

## Appendix A

# **DSRC Reader Description and Operational Procedure**

**Version: Draft**

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### Revisions

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## 1.0 Introduction

### 1.1 Scope

This document applies to the DSRC Reader, hereafter called the Reader, part of the Dedicated Short Range Communications (DSRC) for use in the Integrated Roadside Unit, an element of the Electronic Tolling System.

### 1.2 Purpose

This document describes the Reader, and provides information on operating the Reader using Host Driver (HD) Version 5.0 as the host.

### 1.3 Definitions, Abbreviations, & Acronyms

DSRC	Dedicated Short Range Communications
HD	Host Driver
PC	Personal Computer
REM	Range Extension Module
RF	Radio Frequency
VRC	Vehicle to Roadside Communications

## 2.0 Reader Description

The Reader is an automatic vehicle identification systems that transmits and receives radio frequency (RF) data to/from transponder-equipped vehicles or assemblies. The Reader works in conjunction with a host computer system to identify a passing transponder, verify its operating credentials (if applicable), communicate to the driver whether the vehicle is cleared or not (if applicable), and transmit the transponder's data package to the next appropriate station (dependent of the type of system connected to the Reader). The Reader's functional block diagram, shown in Figure 1, illustrates the interconnections between the assemblies in the Reader's sealed chassis.

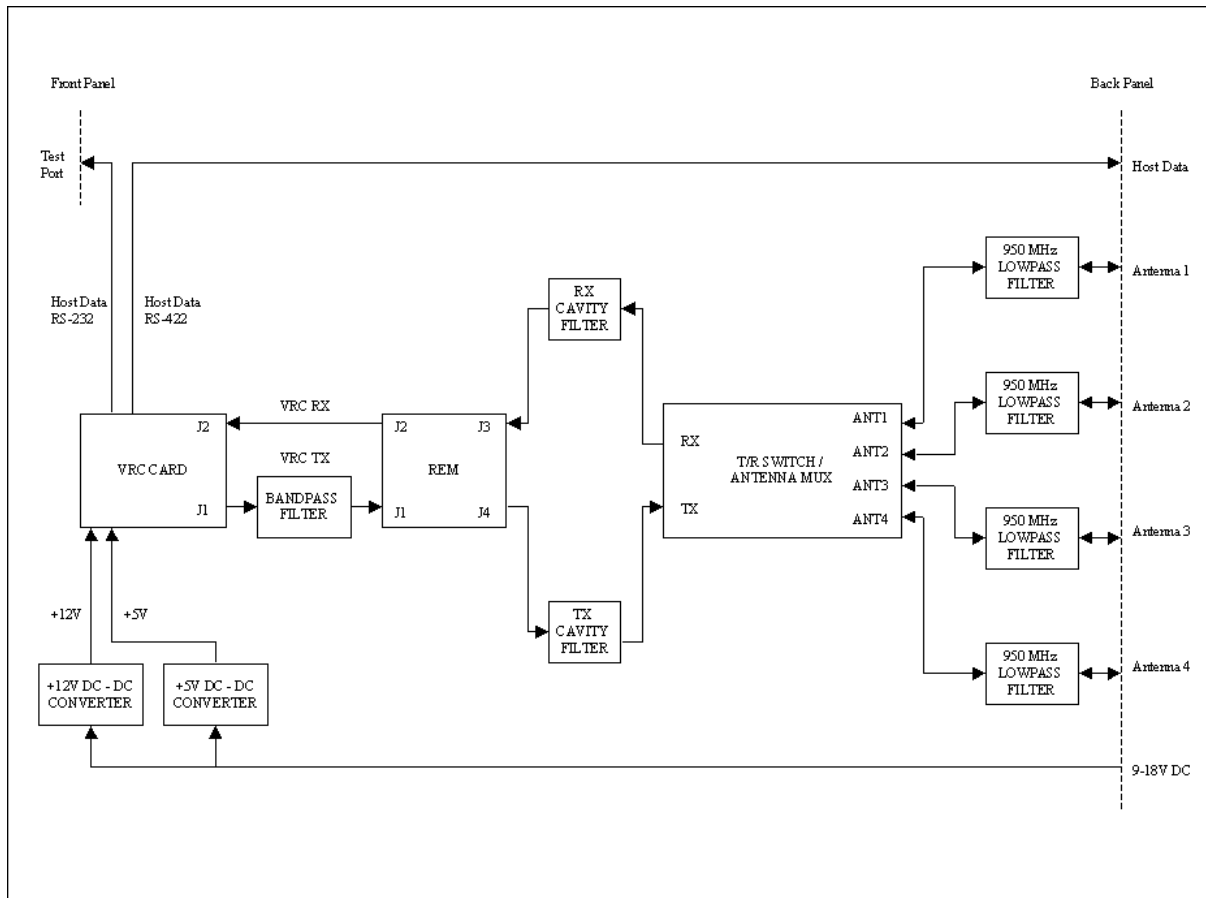


Figure 1-Class A/B Reader Functional Block Diagram

### 3.0 Reader Controls and Indicators

#### 3.1 Reader Power Indicator

A green LED on the front panel of the Reader is lit when the Reader is powered ON.

#### 3.2 Reader Power Switch

A rocker switch on the front panel of the Reader is used to power the Reader ON and OFF.

#### 3.3 Vehicle-to-Roadside Communications (VRC) Card DIP Switch U112 Configuration

The configuration for DIP Switch U112 on the VRC Card is illustrated in Table 1.

VRC CARD DIP SWITCH U112				
SWITCH	DESCRIPTION	DEFINITION		
		POSITION		MODE
1	Not Assigned	N/A		N/A
2	Host Interface Protocol	ON OFF		RS-422 RS-232
3, 4	Host Interface Baud Rate	SW3	SW4	
		ON	ON	115.2 kbaud
		ON	OFF	57.6 kbaud
		OFF	ON	38.4 kbaud
		OFF	OFF	9.6 kbaud
5	Sync Slave Enable	ON		Disabled
		OFF		Enabled
6	Not Assigned	N/A		N/A
7	Not Assigned	N/A		N/A
8	Analog Squelch	ON		Enabled
		OFF		Disabled

**Table 1-VRC Card DIP Switch U112 Configuration**

#### 3.4 VRC Card Reset Indicator

The red LED (DS1) on the VRC Card lights for approximately 1-2 seconds, then remains OFF when the reset switch (S100) on the VRC Card is pressed, or when the Reader is powered ON.

#### 3.5 Reset Switch

The microprocessor (U100) on the VRC Card is reset when the reset switch on the VRC Card (S100) is pressed.

#### 3.6 Squelch Adjustment Potentiometer R13

Potentiometer R13 (closest to the DB-37 connector) on the VRC Card is used to adjust the sensitivity and communication range of the Reader. When the potentiometer adjustment screw is turned clockwise, the Reader is more sensitive to transponders and the communication range increases. When the potentiometer adjustment screw is turned counterclockwise, the Reader is less sensitive to transponders and the communication range decreases. This potentiometer adjustment should only be performed by qualified, trained technicians.



### **3.7 VRC Card Drive Adjustment Potentiometer R41**

Potentiometer R41 (furthest from the DB-37 connector) on the VRC Card is to be used only by a qualified technician to adjust the transmit power output drive level of the VRC Card. Clockwise rotation of the potentiometer adjustment screw increases the transmit power drive; counterclockwise rotation decreases the transmit power drive.

NOTE: The Reader output power should not be adjusted using this method. See section 3.8 for correct output power adjustment.

### **3.8 Reader Transmit Output Power Adjustment**

Potentiometer R5 on the REM is to be used only by a qualified technician to adjust the transmit output power output level of the Reader. Clockwise rotation of the potentiometer adjustment screw increases the transmit power level output; counterclockwise rotation decreases the transmit power level output.

## **4.0 Reader Operation Using HD Version 5.0**

### **4.1 Required Equipment**

#### **4.1.1 Host Driver (HD) Version 5.0**

Test program designed to simulate a Reader host system.

#### **4.1.2 PC (Host Computer) (486 or better)**

Used to run HD Version 5.0. Interface to the Reader is to be either RS-232, or RS-422, which would require an RS-422 to RS-232 adapter between the Host Computer and the Reader. When the interface is selected to be RS-232, the PC is connected to the Test Port (RS-232) port. When the interface is selected to be RS-422, the PC is connected to an RS-232-to-RS-422 converter, and the converter is connected to the Host Data (RS-422) port.

#### **4.1.3 Serial Cable**

DB-9 Female to DB-9 Male RS-232 serial adapter cable used to connect the Reader and the PC.

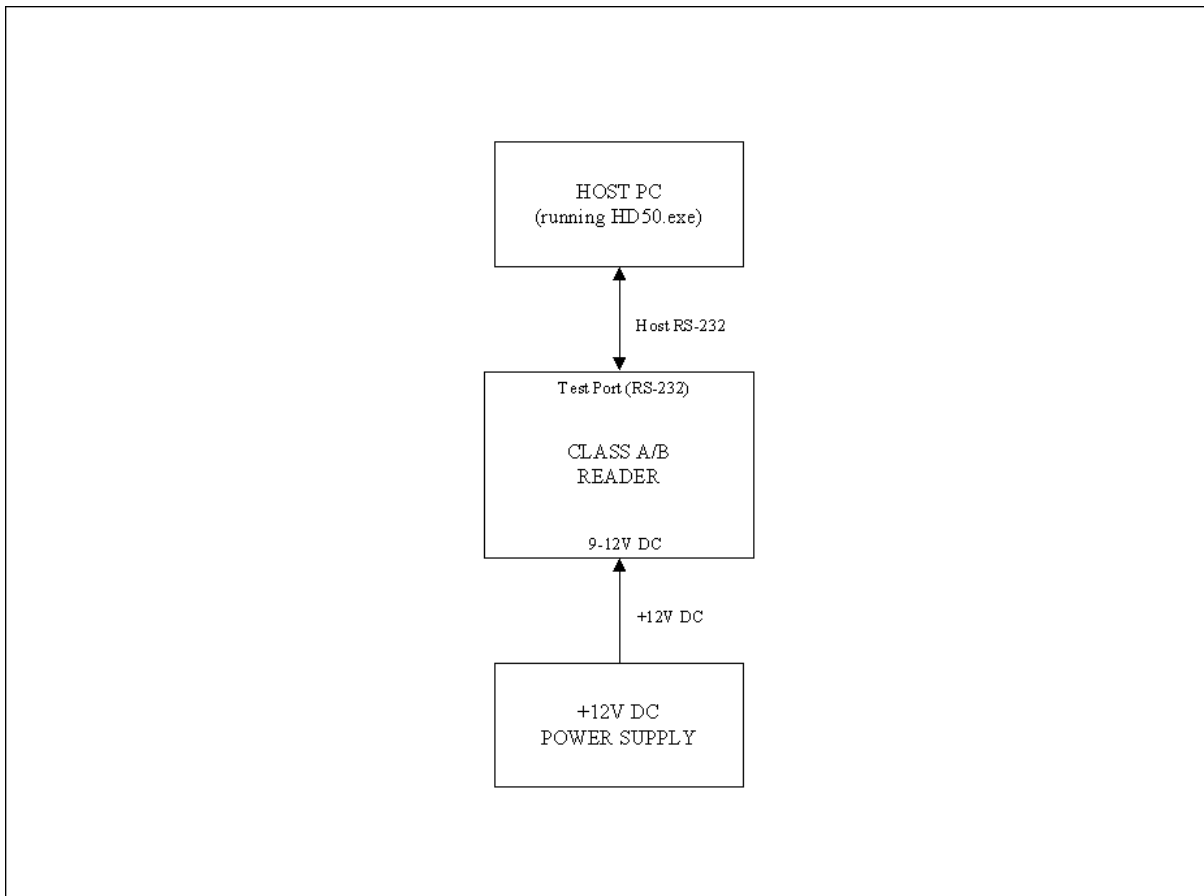
#### **4.1.4 +12V DC Power Supply**

Used to provide power to the Reader. A minimum rating of 3.5A is required.

## 4.2 Reader Operation Procedure Using HD Version 5.0

### 4.2.1 Connecting the System

- Turn the Reader Power switch to the OFF position.
- Connect the system per Figure 2.



**Figure 2-Reader Operational Setup Using HD Version 5.0**

### 4.2.2 Configuring HD Version 5.0

- Run HD 5.0 (HD50.exe) on the PC. Figure 3 is a screenshot of the HD Version 5.0 application upon startup.
- Within HD 5.0, hold down <Shift>, and press <F3>. This will bring up HD's Internal Configuration menu shown in Figure 4.
- In the field "VRC Com Port (1-4)", enter the number of the serial port that HD will be using to communicate with the Reader.
- Verify that the field "VRC Baud (9600, 38400, 57600, 115200)" is set to 115200.
- Hold down <Ctrl>, and press <Enter> to change the Internal Configuration.

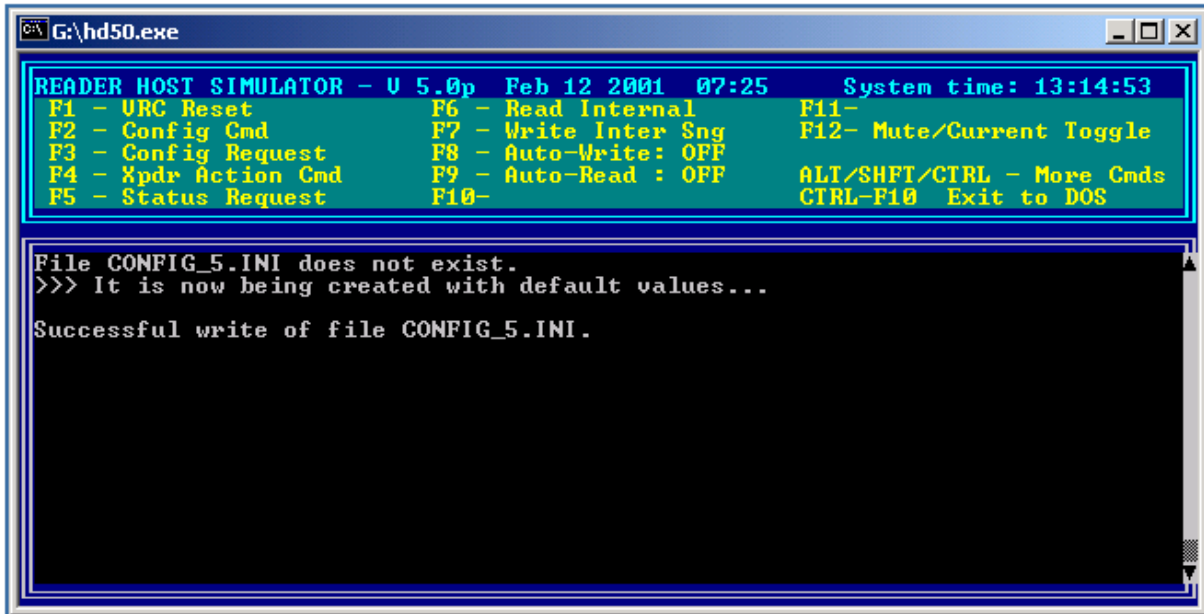


Figure 3-HD Version 5.0 Startup Screen

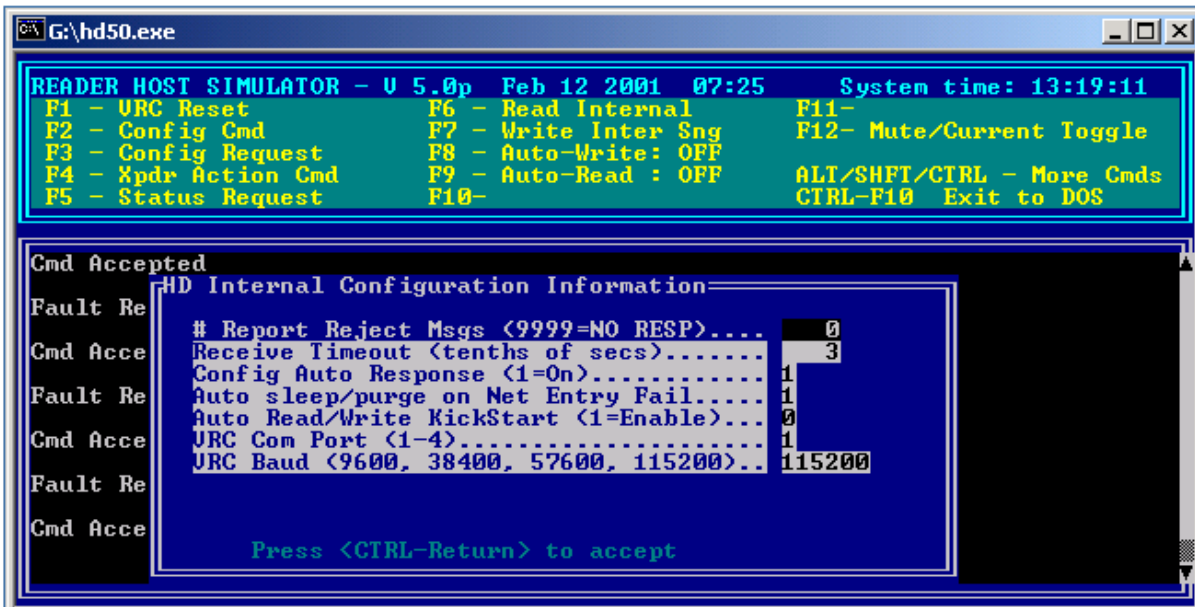


Figure 4-HD 5.0: Internal Configuration Menu

**4.2.3 Configuring the Reader**

- Verify the settings in Table 2 on the VRC Card DIP Switch U112.

VRC CARD DIP SWITCH U112				
SWITCH	DESCRIPTION	DEFINITION		
		POSITION		MODE
1	Not Assigned	N/A		N/A
2	Host Interface Protocol	OFF		RS-232
3, 4	Host Interface Baud Rate	SW3	SW4	115.2 kbaud
		ON	ON	
5	Sync Slave Enable	ON		Disabled
6	Not Assigned	N/A		N/A
7	Not Assigned	N/A		N/A
8	Analog Squelch	ON		Enabled

**Table 2-VRC Card DIP Switch U112 Settings**

**4.2.4 Powering on the Reader**

- Turn the Reader power switch to the ON position.
- Verify successful communication between the Reader and HD by observing the lines “Fault Report: Need Config”, followed by “Cmd Accepted” as displayed within HD. “Fault Report: Need Config” is the result of the Reader alerting the host that it has not been configured. “Cmd Accepted” is the result of the Reader’s acknowledgement to the configuration automatically sent to the Reader by HD.
- If successful communication between the Reader and HD is not observed, verify that the correct com port and baud rate are set in HD’s Internal Configuration menu, and also verify that the green LED on the Reader’s front panel is illuminated.

**4.2.5 Checking Reader Status**

- Communication between the Reader and HD can be checked by pressing <F5> from within HD. This will request the Reader to send a status report to HD. A successfully received status report is shown in Figure 5.

**4.2.6 Resetting the VRC Card**

- The VRC Card can be reset at anytime by pressing <F1> from within HD. “Fault Report: Need Config”, followed by “Cmd Accepted” should be displayed within HD to indicate a successful restart of the VRC Card.

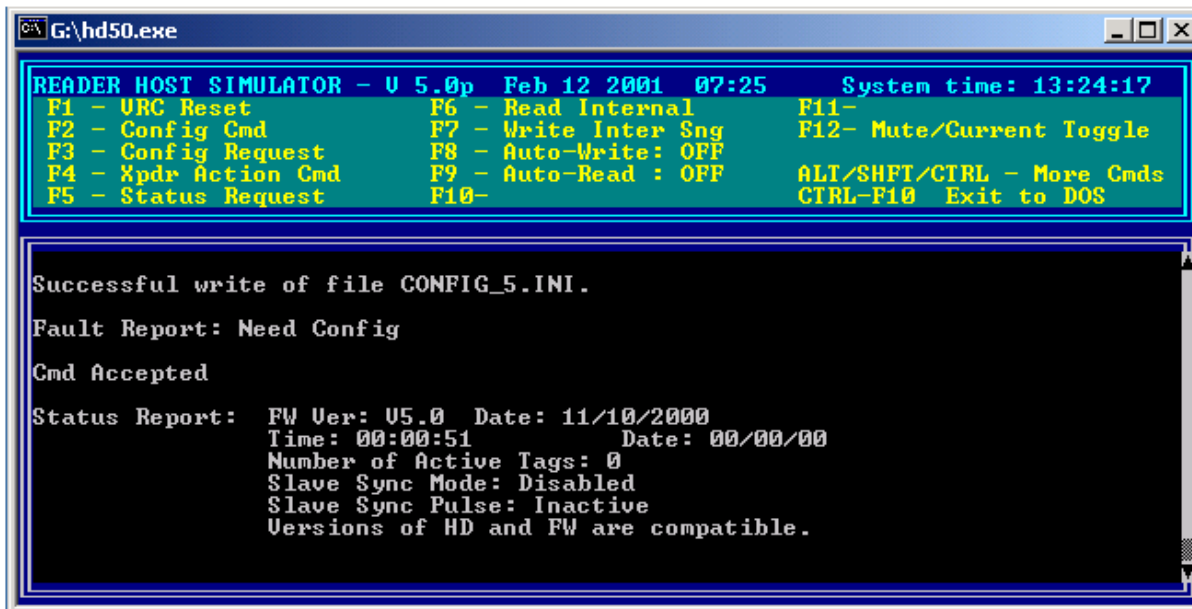


Figure 5-Successful Reader Status Report Received by HD 5.0

#### 4.2.7 Changing the Reader’s Communication Mode

Normal and Mute mode are two of the Reader’s communication modes that are useful for this implementation of the Reader. Normal mode is the Reader’s normal modulated mode of operation. Mute mode places the Reader’s transmitter in a disabled state. The Reader starts up in Mute mode and will remain in this mode until it is successfully configured. When the Reader is powered ON and is informing the host that it is not configured, HD will automatically (depending on the state of the “Config Auto Response” in HD’s Internal Configuration menu) configure the Reader. The default parameters for HD 5.0 are listed in Appendix A.

- To change the Reader’s communication mode, press <F2> from within HD. This will bring up HD’s Configuration Parameters menu shown in Figure 6.
- Change the “Comm Mode” field to change the Reader’s communication mode.
  - 0 = Normal Mode
  - 3 = Mute Mode
- Hold down <Ctrl> and press <Enter> to change the Reader’s Configuration Parameters.

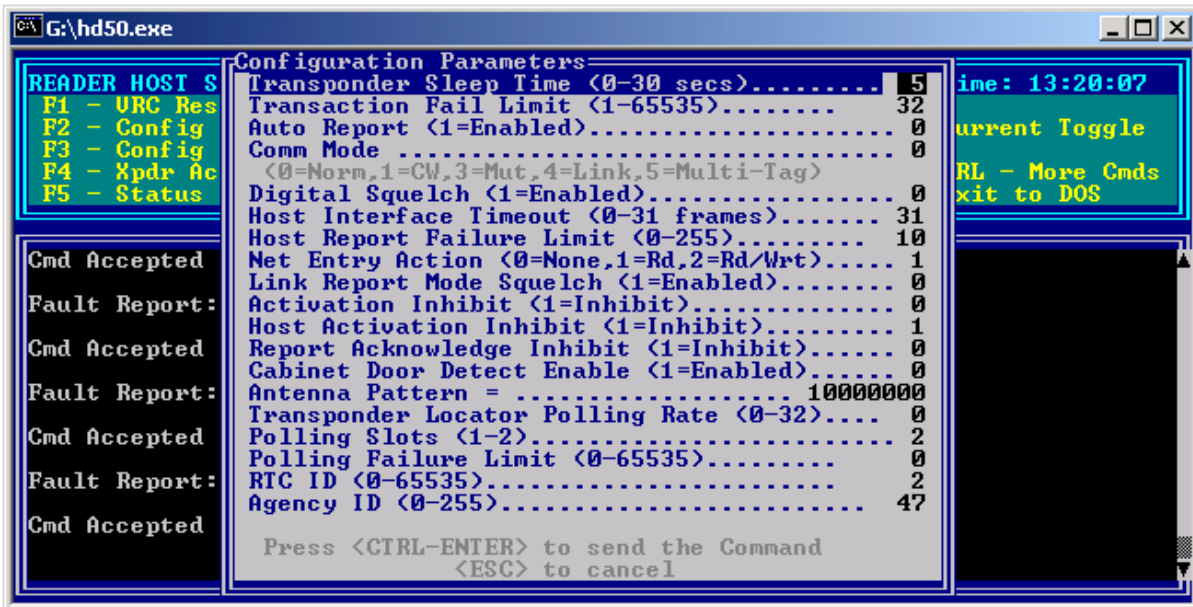


Figure 6-HD 5.0: Configuration Parameter Menu

#### 4.2.8 Changing the Reader’s Antenna Switching Pattern

Only one of the Reader’s antenna ports can be active at one time. The antenna ports are switched on a frame-by-frame basis according to a configurable 8-digit antenna pattern. The antenna pattern can be set with the values 0-4, where 0 indicates the end of the pattern, and 1-4 are antenna numbers.

- To change the Reader’s antenna pattern, press <F2> from within HD. This will bring up HD’s Configuration Parameters menu shown in Figure 6.
- Change the “Antenna Pattern” field to change the Reader’s antenna pattern.

##### Examples

- 10000000 = Antenna 1 Only
- 20000000 = Antenna 2 Only
- 30000000 = Antenna 3 Only
- 40000000 = Antenna 4 Only
- 12000000 = 121212...
- 12300000 = 123123123...
- 12340000 = 123412341234...
- 12343210 = 123432112343211234321...

- Hold down <Ctrl> and press <Enter> to change the Reader’s Configuration Parameters.

### 5.0 Appendix A: HD Version 5.0 Default Parameters

<F11>	Auto-Write	OFF	*Must be <b>OFF</b> when Comm Mode = 4
<F12>	Auto-Read Mode:	OFF	*Must be <b>OFF</b> when Comm Mode = 4

<F2>

**Configuration Parameters:**

Sleep Time (0-30 secs)	<b>5</b>
Transaction Fail Count (1-255, 65535)	<b>32</b>
Auto Report (0-Disabled, 1-Enabled)	<b>0</b>
Comm Mode (0=Norm,1=CW,3=Mut,4=Link,5=Multi-Tag)	<b>0</b>
Digital Squelch (0-Disabled, 1-Enabled)	<b>0</b>
Host Interface Timeout (in frames)	<b>31</b>
Host Report Failure Limit (0-255)	<b>10</b>
Net Entry Action (0=None, 1=Read, 2 = Read/Write)	<b>1</b>
Link Report Mode Squelch (1=Enabled)	<b>0</b>
Activation Inhibit (1 = Inhibit)	<b>0</b>
Host Activation Inhibit (1=Inhibit)	<b>1</b>
Report Acknowledge Inhibit (1=Inhibit)	<b>0</b>
Cabinet Door Detect Enable (1=Enabled)	<b>0</b>
Antenna Pattern	<b>1000000</b>
Transponder Locator Polling Rate (0-32)	<b>0</b>
Polling Slots (1-2)	<b>2</b>
Polling Failure Threshold (0-65535)	<b>0</b>
RTC ID (0-65535)	<b>2</b>
Agency ID (0-255)	<b>47</b>

SHIFT+<F3> **HD Internal Configuration Information:**

# Report Reject Msgs (9999 = NO RESP)	<b>0</b>
Receive Timeout (tenths of secs)	<b>3</b>
Config Auto Response (1=On)	<b>1</b>
Auto sleep/purge on Net Entry Fail	<b>1</b>
Auto Read/Write KickStart (1=Enable)	<b>0</b>
VRC Com Port (1-4)	<b>1</b>
VRC Baud (2400, 9600, 57600, 115200)	<b>115200</b>

ALT+<F5>	LED Select :	<b>GREEN</b>
ALT+<F6>	Beep Select :	<b>CONFIRM</b>
ALT+<F7>	Sleep Cmd :	<b>ON</b>
ALT+<F8>	Purge Cmd :	<b>ON</b>