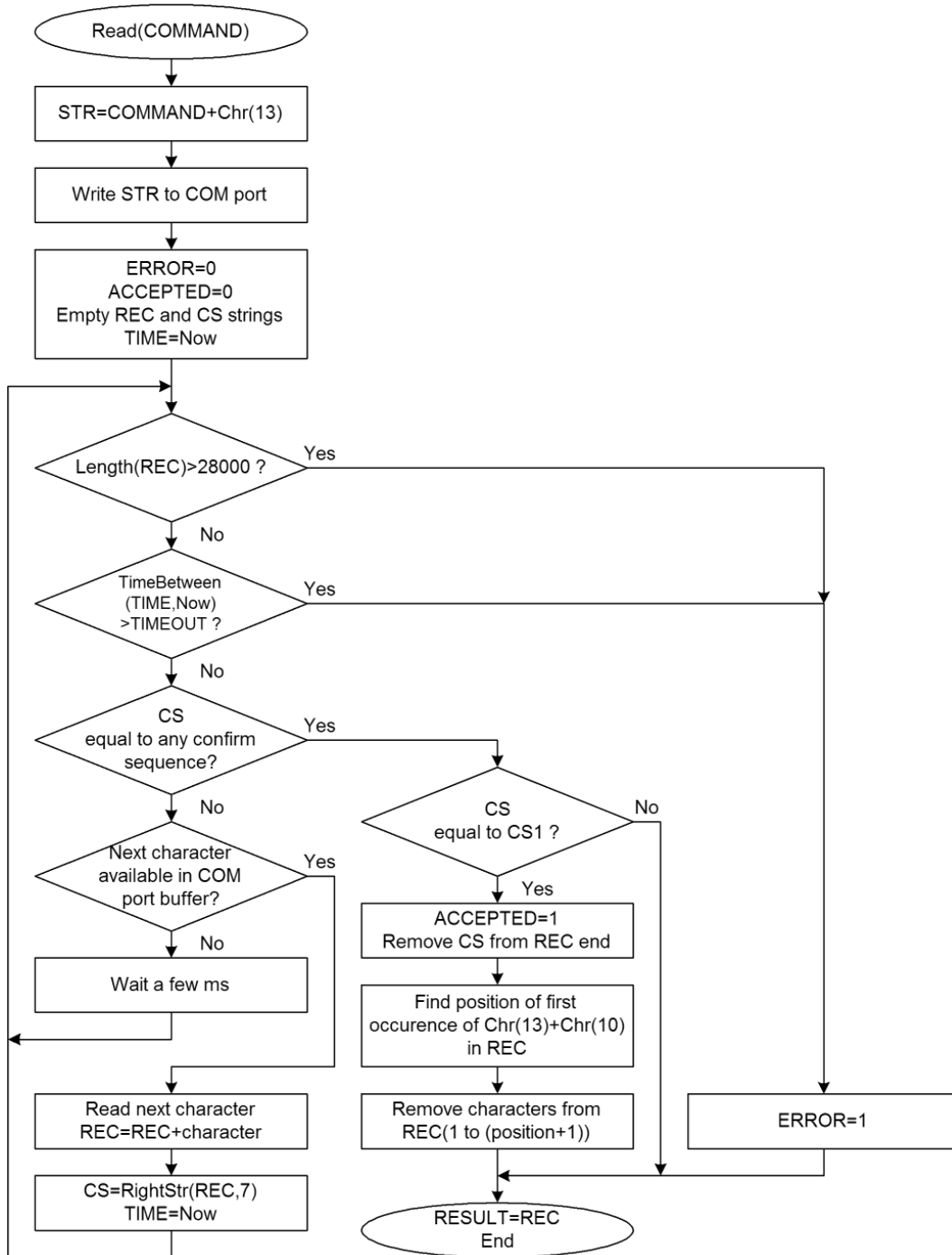
SendBD('PS=PRO 88')
if ERROR or not ACCEPTED then write('Error')
S=Read('PS')
if ERROR or not ACCEPTED then S=""
  
```

*Note: The flowcharts are valid for any ECHO value.*





Send command flowchart (bidirectional communication).



Read value flowchart.

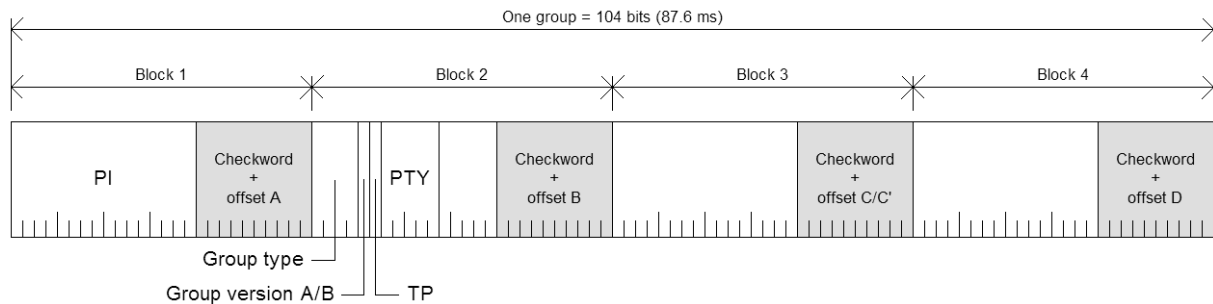
## 10.3 RDS Group Format

*Following information is provided for better understanding to the RDS principles and the user defined group coding.*

The largest element in the RDS coding structure is called a "group" of 104 bits each. Each group comprises 4 blocks of 26 bits each. Each block comprises an information word and a checkword. Each information word comprises 16 bits. Each checkword comprises 10 bits.

All information words, checkwords, binary numbers or binary address values have their most significant bit (MSB) transmitted first.

The data transmission is fully synchronous and there are no gaps between the groups or blocks. The basic data-rate of the system is 1187.5 bit/s. Thus transmission of one group takes about 87.6 ms and about 11.4 groups are transmitted per one second.



General RDS group format.

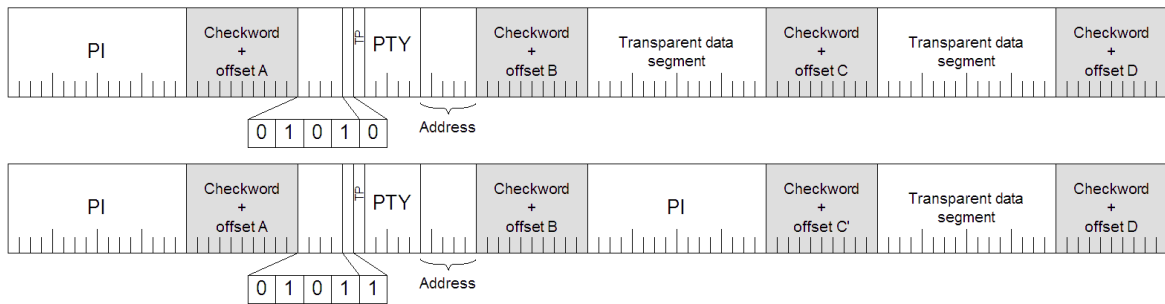
### 10.3.1 Basic principles and rules

- The services which are to be repeated most frequently, and for which a short acquisition time is required (PI, TP, PTY), in general occupy the same fixed positions within every group.
- There is no fixed rhythm of repetition of the various types of group, i.e. there is ample flexibility to interleave the various kinds of message to suit the needs of the users at any given time.
- The first four bits of the second block of every group are allocated to a four-bit code which specifies the application of the group - group type. Groups are referred to as types 0 to 15.
- For each type (0 to 15) two "versions" can be defined. The "version" is specified by the fifth bit of block 2: 0 = version A, 1 = version B.
- For all groups of version B the PI is inserted also in block 3 so this block cannot carry any other information when version B of the group is used.

### 10.3.2 Remarks

- One complete PS label consists of 4 groups. So one PS takes 350 ms of the transmission time. It may be found from experience that any RDS text should be transmitted at least twice to improve reception reliability. With regard to other services included in the RDS the repetition rate of dynamic/scrolling PS usually cannot be lower than one second.
- Checkwords and offsets are always calculated and inserted automatically by the RDS encoder.
- PI is always inserted automatically by the RDS encoder in block 1, and also in block 3 for version B of the group. Due to this the block 1 is never specified when inserting any user defined group.
- TP and PTY are always inserted automatically by the RDS encoder using OR method (logical sum) on the appropriate bit positions.

### 10.3.3 TDC group coding (5A, 5B)

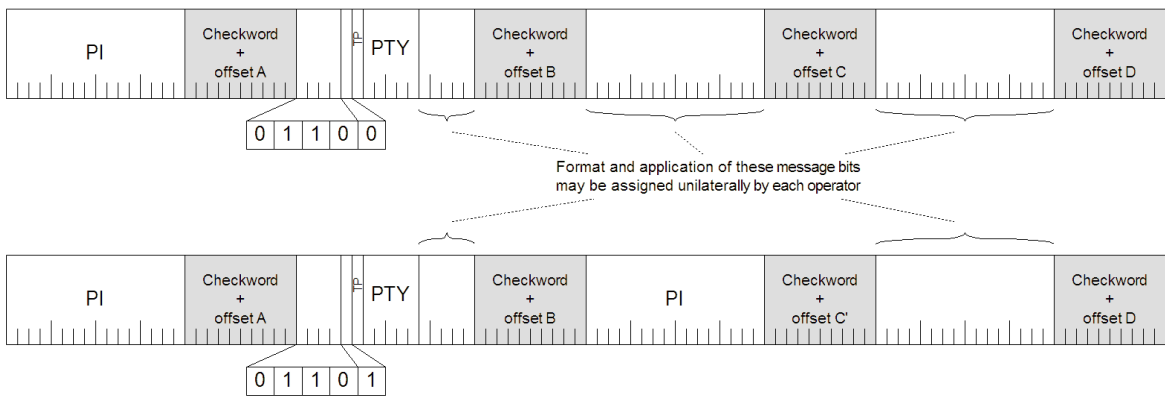


Group format in hexadecimal representation (version A): 50BBCCCCDDDD,

group format in hexadecimal representation (version B): 58BB0000DDDD,

where BB, CCCC and DDDD represent the contents of the block 2 (bits 4 to 0), block 3 and block 4.

### 10.3.4 IH group coding (6A, 6B)

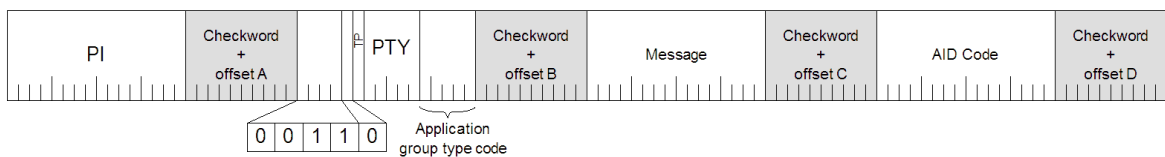


Group format in hexadecimal representation (version A): 60BBCCCCDDDD,

group format in hexadecimal representation (version B): 68BB0000DDDD,

where BB, CCCC and DDDD represent the contents of the block 2 (bits 4 to 0), block 3 and block 4.

### 10.3.5 AID for ODA group coding (3A)



Group format in hexadecimal representation: 30BBCCCCDDDD,

where BB, CCCC and DDDD represent the contents of the block 2 (bits 4 to 0), block 3 and block 4.

These groups are used to identify the Open Data Application in use, on an RDS transmission. The type 3A group conveys, to a receiver, information about which Open Data Applications are carried on a particular transmission (AID Code) and in which groups they will be found (Application group type code).

The Application group type code and the AID Code are obligatory, while the Message field is optional and should be set to zeros if not used.

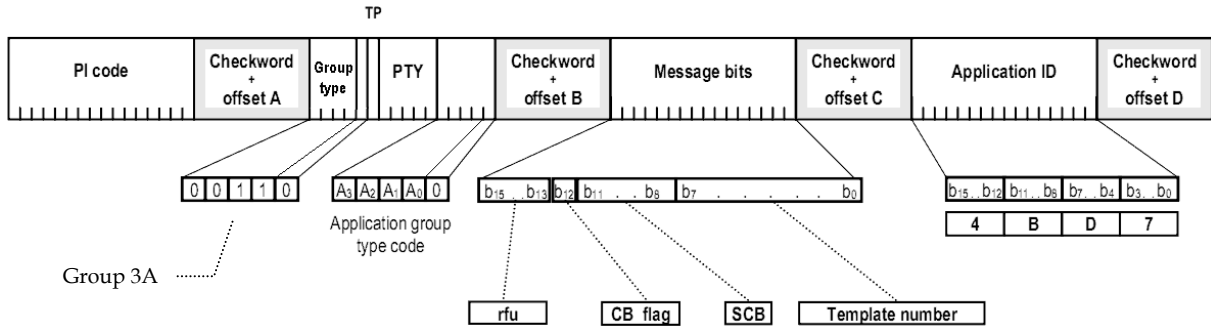
Since the 3A groups usually carry fixed static content, they may be inserted using either the UDG1= or UDG2= command for automatic cyclic transmission while the ODA application groups may be inserted by any command or method (G=, UDG1=, UDG2= or UECP MEC 24 or 42).

### 10.3.6 Example of ODA user defined group coding (Radiotext Plus)

Let's show the group coding example on the popular RT+ service. We need to insert group type 3A (Application identification for ODA) to the RDS stream pointing to the RT+ service which is - in this example - carried in group 11A.

Let's assume following RT content: Enigma - The Eyes of Truth

Appropriate 3A and 11A groups have following structure and coding:



Let's assume following variable values:

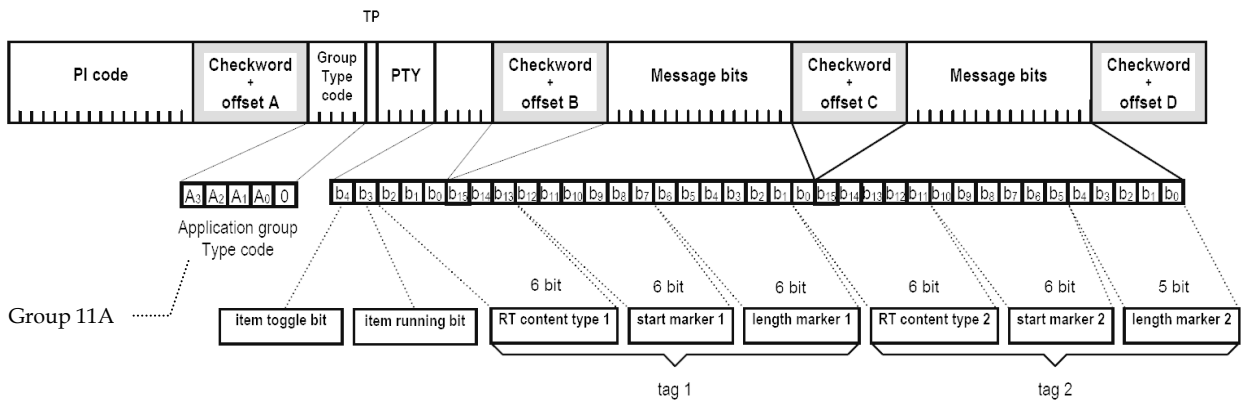
AGT: group type 11, version A (0), rfu: reserved, set as zeros, CB flag: 0, SC flag: 0, TN: N/A, set as zeros, AID code is 4BD7 for the RT+ service.

Blocks 2 to 4 in binary representation:

0011 0000 0001 0110 | 0000 0000 0000 0000 | 0100 1011 1101 0111

Blocks 2 to 4 in hexadecimal representation:

3016 | 0000 | 4BD7



Let's assume following variable values:

AGT: group type 11, version A (0), ITG: 0, IRB: 1, RTCT1: 1 (Title), SM1: 9 (10th RT character), LM1: 16 (17 characters long), RTCT2: 4 (Artist), SM2: 0 (first RT character), LM2: 5 (6 characters long).

Blocks 2 to 4 in binary representation:

1011 0000 0000 1000 | 0010 0100 1010 0000 | 0010 0000 0000 0101

Blocks 2 to 4 in hexadecimal representation:

B008 | 24A0 | 2005

Inserting the RT+ groups using the UDG1 command:

UDG1=301600004BD7,B00824A02005

**Note:**

*This example is for illustration only. The RT+ feature is directly supported by the RDS encoder (see section 7.7).*

## 10.4 Troubleshooting

The RDS encoder has been designed to make its use as easy and painless as possible. However, success depends upon a number of settings and things working together correctly. While correcting problems is usually quite simple, the difficulty lays in knowing where to look.

Factory default settings assure right operation after first power-on. This section of the manual is designed to assist you in determining the cause of problems that may occur so they can be fixed quickly.

Problem	Section related	Solution / Check	
		Windows control software	Terminal
No RDS output, no LED indication.	4.3	Power supply problem.	
No RDS output, but LED indicates operation.	4.1	RDS output connected to right input of the transmitter? Adjust higher RDS level or higher input sensitivity on the transmitter.	
	4.5.1	RDS generator switched on?	
The unit does not communicate with PC and the LED does not indicate data receive.	8.2	RDS Encoder - Special - Switch on RDS	RDSGEN=1
	4.4	Make sure all connectors are seated completely. Make sure you have selected right COM port.	
The unit does not communicate with PC and the LED does not indicate data receive.	6.1	Options - Preferences - List...	
	8.2	Try the unit with different cable and different PC.	
The unit does not communicate with PC but the LED indicates that data are received.	6.2	<ul style="list-style-type: none"> <li>Port 1 baudrate differs from the device configuration.</li> <li>Address does not match (applies to UECP only)</li> </ul>	
	7.6	Enable Bidirectional and Autodetect port speed options (Options - Preferences)	Try typing any command on each baudrate.
Radiotext stopped working although I'm sure that it's enabled and entered correctly.	7.7	RDS Encoder - Device Setup - Set Defaults - Store	
	7.7	The RT service is not included in the Group sequence.	
Pilot tone is fed to the unit but it is not indicated.	4.1	RDS Encoder - Special - Group sequence - Default, Store.	GRPSEQ=
Pilot tone is fed to the unit but it is not indicated.	4.1	System sheet - Clock Source: Auto, Store	EXTSYNC=1
The unit loses time and date after power off.	3	Replace the battery on the board.	
The audio is distorted. There is a whistling in the audio.	4.1	<ul style="list-style-type: none"> <li>The unit is not connected in loopthrough mode but the loopthrough switch is in LOOP position. Switch to the SIDE position.</li> </ul>	
	4.2	<ul style="list-style-type: none"> <li>The RDS level considerably exceeds maximum value allowed. Adjust lower RDS level. Use an FM analyzer for the best result.</li> </ul>	
	4.5.1	<ul style="list-style-type: none"> <li>Applied input of the transmitter is not suitable for RDS. Follow the transmitter's documentation.</li> </ul>	
	4.5.1	<ul style="list-style-type: none"> <li>Power supply failure.</li> </ul>	
No audio on air	4.1	The unit is connected in loopthrough mode but the loopthrough switch is in SIDE position. Switch to the LOOP position.	
No audio on air	4.2	The unit is connected in loopthrough mode but the loopthrough switch is in SIDE position. Switch to the LOOP position.	