Tire Pressure Stem (TPS) Handheld Reader

CA&E Part 83-005001-01
Operation Manual

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1. Introduction

1.1   Tire Pressure Stem Handheld Reader

The Tire Pressure Stem Handheld Reader (TPS HHR) Is a Radio frequency Identification Device (RFID) transponder reader. It generates a 134 kilohertz (kHz) magnetic field that energizes a transponder in close proximity to the tip. The field is modulated to communicate with the transponder. A variety of commands allow pressure measurement, temperature measurement, memory block write, memory block read and more. The transponder is based on the *Sens*IC™ 4215 Application Specific Integrated Circuit (ASIC). The Transponder uses similar field modulation to respond. The TPS HHR is designed to communicate with Transponders placed in an aircraft valve stem and is designed to communicate with a variety of stem types to allow its use on a number of aircraft.

1.2   Applicable Part

This manual describes the operation of the Tire Pressure Stem Handheld Reader (Crane Aerospace & Electronics part number 83-005001-01).

Figure 1 - Tire Pressure Stem Handheld Reader – CA&E Part 83-005001-01

The table below describes the functionality of the Read button and LEDs.

TPS HHR Buttons and LEDs	Description/Status
READ	**Read Button** – Press once to power on the Reader. – Pressing the button when powered on and connected to a PDA via Bluetooth® activates a read cycle. – When in test mode, double pressing terminates the read test mode.
Bluetooth	**Bluetooth® LED** – Flashes blue when the Reader is on and not connected to the PDA. – Lights steady blue when successfully connected via Bluetooth to PDA.
↺	**Read in Progress** Flashes yellow during read activity.
✔	**Successful Read** – On steady green means a successful read. – Off means an unsuccessful read.

1.3 Personal Digital Assistant

The HP iPAQ Pocket PC Personal Digital Assistant (PDA) contains the human interface program and display. It provides the intelligence for computation of accurate Pressure and Temperature measurement. It also keeps a record of valid reads with time/date stamp for later use. Many diagnostic functions of the system can be accessed via menus provided in the software.

Figure 2 - **HP iPAQ Pocket PC (Personal Digital Assistant)**

1.4 SmartStem®

The SmartStem® Tire Pressure Sensing System comprises a Radio Frequency Identification Device (RFID) encased in a valve stem that is mounted to an aircraft wheel. This RFID circuit is unique in that it can measure a pressure sensor and return the value with its ID and stored data. It also has a built-in temperature sensor. Three of these RFID/Pressure sensor circuits are included in the stem for redundancy.

Figure 3 - SmartStem® Tire Pressure Sensing System

1.5 System Overview

To start the system, the PDA is first powered up and the application software run. The TPS HHR is powered up next. The PDA is commanded to establish a Bluetooth® wireless technology link to the TPS HHR and, once established, the PDA or the Read button may be used to activate a read cycle. Other configuration and diagnostic tests are accomplished through the PDA only. When the tip of the TPS HHR is placed on a SmartStem and the read button depressed, the stem pressure is downloaded, time stamped, and stored in the PDA. When the Bluetooth communication link is terminated, the TPS HHR remains on for one minute and, if no communication is reestablished, the device turns off.

1.5.1 Additional Notes

Each of the PDA user interface screens illustrated in this document was extracted from a Microsoft ® Windows development emulator program. The outer shell is not an accurate representation of the front panel of the Pocket PC, but the content of each screen does illustrate the actual display. The menu bar on the bottom of each screen is used to access the other screens.

2. Power Up/Normal Read Mode (134.2 kHz Operations)

The following exercises the device in its intended operating mode. All the commands below activate the 134 kHz driver and associated circuitry. Note that the power-up sequence will not be repeated on subsequent test modes since it is identical.

2.1 Start PDA/Reader "EMC Test.exe"

Use the stylus to tap and select options on the PDA screen.

To start the main test application "**EMC Test.exe**" and establish a Bluetooth connection with the TPS HHR, do the following:

1) Press PDA power button.

2) Press Start, Programs

3) Tap the File Explorer icon

4) Tap the directory HHR

5) Tap the directory Application

6) Tap the application **EMC Test.** The Tire Pressure Stem Reader main application screen opens.

Figure 4 Main screen (not connected to TPS HHR)

7) On the TPS Handheld Reader, press the **READ** button. The Bluetooth® blue LED starts flashing. If the LED does not flash, verify that the batteries are installed properly.

Read button

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8) On the PDA, tap the "Connect" button. When connected, the following screen appears on the PDA. The TPS HHR's Bluetooth® blue LED now lights steady. Note that the Connect button now displays "Disconnect" and the information bar directly above it shows the status of the communication link.
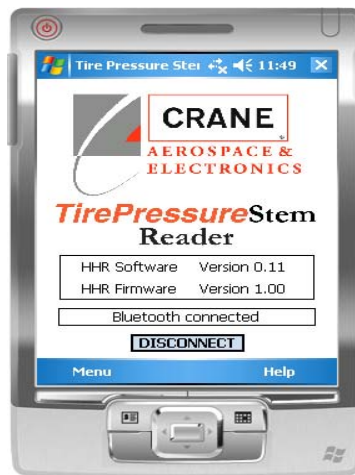

Figure 5 Main screen (connected to TPS HHR)

9) Pressing the Read button on the Basic HHR will now initiate a Read cycle. The Pocket PC beeper beeps once for one second with each successful TPS read, and beeps three times with a duration of 600 mS for each failed TPS read.

The first image shows the results of a failed read attempt. The second image shows a successful read.

Figure 6 Failed Read / Successful Read Display

2.2 READ Test

The READ Test enables the TPS HHR to automatically repeat the normal read cycle indefinitely, or until batteries are depleted, without the need to press the read button. The READ Test generates a TPS interrogation sequence every six seconds.

1) In the main screen, tap "**Menu**" in the lower left.

2) In the popup tap "**HHR Hardware Test**". The following screen appears.

Figure 7 - Optional READ Test

3) Tap "**READ Test**". The Confirm window appears. Tap "**Yes**" to continue. The TPS HHR now cycles a read event every 6 seconds until powered down, or the batteries are depleted.
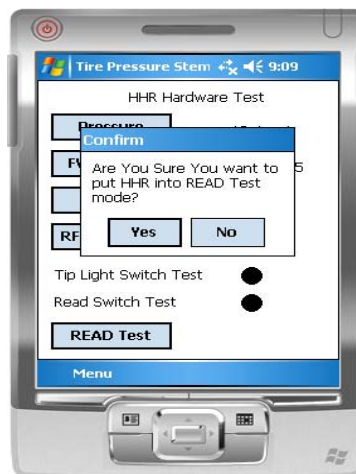

Figure 8 Read test confirmation

4) **Double press** the TPS HHR **Read** button to de-activate.

NOTE
The TPS HHR Read button is disabled during a TPS interrogation operation. The user must double press the button in-between TPS interrogation operations to terminate it.

2.3   134 kHz RF Driver Test

This function operates the driver for 2 second on then 2 second off intervals. This pattern will repeat until commanded to stop, or batteries are depleted.

1) From the main screen tap "**Menu**" in the lower left.

2) In the popup tap "**HHR Hardware Test**".

3) Tap the "**Menu**" button again.

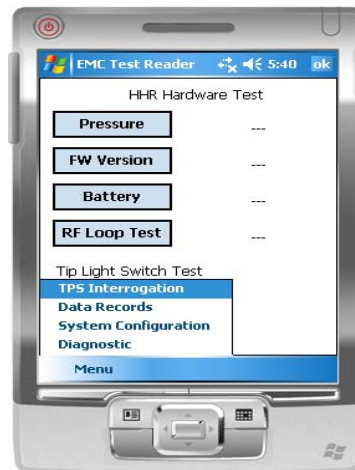4) In the popup, tap "**Diagnostics**"

Figure 9 Diagnostics Pop up

5) The diagnostics screen is displayed as shown below. Locate and tap the Start button in the "134.2kHz RF driver 2 second cycle" section. The TPS HHR will now activate the driver for 2 seconds on then 2 seconds off in a repeating cycle until commanded to Stop.
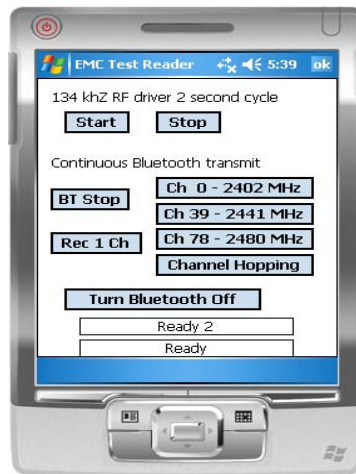
Figure 10 Diagnostics Screen

3. Bluetooth Test Modes (2.45 GHz Operations)

The following provides a way to exercise the Bluetooth section of the reader for FCC testing.

Note
The activation of the following commands forces the communication link to be broken. When this occurs, the reader is left on in the selected mode for a period of 1 minute. After the 1 minute period is up, the TPS HHR shuts off. The communication link must be reestablished via the Power up sequence in Section 2.1 if another command is desired.

3.1 Bluetooth Main Screen

1) From the main screen tap "Menu" in the lower left.

2) In the popup tap "HHR Hardware Test".

3) Tap the "Menu" button again.
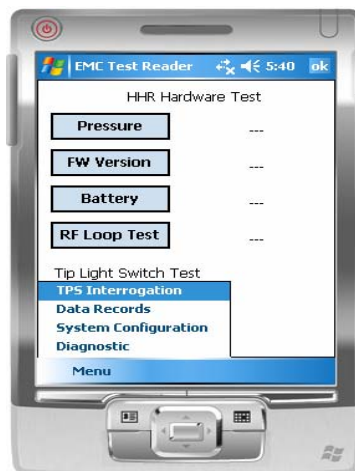
4) In the popup, tap "Diagnostics".

Figure 11 Diagnostics Pop up

5) The diagnostics screen is displayed as shown below. When any of the command buttons are tapped, there is a 4 second delay before the function is initiated. Note that the bottom two status bars indicate the last successful command sent via Bluetooth. A brief description of each command is listed in the table below.
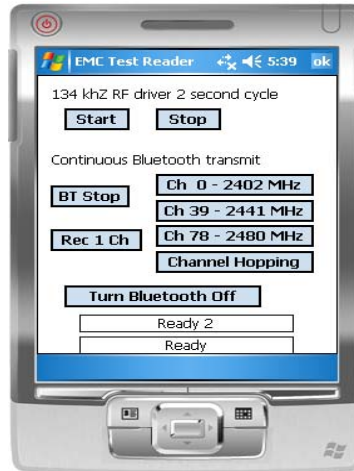
Figure 12 Diagnostics Screen

Diagnostic Command Button	Description
CH 0-2402 MHz	This button activates the Bluetooth transmitter at its lowest frequency of operation, 2.402 GHz. The Bluetooth transmitter will operate at full power at this frequency for a period of 1 minute.
CH 39-2441 MHz	This button activates the Bluetooth transmitter at its middle frequency of operation, 2.441 GHz. The Bluetooth transmitter will operate at full power at this frequency for a period of 1 minute.
CH 78-2480 MHz	This button activates the Bluetooth transmitter at its highest frequency of operation, 2.480 GHz. The Bluetooth transmitter will operate at full power at this frequency for a period of 1 minute
Channel Hopping	This button activates the Bluetooth transmitter at its lowest frequency and slowly sweeps to its highest frequency of operation for a period of 1 minute. It completes at least one full sweep.
BT Stop	This button deactivates the Bluetooth transmitter and receiver but leaves the chip alive for a period of 1 minute.
Rec 1 Ch	This button activates the Bluetooth Receiver at the most recent frequency of operation for a period of 1 minute.
Turn Bluetooth Off	This button hard resets the Blue tooth device for a period of 1 minute.

4. Acronyms and Abbreviations

API	- Application Programming Interface
ASIC	- Application Specific Integrated Circuit
ASK	- Amplitude Shift Keying
COM	- RS-232-C communications serial port
CRC	- Cyclic Redundancy Check
DBSK	- Differential-Bi-phase-Keying
DBF	- Differential Bi-Phase
DCB	- Device-Context Buffer
Down-link	- Communication from the interrogator to the ASIC
DLL	- Dynamic Linked Library
DSD	- DLL Specification Document
EEPROM	- bit Electrically-Erasable/Programmable Read Only Memory
EIA	- Electronic Industries Association
FWSD	- Firmware Specification Document
GUI	- Graphical Users Interface
HHR	- Handheldd Reader
HMD	- HHR-Mobile-DLL
HPD	- HHR-PocketPC-DLL
INI file	- A file containing program initialization parameters
ISO11785	- ISO standard for reading animals
ISO14223	- ISO proposed standard for animal transponders with sensor technologies
POR	- Power-On-Reset
PSK	- Phase-Shift-Keying
RF	- Radio-Frequency
RFID	- Radio-Frequency Identification Device
RS-232-C	- EIA communications standard
HiP-SW	- HHR iPAQ Software Application
HM-SW	- HHR-Mobile Software Application
HP-SW	- HHR-PocketPC Software Application
SOP	- Start of Packet
TCF	- Period after POR for configuration
TPS	- Tire Pressure Stem
UID	- Unique Identification
Up-link	- Communication from the ASIC to the interrogator

5. Regulations

The TPS HHR system comprises a RF transmission device, and is therefore subject to national and international regulations. Phase IV Engineering has obtained approvals from approval authorities in a number of countries and is continuing to apply for approvals in further countries. Actual status can be advised by customer support. In countries where approval has not been obtained, this system may be operated only under an experimental license issued by the relevant approval authority and must not be marketed. Before any such device or system can be marketed, an equipment authorization must be obtained from the relevant approval authority.

FCC Notices (U.S.A.)
This equipment has been tested and found to comply with the limits for a Class A digital device and intentional radiator, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her expense. Modifications to this device shall not be made without the written consent of Phase IV Engineering, Incorporated. Unauthorized modifications may void the authority granted under Federal Communications Commission Rules permitting the operation of this device.

CE Conformity (Europe)
A CE Declaration of Conformity is available for this system through customer support. Any device or system incorporating the TPS HHR system, in full or in part, in any other than the originally tested configuration needs to be verified against the European EMC directive. The System Integrator or user of such a system prior to marketing and operating it in European Community must issue a separate Declaration of Conformity.

For more information regarding regulations and endorsements, including CE, ETL, and FCC, please contact technical support directly.

5.1 Supplemental Information to be in the Reader or System Manual

In addition to reiteration of required information as on intentional radiator, in keeping with sections 15.21 and 15.105 of the FCC rules, the manual supplied with the reader will also include the following admonitions:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio technician for help.

NO MODIFICATIONS: Modifications to this device shall not be made without the written consent of Phase IV Engineering, Incorporated. Unauthorized modifications may void the authority granted under Federal Communications Commission Rules permitting the operation of this device.

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