Interface Specification

AMRUSB-1 Utility Meter Data Receiver

Firmware Version 0.0.2 (Beta)

13 July 2011

Revision History

Version	Date	Author	Change Reference
1.0	15 Dec 2010	Gregory Hancock	Initial Draft
1.1	20 Dec 2010	Gregory Hancock	Added $UMSCN, $UMRSS
1.2	13 March 2011	Gregory Hancock	Renamed document; significant changes for v.0.0.2 Beta firmware.
1.3	13 July 2011	Gregory Hancock	Updates to Theory of Operation section and legal clean-up.

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1 Interface Overview

The AMRUSB-1 Utility Meter Data Receiver operates as a full-duplex serial device over USB. Interaction with it is similar to working with a serial data modem, except the AMRUSB-1 employs a slightly different command language from the "AT" commands used by a typical modem. Moreover, the receiver can accept commands at any time; it DOES NOT need to be switched into a separate command mode with the "+++" command as is necessary with a telecommunications modem.

Because the AMRUSB-1 operates as a virtual serial device over USB by implementing the USB Communications Device Class (CDC) standard, it does not have a fixed baud rate like a standard RS-232 device. For that reason, it will work with serial terminal software configured for any baud rate. However, for best results, we recommend a speed of at least 9600 baud be used. For all other intents and purposes, the AMRUSB-1 operates like an RS-232 device.

To send a command to the AMRUSB-1, simply transmit the command on the serial interface followed by a carriage return and linefeed (or simply a linefeed). If a parameter is required, append it to the command, separated from the command by a space character. Multiple parameters should be delimited by the space character. For example, here is a typical command/response exchange (with control characters shown for clarity):

Sent:

```
VRSN<CR><LF>
```

Received:

```
$UMVER,GRIDINSIGHT_AMRUSB-1,0.0.2,BETA_FIRMWARE*1C<CR><LF>
```

Every valid AMR data packet received by the AMRUSB-1 is output on the serial interface in the form of a one-line data sentence. This sentence can take a number of forms, depending on the mode the receiver is operating in and the type of data received. Details appear later in this document. Here is an example indicating reception of an instantaneous reading of 8738.06 kWh for an ERT Type 07 electricity meter with ERT serial number 18113426:

```
$UMSCM,18113426,7,873806*5C
```

Every sentence conforms to the NMEA 0183 sentence format, as described here:

```
NMEA 0183 Application Layer Protocol Rules
------------------------------------------

Copied from Wikipedia page "NMEA 0183" (http://en.wikipedia.org/wiki/NMEA_0183) on 2011-03-13.

    * Each message's starting character is a dollar sign.
```

```
    * The next five characters identify the talker (two characters) and the type of
message (three characters).
    * All data fields that follow are comma-delimited.
    * Where data is unavailable, the corresponding field contains NUL bytes (e.g., in
"123,,456", the second field's data is unavailable).
    * The first character that immediately follows the last data field character is an
asterisk, but it is only included if a checksum is supplied.
    * The asterisk is immediately followed by a two-digit checksum representing a
hexadecimal number. The checksum is the exclusive OR of all characters between the $ and
*. According to the official specification, the checksum is optional for most data
sentences, but is compulsory for RMA, RMB, and RMC (among others).
    * <CR><LF> ends the message.

As an example, a waypoint arrival alarm has the form:


    $GPAAM,A,A,0.10,N,WPTNME*32

where:
GP  Talker ID (GP for a GPS unit, GL for a GLONASS)
AAM     Arrival alarm
A   Arrival circle entered
A   Perpendicular passed
0.10    Circle radius
N   Nautical miles
WPTNME  Waypoint name
*32     Checksum data
```

In addition to the data sentences representing received data, every command also triggers the receiver to output a data sentence. Command response sentences are therefore interspersed with receiver data sentences in the serial data stream. Each sentence type, whether command response or received data, can be distinguished from by the five-digit sentence type prefix.

2 Theory of Operation

The AMRUSB-1 was designed to be a general purpose utility meter data receiver capable of receiving and decoding digital utility metering signals from a variety of transmitters. In the present version, the AMRUSB-1 works with transmitters that employ the over-the-air radio protocol and packet syntax pioneered by Itron's ERT products and continued in Itron's ChoiceConnect products. Some products by Schlumberger and at least one by Hunt Technologies also use this protocol. We will refer to these transmitters collectively as "ERT-compatible transmitters".

The AMRUSB-1 receiver hides the detail of the underlying proprietary radio protocol, allowing end-user applications to simply connect to the receiver and utilize the received and decoded meter readings. For the purposes of understanding receiver performance, however, we must cover a few basic elements of the radio technology and data protocol used by ERT-compatible transmitters.

The protocol, apparently developed by Itron, Inc., is proprietary, so public documentation is not readily available (though it may provide useful background to review the now-expired U.S. Patent 4,799,059). The protocol is not encrypted and is transmitted over unlicensed airwaves in the 900 MHz industrial, scientific, and medical (ISM) band[1].

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[1] The 900 MHz ISM band ranges from 902.0 MHz to 928.0 MHz in the United States. Numerous consumer devices also use this band, including baby monitors, some cordless phones, some pre-802.11 wireless computer networking protocols, and some walkie-talkies. Amateur radio operators are also licensed to transmit in this range, also known as the 33-centimeter band.

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ERT-compatible transmitters employ a type of frequency-hopping spread spectrum transmission technique. This helps it avoid interference and, for some Type 15.247-compliant transmitters, meets FCC requirements for utilizing a higher transmit power than would otherwise be allowed.

Because ERT-compatible transmitters have come in a variety of types since they first came to market around 1990, the AMRUSB-1, a general-purpose receiver, is not preconfigured to receive signals from any specific transmitter model. (Note that ERT-compatible transmitters always include an "ERT type" field in their transmissions; the ERT type varies between electricity, water, and gas, among other things.) An ERT-compatible transmitter may transmit from 916 to 918 MHz, or from 911 to 915 MHz, or from 916.5 to 917.2 MHz (or some other range), utilizing a random non-channelized frequency-hopping pattern. Some transmitters occasionally change their hopping range seemingly arbitrarily.

Other compatible transmitter models transmit in adjacent, discrete channels utilizing 10 MHz or so of the 26 MHz available within the ISM band. Discrete channelization is required by FCC Part 15.247. Still other models use several chunks of non-adjacent channels.

The AMRUSB-1 handles all this variation by using an adaptive frequency hopping algorithm that tracks and zeroes in on the target signals. At power-up, it looks for signals in the area of the band most likely to contain them, from 910 to 922 MHz. Because it is aggressively scanning a wide frequency range at start-up, the receiver may not report any received data sentences right away. Be patient, because after a few minutes, once the receiver finds signals of interest, it immediately optimizes its own frequency hopping pattern to receive as many valid data packets as possible. It continues to optimize and adapt to changing band conditions as long as it is operating.

Obviously, the receiver does not receive all the data packets transmitted by all meters on all frequencies all the time; a receiver capable of doing this would be significantly larger, more complicated, and several times more expensive. In other words, it would be overkill. But the AMRUSB-1 does receive data frequently enough to be useful – in most stationary applications, just as useful as a much more complex receiver.

How frequently signals from any given meter will be received depends on a number of factors, but anywhere from every three seconds to every five minutes is possible. Distant meters, those more than about 500 feet away, or those blocked by large, grounded metal objects may be received only a few times a day. Antenna choice and positioning also plays a role. Fortunately, the 900 MHz band benefits from "excellent building penetration characteristics" and a "very low noise floor"[2]. That said, only testing with the specific target meter(s) in the specific end-use setting will provide a definitive answer to what is the range and regularity of reception.

In some situations, you may improve reception by adjusting some of the AMRUSB-1's adaptive tuning parameters. The AMRUSB-1 comes with sensible defaults, but tuning range and channel size may be adjusted (see RANG and STEP commands), adaptive tuning may be turned off entirely to allow application-controlled tuning (see AUTO command), the time spent scanning vs. listening on optimized channels may be adjusted (see WGHT command), and specific meters or types of meters may be targeted (see TRGT command). In most deployment environments, none of these commands will be necessary. But they are provided anyway, and may prove useful in lab environments, when working at the limits of the AMRUSB-1's receive range, or when working in an environment consisting of a mix of ERT types, each of which might use a different hopping pattern or portion of the ISM band.

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[2] From Wikipedia article, "33-centimeter band", retrieved on 2011-03-13 from http://en.wikipedia.org/wiki/33-centimeter_band.

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3 Command Summary

The AMRUSB-1 understands the following commands:

Table 1

Command	Parameter	Description	Response
AUTO	"ON" or "OFF"	Toggle adaptive frequency-hopping spread spectrum tuning. Default "ON".	UMMSG
FULL	"ON" or "OFF"	Activate full output format, which includes receive channel and signal strength for each received data packet. Default "OFF".	UMMSG "OK"
MYID	-none-	Report the unique, factory-assigned receiver serial number.	UMSER
PBKT	-none-	Provide a report of spread-spectrum reception statistics.	UMBKT
RANG	Lower frequency, upper frequency	Specify the frequency range to be used for scanning. Default is 9100 to 9218 (910.0 to 921.8 MHz).	UMMSG "OK"
RBKT	-none-	Reset spread-spectrum reception statistics counters.	UMMSG "OK"
RDAT	Address (0 to 255)	Read byte from flash RAM.	UMDAT
RSET	-none-	Reset receiver to start-up defaults.	UMMSG "OK"
RSSI	-none-	Trigger a signal strength reading at the current carrier frequency.	UMRSS
SSCN	-none-	Provide a snapshot spectrum analysis of the entire frequency band.	UMSCN
STEP	Step size (1 to 10)	Set the frequency step size used by automatic tuning. Default "2" (200 kHz).	UMMSG "OK"
TRGT	ERT serial number (0 to 99999999), ERT message type (0 to 255)	Focus reception on a specific target meter and/or message type. Default "0" and "0" (not set).	UMMSG "OK"
TUNE	Frequency (9020 to 9280)	Tune receiver to a specific carrier frequency, specified in 100 kHz units, e.g. "tune 9120" to tune to 912,000,000 Hz (912.0 MHz).	UMMSG "OK"
VRSN	-none-	Report the firmware version number.	UMVER
WDAT	Address (4 to 255), Data byte (0 to 255)	Write byte to flash RAM. Locations 0 to 3 are read-only and will return an error if written to.	UMMSG "OK"
WGHT	0 to 9	Adjust time spent in optimized hopping mode vs. scanning mode. Higher means more time scanning full band. Default "5".	UMMSG "OK"

NOTE: Any command may produce a UMMSG message with payload "ERROR" if the input parameter is invalid.

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4 Received Data Sentence Format

Every received data sentence represents one data packet received over the air. Before the receiver outputs the sentence, it validates the data packet against its internal checksum to ensure the data is complete and has not been corrupted during transmission.

The receiver then decodes the data packet and assembles the data elements into a sentence following NMEA 0183 syntax before writing it out on the serial interface.

Because the AMRUSB-1 receives two general message types, the Standard Consumption Message (SCM) and the Interval Data Message (IDM), it has two basic received data sentence types: UMSCM and UMIDM, respectively. These basic sentence types have corresponding full sentence types, UMSCP and UMIDP, which are used when the receiver is in FULL mode. These full sentence types contain all the data of the basic sentence, but also contain received signal strength and carrier frequency information that may be helpful during troubleshooting.

Common Elements

All carrier frequencies are represented in 100 kHz units (i.e. 9180 = 918,000 kHz = 918.0 MHz).

Received signal strength indication (RSSI) appears in several sentence types. This value represents the digitized logarithmic amplifier output at the receiver's IF stage. The digital to analog converter that measures this value uses the ~5V USB power supply as a voltage reference, so the resulting RSSI number may fluctuate slightly from system to system depending on the given system's actual USB supply voltage. Under typical conditions, RSSI values range from about 90 (at the noise floor) to 240. These figures, however, are approximate. RSSI values are accurate in a relative sense, though, and can be used to determine if a signal from a given target transmitter is coming in better than the signal from another transmitter, or if a certain channel is plagued by interference.

UMSCM Received Data Sentence

As output on the receiver's serial interface, a standard consumption message data sentence appears like this:

```
$UMSCM,18113426,7,873806*5C
```

The fields break down as follows:

Column Number	Example Value	Column Name	Field Format	Description
1	UMSCM	Sentence type	UMSCM	Sentence type indicating ERT SCM data packet was received.
2	18113426	Serial	Numeric (0 to 99999999)	Unique ERT serial number identifying originating utility meter transmitter.
3	7	ERT type	Numeric (1 to 255)	ERT message type indicating type of utility consumption data (electricity, gas, or water) and units measured.

Column Number	Example Value	Column Name	Field Format	Description
4	873806	Consumption register	Numeric (1 to 16777215)	Instantaneous ERT consumption register reading as of the time of transmission. Represents watt-hours, cubic feet, or other appropriate consumption unit for the utility measured.

UMSCP Received Data Sentence

As output on the receiver's serial interface, a UMSCP sentence appears like this:

```
$UMSCP,18113426,7,873806,9210,170*6A
```

The payload of the UMSCP sentence is a superset of the UMSCM sentence. It adds receive frequency and signal strength indicators in the fifth and sixth fields.

Column Number	Example Value	Column Name	Field Format	Description
1	UMSCP	Sentence type	UMSCP	Sentence type indicating ERT SCM data packet was received and receiver is in FULL mode.
2	18113426	Serial	Numeric (0 to 99999999)	Unique ERT serial number identifying originating utility meter transmitter.
3	7	ERT type	Numeric (1 to 255)	ERT message type indicating type of utility consumption data (electricity, gas, or water) and units measured.
4	873806	Consumption register	Numeric (1 to 16777215)	Instantaneous ERT consumption register reading as of the time of transmission. Represents watt-hours, cubic feet, or other appropriate consumption unit for the utility measured.
5	9210	Frequency	Numeric (9020 to 9280)	Carrier frequency on which the data was received.
6	170	RSSI	Numeric (0 to 1023)	Logarithmic-scale received signal strength indication.

UMIDM Received Data Sentence

As output on the receiver's serial interface, an interval data message (IDM) appears as a UMIDM sentence like so:

```
$UMIDM,46453762,23,2,6084558,92,58,3,5,5,5,5,5,18,26,25,6,5,6,4,4,4,6,7,8,9,14,8,3,3,2,3,
2,1,1,3,2,3,3,2,3,2,3,3,4,3,3,2,3,2,3,3,2,4*40
```

Unlike an SCM data sentence which only reports a single, instantaneous meter reading, an interval data message contains exactly what you would expect: historical consumption data broken out into a number of fixed time intervals (47 to be exact). The IDM does not, however, contain an instantaneous reading; every interval begins and ends at some time which can be determined using the current system time minus a time offset included in the sentence.

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Column Number	Example Value	Column Name	Field Format	Description
1	UMIDM	Sentence type	UMIDM	IDM packet
2	46453762	Serial	Numeric (0 to 99999999)	Meter's unique identifier
3	23	ERT type	Numeric (1 to 255)	Identifies the type of meter (electricity, water, gas, etc.).
4	2	Version	Numeric (1 to 255)	Identifies the version of the meter's transmitter module. Different version may have subtle differences in data semantics. For example, version two uses a five minute interval duration, while version three uses a ten minute duration.
5	6084558	Reading	Numeric (0 to 4294967295)	The cumulative amount of the metered quantity that has been consumed since the meter was installed. Units will vary based on meter type and version. For electricity, 10Wh and kWh are the common units. Updates at the end of each interval.
6	92	Offset	Numeric (0 to 65535)	Time elapsed since the last interval ended.
7	58	Interval Counter	Numeric (0 to 255)	Incrementing interval counter. Increments at the end of each interval. Rolls over to 0 after 255.
8 - 55	3,5,5,5,5,5,18,26,25,6,5,6,4,4,4,6,7,8,9,14,8,3,3,2,3,2,1,1,3,2,3,3,2,3,2,3,3,4,3,3,2,3,2,3,3,2,4	Interval data (47 fields)	Numeric (0 to 511)	Amount of the metered quantity that was consumed during each of the 47 prior intervals. Units will vary based on meter type and version. For electricity, 10W is the common unit. The left-most interval is the most recent.

UMIDP Received Data Sentence

As output on the receiver's serial interface, an interval data message (IDM) appears as a UMIDP sentence like so:

```
$UMIDP,46453762,23,2,6084558,92,58,3,5,5,5,5,5,18,26,25,6,5,6,4,4,4,6,7,8,9,14,8,3,3,2,3,
2,1,1,3,2,3,3,2,3,2,3,3,4,3,3,2,3,2,3,3,2,4,9210,170*61
```

The payload of the UMIDP sentence is a superset of the UMIDM sentence. It adds receive frequency and signal strength indicators in the 56th and 57th fields.

Column Number	Example Value	Column Name	Field Format	Description

Column Number	Example Value	Column Name	Field Format	Description
1	UMIDP	Sentence type	UMIDP	IDM packet Plus
2	46453762	Serial	Numeric (0 to 99999999)	Meter's unique identifier
3	23	ERT type	Numeric (1 to 255)	Identifies the type of meter (electricity, water, gas, etc.).
4	2	Version	Numeric (1 to 255)	Identifies the version of the meter's transmitter module. Different version may have subtle differences in data semantics. For example, version two uses a five minute interval duration, while version three uses a ten minute duration.
5	6084558	Reading	Numeric (0 to 4294967295)	The cumulative amount of the metered quantity that has been consumed since the meter was installed. Units will vary based on meter type and version. For electricity, 10Wh and kWh are the common units. Updates at the end of each interval.
6	92	Offset	Numeric (0 to 65535)	Time elapsed since the last interval ended.
7	58	Interval Counter	Numeric (0 to 255)	Incrementing interval counter. Increments at the end of each interval. Rolls over to 0 after 255.
8 - 55	3,5,5,5,5,5,18,26,25,6,5,6,4,4,4,6,7,8,9,14,8,3,3,2,3,2,1,1,3,2,3,3,2,3,2,3,3,4,3,3,2,3,2,3,3,2,4	Interval data (47 fields)	Numeric (0 to 511)	Amount of the metered quantity that was consumed during each of the 47 prior intervals. Units will vary based on meter type and version. For electricity, 10W is the common unit. The left-most interval is the most recent.
56	9210	Frequency	Numeric (9020 to 9280)	Carrier frequency on which the data was received.
57	170	RSSI	Numeric (0 to 1023)	Logarithmic-scale received signal strength indication.

5 Command Response Sentence Format

Every command sent to the receiver generates a response sentence. Table 1 shows which commands generate which responses.

UMMSG Command Response Sentence

The UMMSG sentence reports the success or failure or a command. Success is always indicated with a payload of "OK". Errors are usually indicated by a payload of "ERROR", but a more detailed error message may be provided instead.

As output on the receiver's serial interface, this data would appear like this:

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```
$UMMSG,OK*69

$UMMSG,ERROR*35
```

The fields break down like so:

Column Number	Example Value	Column Name	Field Format	Description
1	UMMSG	Sentence type	UMMSG	This sentence represents a simple, textual command result message.
2	OK	Result	Alphanumeric (no spaces or commas)	Success is always indicated by "OK". Failure can be indicated by "ERROR" or a more detailed message.

UMRSS Command Response Sentence

The UMRSS sentence reports a snapshot of the signal strength detected on a specific carrier frequency. Common use of this value would be to determine the noise floor on a specific carrier frequency. In manual tuning mode, this sentence can also be used to determine the carrier frequency to which the receiver is tuned.

As output on the receiver's serial interface, this data would appear like this:

```
$UMRSS,9134,105*71
```

The fields break down like so:

Column Number	Example Value	Column Name	Field Format	Description
1	UMRSS	Sentence type	UMRSS	This sentence represents instantaneous RSSI data taken on a single channel.
2	9134	Frequency	Numeric (9020 to 9280)	Carrier frequency to which the receiver was tuned at the instant this message was generated.
3	105	RSSI	Numeric (0 to 1023)	Logarithmic-scale received signal strength indication.

UMSCN Command Response Sentence

The UMSCN sentence reports a snapshot of the background radio signal strength detected across the center section of the 900 MHz frequency band. This is useful for diagnostic purposes or for displaying a spectrogram to an end user.

The sentence contains a single field consisting of individual RSSI readings. Each reading is taken at a different carrier frequency.

In this version of firmware, there are 60 readings. This may change in future versions. The first reading is taken at 910.0 MHz and the last at 921.8 MHz. Intermediate readings are spaced 200 kHz apart.

As output on the receiver's serial interface, this data would appear like this:

```
$UMSCN,104:102:102:101:98:101:99:100:100:100:100:98:101:99:99:102:100:100:110:111:102:102
:102:102:103:102:103:101:100:103:100:102:101:102:106:102:104:102:101:105:117:136:135:113:
102:108:104:104:105:105:104:109:115:106:105:112:107:108:114:111*6E
```

The fields are as follows:

Column Number	Example Value	Column Name	Field Format	Description
1	UMSCN	Sentence type	UMSCN	This is a spectrum RSSI scan response.
2	104:102:102:101:98:101:99:100:100:100:100:98:101:99:99:102:100:100:110:111:102:102:102:102:103:102:103:101:100:103:100:102:101:102:106:102:104:102:101:105:117:136:135:113:102:108:104:104:105:105:104:109:115:106:105:112:107:108:114:111	RSSI	60 numeric (0 to 1023) subfields separated by the ":" character.	Logarithmic-scale received signal strength indication.

UMVER Command Response Sentence

The UMVER sentence reports information about the receiver's firmware revision.

As output on the receiver's serial interface, this data would appear like this:

```
$UMVER,GRIDINSIGHT AMRUSB-1,0.0.2,BETA FIRMWARE*1C
```

The fields break down like so:

Column Number	Example Value	Column Name	Field Format	Description
1	UMVER	Sentence type	UMVER	This sentence represents firmware version information.
2	GRIDINSIGHT_AMRUSB-1	Firmware name	Alphanumeric (no spaces or commas)	Should always be "GRIDINSIGHT_AMRUSB-1".

Column Number	Example Value	Column Name	Field Format	Description
3	0.0.2	Version	Three-element numeric, with '.' between the elements. (0.0.0 to 255.255.255).	This is a major-minor-revision three-part version number. Elements will always be numeric.
4	BETA_FIRMWARE	Comment	Alphanumeric (no spaces or commas)	This is a comment intended for reading by humans.

UMSER Command Response Sentence

The UMSER sentence reports the receiver's serial number.

As output on the receiver's serial interface, this data would appear like this:

```
$UMSER,0000000002*72
```

The fields break down like so:

Column Number	Example Value	Column Name	Field Format	Description
1	UMSER	Sentence type	UMSER	This sentence represents the receiver's unique serial number assigned at time of manufacture.
2	0000000002	Serial number	Zero-padded numeric (0000000001 to 4294967295)	Unique serial number, stored in the receiver's flash memory. Once assigned at time of manufacture, the serial number is not changeable.

UMBKT Command Response Sentence

The UMBKT sentence reports diagnostic statistics from the receiver's adaptive spread-spectrum frequency hopping algorithm.

As output on the receiver's serial interface, this data would appear like this:

```
$UMBKT,0:0:0:0:0:0:0:0:0:4:7:11:8:6:12:13:13:8:7:4:3:0:0:0:0:0:0:0*55
```

These statistics represent counters of how many valid data packets have been received in different portions of the 900 MHz frequency band. These counters are all reset to zero when the receiver starts.

The fields break down like so:

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Column Number	Example Value	Column Name	Field Format	Description
1	UMBKT	Sentence type	UMBKT	This sentence represents the receiver's unique serial number assigned at time of manufacture.
2	0:0:0:0:0:0:0:0:4:7:11:8:6:12: 13:13:8:7:4:3:0:0:0:0:0:0	Counters	26 element numeric, where each element ranges from 0 to 255.	Each element represents a counter of the number of valid data packets received in a specific frequency range during full band-scanning tuning optimization. The first element corresponds to 902.0 – 902.9 MHz, the second to 903.0 – 903.9 MHz, and so on up to 927.0 – 927.9 MHz in the last element. These values will decrease by 50% once any one element exceeds an internal limit.

Note that these counters reflect only data packets received during full band scanning, and then only count those packets matching the ERT serial number and ERT message type specified by the TRGT command (if provided). The counters can be reset to zero by the RBKT command.

UMDAT Command Response Sentence

The UMDAT sentence reports a byte of data read from the receiver's flash memory.

As output on the receiver's serial interface, this data would appear like this:

```
$UMDAT,200,128*40
```

The flash memory can be read using the RDAT command.

The fields break down like so:

Column Number	Example Value	Column Name	Field Format	Description
1	UMDAT	Sentence type	UMDAT	This sentence represents the value of a single flash memory location.
2	200	Location	Numeric (0 to 255)	This is the memory location whose value is displayed. The receiver has 256 memory locations, some of which are user-programmable.
3	128	Value	Numeric (0 to 255)	This is the memory location value. Uninitialized locations typically return a value of 255.

For more information about flash memory allocation, see the table below.

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6 Flash Memory

The AMRUSB-1 contains 256 bytes of persistent flash memory. The following table shows the allocation of that memory.

Location start	Location end	Designated use
0	3	Receiver serial number
4	255	Unallocated (available to application software)

7 Background

Grid Insight has performed extensive research, reverse engineering, hardware and software design, and testing to develop new technology to receive and decode the AMR metering signals (so-called ERT signals) transmitted by meters manufactured by Itron, Inc. and others in the 900 MHz spectrum. Grid Insight has made this technology available in the form of a receiver/decoder device in a "USB stick" form factor.

Figure 1. Grid Insight AMRUSB-1 Receiver (shown with ¼ wave helical antenna)