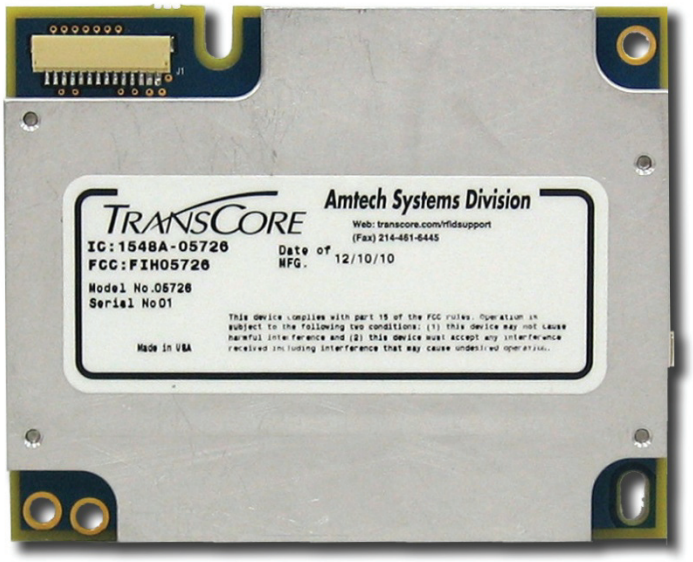
05726 IAG Read-Only Radio Module Developer's Guide



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Introduction to the 05726 IAG Read-Only Radio Module

The 05726 embedded IAG read-only module is a radio frequency identification (RFID) radio that can be integrated into other systems to create RFID-enabled products that support the E-ZPass® Interagency Group (IAG) protocol.

This document is written for developers and explains how to incorporate the 05726 TransCore Radio Module (hereafter called the 05726 radio module) into a third-party host system.

Hardware Overview

The 05726 radio module is a single board module designed for more space-constrained applications. The digital and analog electronics are located on the same circuit board.

The 05726 radio module is designed to be incorporated into products requiring capabilities in a small form factor. Table 1 shows the basic features of the radio hardware.

Table 1. Features of the 05726 Radio Module

Specification	Value
Input Power Requirements	+5V DC
Communication Interfaces	High-speed serial interface
Protocols supported	IAG read-only
Dimensions (L x D x H)	3.1 x 2.5 x 0.3 in. (78 x 63 x 8 mm)

RF Connector

The 05726 radio module supports one MMCX connector for a single monostatic antenna.

Digital Connector

The digital connector provides power and serial communications signals. The connector is a 14-pin digital connector. Table 2 lists the pin-outs and descriptions.

Table 2. Digital Connector Pin Assignments

Pin No.	Description
1	GND
2	GND
3	GND
4	+5V
5	+5V
6	NO CONNECTION
7	NO CONNECTION
8	NO CONNECTION
9	NO CONNECTION
10	NO CONNECTION
11	RS-232 RX TTL from host
12	RS-232 RX TTL to host
13	NO CONNECTION
14	NO CONNECTION

Firmware Overview

The software for the 05726 radio module is loaded at the factory and cannot be updated in the field. If the software requires updating, the radio module has to be returned to the factory.

Functionality of the Embedded Module

Regional Support

This radio module has been designed to comply with the following regulatory requirements:

North America Region	FCC 47 CFG Chapter 1, Part 15 Industrie Canada RSS-210

Frequency

The 05726 radio module has been designed to operate at a fixed frequency of 915.00 MHz.

Overview of the Communication Protocol

The serial communication between a host and the reader is based on a synchronized command-response/master-slave mechanism. Whenever the host sends a message to the reader, it cannot send another message until after it receives a response. The reader never initiates a communication session, only the host initiates a communication session.

This protocol allows for each command to have its own timeout because some commands require more time to execute than others. The host manages retries if necessary, and the host tracks the state of the intended reader if it reissues a command.

Host-to-Reader Communication

Host-to-reader communication is packetized according to Figure 1. The reader can only accept one command at a time, and commands are executed serially, so the host waits for a reader-to-host response before issuing another host-to-reader command packet.

Header	Data Length	Command	Data	CRC-16 Checksum
Hdr	Len	Cmd	- - - - -	CRC HI CRC LO
1 byte	1 byte	1 byte	0 to *N* bytes	2 bytes

Figure 1. Host-to-Reader Communication Packets

The communication packet fields are summarized in Table 3.

Table 3. Host-to-Reader Communications

Field	Length	Description
Header (Hdr)	1 byte	Defines the start of the packet. Equal to 0xFF
[1]Data Length (Len)	1 byte	Defines the length, *N*, of the data field contained in the packet.
Command	1 byte	Specifies the command that the reader is to execute.
Data	*N* bytes (0 to 250)	Defines the binary data required by the reader for use with a command. This could, for example, represent the transponder data to be written. The length, *N*, can vary between 0 and 250 bytes.
CRC-16 Checksum (CRC HI, CRC LO)	2 bytes	CRC-16 checksum (high order byte first). CRC polynomial is CCITT CRC-16, with a preload of 0xFFFF. This does not fully specify the operation of the CRC. See the CCITT CRC-16 Calculation section for more details.

Reader -to-Host Communication

Figure 2 defines the format of the generic response packet that is sent from the reader to the host. The response packet is different in format from the request packet.

Header	Data Length	Command	Status Word	Data	CRC-16 Checksum
Hdr	Len	Cmd	Status Word	- - - - -	CRC HI CRC LO
1 byte	1 byte	1 byte	2 bytes	0 to *M* bytes	2 bytes

Figure 2. Reader-to-Host Communication Packets

The response packet fields are summarized in Table 4.

Table 4. Reader-to-Host Communications

Field	Length	Description
Header (Hdr)	1 byte	Defines the start of the packet. Equal to 0xFF
[1]Data Length (Len)	1 byte	Defines the length, *M*, of the data field contained in the packet. Length can be 0 to 248 bytes.
[2]Command	1 byte	Specifies the command that the reader is to execute.
[3]Status Word	2 bytes	Specifies the status of the last command. Successful = 0x0000, else it contains a fault code.

[1] Minimum packet length is 5 bytes and the maximum packet length is 255 bytes.
[2] Each host command receives a response from the reader. In the response packet, the Header, Data Length, Command, Data, and Checksum are functionally similar to the command packet.
[3] The only difference is the addition of the Status Word field. The Status Word has two types of values: a Status Word value of 0 (zero) means the command received was successful; any other value represents a fault.

Field	Length	Description
Data	*M* bytes (0 to 248)	Defines the binary data required by the reader for use with a command. This could, for example, represent data read from a transponder. Data length, *M*, can be a minimum of 0 bytes and a maximum of 248 bytes.
CRC-16 Checksum (CRC HI, CRC LO)	2 bytes	CRC-16 checksum (high order byte first). CRC polynomial is CCITT CRC-16, with a preload of 0xFFFF. This does not fully specify the operation of the CRC. See the CCITT CRC-16 Calculation section for more details.

CCITT CRC-16 Calculation

The same CRC calculation is performed on all serial communications between the host and the reader. The CRC is calculated on the Data Length, Command, Status Word, and Data bytes. The Header (SOH, 0xFF) is not included in the CRC.

Command Set

The 05726 radio module uses only one command:

- 0xFF – IAG read-only command.

The Read command from the host causes the microcontroller to generate a Tx_enable signal, used by a 915-MHz oscillator and output RF switch, to generate a 20-microsecond trigger pulse. Instead of a timeout period specified in a command, the microcontroller generates up to 10 trigger pulses separated by 100 milliseconds. The microcontroller stops when a tag is seen or when 10 pulses have been generated.

Following the command formatted used by ThingMagic and TransCore's Encompass® 1d host programs, the commands necessary for the 05726 radio module prototype are listed in the following tables.

Table 5. Proposed Host-to-Reader Format of IAG Read (follows ThingMagic requirements)

Header	Data Length	Command	Data	CRC-16
FFH	02H	21H	XXXXH	XXH

Where

Data Length	Number of bytes in the Data field
Data payload	Set Data 0000H
CRC	CRC-16 Checksum. See Reader-to-Host Communications for details.

Table 6. Reader-to-Host Format of IAG Read Response

Header	Data Length	Command	Status Word	Data	CRC-16
FFH	20H	21H	0X00H	(256 bits)	XXH

Where

Data Length	Number of bytes in the Data field
Status Word	0000H if tag CRC check succeeds 0400H if no tag found 0500H if tag CRC check fails
Data Payload	Current firmware returns all zeros (0)
CRC	CRC-16 Checksum. See Host-to-Reader Communications for details.

Hardware Details

This section details the physical components of the 05726 radio module including the pin 1 location for the serial connector.

Antenna Connector

The 05726 radio module has one MMCX connector for interfacing to an antenna.

Communications Connector

The communications interface on the module provides power, serial communications signals, and access to the general purpose inputs and outputs.

The 05726 radio module has a 14-pin connector. For the interface pin-out, see the 05726 Radio Digital Connectors section for more detail.

Figure 3 shows the 05726 radio module communications interfaces.

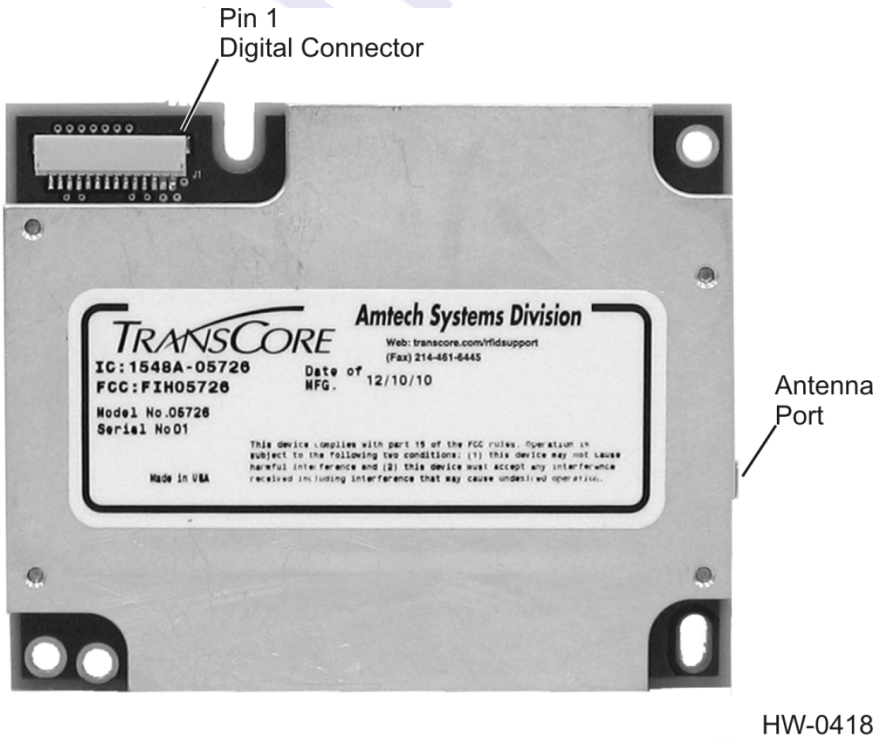

Figure 3. 05726 Radio Module Communications Interfaces

Connectors

The connector used for the communications interface on the 05626 radio module is as follows:

- JST SM14B-SRSS-TB

The mating connectors are as follows:

- **Connector Shell:** JST SHR-14V-S-B
- **Crimp Contacts:** JST SSH-003T-PO.2-H