IdentiTAG

IWC
COMMUNICATIONS PROTOCOL

IdentiTAG (Pty) Ltd

Preliminary – Subject to Change

AMENDMENT

AMENDMENT RECORD			
ISSUE	**DATE**	**CHANGE**	**NAME**
Draft A	2009-09-01	First Draft Release	NJ Dearham
Draft B	2009-09-04	Added Network Topology	NJ Dearham
Draft C	2012-05-15	Added Fleet Checking (D0 & D2)	SL Cowley
Draft D	2012-11-12	Added Improx Support	SL Cowley
Draft E	2013-05-24	Added support for V02.21 of the IWC	SL Cowley
Draft F	2013-07-24	Various Minor Modifications	SL Cowley

ABBREVIATIONS

CRC	***Cyclic Redundancy Check***
DP	***Diagnostic Protocol***
IWC	***IdentiTAG Wireless Controller***
IWI	***IdentiTAG Wireless Interface***
MMP	***Magstripe-Mirror Protocol***
NS	***Nozzle Suppression***
RF	***Radio Frequency***
RRP	***Raw-RF Protocol***
RTC	***Real Time Clock***
SPP	***Serial Port Protocol***

1 SCOPE

This document describes the serial communications protocol applicable to the IdentiTAG IWC product for the configuaration of the IWC Receiver, so that it may corretly push serial data to a Host Master.

2 PROTOCOL DESCRIPTION

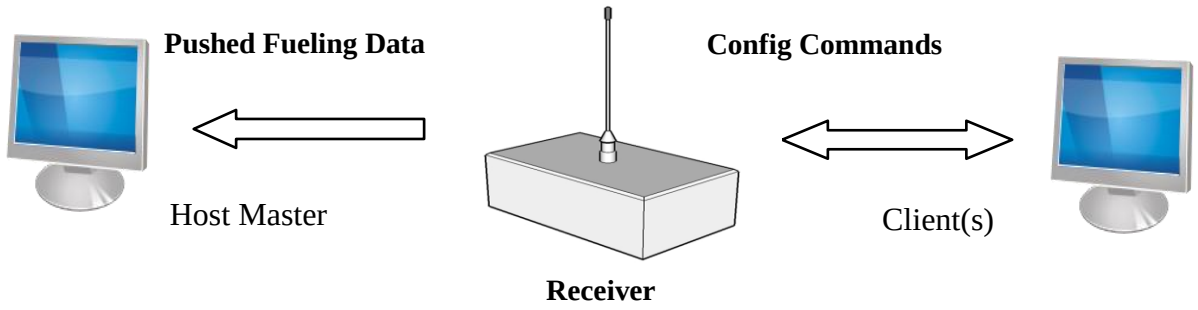
2.1 PROTOCOL OVERVIEW

The IdentiTAG Wireless Controller (IWC) serial communications protocol shall be an ASCII half-duplex protocol operating at 19200 baud, 8 bits, no Parity, 1 Stop bit (where applicable).

The network topology typically consists one Host Master, and one (or more) Receiver units for the reception of RF packets – primarily used for the Authorisation of transactions through IdentiTAG's portfolio of fueling products. The details of this Host Master communication is not covered by this document, but rather the protocol used through various client interfaces to configure the Receiver system, so that it may correctly communicate these authourisations to the Master Host.

Many physical interface options exist for a client to transfer configuation data to a Receiver. Each of these interfaces should be kept electrically and logically separated, with only one type of interface used simultaneously.

All configuration messages are initiated by the client and, if received by the Receiver, shall always result in a reply message (unless otherwise stated). Provision is made for (logically) addressing an individual Receiver that may reside on a multi-drop interface with mutiple Receivers present on the same phyical bus, for example multi-drop RS-485.



2.2 INTERFACE DEFINITION

2.2.1 Client to Receiver

All message fields shall be fixed in size with the exception of the Data field that shall be dependent on the command type. The general format of the messages from the client to the Receiver unit shall be as follows:

← HEADER SENT / RECEIVED FIRST

Mode	Header @	Source Address	Destination Address	Message Identifier	Improx Command Field	IWC Command Field	Data Field	CRC Field	Footer <CR> <LF>
Legacy	1 char	N/A	2 char	N/A	N/A	2 char	n char	4 char	2 char
Improx	1 char	4 char (hhcc)	6 char (hhcctt)	4 char	2 char (65h)	2 char	n char	4 char	2 char

Header

The message header shall be the ASCII character @.

Source Address (Improx)

The source address shall be 4 ASCII characters in length and shall fully specify the logical address of the Host / Controller from which the command originated as ***hhcc***. The first two characters ***hh*** shall represent the host address and the second 2 characters ***cc*** shall represent the controller address. A message shall be initiated from either a host or a controller.

For messages being sent by a controller, ***hh*** shall be zero. For messages being sent from a Host to a terminal, ***cc*** shall be zero in order that the controller interprets the message as a pass through message.

NOTE: In the case of the IWC the host will be 01 and the controller 00.

Destination Address (Improx)

The destination address shall be 6 ASCII characters in length and shall fully specify the logical address of the Host / Controller / Terminal as ***hhcctt***.

If a controller is being addressed then ***tt*** shall be zero. If a host is being addressed then ***cc*** and ***tt*** shall be zero.

Within the each full address range of 00h – FFh, for Masters and Slaves, sub-ranges have been defined:

Address	Usage
hh = 00 Hex	A controller is addressing a terminal on its own bus
cc = 00 Hex	A host is addressing a slave on another host
tt = 00 Hex	The slave is not a terminal
01 Hex -7F Hex	Master / Slave address [127 addresses]
80 Hex – BF Hex	Group address [64 groups]
C0 Hex – FD Hex	Reserved
FF Hex	Global address

NOTE: In the case of the IWC the host will be 00 and the controller 00 and the terminal will be the logical address. For example, if the logical address is 01 then the destination address will be 000001 and for global addresses 0000FF.

Destination Address (Legacy)

The destination address shall be 2 ASCII characters in length and shall fully specify the logical address of the Receiver. Therefore, the possibility exists for 255 recevers being present on a bus, with the 0xFF address being reserved for broadcast purposes.

Message Identifier (Improx)
The message identifier shall be 4 characters in length. This counter shall be incremented on each new message generated by the Master Unit. The counter shall remain unchanged should a message need to be re-sent. The counter shall have a range 1h to FFFFh and shall rollover back to 1h on overflow. On System Reset, the record of the last message identifier received shall be set to zero. A Master shall start sending with message identifier 1. A message identifier of zero is reserved. A slave shall re-send a reply only if the last and current message identifiers are the same.

Improx Command Field

The command field shall identify the particular message and the processing that needs to be performed by the Slave Unit. The command field shall be 2 characters in length. The command shall be within the range 00h to FFh. The Improx Extended commands for the IWC will always use a value of 65h.

IWC Command Field

The command field shall identify the particular message and the processing that needs to be performed by the Receiver unit. The command field shall be 2 ASCII characters in length. The command shall be within the range 00h to FFh.

Data Field

The data field shall contain any data associated with the command, and the length of the data field may vary according to the specific command and the data available at the client. The maximum length of the data field for a message to Receiver is 1000 bytes.

CRC Field

The CRC field shall comprise a 16 bit CRC generated from and including the Header, to and including the data fields. The CRC field shall be included when performing an error check on the received message. The following CRC generating polynomial shall be used:

$$\textbf{CRC-16} = X_{16} + X_{12} + X_5 + 1$$

The CRC field shall be 4 characters in length within the range 0000h to FFFFh, with the most significant byte being sent / received first. Refer to *Appendix A - CRC Calculation Example* for details of encoding and decoding the CRC.

Footer

The message footer shall be the ASCII characters <CR><LF>, i.e. 0x0D, 0x0A.

2.2.2 Receiver to Client

All message fields shall fixed in size with the exception of the Data field that shall be dependent on the command type. The general format of the messages from the Receiver unit to the client shall be as follows:

Mode	Header %	Dest. Address	Source Address	Status Field 1	Message Identifier	IWC Command Field	Data Field	Improx Command Field	IWC Command Field	Status Field 2	CRC Field	Footer <CR> <LF>
Legacy	1 char	N/A	2 char	4 char (Legacy)	N/A	2 char	n char	N/A	N/A	N/A	4 char	2 char
Improx	1 char	4 char (hhcc)	6 char (hhcctt)	2 char (Improx)	4 char	N/A	n char	2 char	2 char	4 char	4 char	2 char

Header

The message header shall be the ASCII character %.

Destination Address

The destination address shall be 4 ASCII characters in length and shall specify the logical address in hex of the Host / Controller that originated the message. The first two characters hh shall represent the originating host address and the second 2 characters cc shall represent the originating controller address.

Source Address

The source address shall be 2 ASCII characters in length and shall fully specify the logical address of the Receiver.

Message Identifier

The message identifier shall be the same as that of the originating message received from the Master. The Slave Unit shall not modify the message identifier in any way.

Status Field 1 (Legacy)

The status byte indicates the state of the Receiver and any problems experienced during the execution of the command. This field is also used in Improx mode but in a different position.

Status Bit (MSB first)	Description
15	Command incomplete or invalid
14	Nozzle Suppression Enabled
13	Diagnostic Protocol Enabled
12	Raw RF Protocol Enabled
11	Magstripe Mirror Protocol Enabled
10	Serial Port Protocol Enabled
9	Nozzle Learn Mode Enabled
8	Test Mode Enabled
7	Unit in Boot Mode
6	**Set:** TCP Enabled **Clear**: UDP Enabled
5	RF attenuation value bit 1
4	RF attenuation value bit 0

Status Bit (MSB first)	Description
3	Protocol Interface to Master Host bit 1
2	Protocol Interface to Master Host bit 0
1	**Set:** USB Enabled **Clear**: RS-232 Enabled
0	**Set:** Software Select **Clear**: Harware DIP Select

The RF attenuation values are as follows:

Bit 1	Bit 0	Attenuation Settings
0	0	0 dB
0	1	-6 dB
1	0	-12 dB
1	1	-18 dB

The Protocol Interface to the Master Host status settings are as follows:

Bit 1	Bit 0	Protocol Interface to Master Host
0	0	USB or RS-232
0	1	RS-485
1	0	Ethernet (TCP or UDP)
1	1	Undefined - Test Mode Activated

Status Field 1 (Improx)

The status byte shall indicate the state of the slave and any exceptions experienced during the execution of the command.

Status Bit (MSB first)	Description
7	Reserved
6	Command Not Completed
5	Firmware Download Mode
4	Duplicate Reply
3	Authentication Failed
2	Unknown Command
1	Command Not Executed
0	Unit Has Reset

IWC Legacy Command Field

The command field identifies the reply message for the client and shall match that sent by the client. This field is also used in Improx mode but in a different position.

Data Field

The data field shall contain any data associated with the command, and the length of the data field may vary according to the specific command and the data available at the Receiver unit. The

maximum length of the data field from a Receiver is 1000 characters.

Improx Command Field

The command field identifies the reply message for the client and shall match that sent by the client.

IWC Improx Command Field

Please see IWC Legacy Command Field. The fields are identical but the positions in the packet have changed.

Status Field 2 (Improx)

Please see Status Field 1 (Legacy). The fields are identical but the positions in the packet have changed.

CRC Field

The CRC field shall comprise a 16 bit CRC generated from and including the Header, to and including the data fields. The CRC field shall be included when performing an error check on the received message. The following CRC generating polynomial shall be used:

$$\textbf{CRC-16} = X_{16} + X_{12} + X_5 + 1$$

The CRC field shall be 4 characters in length within the range 0000h to FFFFh, with the most significant byte being sent / received first. Refer to *Appendix A - CRC Calculation Example* for details of encoding and decoding the CRC.

Footer

The message footer shall be the ASCII characters <CR><LF>, i.e. 0x0D, 0x0A.

2.2.3 Synchronisation & Error Control

Message synchronisation and processing shall be acheived by monitoring the incoming serial data for the Footer. All data is buffered on until the Footer is received, in which case the buffered ASCII string residing in the buffer is processed by the Receiver and the appropriate reply message returned.

Error detection shall be performed by means of verifying the CRC of all applicable messages received at the client and Receiver units.

In case of an erroneous message being received by the Receiver unit, this message shall be discarded and no reply message shall be sent. This shall result in a time-out at the client. The Master shall then re-transmit the message for a responce.

In case of an erroneous message being received by the client, this message shall be discarded. The client shall then either time-out on the expected response, or shall immediately re-transmit the message for a correct responce.

The time-out period for a message expected from a Receiver unit shall be variable with a minimum value of 20 milliseconds. The time-out value shall be determined by the particular message and the requirements of the client.

2.3 COMMAND SUMMARY

The commands from the client to the Receiver unit shall be as specified in the table below. The Receiver unit shall determine the acceptance and interpretation of a specific command.

Note that when the Receiver is in Boot Mode (the operational mode of the unit immediately after any reset - whether power-up, Watch-Dog Timeout, firmware update, or otherwiwe) only configuration (as opposed to operational) commands will be accepted. Once the applciation firmware has started (i.e. when Status bit 7 is clear), this restriction falls away. In addition, if DHCP is utilised for obtaining an IP Address, further network dependent startup delays may be experienced before the client will be able to communicate to the Receiver over the Ethernet interface.

2.3.1 IMPROX COMMANDS

Command (Hex)	Description	Can use in Boot Mode?
01	Synchronise	Yes
02	Improx Auto Unit Address Identification	Yes
04	Configure logical address	Yes
08	Reset unit	Yes
0A	Request firmware version	Yes
65	**Extended Command (Must be used with IWC Commands)**	**Yes**

2.3.2 IWC COMMANDS (For use with Improx Command 65h)

Command (Hex)	Description	Can use in Boot Mode?
02	IWC Auto Unit Address Identification	Yes
04	Configure Unit Logical Address	Yes
3 05	**4 Configure Module Logical Address**	**5 Yes**
07	Factory Defaults	Yes
08	Reset Unit	Yes
0A	Request Firmware Version	Yes
0B	Read Boot Number	Yes
0F	Configure Real-Time Clock	Yes
10	Request Real-Time Clock	Yes
16	Request transactions	No
60	Configure Packet Success Rate	No
61	Request Packet Success Rate	No
62	Configure Temperature Rate	No
63	Request Temperature Rate	No

Command (Hex)	Description	Can use in Boot Mode?
64	Activate Relay	No
65	Read Relay State	No
66	Configure Relay Mode	No
70	Configure Network Parameters	Yes
71	Request Network Parameters	Yes
72	Configure DHCP	Yes
73	Request DHCP	Yes
74	Configure Host Parameters	Yes
75	Request Host Parameters	Yes
76	Set Ethernet Interface TCP	Yes
77	Set Ethernet Interface UDP	Yes
80	Write RF Table	No
81	Read RF Table	No
82	Write PA Table	No
83	Read PA Table	No
84	Write Nozzle Table	No
85	Read Nozzle Table	No
86	Delete Nozzle Table	No
E0	Enter Test Mode	No
E1	Exit Test Mode	No
E2	Configure RF Attenuation	No
E3	Request RF Attenuation	No
E4	Configure Temperature Sensor	No
E5	Set Firmware Download Mode	Yes
E6	Erase FLASH Memory	Yes
E7	Program FLASH Memory	Yes
E8	Execute Application Code	Yes
E9	Read FLASH Memory	Yes
EA	Set IWI Firmware Download Mode	No
EB	Erase IWI FLASH Memory	No
EC	Program IWI FLASH Memory	No
ED	Execute IWI Application Code	No
EE	Read IWI FLASH Memory	No
EF	IWI Program Complete	No
F1	Request Temperature	No
F2	Enter Learn Mode	No
F3	Exit Learn Mode	No
F4	Enter SPP Mode	No
F5	Exit SPP Mode	No
F6	Enter MMP Mode	No

Command (Hex)	Description	Can use in Boot Mode?
F7	Exit MMP Mode	No
F8	Enter RRP Mode	No
F9	Exit RRP Mode	No
FA	Enter DP Mode	No
FB	Exit DP Mode	No
FC	Enter NS Mode	No
FD	Exit NS Mode	No
FE	Configure Sequence Number	No
FF	Request Sequence Number	No

5.1 COMMAND DEFINITION

Note: The column in the description of commands indicating the range of valid hex values is indicated for example as 0:FFF. This means that the hex value of that field can range from 0 to FFF and that 3 characters will be used for that field. Thus the number of characters for a particular field is not specified directly but deduced from the range information.

5.1.1 Improx Commands

5.1.1.1.1 Synchronise

The synchronisation message command shall be sent to Slave Units for the purposes of acquiring and verifying synchronisation. The Slave Unit being addressed shall reply to the message received except for a global address.

Command Value	**01 Hex**
Send Data	None
Reply Data	None

5.1.1.1.2 Improx Auto Unit Address Identification

Every unit shall have a 32-bit Fixed Address programmed at the time of manufacture. The auto unit address identification command shall be used for the purposes of acquiring the fixed addresses of the Slave Unit. This shall enable a Logical Address to be assigned to each unit for all subsequent addressing. Since the unit cannot be addressed by a specific Logical Address prior to one being assigned, the Global Logical Address FF hex shall be used for this command. The Slave Unit shall randomly, within the specified time frame, reply with its Fixed Address to the Master Unit. Once the Master Unit has received a valid reply from a Slave Unit, it can then send the „Configure Auto Unit Address Identification Command" command to stop the Slave Unit replying again if necessary. The time frame shall be specified in milliseconds in the range 0 to 65535.

This command shall only generate a reply if the message destination address is the global address FFh or if the message destination address matches the unit's address.

Command Value	**02 Hex**

Send Data	1	0:FFFF	Time frame in ms
Reply Data	1	0:FFFFFFFF	Slave Unit's Fixed Address
	2	0:FF	Slave Unit's Logical Address (FFh = not assigned)
	3	0:FF	Product ID

5.1.1.1.3 Configure Unit Logical Address

The configure unit logical address command shall instruct the Slave Unit which Logical Address shall be used for subsequent messages.

This command shall only be executed if the fixed address in the message matches the unit's fixed address and the destination address is either global or matches the unit's logical address.

Command Value		**04 Hex**	
Send Data	1	0:FFFFFFFF	Fixed Address
	2	0:FF	New Logical Address
Reply Data		None	

5.1.1.1.4 Reset Unit

The reset unit command shall instruct the Receiver to perform a reset by suspending the watchdog signal. This command will cause the Boot Counter to be incremented by 1.

Command Value		**08 Hex**
Send Data		None
Reply Data		None

5.1.1.1.5 Request Firmware Version

The configure module logical address command instructs the Receiver unit to assign the given Logical Address to the IWI Module for all future messages to it.

This command will only be executed if the fixed address in the message matches the IWI Module's fixed address and the destination address matches the Receiver unit's logical address.

Command Value		**0A Hex**	
Send Data		None	
Reply Data	1	0:FF	Boot Block Firmware Major Version Number
	2	0:FF	Boot Block Firmware Minor Version Number
	3	0:FF	Application Firmware Major Version Number
	4	0:FF	Application Firmware Minor Version Number
	5	0:FF	Reserved (Packed as 0x00)
	6	0:FF	Reserved (Packed as 0x00)
	7	0:FFFFFFFF	Fixed Address
	8	0:FF	Product ID
	9	16 CHAR ASCII	Stock Code
	10	10 CHAR ASCII	Product Name

11	10 CHAR ASCII	Serial Number
12	64 CHAR ASCII	Product Description

5.1.1.1.6 Extended Command (For IWC Commands)

This enables the use of the IWC Commands through the Improx Protocol. Please see IWC Commands for the list of extended commands.

Command Value	**65 Hex**
Send Data	N/A
Reply Data	N/A

5.1.2 IWC Commands

5.1.2.1 General Commands

5.1.2.1.1 IWC Auto Unit Address Identification

Every unit shall have a 32-bit Fixed Address programmed during manufacture. The auto unit address identification command shall be used for the purposes of acquiring the fixed addresses of the Receiver unit. This enables Logical Addresses to be assigned to each unit for all future addressing. Since the unit cannot be addressed by a specific Logical Address before one has been assigned, the Global Logical Address FF hex shall be used for this command.

This command will only reply if the message destination address is the global address FF or if the destination address matches the unit's address.

Command Value		**02 Hex**	
Send Data		None	
Reply Data	1	0:FFFFFFFF	Receiver unit's Fixed Address (Serial Number)
	2	0:FF	Receiver unit's Logical Address (FFh = not assigned)
	3	0:FFFFFFFF	IWI Module's Fixed Address (Serial Number)
	4	0:FF	IWI Module's Logical Address (FFh = not assigned)

5.1.2.1.2 Configure Unit Logical Address

The configure unit logical address command instructs the Receiver unit which Logical Address will be used for future messages.

This command will only be executed if the fixed address in the message matches the unit's fixed address and the destination address is either global or matches the unit's logical address.

Command Value		**04 Hex**	
Send Data	1	0:FFFFFFFF	Receiver unit's Fixed Address (Serial Number)
	2	0:FF	Receiver unit's new Logical Address
Reply Data		None	

5.1.2.1.3 Configure Module Logical Address

The configure module logical address command instructs the Receiver unit to assign the given Logical Address to the IWI Module for all future messages to it.

This command will only be executed if the fixed address in the message matches the IWI Module's fixed address and the destination address matches the Receiver unit's logical address.

Command Value		**04 Hex**	
Send Data	1	0:FFFFFFFF	IWI Module's Fixed Address (Serial Number)
	2	0:FF	IWI Module's new Logical Address
Reply Data		None	

5.1.2.1.4 Factory Defaults

The restore factory defaults command shall instruct the Receiver to reset the internal parameters to those defined at the time of manufacture (including the restoration of the factory parameters for the IWI Module).

Command Value	**07 Hex**
Send Data	None
Reply Data	None

5.1.2.1.5 Reset Unit

The reset unit command shall instruct the Receiver to perform a reset by suspending the watchdog signal. This command will cause the Boot Counter to be incremented by 1.

Command Value	**08 Hex**
Send Data	None
Reply Data	None

5.1.2.1.6 Request Firmware Version

The request firmware command shall interrogate the Receiver for the firmware version numbers of the unit's Application, Boot, and IWI Module Application, respectively. The three version numbers shall be in the format XX.YY(Z) with XX being the major version number, YY being the minor version number, and Z being the engineering/interim release version number ('0' indicating a non-engineering release). The decimal point and braces shall be implied and not sent as part of the message.

Command Value		**0A Hex**	
Send Data		None	
Reply Data	1	0:FF	Receiver's Application Firmware Major Version Number
	2	0:FF	Receiver's Application Firmware Minor Version Number

	3	0:F	Receiver's Application Firmware Engineering/Interim Release Version Number ('0' = none; otherwise 'a'-'z')
	4	0:FF	Receiver's Boot Firmware Major Version Number
	5	0:FF	Receiver's Boot Firmware Minor Version Number
	6	0:F	Receiver's Boot Firmware Engineering/Interim Release Version Number ('0' = none; otherwise 'a'-'z')
	7	0:FF	IWI Module's Application Firmware Major Version Number
	8	0:FF	IWI Module's Application Firmware Minor Version Number
	9	0:F	IWI Module's Application Firmware Engineering/Interim Release Version Number ('0' = none; otherwise 'a'-'z')

5.1.2.1.7 Read Boot Number

The read boot number command simply returns the boot counter of the Receiver, which is incremented every time the unit is reset/powered-on.

Command Value		**0B Hex**	
Send Data		None	
Reply Data	1	0:FFFFFFFF	The Receiver's Boot Counter value

5.1.2.1.8 Configure Real-Time Clock

The configure real time clock command shall reset the Receiver's internal clock to the specified time and date.

Command Value		**0F Hex**	
Send Data	1	0:FFF	Year: 1999 to 2098
	2	0:F	Month: 1 to 12
	3	0:FF	Day: 1 to 31
	4	0:FF	Hours: 0 to 23
	5	0:FF	Minutes: 0 to 59
	6	0:FF	Seconds: 0 to 59
Reply Data		None	

5.1.2.1.9 Request Real-Time Clock

The request real time clock command retrieves the current Receiver's clock setting.

Command Value		**10 Hex**	
Send Data		None	
Reply Data	1	0:FFF	Year: 1999 to 2098
	2	0:F	Month: 1 to 12
	3	0:FF	Day: 1 to 31
	4	0:FF	Hours: 0 to 23
	5	0:FF	Minutes: 0 to 59
	6	0:FF	Seconds: 0 to 59

5.1.2.1.10 Request Transaction

Retrieve SPP Data as generated by authorised transactions. Returns the number of transactions

left in the buffer, the length of the current transaction reported, and applicable data.

Command Value		**16 Hex**	
Send Data		None	
Reply Data	1	0:FF	Number of Transactions in Buffer
	2	0:FF	Length of Current Transaction
	3	Variable	Data (Of Length listed above)

5.1.2.2 Diagnostic Related Commands

5.1.2.2.1 Configure Packet Success Rate

The configure packet success rate command is used to set the reporting time period of the packet success rate indicator of the Receiver unit. This indicator measures the percentage of packets received by the IWI Module with the correct CRC vs the total number of packets received during that time period. The results of this calcuation will only be reported to the Master Host if the Receiver has its Diagnostic Protocol enabled.

Command Value		**60 Hex**	
Send Data	1	0:FFFFFFFF	Reporting interval in seconds
Reply Data		None	

5.1.2.2.2 Request Packet Success Rate

The request packet success rate command retrieves the value (in seconds) of this diagnostic's indicator.

Command Value		**61 Hex**	
Send Data		None	
Reply Data	1	0:FFFFFFFF	Reporting interval in seconds

5.1.2.2.3 Configure Temperature Rate

The configure temperature rate command is used to set the reporting time period for temperature readings. The value given is in mutilples of the Packet Success Rate timer, where a value of zero will disable this feature. If enabled, temperature readings will only be reported to the Master Host if the Receiver has its Diagnostic Protocol enabled.

Command Value		**62 Hex**	
Send Data	1	0:FF	Reporting interval in multiples of the Packet Success Rate timer
Reply Data		None	

5.1.2.2.4 Request Temperature Rate

The request temperature rate command retrieves the temperature reading time period (in multiples of the Packet Success Rate timer).

Command Value		**63 Hex**	
Send Data		None	
Reply Data	1	0:FF	Reporting interval in multiples of the Packet Success Rate timer

5.1.2.2.5 Activate Relay

The activate relay command shall instruct the Receiver unit to activate one or more relays for the given time period. This period shall be expressed in 100 millisecond units with a range between 0 and FFFFh. A period value of 0 shall de-activate the relays, whilst a period value of FFFFh shall activate the relays indefinitely.

The Mask is a bit mapped parameter that allows for (up to) 8 realys be address simultaneously. On the IWC, only the first two LSB are defined, with a Mask value of 0 being meaningless.

The Mode parameter indicates what action to do on the Masked relays. The defined actions are listed below.

Mode= 0	Turn Relay(s) OFF
Mode= 1	Turn Relay(s) ON
Mode= 2	Toggles the current state of the Relay(s)

Command Value		**64 Hex**	
Send Data	1	0:FF	Mask: 0-3 (Defined only)
	2	0:FF	Mode: 0-2 (Defined only)
	3	0:FFFF	Duration in 100 millisecond units.
Reply Data		None	

5.1.2.2.6 Read Relay State

This command shall request the Receiver to return the present state of the relays. The returned mode parameter indicates which relays are inverted (Normally Closed).

Command Value		**65 Hex**	
Send Data		None	
Reply Data	1	0:FF	Relay State Bit map: 0-3 (Defined only)
	2	0:FF	Relay Mode Bit map: 0-3 (Defined only)

5.1.2.2.7 Configure Relay Mode

The configure relay mode command sets the mode of the relay(s). The default mode of each relay is Normally Open, however, this can be individually changed to Normally Closed through this

command. On the IWC, only the first two LSB are defined.

Command Value		**66 Hex**	
Send Data	1	0:FF	Mode Bit map: 0-2 (Defined only), with bit position of "1" indicating Normally Closed and "0" Normally Open.
Reply Data		None	

5.1.2.2.8 Read HVU Timers

This command shall request the receiver to return the HVU timers.

Command Value		**67 Hex**	
Send Data		None	
Reply Data	1	0:FF	HVU Rate
	2	0:FF	HVU Timeout

5.1.2.2.9 Configure HVU Timers

This command shall set the receiver's HVU timers values.

Command Value		**68 Hex**	
Send Data	1	0:FF	HVU Rate
	2	0:FF	HVU Timeout
Reply Data		None	

5.1.2.2.10 Read Unit Flags

This command shall request the Receiver to return the present state of the unit flags. For more information on the flags please see the Unit Flags section at the end of the document.

Command Value		**69 Hex**
Send Data		None
Reply Data	1	0: FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

5.1.2.2.11 Set Unit Flags

The configure relay mode command sets unit flags. For more information on the flags please see the Appendix.

Command Value		**6A Hex**
Send Data	1	0: FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
Reply Data		None

5.1.2.2.12 Read Relay Timeout Timer

This command shall request the Receiver to return the present state of the relays. The returned

mode parameter indicates which relays are inverted (Normally Closed).

Command Value		**6B Hex**	
Send Data		None	
Reply Data	1	0:FFFF	Time in 100 milliseconds.

5.1.2.2.13 Configure Relay Timeout Timer

The configure relay mode command sets the mode of the relay(s). The default mode of each relay is Normally Open, however, this can be individually changed to Normally Closed through this command. On the IWC, only the first two LSB are defined.

Command Value		**6C Hex**	
Send Data	1	0:FFFF	Time in 100 milliseconds.
Reply Data		None	

5.1.2.3 Network Related Commands

5.1.2.3.1 Configure Network Parameters

The configure network parameters command sets the IP Address, Default Gateway Address, the Network Mask, the Primary DNS Address, and the Secondary DNS Address of the Receiver unit.

Note that DHCP on the Receiver needs to be OFF before these parameters are passed to it – otherwise DHCP will override these settings automatically.

All Addresses are passed in HEX using the format FF.FF.FF.FF, where the decimal points are implied and not sent as part of the message.

Command Value		**70 Hex**	
Send Data	1	0:FFFFFFFF	The IP Address of the unit
	2	0:FFFFFFFF	The Default Gateway Address of the unit
	3	0:FFFFFFFF	The Network Mask of the unit
	4	0:FFFFFFFF	The Primary DNS Address of the unit
	5	0:FFFFFFFF	The Secondary DNS Address of the unit
Reply Data		None	

5.1.2.3.2 Request Network Parameters

This command shall request the Receiver's network parameters, set either manually or via DHCP. All Addresses are passed in HEX using the format FF.FF.FF.FF, where the decimal points are implied and not sent as part of the message.

Command Value		**71 Hex**	
Send Data		None	

Reply Data	1	0:FFFFFFFF	The IP Address of the unit
	2	0:FFFFFFFF	The Default Gateway Address of the unit
	3	0:FFFFFFFF	The Network Mask of the unit
	4	0:FFFFFFFF	The Primary DNS Address of the unit
	5	0:FFFFFFFF	The Secondary DNS Address of the unit

5.1.2.3.3 Configure DHCP

The configure DHCP instructs the Receiver to either use DHCP or to disable this feature. By default DHCP is enabled. DHCP is required to be disabled on the Receiver prior to sending any network configuration settings – otherwise these may be overridden. This command may optionally send the network parameter update rate. By default this rate is set to 10 seconds.

Command Value		**72 Hex**	
Send Data	1	0:F	0: DHCP disabled; 1: DHCP enabled (default)
(Optional)	2	0:FF	Network Update rate (in seconds) – default = 10 seconds
Reply Data		None	

5.1.2.3.4 Request DHCP

This command shall request the Receiver's DHCP settings.

Command Value		**73 Hex**	
Send Data		None	
Reply Data	1	0:F	0: DHCP disabled; 1: DHCP enabled
	2	0:FF	Network Update rate (in seconds)

5.1.2.3.5 Configure Host Parameters

The configure host parameters command is used to pass the Port and IP address of the Master Host, so that the Receiver may push relavent fueling information onto the Master Host via Ethernet. In addtion, this command also sets the Port at which commands, such as this one, will be processed.

Note that if any port values are changed, the Receiver unit shall issue a Watch-Dog reset so that these new values can be immediately put into effect, thereby causing an increment in the Boot Count.

The IP Address is passed in HEX using the format FF.FF.FF.FF, where the decimal points are implied and not sent as part of the message.

Command Value		**74 Hex**	
Send Data	1	0:FFFFFFFF	The IP Address of the Master Host
	2	0:FFFF	The Port at the Master Host to push UDP / TCP data
	3	0:FFFF	The Port on the Receiver where commands will be processed (Default Port value = 10005(decimal))
Reply Data		None	

5.1.2.3.6 Request Host Parameters

This command shall request the Receiver's host parameter settings. The IP Address is passed in HEX using the format FF.FF.FF.FF, where the decimal points are implied and not sent as part of the message.

Command Value		**75 Hex**	
Send Data		None	
Reply Data	1	0:FFFFFFFF	The IP Address of the Master Host
	2	0:FFFF	The Port at the Master Host to push UDP / TCP data
	3	0:FFFF	The Port on the Receiver where commands will be processed (Default Port value = 10005(decimal))

5.1.2.3.7 Set Ethernet Interface TCP

The set Ethernet interface TCP command is used to set the Receiver's Ethernet protocol to TCP when pushing Fuel Management data to the Master Host.

Note that no "Get Ethernet Interface" command exists, this is reflected in the Status bit 6.

Command Value	**76 Hex**
Send Data	None
Reply Data	None

5.1.2.3.8 Set Ethernet Interface UDP

The set Ethernet interface UDP command is used to set the Receiver's Ethernet protocol to UDP when pushing Fuel Management data to the Master Host.

Note that no "Get Ethernet Interface" command exists, this is reflected in the Status bit 6.

Command Value	**77 Hex**
Send Data	None
Reply Data	None

5.1.2.4 Table Related Commands

5.1.2.4.1 Write RF Table

The write RF table command is used to re-configure the bi-directional radio with device specific parameters. The details of these parameters are beyond the scope of this document, but note that if invaild values are passed to the radio device the Receiver may no longer receive RF data correctly.

Note that valid range of the start address is 0 – 2F (hex), and that the start address + the number of bytes should not exceed 2F. In addition, the Data length is determined by the number of bytes passed and should always be in the format 0:FF per byte passed.

Command Value		**80 Hex**	
Send Data	1	0:FF	Start Address
	2	0:FF	Number of bytes (n)
	3	0:FF	Data 0
			Data 1
			...
	n+2	0:FF	Data n-1
Reply Data		None	

5.1.2.4.2 Read RF Table

This command shall request all of the Receiver's current radio device parameters starting from address 00 (hex) through to 2F (hex).

Command Value		**81 Hex**	
Send Data		None	
Reply Data	1	0:FF	Data 0
	2	0:FF	Data 1
			...
	48	0:FF	Data 47

5.1.2.4.3 Write PA Table

The write Power Amplifier table command is used to set the transmission level of the radio device on the Receiver. Currently, the only use for this command is in the testing the level of the constant carrier, which is done during production. Therefore, this command currently has no relavence to the customer.

Command Value		**82 Hex**	
Send Data	1	0:FF	Data 0
	2	0:FF	Data 1
			...
	8	0:FF	Data 7
Reply Data		None	

5.1.2.4.4 Read PA Table

This command shall request the Receiver's current Power Amplifier table settings.

Command Value		**83 Hex**	
Send Data		None	
Reply Data	1	0:FF	Data 0
	2	0:FF	Data 1
			...
	8	0:FF	Data 7

5.1.2.4.5 Write Nozzle Table

The write nozzle table shall be used to manually insert a Nozzle ID into the Receiver's Learnt nozzle table (provided that this table is not full). This command negates the need to place the Receiver unit into Learn mode, thereby learning unwanted Nozzle ID's. Once insterted, the starting sequence number will be retrieved from the first packet received by that nozzle.

Command Value		**84 Hex**	
Send Data	1	0:FFFFFF	Nozzle ID
Reply Data		None	

5.1.2.4.6 Read Nozzle Table

This command shall request the Receiver's current Learnt Nozzle table. Up to 20 Nozzle ID's can be returned through this command, however, only those nozzles currently learnt will be passed. Therefore, the number of nozzles can be determined by dividing the amount of bytes returned by 6 (the length of each Nozzle ID).

Command Value		**85 Hex**	
Send Data		None	
Reply Data	1	0:FFFFFF	Nozzle ID 0 Nozzle ID 1 ....
	n	0:FFFFFF	Nozzle ID n-1

5.1.2.4.7 Delete Nozzle Table

The delete nozzle table shall be used to remove a Nozzle ID from the Receiver's Learnt Nozzle table. Note that this command will fail if the Nozzle ID passed cannot be found within the current Learnt Nozzle table of the Receiver. In addtion, verification that the Nozzle ID was been removed can be obtained by sending the Read Nozzle Table command.

Command Value		**86 Hex**	
Send Data	1	0:FFFFFF	Nozzle ID to remove
Reply Data		None	

5.1.2.5 Production Related Commands

5.1.2.5.1 Enter Test Mode

The enter test mode command shall instruct the Receiver to output a constant carrier with the power settings present in the PA table.

Note that verification that the unit has indeed entered into Test Mode can be esablished through

Status bit 8.

Command Value	**E0 Hex**
Send Data	None
Reply Data	None

5.1.2.5.2 Exit Test Mode

The exit test mode command shall instruct the Receiver to quit outputting a constant carrier.

Note that verification that the unit has indeed exited Test Mode can be esablished through Status bit 8.

Command Value	**E1 Hex**
Send Data	None
Reply Data	None

5.1.2.5.3 Configure RF Attenuation

The configure RF attenuation command is used to set the RF attenuation of the Receiver. Only 4 values are currently vaild; namely: 0, 1, 2, 3 corresponding to 0,-6dB,-12dB and -18dB's, respectively.

Note that verification that the unit has altered its attenuation can be determined through Status bits 4 & 5.

Command Value		**E2 Hex**	
Send Data	1	0:F	Attenuation Setting
Reply Data		None	

5.1.2.5.4 Request RF Attenuation

This command shall instruct the Receiver to return its current RF attenuation setting. Since this can already be done through Status bits 4 & 5, this command is no longer required but may be used to get the current status of the Receiver.

Note that the return values of 0, 1, 2, 3 correspond to 0,-6dB,-12dB and -18dB's, respectively.

Command Value		**E3 Hex**	
Send Data		None	
Reply Data	1	0:F	Attenuation Setting

5.1.2.5.5 Configure Temperature Sensor

The configure temperature sensor command is used to calibrate the Radio devices temperature sensor on the Receiver. The temperature senor is only accurate to ± 3°C, after 1-point calibration at room temperature, but does have a range from –20 °C to +80 °C.

In order to perform 1-point calibration, the current reading needs to be first returned through the Request Temperature command. Then, through the use of the equation given below, a 12-bit signed calibration value can be determined.

$$CurrentTemperature = ((CurrentReading - CalibrationValue) * (3.3/2.5088))$$

This determined calibration value then needs to be sent to the Receiver unit as a 2's complement value, if negative.

Note that since calibration does not affect the value returned by the Request Temperature command, its applicability is for the Receiver unit to report the current temperature in °C when the Diagnostic Protocol is enabled with the temperature reading time period feature active.

Command Value		**E4 Hex**	
Send Data	1	0:FFF	Signed Calibration Value
Reply Data		None	

5.1.2.5.6 Set Firmware Download Mode

This command shall instruct the Receiver unit to enter the Firmware Download mode whereby the application firmware can be upgraded.

Note that this command is required to be excuted before the execute application code command, otherwise the unit will not issue a reset for the Boot application to update the upgraded firmware.

Command Value		**E5 Hex**	
Send Data		None	
Reply Data		None	

5.1.2.5.7 Erase FLASH Memory

The erase FLASH memory command is used to erase the entire FLASH device before new firmware data is uploaded to it.

Command Value		**E6 Hex**	
Send Data		None	
Reply Data		None	

5.1.2.5.8 Program FLASH Memory

This command shall instruct the Receiver unit to program the non-volatile memory at the specified start address with the 256 bytes of data given. The Receiver shall reply with an error condition should the address given not fall on a 256 byte boundry or the programming of the data be unsuccessful.

Command Value		**E7 Hex**	
Send Data	1	0:FFFFFFFF	Start Address
	2	0:FF	Data 0
			Data 1

			...
	257	0:FF	Data 255

Reply Data	None

5.1.2.5.9 Execute Application Code

This command shall instruct the Receiver to entering into Boot Mode, so that the Boot Application can update the firmware of the Receiver's Application. Note, however, that the unit will only enter into Boot Mode if the set firmware download mode was sent prior to this command.

Command Value	**E8 Hex**
Send Data	None
Reply Data	None

5.1.2.5.10 Read FLASH Memory

The read FLASH memory command shall instruct the Receiver to return 256 bytes of data from a specified address, and can be used to verify data sent via the program FLASH memory command. Note that this address is required to fall on a 256 byte boundry, otherwise an error condition will be sent.

Command Value		**E9 Hex**	
Send Data	1	0:FFFFFFFF	Start Address
Reply Data	1	0:FF	Data 0
			Data 1
			...
	256	0:FF	Data 255

5.1.2.5.11 Set IWI Firmware Download Mode

This command shall instruct the Receiver unit to enter the IWI Firmware Download mode whereby the IWI module application firmware can be upgraded.

Note that this command is required to be excuted before the execute IWI application code command, otherwise the unit will not issue a reset for the Boot application to update the upgraded firmware.

Command Value	**EA Hex**
Send Data	None
Reply Data	None

5.1.2.5.12 Erase IWI FLASH Memory

The erase IWI FLASH memory command is used to erase the entire IWI module's FLASH before new firmware data is uploaded to it.

Command Value	**EB Hex**

Send Data	None
Reply Data	None

5.1.2.5.13 Program IWI FLASH Memory

This command shall instruct the Receiver unit to program the non-volatile memory of the IWI module at the specified start address with the 256 bytes of data given. The Receiver shall reply with an error condition should the address given not fall on a 256 byte boundry or the programming of the data be unsuccessful.

Command Value		**EC Hex**	
Send Data	1	0:FFFFFFFF	Start Address
	2	0:FF	Data 0
			Data 1
			...
	257	0:FF	Data 255
Reply Data		None	

5.1.2.5.14 Execute IWI Application Code

This command shall instruct the Receiver to program the updated IWI firmware given. Note, however, that the unit will only excute this command if the set IWI firmware download mode command was sent prior to it. Once the programming has completed, the Receiver will send the program complete command.

Command Value		**ED Hex**	
Send Data		None	
Reply Data		None	

5.1.2.5.15 Read IWI FLASH Memory

The read IWI FLASH memory command shall instruct the Receiver to return 256 bytes of data from a specified IWI address, and can be used to verify data sent via the program IWI FLASH memory command. Note that this address is required to fall on a 256 byte boundry, otherwise an error condition will be sent.

Command Value		**EE Hex**	
Send Data	1	0:FFFFFFFF	Start Address
Reply Data	1	0:FF	Data 0
			Data 1
			...
	256	0:FF	Data 255

5.1.2.5.16 IWI Programming Complete

This command will be automatically sent by the Receiver unit to the client once the IWI module has been completed successfully.

Command Value		**EF Hex**
Reply Data		None

5.1.2.5.17 Unit Specific Commands

5.1.2.5.18 Request Temperature

The request temperature command simply returns the RAW 12-bit reading received from the Radio devices temperature sensor. It is up to the client to convert this value into a meaningful

temperature reading. Please see the configure temperature sensor command for more details.

Command Value	**F1 Hex**		
Send Data	None		
Reply Data	1	0:FFF	12-bit Temperature Reading (uncalibrated)

5.1.2.5.19 Enter Learn Mode

The enter learn mode command shall instruct the Receiver to learn any Nozzle ID's it receives. These Nozzle ID's will be saved to the Nozzle table and can be read back through the read nozzle table command.

Note that verification that the unit has indeed entered into Learn Mode can be esablished through Status bit 9.

Command Value	**F2 Hex**
Send Data	None
Reply Data	None

5.1.2.5.20 Exit Learn Mode

The exit learn mode command shall instruct the Receiver to quit learning new Nozzle ID's.

Note that verification that the unit has indeed exited Learn Mode can be esablished through Status bit 9.

Command Value	**F3 Hex**
Send Data	None
Reply Data	None

5.1.2.5.21 Enter SPP Mode

The enter Serial Port Protocol (SPP) mode command shall instruct the Receiver to turn on the SPP feature.

Note that verification that the unit has indeed entered into SPP Mode can be esablished through Status bit 10.

Command Value	**F4 Hex**
Send Data	None
Reply Data	None

5.1.2.5.22 Exit SPP Mode

The exit Serial Port Protocol (SPP) mode command shall instruct the Receiver to turn the SPP feature off.

Note that verification that the unit has indeed exited SPP Mode can be esablished through Status bit 10.

Command Value	**F5 Hex**
Send Data	None
Reply Data	None

5.1.2.5.23 Enter MMP Mode

The enter Magstripe-Mirror Protocol (MMP) mode command shall instruct the Receiver to turn on the MMP feature.

Note that verification that the unit has indeed entered into MMP Mode can be esablished through Status bit 11.

Command Value	**F6 Hex**
Send Data	None
Reply Data	None

5.1.2.5.24 Exit MMP Mode

The exit Magstripe-Mirror Protocol (MMP) mode command shall instruct the Receiver to turn the MMP feature off.

Note that verification that the unit has indeed exited MMP Mode can be esablished through Status bit 11.

Command Value	**F7 Hex**
Send Data	None
Reply Data	None

5.1.2.5.25 Enter RRP Mode

The enter Raw-RF Protocol (RRP) mode command shall instruct the Receiver to turn on the RRP feature.

Note that verification that the unit has indeed entered into RRP Mode can be esablished through Status bit 12.

Command Value	**F8 Hex**
Send Data	None
Reply Data	None

5.1.2.5.26 Exit RRP Mode

The exit Raw-RF Protocol (RRP) mode command shall instruct the Receiver to turn the RRP feature off.

Note that verification that the unit has indeed exited RRP Mode can be esablished through Status bit 12.

Command Value	**F9 Hex**
Send Data	None
Reply Data	None

5.1.2.5.27 Enter DP Mode

The enter Diagnostic Protocol (DP) mode command shall instruct the Receiver to turn on the DP feature.

Note that verification that the unit has indeed entered into DP Mode can be esablished through Status bit 13.

Command Value	**FA Hex**
Send Data	None
Reply Data	None

5.1.2.5.28 Exit DP Mode

The exit Diagnostic Protocol (DP) mode command shall instruct the Receiver to turn the DP feature off.

Note that verification that the unit has indeed exited DP Mode can be esablished through Status bit 13.

Command Value	**FB Hex**
Send Data	None
Reply Data	None

5.1.2.5.29 Enter NS Mode

The enter Nozzle Suppression (NS) mode command shall instruct the Receiver to turn on the NS feature, which will ignore any Nozzle ID's not present in its Nozzle table.

Note that verification that the unit has indeed entered into NS Mode can be esablished through Status bit 14.

Command Value	**FC Hex**
Send Data	None
Reply Data	None

5.1.2.5.30 Exit NS Mode

The exit Nozzle Suppression (NS) mode command shall instruct the Receiver to turn the NS feature off, thus allowing un-learnt Nozzle's to fuel vehicles.

Note that verification that the unit has indeed exited NS Mode can be esablished through Status bit 14.

Command Value		**FD Hex**	
Send Data		None	
Reply Data		None	

5.1.2.5.31 Configure Sequence Number

This command shall instruct the Receiver either to make use of sequence numbers, or to completely ignore these numbers when authorising the fueling of vehicles.

Note that any non-zero number will enable sequence number, whilst a value of zero will disable their use.

Command Value		**FE Hex**	
Send Data	1	0:F	Use sequence numbers?
Reply Data		None	

5.1.2.5.32 Request Sequence Number

The request sequence number command will indicate whether sequence number are being used on that Receiver for the purposes of authorising fueling transactions. If enabled, an ASCII '1' will be returned; otherwise a value of '0' will be sent.

Command Value		**FF Hex**	
Send Data		None	
Reply Data	1	0:F	Sequence numbers in use?

5.1.2.5.33 Configure Fleet Bypass

This command shall instruct the Receiver either to make use of Fleet+ Tags as usual (default status), or to have the Fleet+ Tags behave as Retail Tags.

Note that any non-zero number will bypass Fleet+ Checking, whilst a value of zero will react to Fleet+ Tags as usual.

Command Value		**D0 Hex**	
Send Data	1	0:F	Use sequence numbers?
Reply Data		None	

5.1.2.5.34 Request Fleet Bypass

The request Fleet Bypass command will indicate whether Fleet Bypass is being used on that unit. If bypass is enabled, an ASCII '1' will be returned; otherwise a value of '0' will be sent.

Command Value		**D1 Hex**	
Send Data		None	

Reply Data	1	0:F	Sequence numbers in use?

5.1.2.5.35 Request IWC Filter Settings

The request IWC Filter Settings command will indicate which the filter values for Vehicles Tags and Slimtags. Please contact IdentiTAG for more information on the results.

Command Value		**D2 Hex**	
Send Data		None	
Reply Data	1	0:FF	Vehicle Filter
	2	0:FF	Slimtag Filter

5.2 Unit Flags

The flags are used to configure certain aspect of the unit's operation. These may be custom for specific sites or modes of operations. The following is an up to date last as of IWC Boot V02.03 and IWC Application V02.21

Byte 3

Bits	Description if flag is set
31	Disable Sequence Number Checking
30	Bypass Fleet+ Checking
29	Disable Magstripe Output
28	Display Enrolled HVU's only (SPP0003)
27	Enable SPP Card Replacement
26	Disable Magstrip Architecture Type
25	Enable Magstripe Correct Packing
24	Enable Magstripe Card Replacement
23	Learnt Nozzle 1/2 Relay Output Enabled
22	Any Learnt Nozzle Relay Output Enabled
21	Enable Range Test Mode
20	Enable LED Relays
19	Disable Transaction Auth State Machine

If a value is not mentioned here is it is assumed to be 0. All defaults are 0. If a unit is restarted without a CR2032 battery backup then the unit will have all flags set to 0.

6 APPENDIX A – CRC CALCULATION EXAMPLE

```
#include "stdio.h"
#include "stdlib.h"

#define CRCDIV 0x8005

unsigned int encode_decode_crc (unsigned char *data, unsigned int data_length);
unsigned char data[8] = {0x01, 0x00, 0x00, 0x00, 0x0A, 0x80, 0x47, 0};

void main (void)
{
      unsigned int crc_enc;
      unsigned int crc_dec;
```

```
	crc_enc = encode_decode_crc (data, 5); // EXCLUDE CRC BYTES
	crc_dec = encode_decode_crc (data, 7); // INCLUDE CRC BYTES
	printf ("Encode : %0X Decode : %0X", crc_enc, crc_dec);
}

unsigned int encode_decode_crc (unsigned char *data, unsigned int data_length)
{
	unsigned int accum;
	unsigned int curr_byte;
	unsigned int curr_bit;
	unsigned int data_store;

	accum = 0;

	/*repeat for all bytes in message from the header to the data*/
	for (curr_byte = 0; curr_byte < data_length; curr_byte++)
	{
		data_store = ((unsigned int) data[curr_byte]) << 8;

		for (curr_bit = 0; curr_bit < 8; curr_bit++)
		{
			if ((data_store ^ accum) & 0x8000)
				accum = (accum << 1) ^ CRCDIV;
			else
				accum <<= 1;

			data_store <<= 1;
		}
	}

	/*return CRC*/
	return (accum);
}
```