USING RDS/RBDS WITH THE Si4701/03

1. Scope

This document applies to the Si4701/03 firmware revision 15 and greater. Throughout this document, device refers to an Si4701 or Si4703.

2. Purpose

- Provide an overview of RDS/RBDS
- Describe the high-level differences between RDS and RBDS
- Show the procedure for reading RDS/RBDS data from the Si4701
- Show the procedure for post-processing of RDS/RBDS data
- Point the reader to additional documentation

3. Additional Documentation

[1] The Broadcaster's Guide to RDS, Scott Wright, Focal Press, 1997.

[2] CENELEC (1998): Specification of the radio data system (RDS) for VHF/FM sound broadcasting. EN50067:1998. European Committee for Electrotechnical Standardization. Brussels Belgium.

[3] National Radio Systems Committee: United States RBDS Standard, April 9, 1998 - Specification of the radio broadcast data system (RBDS), Washington D.C.

[4] Si4701-B15 Data Sheet

[5] Si4703-B16 Data Sheet

[6] Application Note "AN230: Si4700/01/02/03 Programming Guide"

[7] Traffic and Traveller Information (TTI)—TTI messages via traffic message coding

(ISO 14819-1) Part 1: Coding protocol for Radio Data System—Traffic Message Channel (RDS-TMC) using ALERT-C

(ISO 14819-2) Part 2: Event and information codes for Radio Data System—Traffic Message Channel (RDS-TMC)

(ISO 14819-3) Part 3: Location referencing for ALERT-C

(ISO 14819-6) Part 6: Encryption and conditional access for the Radio Data System—
        Traffic Message Channel ALERT C coding

[8] Radiotext plus (RTplus) Specification

4. RDS/RBDS Overview

The Radio Data System (RDS*) has been in existence since the 1980s in Europe, and since the early 1990s in North America as the Radio Broadcast Data System (RBDS). In 1998, the US and Europe spurred RDS adoption rates by largely unifying the existing RDS and RBDS standards.

Since the 1998 unifying amendments, RDS has gained substantial market adoption in the US, Europe, and other countries worldwide. It is standard in vehicles and radio equipment from many leading manufacturers. The cost to enable a broadcast station with RDS can be less than $500, and many North and South American, European, and Asian radio stations broadcast with some RDS capability. And with extremely small, power-efficient RDS solutions such as the Si4701/03, RDS is making in-roads in many millions of portable devices such as handsets, portable radios, and portable music/media players.

RDS is an auxiliary signal to the FM broadcast system. As it is auxiliary, the modulated signal must not degrade the primary audio signal, and so RDS is typically only decipherable on strong broadcasts. Figure 1 depicts the FM broadcast components. At the far left of the graphic the mono signal is broadcast with the greatest strength or deviation in kHz along the y-axis. This means that a signal will first be received and output in mono until the FM signal is clear enough for the FM receiver to demodulate the stereo signals. RDS is broadcast with the least

deviation, limited to 7.5 kHz in the standard, but typically broadcast at about 2 kHz; therefore, RDS is generally difficult for the receiver to decode unless a signal is fairly strong. In urban environments with many large broadcasting stations, an FM tuner with modest performance can typically receive many signals which exceed the requirements for decoding RDS.

*Note: RDS/RBDS will be noted as only RDS throughout this paper since the two standards are largely unified.
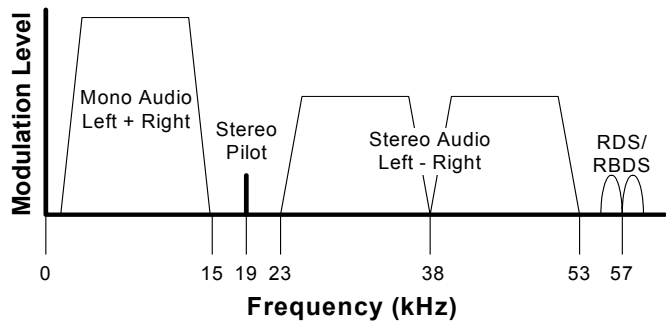

Figure 1. MPX Signal Spectrum

RDS in Europe and RBDS in North America are identical at the physical layer, and nearly identical at the data-link and presentation layers, with exceptions highlighted in Section 7. Differences between the data-link layers are managed internally by the device. Key differences at the presentation layer are discussed later in this document. The remainder of this document refers to RDS and RBDS simply as RDS where a distinction is not required.

RDS is transmitted in a continuous stream of four data blocks each containing 26 bits of content and error-correction information. Each set of four blocks constitutes a group. There are required repetition rates in the standard to which all RDS-certified transmitting devices must adhere (shown in Table 2), but aside from this, all information related to presenting the content of an RDS group is contained within the four blocks of data.
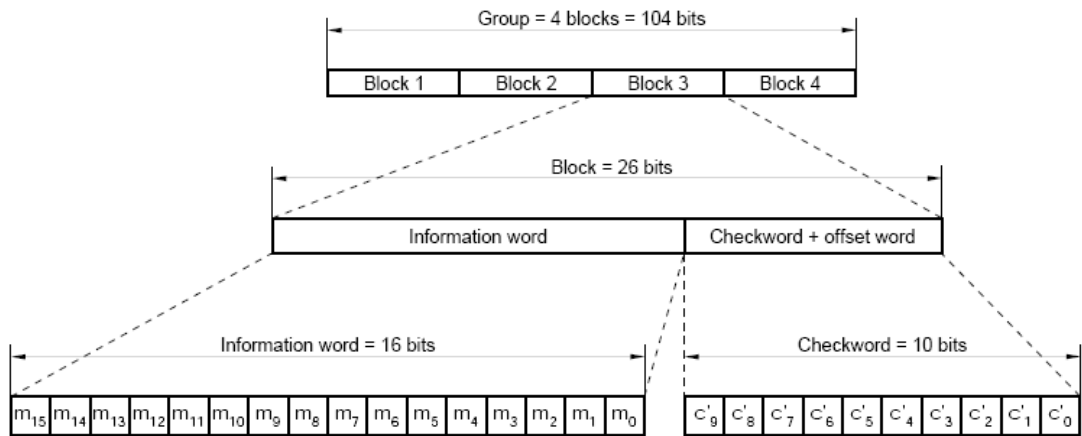

Figure 2. Structure of the Baseband Coding

The blocks each contain 26 bits; 16 bits in the information word, and 10 bits in the checkword and offset word. The checkword and offset word contain error correction, synchronization, and block identification information. The information word contains the coded content of the data blocks including RDS group types and associated content, and represents 64 total bits per group of four data blocks (16 x 4 = 64).

There are 32 possible group types ranging from basic tuning information and emergency warnings, to "Open Data Applications (ODA)" which can support many content types. In most of the North American and European markets, only a few RDS groups are used by the broadcasters conveying station identifiers, alternative frequencies between broadcast coverage areas, traffic alerts and locations, and relevant information to the broadcast content. Other markets are currently using similar group patterns.

The information coded into each RDS group has a common fixed structure according to the RDS group type. The structure dictates a standard repetitive data format and repetition rate to maximize reliability in all environments, while allowing for content flexibility. The structure for all RDS group types is shown in Figure 3.

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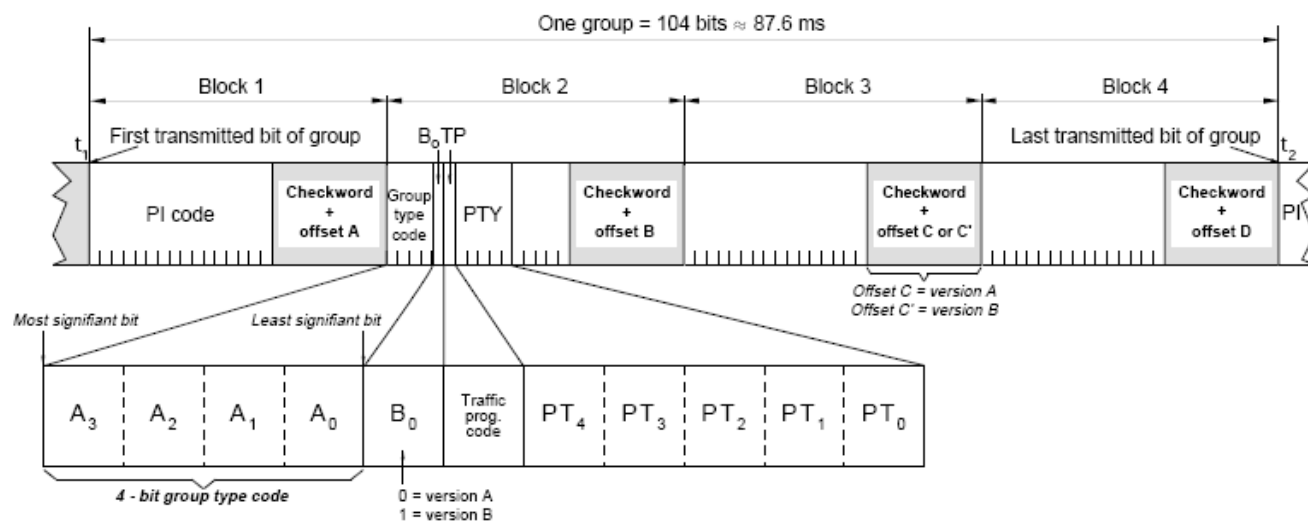
Figure 3. Message Format and Addressing

Figure Notes:

1. PI code = Program Identification code = 16 bits (see Section 3.2.1.1 and annex D of the RBDS Standard)
2. Checkword + offset "N" = 10 bits added to provide error protection and block and group synchronization information (see Sections 2.3 and 2.4 and annexes A, B and C of the RBDS Standard)
3. Group type code = 4 bits A[3:0] (see Section 3.1 of the RBDS Standard)
4. B_o = version code = 1 bit (see Section 3.1 of the RBDS Standard)
5. TP = Traffic Program Identification code = 1 bit (see Section 3.2.1.3 of the RBDS Standard)
6. PTY = Program Type code = 5 bits PT[4:0] (see Section 3.2.1.2 and annex F of the RBDS Standard)
7. $t_1 < t_2$: Block 1 of any particular group is transmitted first and block 4 last

Although the common data format is complex across 32 different group types, it can be defined at a high level as follows:

Block 1: Block 1 of every RDS group contains the 16 bit PI (pronounced "pie") code, or Program Identification code.

For Europe, the PI code contains information related to the country of the broadcasting station, coverage area and program reference. In all cases the PI code for identical programs on different stations will be identical. This information, along with the optional alternate frequency list broadcast in group 0A, can be used for automatically switching between frequencies.

For North America, the PI code is calculated from the station call letters, with five exceptions. Refer to [1] for more information. The exceptions include modifications to the calculated PI code in some cases for RDS/RBDS compatibility, a lookup table rather than calculation for stations with only three call letters, and a lookup table for regionally or nationally linked radio stations with different call letters. Alternate frequency switching is allowed for regionally or nationally linked radio stations when an alternate frequency list is broadcast in group 0A.

Determining the country of origin of the broadcast is possible if the Extended Country Code (ECC) is broadcast in group 1A and a look-up table is included at the presentation level. With this information it is possible to properly configure the tuner for FM band edges, tuning steps, de-emphasis, Program Type Code (PTY) definitions and other country-specific settings.

Block 2: Block 2 contains the RDS Group Type code, Version Code, Traffic Program Code (TP), Program Type Code (PTY), and five (5) unassigned message bits shown to the right of the PTY code in Figure 3.

Group Type Code - The group type code contains four bits and indicates what RDS Group the data blocks represent. As mentioned previously, there are 32 possible group types ranging from basic tuning information or emergency warnings, to "Open Data Applications." The RDS Groups are

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identified by the numbers 0–15 and modifiers A or B; thus each group has two versions. For example, group 0 has both a 0A and 0B. The result is 32 total possible groups. Table 1 lists all groups and their purpose.

Version Code - The Version Code indicates whether an RDS Group is type A or B.

Traffic Program Code - The Traffic Program Code provides an indicator that the station will at some time broadcast traffic announcements. The Traffic Announcement Code (TA) is broadcast in groups 0A, 0B, 14B, or 15B when a traffic announcement is currently being broadcast.

Five Unassigned Message Bits - These bits are modifiers to the RDS Group Type and carry either content, or additional group designation information.

Block 3/4: The content of Blocks 3 and 4 varies according to the Group Type and Version Code. For example, Program Service (PS), Radio Text (RT), and alternate frequency information is broadcast in these blocks dependent upon RDS group type. Note that all type B blocks repeat the PI code in block 3.

Table 1. Block 2 Group Types

Group Type	Group Type Code/Version					Flagged in Type 1A Groups	Description
	A_3	A_2	A_1	A_0	B_0		
0A	0	0	0	0	0		Basic Tuning and Switching Information only
0B	0	0	0	0	1		Basic Tuning and Switching Information only
1A	0	0	0	1	0		Program Item Number and Slow Labeling Codes only
1B	0	0	0	1	1		Program Item Number
2A	0	0	1	0	0		Radio Text only
2B	0	0	1	0	1		Radio Text only
3A	0	0	1	1	0		Applications Identification for ODA only
3B	0	0	1	1	1		Open Data Applications
4A	0	1	0	0	0		Clock Time and Date only
4B	0	1	0	0	1		Open Data Applications
5A	0	1	0	1	0		Transparent Data Channels (32 channels) or ODA
5B	0	1	0	1	1		Transparent Data Channels (32 channels) or ODA
6A	0	1	1	0	0		In-House Applications or ODA
6B	0	1	1	0	1		In-House Applications or ODA
7A	0	1	1	1	0	Y	Radio Paging or ODA
7B	0	1	1	1	1		Open Data Applications
8A	1	0	0	0	0	Y	Traffic Message Channel or ODA
8B	1	0	0	0	1		Open Data Applications
9A	1	0	0	1	0	Y	Emergency Warning System or ODA
9B	1	0	0	1	1		Open Data Applications
10A	1	0	1	0	0		Program Type Name
10B	1	0	1	0	1		Open Data Applications
11A	1	0	1	1	0		Open Data Applications

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Table 1. Block 2 Group Types (Continued)

Group Type	Group Type Code/Version					Flagged in Type 1A Groups	Description
	A$_3$	A$_2$	A$_1$	A$_0$	B$_0$		
11B	1	0	1	1	1		Open Data Applications
12A	1	1	0	0	0		Open Data Applications
12B	1	1	0	0	1		Open Data Applications
13A	1	1	0	1	0	Y	Enhanced Radio Paging or ODA
13B	1	1	0	1	1		Open Data Applications
14A	1	1	1	0	0		Enhanced Other Networks Information only
14B	1	1	1	0	1		Enhanced Other Networks Information only
15A	1	1	1	1	0		Defined in RBDS only
15B	1	1	1	1	1		Fast Switching Information only

Table 2. Feature Block Type Locations and Repetition Rates

Main Features	Group Types which contain this Information	Appropriate Repetition Rate/ Second
Program Identification (PI) code	all	11.4
Program Type (PTY) code	all	11.4
Traffic Program (TP) identification code	all	11.4
Program Service (PS) name	0A, 0B	1
Alternative frequency (AF) code pairs	0A	4
Traffic announcement (TA) code	0A, 0B, 14B, 15B	4
Decoder identification (DI) code	0A, 0B, 15B	1
Music/speech (M/S) code	0A, 0B, 15B	4
Radiotext (RT) message	2A, 2B	0.2
Enhanced other networks information (EON)	14A	up to 2

5. Alternate Frequency (AF) Considerations

Alternate frequency switching is a feature which allows functionally equipped tuners to switch intelligently between two or more frequencies to receive identical programming on the frequency with the best reception. If a station has alternate frequencies, they will be indicated in block C of type 0A groups. Two different formats exist for indicating alternate frequencies; method A which is limited to 25 alternate frequencies and method B which is more flexible. The format of both groups can be found in section 3.2.1.6 of the RDS/RBDS standards. Because the alternate frequency feature requires that stations be relatively near one another, it is much more common to find this feature in Europe. It is rare to find this feature in use in the US, but it is used in some of the more densely populated areas.

When implementing alternate frequency switching on the Si4701 or Si4703, the channel information indicated by the AF data should be stored until needed. One method of gauging whether or not it is needed is to monitor the signal strength (RSSI) on the current station until it reaches a predefined threshold. When the signal strength drops below this threshold, the host code begins hopping to the channels indicated by AF to check the power level at those frequencies. To do this, the host programs the device to tune to the AF frequency, reads back the RSSI at

that frequency, and then immediately returns to the original frequency. This will result in an audio drop out between 100–120 ms which is only slightly noticeable to the end user. Once a frequency with acceptable signal strength is located, the host then programs the device to tune to that frequency long enough to monitor the PI code. If the PI code matches the original frequency's PI code, then the new frequency is indeed the correct alternate frequency and the tuner can remain at the new frequency. If the PI code does not match, the algorithm can jump to the frequency with the next highest power level and repeat the process. If none of the alternate frequencies have a high enough power level or a matching PI code, the algorithm should limit how often it jumps to the alternate frequencies to minimize the disruption to the end user.

RDS block error rate could be used in conjunction with or in place of RSSI as an indicator of signal quality. AN230SW provides example code which tracks AF frequencies (method A), calculates block error rate, and provides an example function for quickly tuning to a frequency and back again.

6. Traffic Message Channel (TMC) and Open Data Applications (ODA)

RDS is capable of conveying more than just station identification, song name, and the current time. In addition to this basic information, RDS can transmit complex information such as traffic or any other data stream. Group 3A is the key to understanding what information is being transmitted in the non-specific group types.

Group 3A contains an application identification code (AID) in block D. This code indicates the content of the group described by the group type code found in the 5 least significant bits of block B (See ISO 14819-1). AID codes are issued by the RDS forum and the most recent list can be found on their website (http://www.rds.org.uk/).

To use TMC or any ODA, it is necessary to reference the specification for that application. Some applications encrypt the data and require a subscription fee in order to decode the data. Others are free to the public. Some of the more common open data applications and their specifications are listed in Table 3.

Table 3. Open Data Applications (ODA)

| Application	Specifications
ISO 14819-1	Traffic and Traveller Information (TTI)—TTI messages via traffic message coding—Part 1: Coding protocol for Radio Data System—Traffic Message Channel (RDS-TMC) using ALERT-C
ISO 14819-2	Traffic and Traveller Information (TTI)—TTI messages via traffic message coding—Part 2: Event and information codes for Radio Data System—Traffic Message Channel (RDS-TMC)
ISO 14819-3	Traffic and Travel Information (TTI)—TTI messages via traffic message coding—Part 3: Location referencing for ALERT-C
ISO 14819-6	Traffic and Traveller Information (TTI)—TTI messages via traffic message coding—Part 6: Encryption and conditional access for the Radio Data System—Traffic Message Channel ALERT C coding
RDS Forum 2005 R05/036_1	Radiotext plus (RTplus) Specification
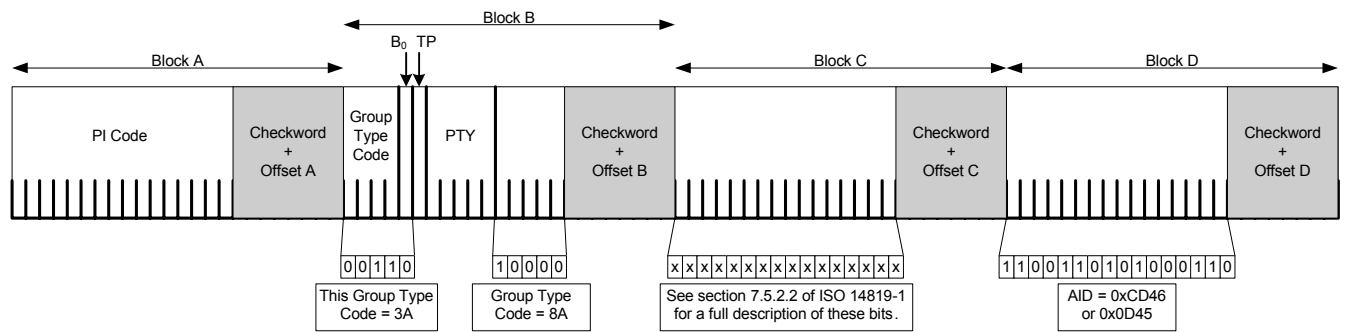
Figure 4. Group 3A Structure for Indication of TMC in Group 8A

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Figure 4 shows a 3A group indicating the presence of TMC in group 8A. When group 3A indicates the presence of TMC, the AID code will be 0xCD46 and the group type code which indicates which group will contain the RDS information will typically be 8A. However, it is permissible by the transmitting station to use any of the available ODA groups.

Block C of a type 3A group varies depending on which ODA application it is describing. When it is describing a TMC application, it takes on multiple meanings. The definition of these bits is first determined by the two most significant bits which are referred to as the variant code. When the variant code is zero, the remaining bits are defined as a location table number (LTN, 6-bits), alternate frequency indicator (AFI, 1 bit), message geographical scope (MGS, 4 bits), and mode of transmission (M, 1 bit). For a full explanation of these bits, please reference ISO 14819-1.

Whether or not the TMC information is encrypted is determined by the LTN bits. If LTN is zero, then the data is encrypted. Otherwise, LTN in combination with the country code, extended country code, and location code indicates which location table to use. The LTN values for each country are described in ISO 14819-3.

When group 8A contains unencrypted TMC information, the RDS blocks are divided into various terms as shown in Figure 5. This particular definition is only true if $T = 0$ and $F = 1$ (single group user message). Otherwise blocks C and D take on different meanings as defined in ISO 14819-1. This diagram is given as an example only. For the authoritative definition, please refer to the TMC specifications.
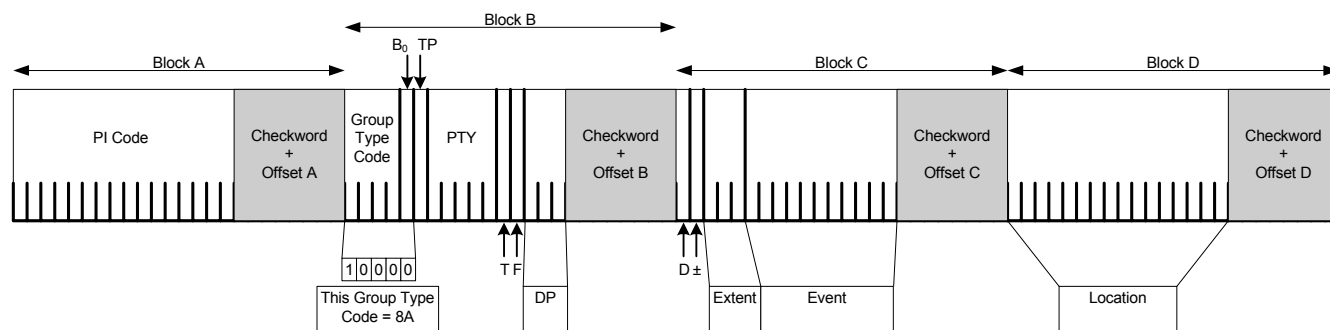

Figure 5. Example structure of TMC group 8A

7. Overview of Differences Between RDS and RBDS

- Program Type definitions (PTY) - Due to differing broadcast styles, the program type code definitions (i.e. Jazz, Rock, etc.) differ between RDS and RBDS. PTY codes and definitions vary between Europe and North America.
- Program Identification coding (PI) - North American PI codes differ in functionality in three ranges. This affects alternate frequency switching and regionalization.
- "Dynamic" Program Service (PS) name - The RBDS Standard allows "nondistracting" changes to the PS, while the RDS Standard strictly forbids dynamic changes to the PS.
- Phase out of Fast Program Service (PS) feature - Group 15A of RBDS was previously defined for use as a Fast PS feature. This usage is being discontinued.
- Mobile Broadcast Service (MBS) / Modified Mobile Broadcast Service (MMBS) - MBS is the predecessor system to RDS in Europe. It is used as a commercial nationwide paging system in the United States. Since it shares the same modulation format as RDS, it may be time multiplexed with RDS.
- ID Logic feature (IDL) / RDS Updates to In Receiver Database (IRDS) - A licensed feature which allows the receiver to identify the call sign and format of non-RDS FM and AM broadcast stations via a built in database. This database may be updated via an Open Data Application (ODA).
- Emergency Alert System (EAS) Open Data Application - An ODA has been developed to carry emergency information compatible with the U.S. Federal Communication Commissions (FCC) EAS protocol. This public ODA also offers increased consumer receiver functionality with emergency messaging.
- AMRDS - The RBDS standard has a reserved section for an AM equivalent to RDS.

Further information and discussion of these differences between RDS and RBDS can be found in the additional documentation [1].

8. Reading RDS Data from the Si4701/03

(Refer to AN230 revision 0.4 and the latest device data sheet in conjunction with the following sections.)

The device implements an RDS/RBDS processor for symbol decoding, block synchronization, error detection, and error correction. RDS functionality is enabled by setting the RDS bit and selecting the appropriate RDS mode (RDSM): standard or verbose. When set to standard mode, RDSM = 0, the device will only set the RDS ready (RDSR) bit if all 4 blocks had few enough errors to be correctable (at most 5 errors). Also, the synchronization indicator and block error indicators (RDSS, BLERA, BLERB, BLERC, and BLERD registers) will always return 0. When set to verbose mode, RDSM = 1, the device will provide synchronization status (RDSS) and set the RDS ready (RDSR) bit even if some blocks were not correctable. In this mode it is possible to determine how many errors were corrected in each block by examining the respective BLER register. This mode is slightly more complicated to deal with in the host software and can result in more interrupts, but the benefit is that data can be obtained from blocks even when not all 4 blocks were correctable. This can result in faster RDS data decode times.

When the device has RDS data available it will set the RDS Ready (RDSR) bit for a minimum of 40 ms. If the RDS Interrupt Enable bit is set and GPIO2 is configured for interrupts (GPIO2[1:0] = 01b), the device will also drive GPIO2 to logic 0 for at least 5 ms. The RDS data is available in the RDSA, RDSB, RDSC, and RDSD registers.

RDS is considered synchronized if 2 error free blocks are received in a row. Synchronization is lost only if 20 consecutive blocks have uncorrectable errors. No interrupt will be issued if RDS is not synchronized.

9. Decoder Errors and Failures

RDS error correcting codes function by appending a modestly sophisticated set of parity check bits to a block of information bits. The combination of information bits and parity bits produce codewords with redundancy. This means that only a small subset of bit patterns correspond to valid codewords. The non-valid patterns can thus be detected as possessing errors.

We can "correct" some errors in received words using a probabilistic argument. If the probability of an individual bit being in error is less than ½ (i.e., each bit is more likely to be correct than in error), then the codeword that differs from the received word in the fewest number of bits is most likely the transmitted word. Hence, we can correct the errors by mapping the received word to the closest codeword. Note, however, that this will not always produce the correct result, since it is possible (just less probable) that a different error sequence is present. The decoder makes the best estimate, which means that occasionally the wrong codeword will be chosen. This is called a decoder error.

In practice, the mapping of received words to codewords is not performed in the ideal manner described above. This is because the map is not always easy to implement. For example, the code used in RDS blocks consists of 26 bit codewords. An ideal decoder could use a table lookup to do an optimum decoding. This would require a table of 2^{26} = 67,108,864 entries, which is impractical for embedded products. Instead, clever (but suboptimal) schemes are used to create parity check patterns that can be used to find the common classes of error patterns. This is what is done in RDS systems. The scheme used permits the efficient implementation of a decoder that can find and correct any pattern of up to 5 contiguous error bits that occur in the information block of a received word.

If the error pattern does not conform to this restriction, one of two possible events occurs. One possibility is a decoder error as mentioned above. The second is that the decoder cannot find a codeword that differs from the received word by a variant of the error pattern just described. This is called a decoder failure.

Note that either of these conditions can occur with reasonable probability because of the structure of this error correcting code. In particular, any error (even a single bit) that occurs in the parity check bits of a received word will result in a non-correctable output. (By this we mean that this results in either decoder failure or decoder error with probability 1.) This is part of the tradeoff between error correction robustness and ease of implementation that is inherent in the RDS error correcting function. For this reason, post processing of RDS data is desirable.

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10. Presentation Layer and Post Processing of RDS Data

The Si470x presents the raw block data to the host processor. It is up to the host processor to transform that data into something presentable to the end user. Group types can be transmitted in any order, so it is necessary for the host software to track the data appropriately.

The PI field in block A and the PTY and TP fields within block B can be processed with every valid group. The group type, which can be used to selectively process specific groups, such as 0A and 2A shown in this example, is also available in block B.

Table 4 shows an example RDS broadcast. Each row in the table is a complete group consisting of blocks B, C, and D. Block A is not shown because of the simplicity and redundancy of decoding. All blocks are decoded into end data with the exception of the encrypted TMC. The table demonstrates the decoding of an entire radio text message ('Casting Crowns - Lifesong -102.3 The River - \r'), the program service identifier ('River'), the date/time group, and the ODA identifier group (3A).

Group 0A returns the PS and TP fields. The same PS message typically repeats three to four times and in some cases it may be advantageous to compare multiple PS messages and update the display only when multiple messages are equivalent. This is desirable for several reasons. First, RBDS broadcasts are permitted to dynamically update the PS message but there is no provision for indicating a message change (such as is the case with the A/B flag for radio text). Second, during poor reception conditions it could be possible to drop four or more groups due to blocks errors, at which point a dynamic PS message may overlap with the previous message without any indication. And finally, decoder errors or failures could result in the incorrect display of data.

Group 2A returns the RT field. In some cases it may be desirable to compare multiple RT messages and update the display only when the messages are equivalent. During poor reception conditions decoder errors or failures could result in the incorrect display of data.

Group 3A indicates which application is being presented in the ODA groups. In this example, it is indicating that group 8A contains encrypted TMC information.

Group 4A indicates the current data and time. It is not possible to wait for duplicate messages of this type, so it is best to only accept the data in this group type if blocks B, C, and D indicate 0 errors have been corrected. Otherwise, the date or time could get set or displayed incorrectly.

Refer to AN230SW, available at www.mysilabs.com, for example code.

Table 4. RDS Broadcast Example

RDSB	RDSC	RDSD	Group Description	Other Data Contained in Group*	Cumulative Text*
0x8268	0x0191	0x55A8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'Ri '
0x2262	0x4372	0x6F77	(2A) RadioText only	RT1 = u'Crow' @ index:8	RT = u' Crow '
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'Rive '
0x8268	0x6191	0x4230	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r ' @ index:4	PS = u'River '
0x2263	0x6E73	0x202D	(2A) RadioText only	RT1 = u'ns - ' @ index:12	RT = u' Crowns - '
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8268	0x6191	0x4230	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x3270	0x0003	0xCD46	(3A) Applications Identification for ODA only	AID = 0xCD46 (RDS-TMC: ALERT-C (service use only))	ODA Group = 8A
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2264	0x204C	0x6966	(2A) RadioText only	RT1 = u' Lif' @ index:16	RT = u' Crowns - Lif '
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8268	0x6191	0x4230	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r' @ index:4	PS = u'River '
0x2265	0x6573	0x6F6E	(2A) RadioText only	RT1 = u'eson' @ index:20	RT = u' Crowns - Lifeson '
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8268	0x4191	0x55A8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2266	0x6720	0x2D20	(2A) RadioText only	RT1 = u'g - ' @ index:24	RT = u' Crowns - Lifesong - '
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8268	0x4191	0x55A8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r' @ index:4	PS = u'River '

*Note: The 'u' in front of the text indicates unicode.

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Table 4. RDS Broadcast Example (Continued)

RDSB	RDSC	RDSD	Group Description	Other Data Contained in Group*	Cumulative Text*
0x2267	0x3130	0x322E	(2A) RadioText only	RT1 = u'102.' @ index:28	RT = u' Crowns - Lifesong - 102.
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8268	0x4191	0x55A8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2268	0x3320	0x5468	(2A) RadioText only	RT1 = u'3 Th' @ index:32	RT = u' Crowns - Lifesong - 102.3 Th
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8268	0x5191	0x4F6C	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r ' @ index:4	PS = u'River '
0x2269	0x6520	0x5269	(2A) RadioText only	RT1 = u'e Ri' @ index:36	RT = u' Crowns - Lifesong - 102.3 The Ri
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8268	0x5191	0x4F6C	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x3270	0x40C0	0xCD46	(3A) Applications Identification for ODA only	AID = 0xCD46 (RDS-TMC: ALERT-C (service use only))	ODA Group = 8A
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x226A	0x7665	0x7220	(2A) RadioText only	RT1 = u'ver ' @ index:40	RT = u' Crowns - Lifesong - 102.3 The River
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8268	0x5191	0x4F6C	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r ' @ index:4	PS = u'River '
0x226B	0x2D20	0x0D20	(2A) RadioText only	RT1 = u'- \r' @ index:44	RT = u' Crowns - Lifesong - 102.3 The River - \r
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8268	0x2191	0x4220	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2270	0x4361	0x7374	(2A) RadioText only	RT1 = u'Cast' @ index:0	RT = u'Cast Crowns - Lifesong - 102.3 The River - \r

*Note: The 'u' in front of the text indicates unicode.

Table 4. RDS Broadcast Example (Continued)

RDSB	RDSC	RDSD	Group Description	Other Data Contained in Group*	Cumulative Text*
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8268	0x2191	0x4220	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r ' @ index:4	PS = u'River '
0x2271	0x696E	0x6720	(2A) RadioText only	RT1 = u'ing ' @ index:4	RT = u'Casting Crowns - Lifesong - 102.3 The River - \r
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8268	0x2191	0x4220	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2272	0x4372	0x6F77	(2A) RadioText only	RT1 = u'Crow' @ index:8	RT = u'Casting Crowns - Lifesong - 102.3 The River - \r
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8265	0xB191	0x41C8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r ' @ index:4	PS = u'River '
0x2273	0x6E73	0x202D	(2A) RadioText only	RT1 = u'ns - ' @ index:12	RT = u'Casting Crowns - Lifesong - 102.3 The River - \r
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8265	0xB191	0x41C8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x3270	0x0003	0xCD46	(3A) Applications Identification for ODA only	AID = 0xCD46 (RDS-TMC: ALERT-C (service use only))	ODA Group = 8A
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2274	0x204C	0x6966	(2A) RadioText only	RT1 = u' Lif' @ index:16	RT = u'Casting Crowns - Lifesong - 102.3 The River - \r
0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '
0x8265	0xB191	0x41C8	(8A) Traffic Message Channel or ODA	Encrypted TMC information	
0x026A	0xE0CD	0x7220	(0A) Basic tuning and switching information only	PS = u'r ' @ index:4	PS = u'River '
0x2275	0x6573	0x6F6E	(2A) RadioText only	RT1 = u'eson' @ index:20	RT = u'Casting Crowns - Lifesong - 102.3 The River - \r
0x026B	0xE0CD	0x2020	(0A) Basic tuning and switching information only	PS = u' ' @ index:6	PS = u'River '
0x8265	0x41C0	0x0000	(8A) Traffic Message Channel or ODA	Encrypted TMC information	

*Note: The 'u' in front of the text indicates unicode.

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Table 4. RDS Broadcast Example (Continued)

RDSB	RDSC	RDSD	Group Description	Other Data Contained in Group*	Cumulative Text*
0x427D	0xA6C9	0x46AC	(4A) Clock-time and date only	Time = 2007-01-16 14:26:00-06:00	
0x0268	0xE0CD	0x5269	(0A) Basic tuning and switching information only	PS = u'Ri' @ index:0	PS = u'River '
0x2276	0x6720	0x2D20	(2A) RadioText only	RT1 = u'g - ' @ index:24	RT = u'Casting Crowns - Lifesong - 102.3 The River - \r '
	0x0269	0xE0CD	0x7665	(0A) Basic tuning and switching information only	PS = u've' @ index:2	PS = u'River '

***Note:** The 'u' in front of the text indicates unicode.

DOCUMENT CHANGE LIST

Revision 0.11 to Revision 0.2

- Added description of AF.
- Added description of TMC.
- Modified for RDS verbose mode.
- Supports firmware revision 16 and greater.
- Added unicode explanation in footer of Table 4.

NOTES:

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