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HHT User Manual
Document # 200422

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Approvals

Revision	Name	Title	Signature
08	Edward Li	General Manager	

Revision History

Revision	Date	Responsible Person	Description
01d	May 13, 2018	Karin Garandza	Draft for Review
02	May 22, 2018	Karin Garandza	First Release
03	Oct 24, 2017	Edward Li	Added SAFT batt replacement option
04	July 29, 2018	Derek Soo	Continuous mode operation 4.1
05	June 27, 2018	Derek Soo	Update to LV2017
06	Oct 16, 2020	Derek Soo	LVNXG installer
07	July 3, 2024	Wesley Lam	Software limitations and known issues
08	Jan 29, 2025	Karin Garandza	New software revision, new features

Confidentiality Statement

Copyright Declaration

Trade-mark Declaration

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DEFINITIONS AND ABBREVIATIONS

The following terms and/or abbreviations are used in this manual:

Term	Definition
IR	Infrared – the type of communications interface which the HHT uses to transmit data.
SAE J2799	The SAE standard that defines the serial packets that are sent via infrared, from a fuel cell vehicle to a hydrogen station.
HHT	Hand-held transmitter – the product discussed in this manual, which is used to test infrared data communications.
Data message	One single line of SAE J2799 infrared data
Test pattern	The entire data file containing many data messages

APPLICABLE DOCUMENTS

The following documents are recommended as reference material.

Document Reference	Document Title	Document Number
[1]	SAE J2799-2024: Hydrogen Surface Vehicle to Station Communications Hardware and Software	SAE J2799-2024
[2]	SAE J2601-5_202402: High-Flow Prescriptive Fueling Protocols for Gaseous Hydrogen Powered Medium and Heavy-Duty Vehicles	SAE J2601-5_202402

1 SCOPE

This user manual provides an overview description of the **hand-held transmitter (HHT).** The HHT is a hand-held device used to test IR communication at a hydrogen fueling station.

2 INTRODUCTION

The **SAE J2799 standard** is a method of communicating information such as tank pressure and tank temperature from a hydrogen-powered vehicle to a hydrogen fueling station, during a fueling operation, using infrared. This communication is used to ensure that the hydrogen fueling is conducted in a controlled and safe manner.

The **HHT** is a hand-held device that can be used to test the infrared data communication at a hydrogen dispenser. The HHT is preprogrammed with a set of four test patterns that can be transmitted to the hydrogen station. The HHT can also be programmed by the user with a custom set of test patterns. The HHT is compatible with SAE J2799 version 1.0, 1.1, and 2.0 messages and SAE J2601-5.

FIGURE 2-1 HHT (HAND-HELD TRANSMITTER) FRONT VIEW

This manual includes the following:

- An overview of the HHT, including:
  - HHT interface details;
  - Pre-programmed test pattern information; and,
  - A quick-start guide.
- A guide to programming the HHT with user-defined test patterns, including:
  - An overview of SAE J2799 infrared data packets; and,
  - A guide to using the HHT Test Pattern Generator software to program the HHT.
- A troubleshooting section;
- A guide to installing the HHT test pattern generator software; and,
- A guide to updating the HHT firmware if/when new firmware upgrades are released.

3 REQUIREMENTS

The HHT requires the following equipment:

TABLE 3-1: REQUIRED EQUIPMENT

Qty	Part #	Description
1	200428	HHT (hand-held transmitter)
1		Desktop or laptop computer, Windows 7 SP1 or higher
1	200421	HHT test pattern generator software
1		USB cable (supplied by user) – USB A-Type to USB Mini-b (5-pin)

The batteries used in the HHT **must be purchased** on the one of the two following web sites:

Eve Batteries ER1405 at https://www.evemall.eu/

SAFT battery LS14500 at Amazon.com

4 GETTING STARTED

The HHT is a simple hand-held device that allows the user to select one of **four pre-programmed IRDI test patterns** to transmit to a hydrogen nozzle.

4.1 HHT USER INTERFACE

The HHT has the following features:

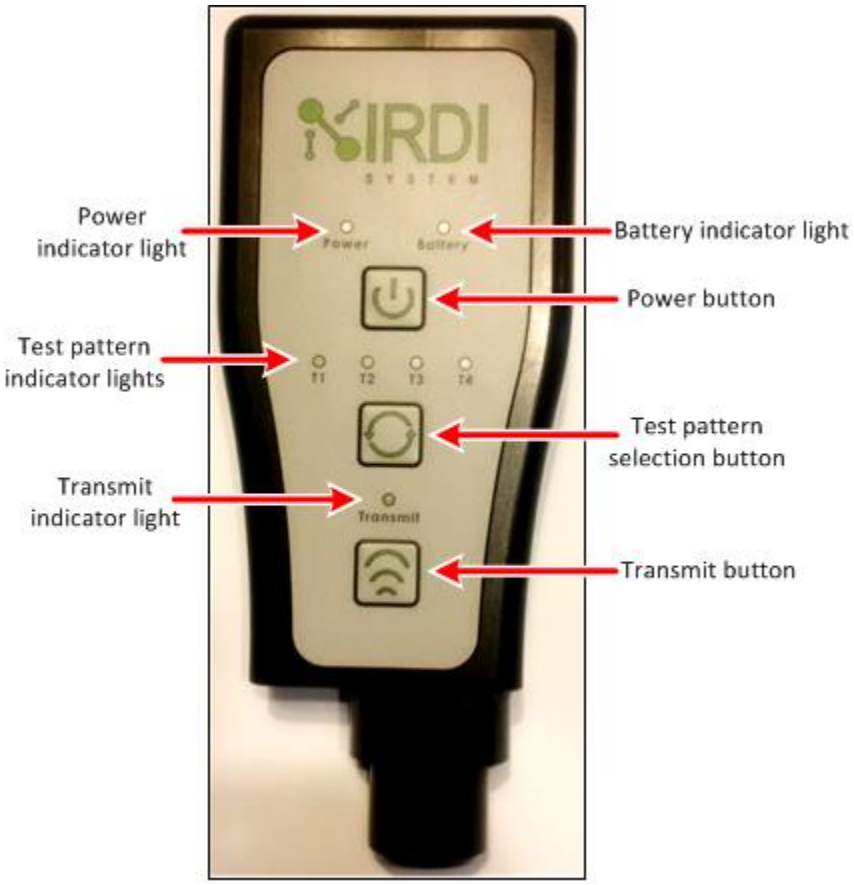

FIGURE 4-1 HHT FEATURES – BUTTONS AND LIGHTS

Button/LED	Action
Power button	a. When the HHT is turned off, hold the power button down for approximately 2 seconds to turn on the HHT. b. When the HHT is turned on, hold the power button down for approximately 2 seconds to turn off the HHT. NOTE: If the HHT is idle for 5 minutes or more, it will turn off automatically.
Power indicator light	The light is on when the HHT is powered up.
Battery indicator light	The light is on when the batteries need to be changed.
Test pattern selection button	When the HHT is turned on, press the test button to change the test pattern to one of the 4 selections – T1, T2, T3 or T4. Each time the test button is pressed, the selection moves to the next test pattern (e.g. from T2 to T3).
Test pattern indicator lights	The light is on when the corresponding test pattern is selected (e.g. T1 light is on when test pattern T1 is selected). NOTE: Only one test pattern can be selected at any given time.
Transmit button	1. When the HHT is turned on, **press and release** the transmit button to send the selected test pattern – all test packets in the test pattern will be **transmitted through once**, at 100 ms intervals. 2. When the HHT is turned on, **press-and-hold** *(for 4 seconds, minimum)* & release the transmit button to send the selected test pattern **continuously** – all test packets in the test pattern will be transmitted through, at 100 ms intervals, and repeated. **Press-and-hold** *(for 4 seconds, minimum)* & release the transmit button to finish the test pattern and **stop** *(end continuous transmission)* NOTE: While a test pattern is being transmitted, all other button presses will be ignored [except **press-and-hold** *(for 4 seconds, minimum)* & release the transmit button]
Transmit indicator light	The light is on while the HHT is transmitting a test pattern. The light goes off when the test pattern is finished transmitting.

The HHT's infrared transmitter is located as follows:

FIGURE 4-2 HHT INFRARED TRANSMITTER LOCATION

4.2 CHANGING THE BATTERIES

The HHT uses two **3.6V Lithium batteries**. Please purchase these batteries from the one of the following two suppliers **only**:

Eve Batteries ER14505 at https://www.evemall.eu/

SAFT battery LS14500 at Amazon.com

To change the batteries in the HHT, do the following:

Action	
STEP 1	Using a 2.5 mm HEX driver, open the back cover of the HHT.
STEP 2	Remove the old batteries – see Figure 4-3.
STEP 3	Install two new batteries – see Figure 4-3. **Make sure to place the batteries in the right orientation** – see the polarity markings on the circuit board under the battery holders.
STEP 4	Using a 2.5 mm HEX driver, reattach the back cover of the HHT.
STEP 5	Test the new batteries - press and hold the power button on the HHT for about 2 seconds, until the “power” light comes on.

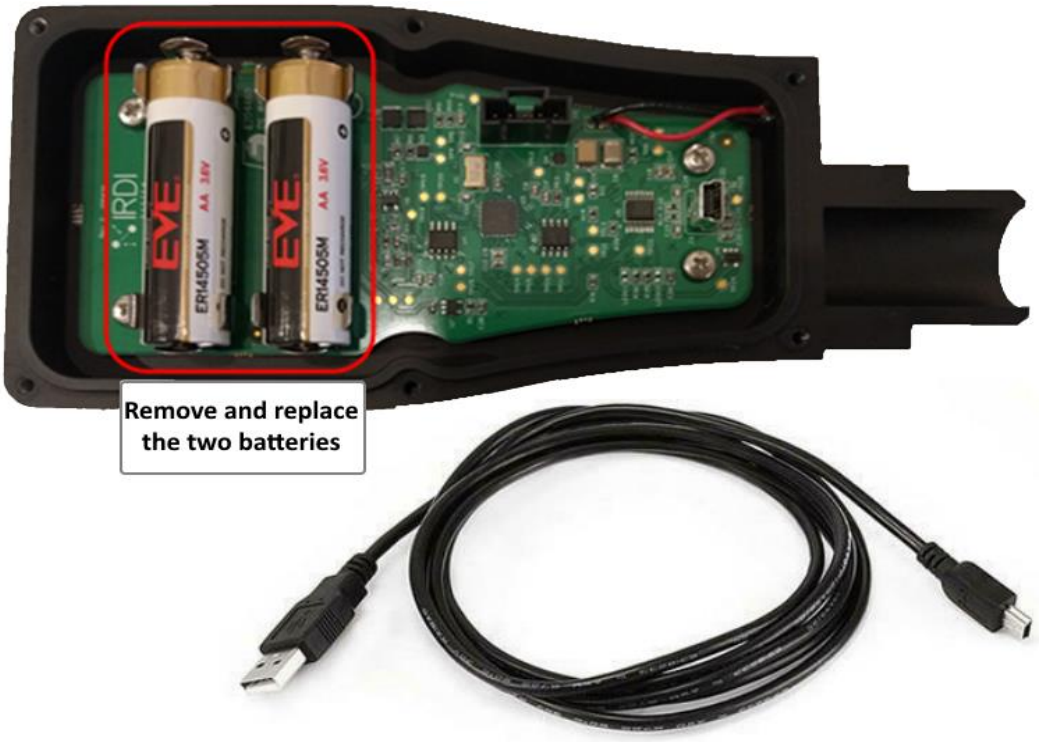

FIGURE 4-3 HHT BATTERIES - LOCATION IN HHT

4.3 HHT QUICK-START GUIDE

To use the HHT, do the following:

	Action
STEP 1	Prepare the hydrogen dispenser to display and record IR data.
STEP 2	Press and hold the power button on the HHT for about 2 seconds, until the "power" light comes on.
STEP 3	Press the "test pattern selection" button on the HHT, to select the test pattern (T1, T2, T3 or T4) - the associated LED for the selection will light up.
STEP 4	Holding the nozzle in one hand, insert the HHT into the end of the hydrogen nozzle, as shown in Figure 4-4 below.
STEP 5	Press the "transmit" button on the HHT, to transmit the selected test pattern. Verify that the station received the IRDI test pattern correctly.
STEP 6	Repeat steps 3 and 5 above, to transmit additional test patterns.
NOTE	To turn off the HHT, press and hold the power button for about 2 seconds.

FIGURE 4-4 HHT ATTACHED TO HYDROGEN NOZZLE

4.4 NOTES

Action	
NOTE 1	The HHT will turn off automatically after 5 minutes.
NOTE 2	If the battery is too low to operate, pressing the power button will cause the battery light to come on for 3 seconds, after which the HHT will power down.
NOTE 3	If the HHT is on and the battery voltage falls below the operating threshold, the battery light will turn on, and the HHT will continue to function.
NOTE 4	If the battery light is on, and the HHT is turned off, the user will no longer be able to turn on the HHT – if the power button is pressed, the battery light will come on for 3 seconds, then the HHT will turn off.

4.5 PRE-PROGRAMMED (DEFAULT) TEST PATTERNS

The HHT is delivered with **four pre-programmed (default)** infrared data message test patterns - T1, T2, T3 and T4.

These four pre-programmed test patterns are as follows:

4.5.1 Test Pattern 1 (T1)

NOTE: The BOF, CRC and EOF fields are included but not shown.

Number of transmitted IRDI packets: 5 identical test messages, as follows:

Line #	Test Pattern	OD Field
1	ID=SAE J2799|VN=1.10|TV=0180.0|RT=H70|FC=Dyna|MP=010.0|MT=116.0|	None

4.5.2 Test Pattern 2 (T2)

NOTE: The BOF, CRC and EOF fields are included but not shown.

Number of transmitted IRDI packets: 10 test messages in compliance with ISO 17268-2020 (Section 7.28 – Communication Test)

Line #	Test Pattern	OD Field
1, 3, 5, 7, 9	ID=SAE J2799|VN=01.00|TV=0050.0|RT=H70|FC=Abort|MP=087.5|MT=358.2|	None
2, 4, 6, 8, 10	ID=SAE J2799|VN=01.00|TV=0050.0|RT=H70|FC=Dyna|MP=087.5|MT=358.2|	None

4.5.3 Test Pattern 3 (T3)

NOTE: The BOF, CRC and EOF fields are included but not shown.

Number of transmitted IRDI packets: 50 test messages with increasing MP and MT data, as follows:

Line #	Test Pattern	OD Field
1 to 25	ID=SAE J2799|VN=1.10|TV=0180.0|RT=H70|FC=Halt|MP=X|MT=Y| NOTE: see table # below for the MP and MT values	None
26 to 50	ID=SAE J2799|VN=1.10|TV=0180.0|RT=H70|FC=Abort|MP=X|MT=Y| NOTE: see Table 4-1 below for the MP and MT values	None

TABLE 4-1: TEST PATTERN 3 – MT AND MP VALUES

Line #	MP, X Value	MT, Y Value	Line #	MP, X Value	MT, Y Value
1	0	20	26	25	170
2	1	26	27	26	176
3	2	32	28	27	182
4	3	38	29	28	188
5	4	44	30	29	194
6	5	50	31	30	200
7	6	56	32	31	206
8	7	62	33	32	212
9	8	68	34	33	218
10	9	74	35	34	224
11	10	80	36	35	230
12	11	86	37	36	236
13	12	92	38	37	242
14	13	98	39	38	248
15	14	104	40	39	254
16	15	110	41	40	260
17	16	116	42	41	266
18	17	122	43	42	272
19	18	128	44	43	278
20	19	134	45	44	284
21	20	140	46	45	290
22	21	146	47	46	296
23	22	152	48	47	302
24	23	158	49	48	308
25	24	164	50	49	314

4.5.4 Test Pattern 4 (T4)

NOTE: The BOF, CRC and EOF fields are included but not shown.

Number of transmitted IRDI packets: 100 test messages with increasing MP and MT data, as follows:

Line #	Test Pattern	OD Field
1 to 100	ID=SAE J2799|VN=1.10|TV=0180.0|RT=H70|FC=Dyna|MP=X|MT=Y| NOTE: see Table 4-2 below for the MP and MT values	None

TABLE 4-2: TEST PATTERN 4 – MT AND MP VALUES

Line #	MP, X Value	MT, Y Value	Line #	MP, X Value	MT, Y Value
1	0	20	51	25	268
2	0.5	25	52	26	271
3	1	30	53	26	274
4	2	35	54	27	277
5	2	40	55	27	280
6	3	45	56	28	283
7	3	50	57	28	286
8	4	55	58	29	289
9	4	60	59	29	292
10	5	65	60	30	295
11	5	70	61	30	298
12	6	75	62	31	301
13	6	80	63	31	304
14	7	85	64	32	307
15	7	90	65	32	310
16	8	95	66	33	313
17	8	100	67	33	316
18	9	105	68	34	319

Line #	MP, X Value	MT, Y Value	Line #	MP, X Value	MT, Y Value
19	9	110	69	34	322
20	10	115	70	35	325
21	10	120	71	35	328
22	11	125	72	36	331
23	11	130	73	36	334
24	12	135	74	37	337
25	12	140	75	37	340
26	13	145	76	38	343
27	13	150	77	38	346
28	14	155	78	39	349
29	14	160	79	39	352
30	15	165	80	40	355
31	15	170	81	40	358
32	16	175	82	41	361
33	16	180	83	41	364
34	17	185	84	42	367
35	17	190	85	42	370
36	18	195	86	43	373
37	18	200	87	43	376
38	19	205	88	44	379
39	19	210	89	44	382
40	20	215	90	45	385
41	20	220	91	45	388
42	21	225	92	46	391
43	21	230	93	46	394
44	22	235	94	47	397
45	22	240	95	47	400
46	23	245	96	48	403
47	23	250	97	48	406
48	24	255	98	49	409
49	24	260	99	49	412
50	25	265	100	50	415

5 PROGRAMMING THE HHT TEST PATTERNS

The HHT is delivered with four pre-programmed (default) test patterns (see Section 4.5 for details). To **change these test patterns**, use the supplied **HHT test pattern generator software**. The test pattern generator software installer can be found at https://irdisystem.com/software/ .

This section describes how to use the HHT test pattern generator software.

5.1 SETTING UP HHT FOR PROGRAMMING

The HHT can be programmed with new user-defined test patterns, using the HHT test pattern generator software.

The following figure shows the HHT with its back cover removed:

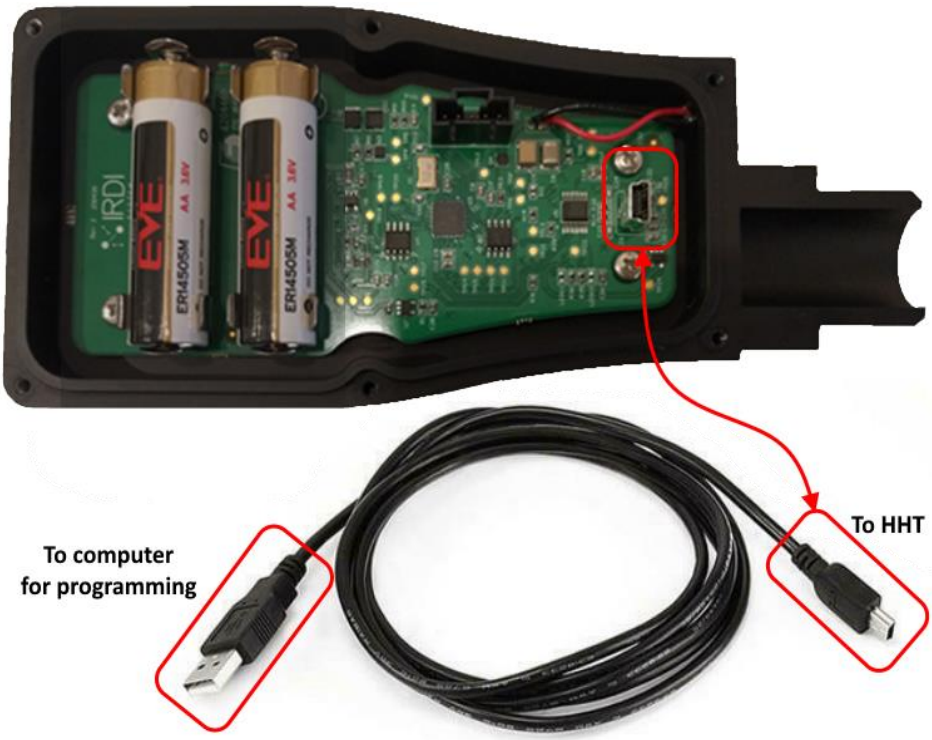

FIGURE 5-1 HHT PROGRAMMING SETUP

To set up the HHT for reprogramming, do the following:

Action	
STEP 1	Using a 2.5 mm HEX driver, open the back cover of the HHT.
STEP 2	Attach the USB cable (5-pin Mini-b connector) to the USB connector on the HHT's circuit board – see Figure 5-1 above.
STEP 3	Attach the other end of the USB cable (A-type connector) to a USB port on your computer.
STEP 4	Depending on your PC settings, the USB drivers may install automatically from Windows Update – Note that you must be connected to the Internet.
STEP 5	Device may appear in Device Manager with a yellow exclamation mark. If this happens, open Device Manager - see Figure 5-2. To verify– see Figure 5-3. Initiate the USB driver installation by right-clicking the USB device and selecting "> Update Drivers > Automatic? (Search Windows Update)"

5.1.1 Plugging in the HHT

To set up infrared data transmitter hardware, be sure that you are connected to the internet, then follow the steps below, and see Figure 5-1.

Action	
STEP 1	Insert the infrared data transmitter's USB plug into an available USB port on the computer.
STEP 2	Depending on your PC settings, the USB drivers may install automatically from Windows Update – Note that you must be connected to the Internet.
STEP 3	Device may appear in Device Manager with a yellow exclamation mark. If this happens, open Device Manager - see Figure 5-2. To verify– see Figure 5-3. Initiate the USB driver installation by right-clicking the USB device and selecting "> Update Drivers > Automatic? (Search Windows Update)".

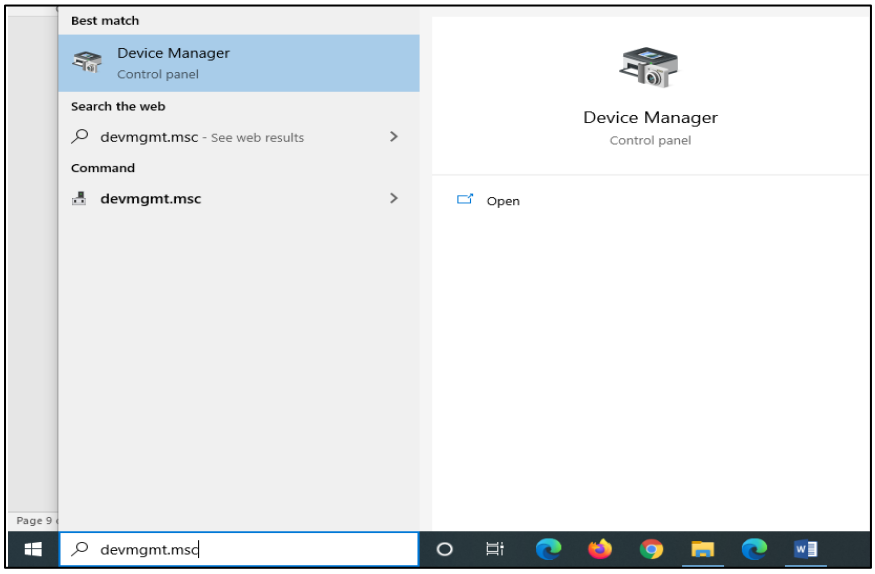

FIGURE 5-2 OPEN DEVICE MANAGER

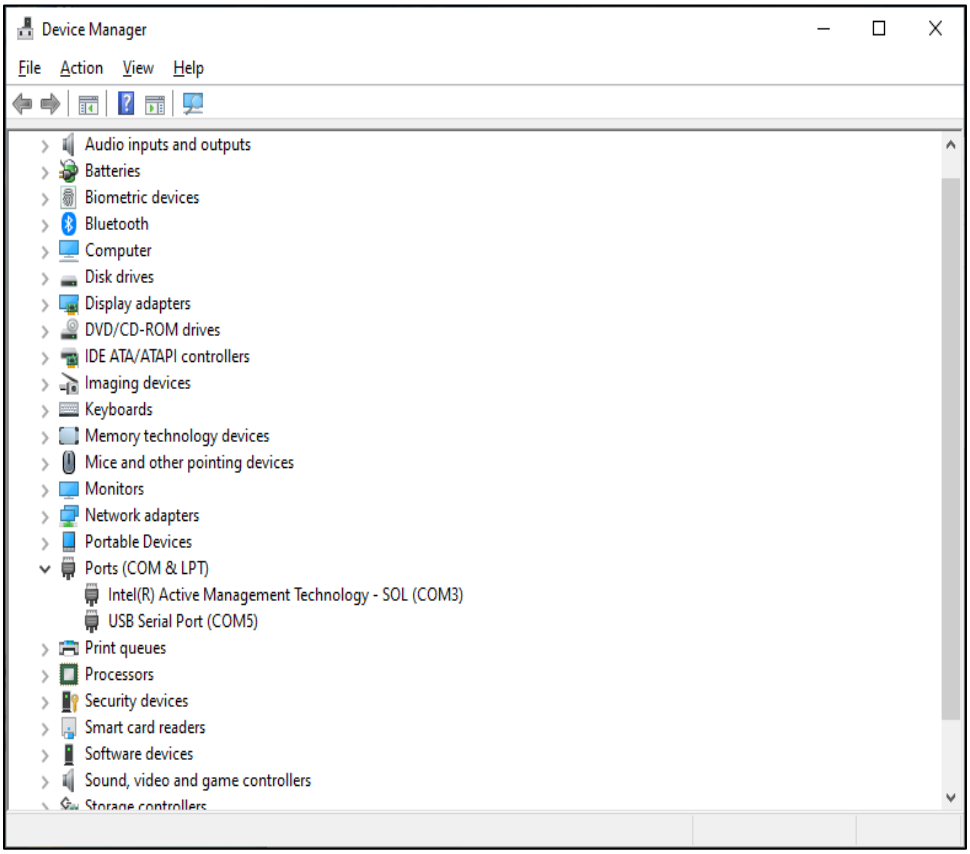

FIGURE 5-3 VERIFY IN DEVICE MANAGER

5.1.2 Installing HHT Test Pattern Generator Software

	Action
STEP 1	Download the test pattern generator software installer from https://irdisystem.com/software/. Locate the installation files for 200421_R05 - IRDI HHT Test Pattern Generator. Double-click on “setup” to begin – see Figure 5-4.

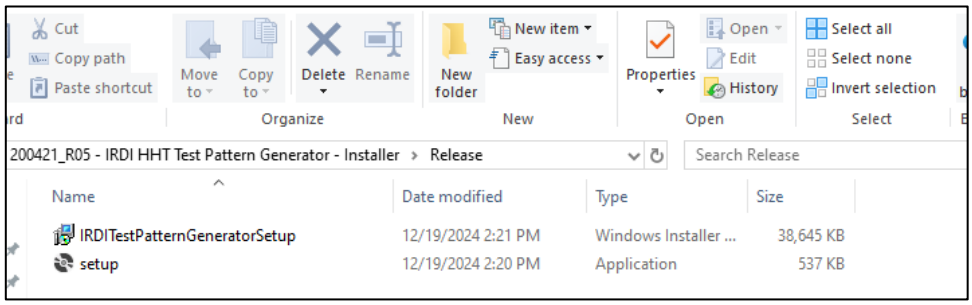

FIGURE 5-4 INSTALLER FILE LOCATION

	Action
STEP 2	The installer splash screen will appear as follows – click on the “Next” button:

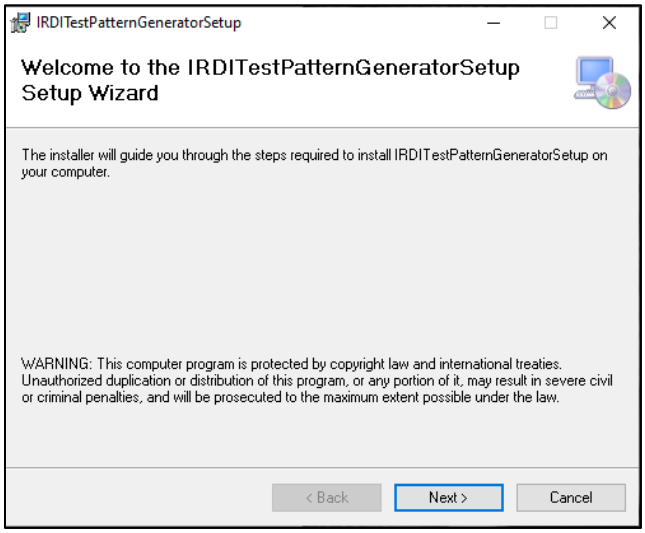

FIGURE 5-5 INSTALLER SPLASH SCREEN

Action	
STEP 3	Select the destination directory, then click on the “Next” button – see Figure 5-6.

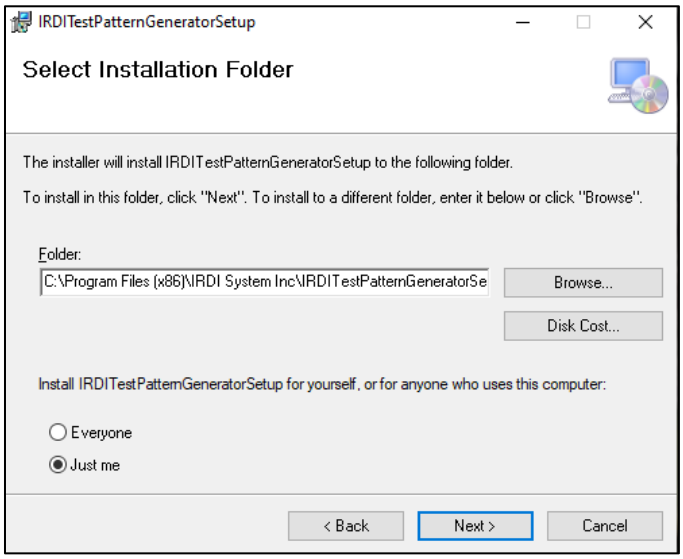

FIGURE 5-6 DESTINATION DIRECTORY

	Action
STEP 4	Confirm the installation process by clicking the “Next” button - see Figure 5-7. (To cancel the installation, click on the “Cancel” button.)

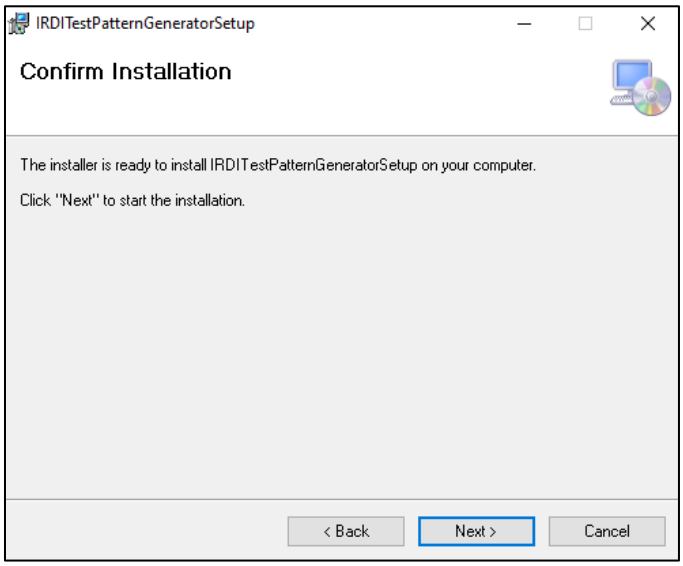

FIGURE 5-7 CONFIRMING INSTALLATION

	Action
STEP 5	Wait for the software to install – see Figure 5-8.

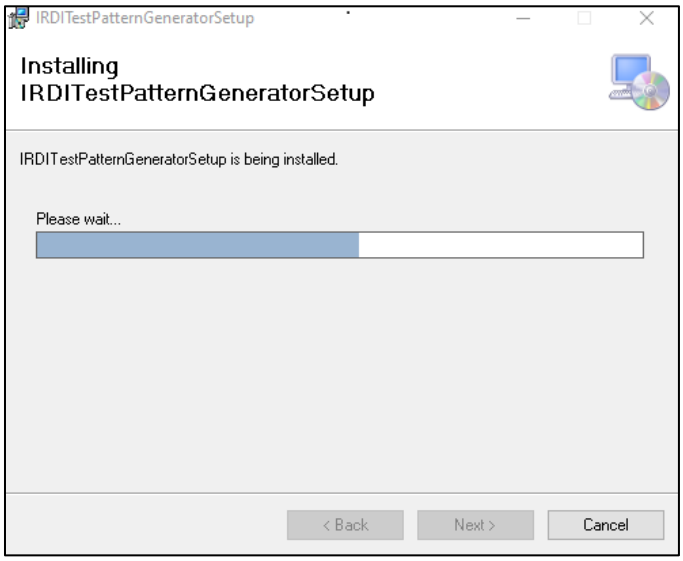

FIGURE 5-8 INSTALLING SOFTWARE

Action	
STEP 6	When the installation is complete, click on the “Close” button – see Figure 5-9.

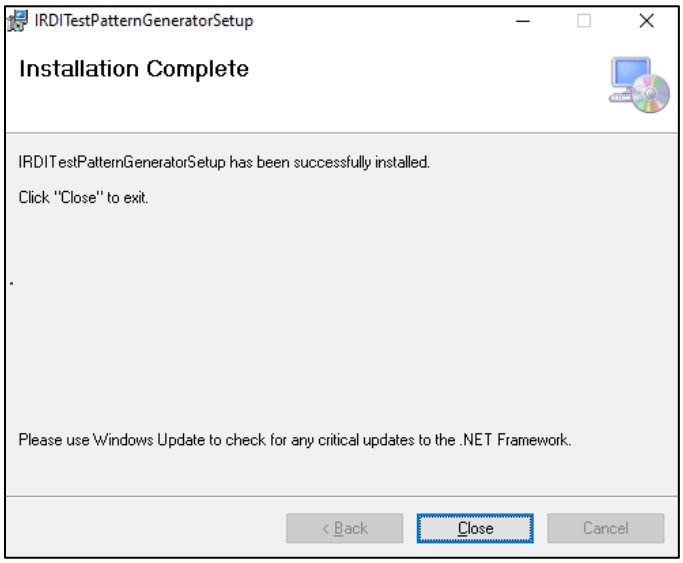

FIGURE 5-9 INSTALLATION COMPLETE

5.1.3 Starting HHT Test Pattern Generator Software

To start the HHT Test Pattern Generator software, do the following:

Action	
STEP 1	Locate the program in the Windows Start menu – see Figure 5-10.

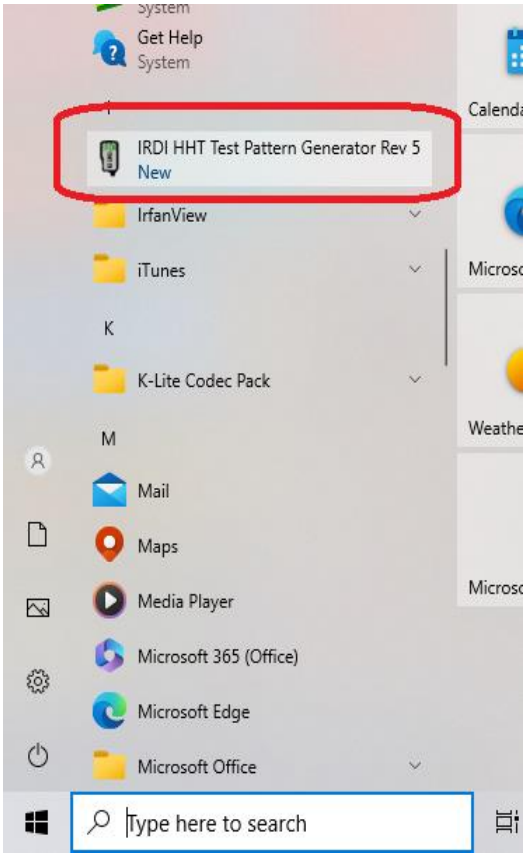

FIGURE 5-10 SOFTWARE SHORTCUT IN START MENU

Action	
STEP 2	Click on the icon for the HHT program. The IRDI HHT Test Pattern Generator main screen will appear – see Figure 5-11.

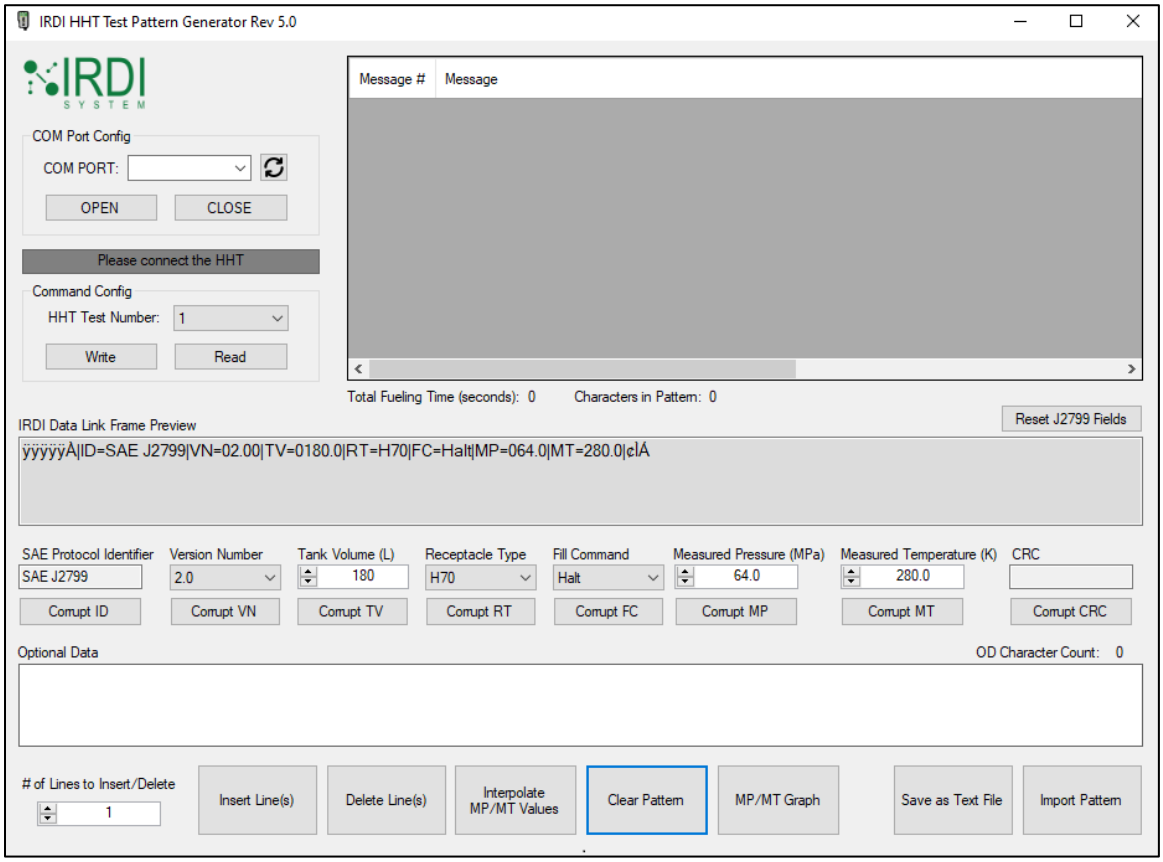

FIGURE 5-11 HHT TEST PATTERN GENERATOR SOFTWARE

6 HHT PROGRAMMING GUIDE

6.1 UNDERSTANDING THE INFRARED DATA MESSAGES

The HHT transmits infrared data messages through an infrared data transmitter. The user can receive these messages via a user-supplied infrared data receiver, and can view these messages using any terminal program, such as HyperTerminal.

Each message is a text string of fixed length, with a fixed set of fields. The meaning of each field in the infrared data message is as follows:

TABLE 6-1 INFRARED DATA MESSAGE FIELDS

Field Identifier	Definition	Range of Values
ÿÿÿÿÿÀ	Delimiting characters that define start of infrared data message	n/a
ID	Name of the communication protocol – in this case, SAE J2799	SAE J2799
VN	Version number of the communications protocol	Range: 00.00 – 99.99 Valid values: 1.0, 1.1, 2.0
TV	Total volume – the volume of the hydrogen tank(s) in the vehicle	0000.0 – 5000.0 litres
RT	Receptacle type – style of hydrogen receptacle used on the vehicle	H25, H35, H50 and H70
FC	Fill command – indicates the type of hydrogen fill in progress, or the reason for the fill's termination	Dyna, Stat, Halt and Abort
MP	Measured pressure – the pressure reading of the hydrogen tank in the vehicle	000.0 – 100.0 MPa
MT	Measured temperature – the temperature reading of the hydrogen tank in the vehicle	16.0 – 425.0 K
MéÁ	Delimiting characters that define end of infrared data message, plus checksum	Varies depending on the checksum

6.2 USING THE IRDI HHT TEST PATTERN GENERATOR SOFTWARE

The Test Pattern Generator software and handheld transmitter (HHT) provide the user with full control over the transmitted infrared data messages, allowing the user to generate test messages to the infrared data transmitter using manually-entered data.

To set up and use the HHT hardware and software, do the following:

	Action
STEP 1	Set up the HHT hardware and Test Pattern Generator software as per Section 5.1.
STEP 2	Start the computer on which the HHT Test Pattern Generator software is installed.
STEP 3	From the Start menu, locate and start the program. The program's main screen appears as shown in Figure 6-1.

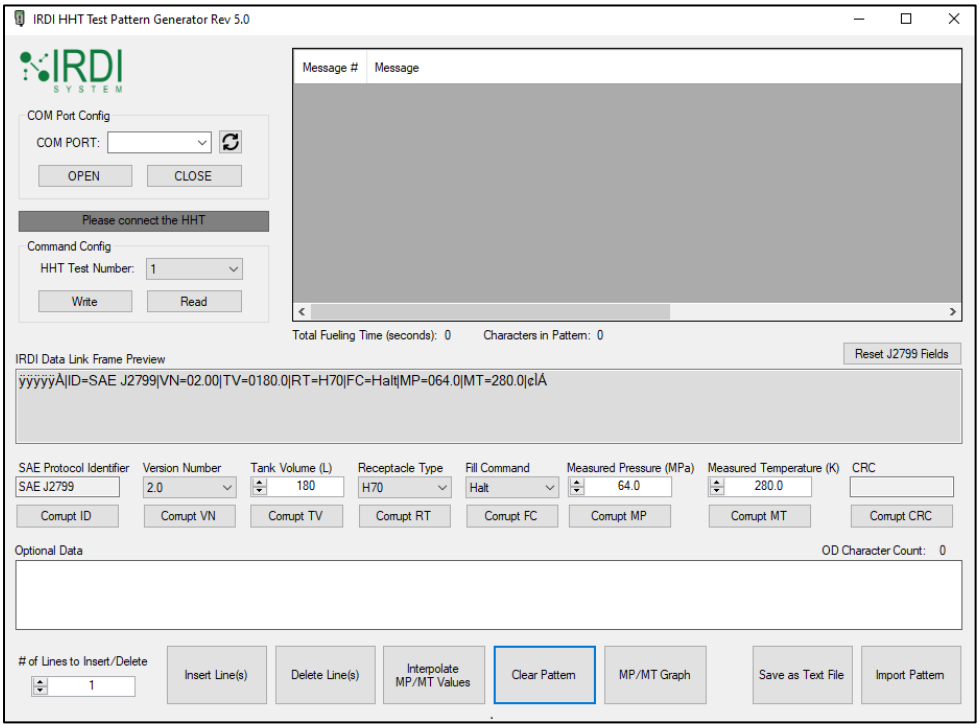

FIGURE 6-1 HHT TEST PATTERN GENERATOR SOFTWARE, MAIN SCREEN

Action	
STEP 4	Select the communications port in the “COM PORT” drop-down menu – see Figure 6-2. This port should correspond to the IRDI Transmitter found in Device Manager (see Figure 5-3).
NOTE	If the HHT was not connected at program startup, you may need to use the refresh button at the right side of the “COM PORT” field, to refresh the COM port list (see below).

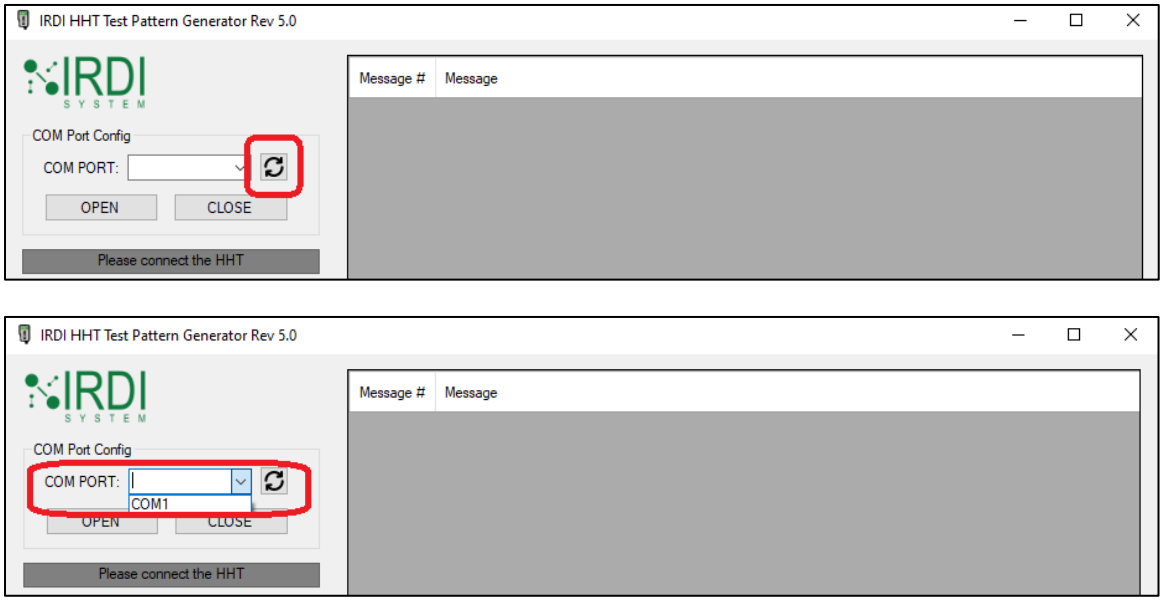

FIGURE 6-2 REFRESH PORTS, SELECT A COMMUNICATION PORT

	Action
STEP 5	Click on the “OPEN” button under the “COM PORT”, to open the port and start communicating with the HHT. If the port opens successfully, the screen will appear as shown in Figure 6-3, with the “HHT Connected…” message shown in green.

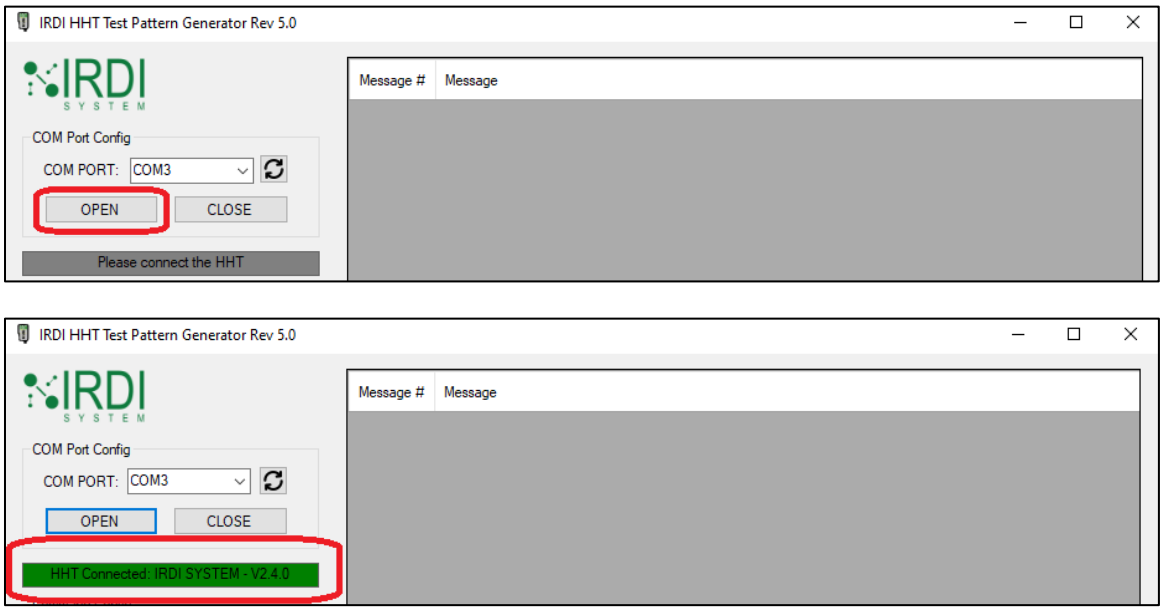

FIGURE 6-3 COMMUNICATION PORT OPENED

To exit from the HHT Test Pattern Generator application, click on the “X” in the top right corner of the screen.

The HHT Test Pattern Generator software screen is comprised of several areas, as follows:

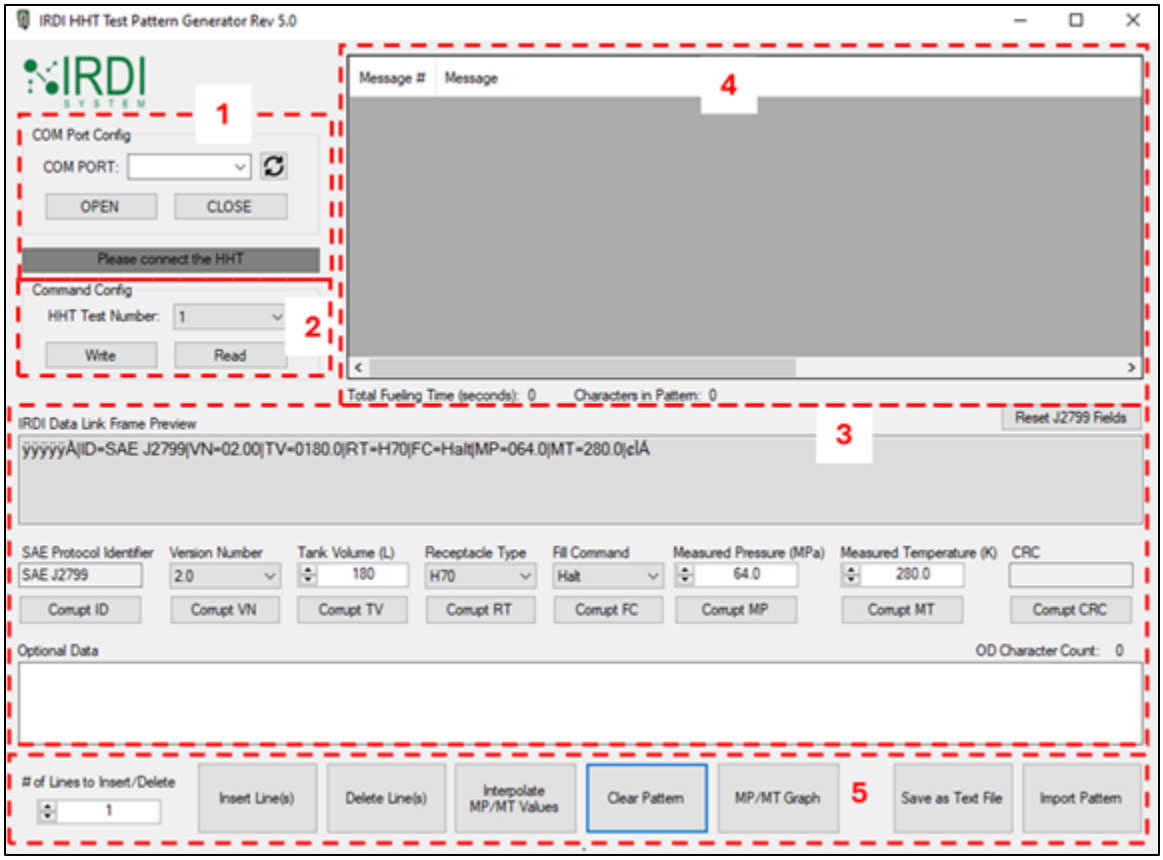

FIGURE 6-4 HHT TEST PATTERN GENERATOR SOFTWARE – SCREEN AREAS

The main screen areas include the following (refer to Figure 6-4 above):

- **1: HHT communications status:**
  - Allows user to select and open a communication port
  - Shows the state of the HHT communications – either “Please connect the HHT” or “HHT connected”.
- **2: Test pattern file control:**
  - Allows user to select an HHT Test Number to either write to (programming the HHT), or read (reading existing test pattern from the HHT).

- **3: Test pattern assembly area:**
  - Used to create and preview a user-defined test pattern line, consisting of user-defined values for each IR data field.
  - NOTE: The CRC is generated automatically, based on the pattern values.
- **4: Test pattern file information:**
  - Shows the test pattern lines that have been either read from the HHT, or assembled for the HHT. Includes the amount of time (total fueling time) it takes to transmit the file using the HHT, and the total number of characters in the test pattern.
- **5: Test pattern file management area:**
  - Used to insert or delete new lines for a new test pattern, create and save a new test pattern file, open an existing test pattern file, interpolate temperature and pressure values for a new test pattern, and graph the temperatures and pressures in a test pattern.

6.2.1 Maximum Single Data Message Length

The HHT can accommodate custom data messages up to 320 characters. Single messages that exceed the 320 characters will be truncated automatically.

6.2.2 Maximum Test Pattern Length

The HHT can accommodate up to 1024 lines of custom data messages in each test pattern, provided that they do not exceed 200,000 characters in length. Test patterns exceeding this limit may appear corrupted, and will not properly signal the termination of a test. Refer to Table 6-1 below for the approximate maximum number of lines based on optional data length.

TABLE 6-1: APPROXIMATE MAXIMUM TEST PATTERN LENGTHS

Optional Data Characters	Single Data Message Length	Maximum Lines
0	76*	2631*
16	96*	2083*
70	151*	1324*
240	320*	625*

* approximate values

6.3 OPENING A TEST PATTERN FILE

To open an existing test pattern file, do the following:

	Action
STEP 1	Click on the “Import Pattern” button – see Figure 6-5.

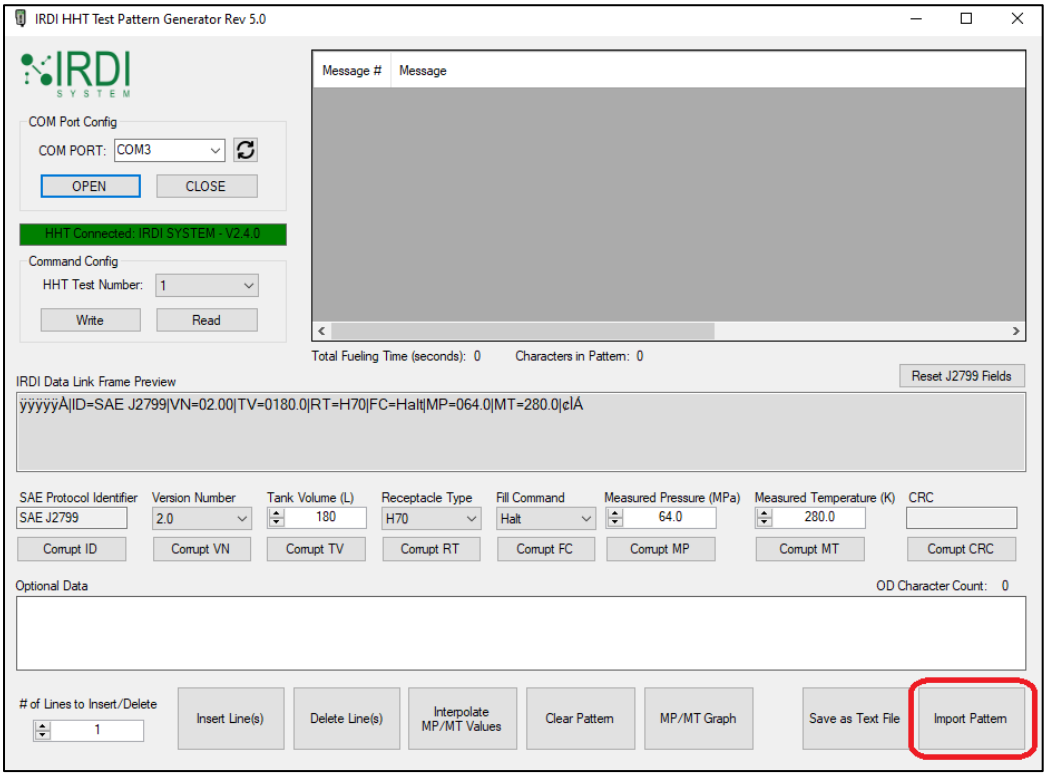

FIGURE 6-5 HHT TEST PATTERN GENERATOR SOFTWARE - IMPORT PATTERN BUTTON

	Action
STEP 2	A browser window will appear. Browse to the directory containing the file, and click on the file to select it (e.g. “myPattern1” in Figure 6-6).
STEP 3	Click on the “Open” button to open the file.

Action	
NOTE	A test pattern file can contain a maximum of 200,000 characters.

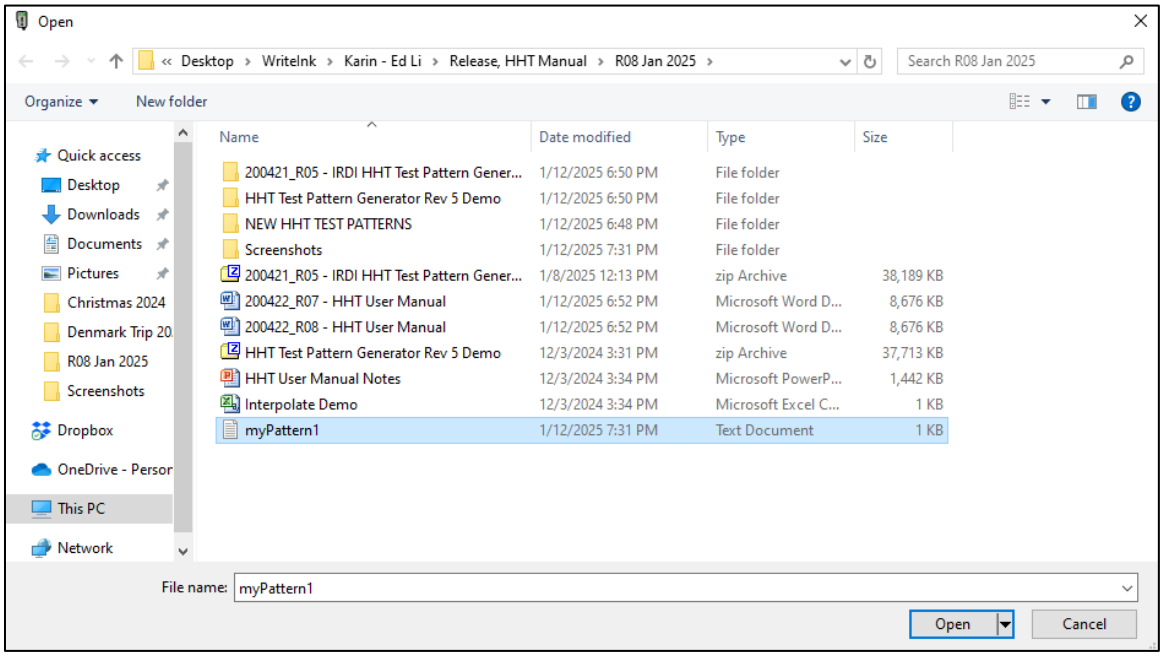

FIGURE 6-6 HHT TEST PATTERN GENERATOR SOFTWARE – SELECT A FILE TO OPEN

Action	
STEP 4	View the imported test pattern in the upper right area of the HHT Test Pattern Generator screen – see Figure 6-7.

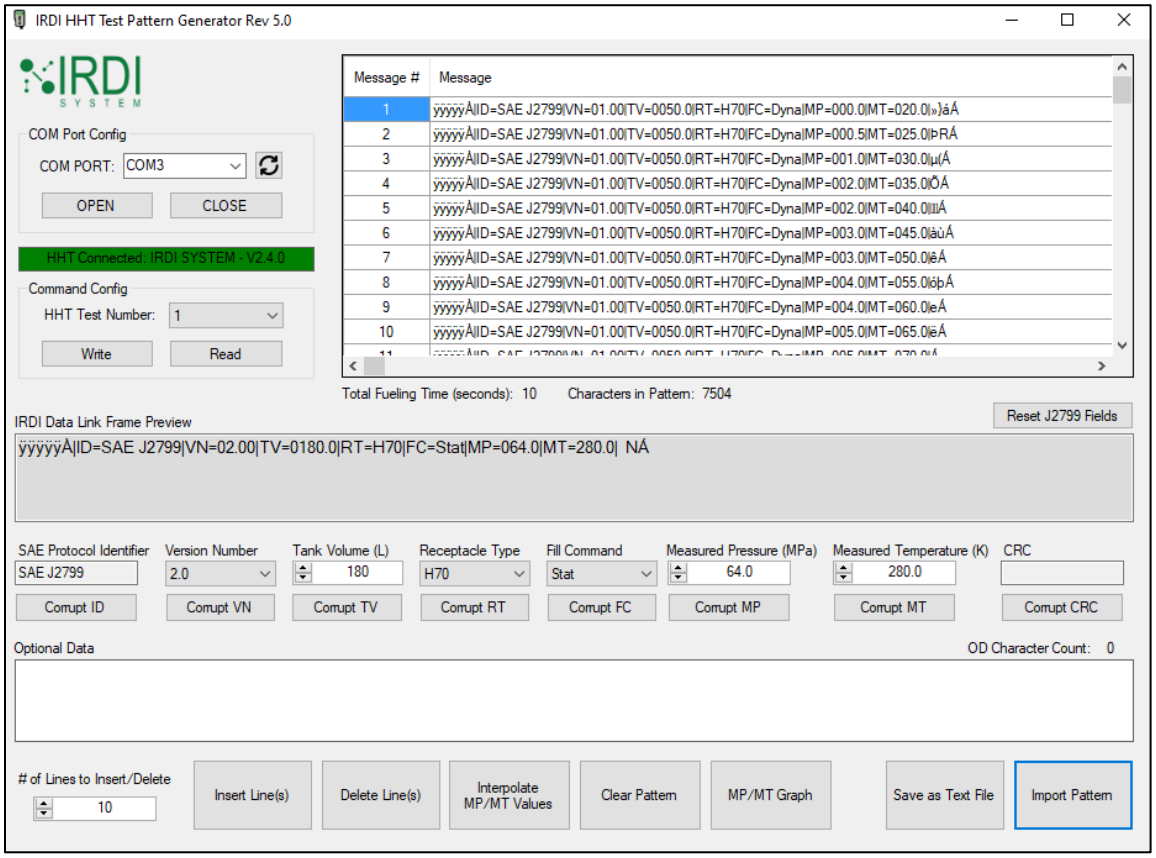

FIGURE 6-7 HHT TEST PATTERN GENERATOR SOFTWARE – FILE CONTENTS

At the **top right** of the screen, the messages in the test pattern file are shown – each line is a single IR test packet with a unique "Message #". To scroll through the message lines, use the scroll bar on the right side of the file contents display.

See Section 6.1 for details on how to read an IR message.

Below the file contents display, the following is shown:

- Total fueling time – the time, in milliseconds, that it will take to transmit the contents of the test pattern file.
- Characters in pattern – the total number of characters in the test pattern messages.

NOTE: The HHT transmits 1 test pattern line every 100 ms. For example, a test pattern file with 5 lines will take 500 ms, so “Total fueling time” will be “00:00.500”.

6.4 CREATING A NEW TEST PATTERN FILE

To create a new user-defined test pattern file, do the following:

	Action
STEP 1	Create and add test pattern lines (IR packets), using the “Test Pattern Assembly Area” of the HHT Test Pattern Generator software.
STEP 2	Save the file under a file name.

Each of these steps is described in detail in the following subsections.

6.4.1 Creating and Adding Test Pattern Lines

The user can create unique test pattern lines by changing the values of the “VN”, “TV”, “RT”, “FC”, “MP”, “MT” and/or “OD” message fields manually.

To create a new test pattern line, do the following (refer to Figure 6-8):

Action	
STEP 1	Select the desired values for each of the message fields (see the following subsections for details on each message field).
STEP 2	View the test pattern in the “IRDI Data Link Frame Preview” window, to make sure that it is correct.
STEP 3	Click in the “# of Lines to Insert/Delete” field at the bottom left of the screen, and enter the number of copies of the line that you wish to add to the file.
STEP 4	Click on the “Insert Line(s)” button to add the line or lines to the test pattern file.
STEP 5	View the new test pattern lines in the “Test Pattern File Information” area of the screen.

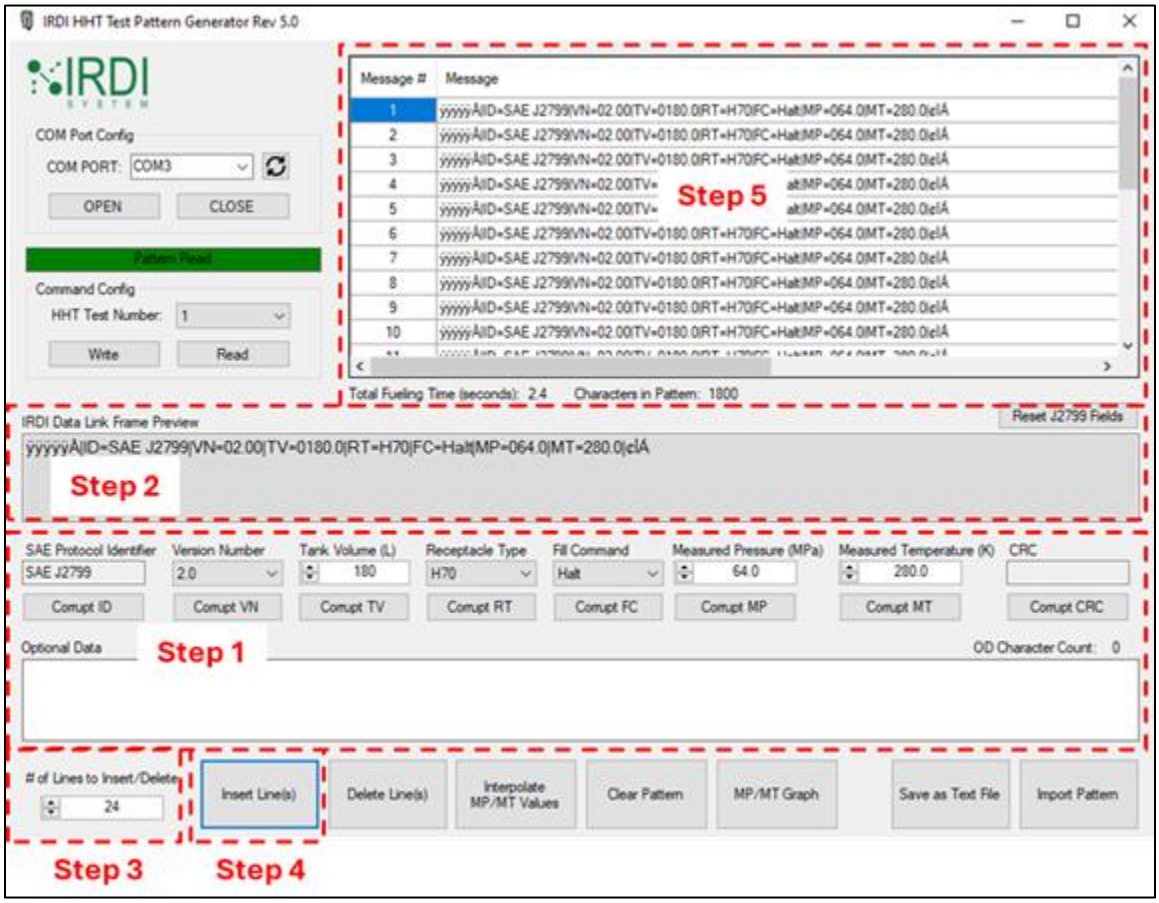

FIGURE 6-8 HHT TEST PATTERN GENERATOR SOFTWARE - CREATING TEST PATTERN LINES

The following shows an example of changing the “FC” field – the selected value, “HALT”, is displayed as part of the test pattern line in the “IRDI Data Link Frame Preview” window:

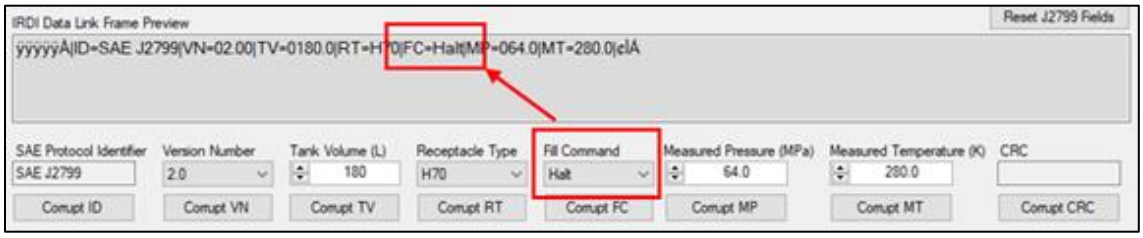

FIGURE 6-9 HHT TEST PATTERN GENERATOR SOFTWARE – FILL COMMAND INPUT

The following sub-sections provide details on how to change the value of each field in the test pattern:

Changing the “VN” Value

To change the “VN” (version number) value manually, do the following:

	Action
STEP 1	Click on the “down” arrow to the right of the “VN” window, to see a pull-down menu of version number options. (see below)
STEP 2	Select one of the available version numbers, to change the version number value in the infrared data message. (see below)

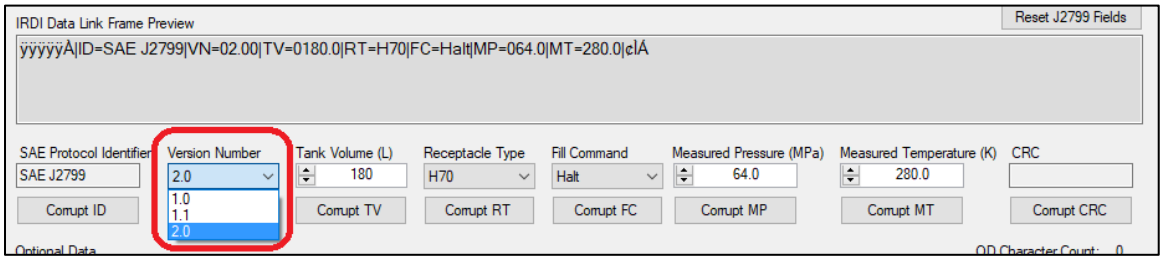

FIGURE 6-10 HHT TEST PATTERN GENERATOR SOFTWARE – VERSION NUMBER INPUT

Changing the "RT" Value

To change the "RT" (receptacle type) value manually, do the following:

	Action
STEP 1	Click on the "down" arrow to the right of the "RT" window, to see a pull-down menu of options. (see below)
STEP 2	Select one of the available RT values ("H25", "H35", "H50" or "H70") to change the receptacle type value in the infrared data message. (see below)

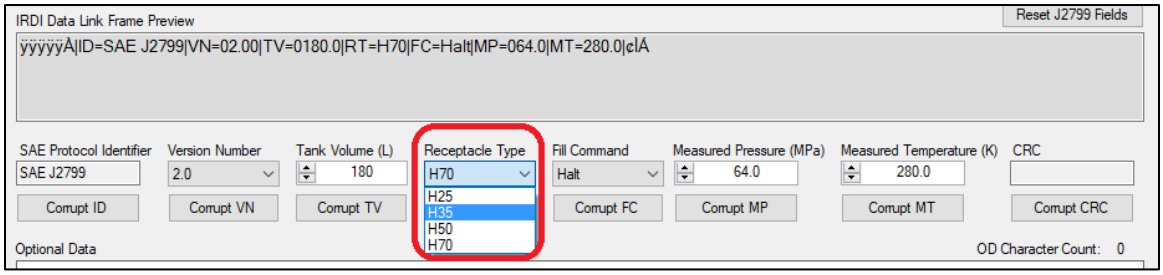

FIGURE 6-11 HHT TEST PATTERN GENERATOR SOFTWARE - RECEPTACLE TYPE INPUT

Changing the "TV" Value

To change the "TV" (total volume) value manually, do the following:

	Action
STEP 1	Click on the "TV" window and use the keyboard to enter a new value OR click on the "up" or "down" arrows to the left of the "TV" window, to change the total volume value in the infrared data message. (see below)
NOTES	The user must include the decimal place when entering a value in the window. Each "up" or "down" arrow click will increment or decrement the "TV" value by 1.0. If the user enters a fractional number, the value will be automatically rounded to the nearest whole number.

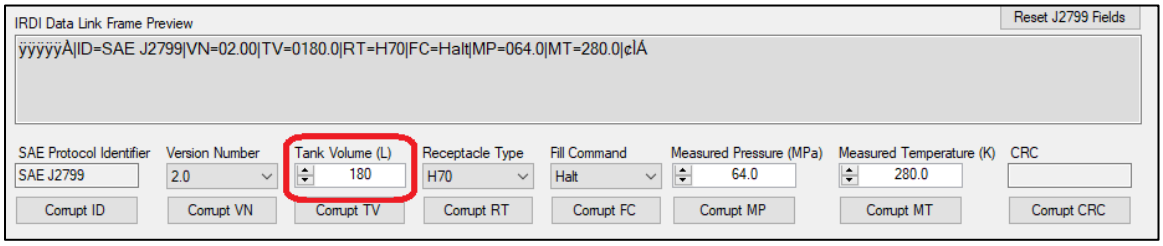

FIGURE 6-12 HHT TEST PATTERN GENERATOR SOFTWARE - TOTAL VOLUME INPUT

Changing the "FC" Value

To change the "FC" (fill command) value manually, do the following:

	Action
STEP 1	Click on the "down" arrow to the right of the "FC" window, to see a pull-down menu of options. (see below)
STEP 2	Select one of the available fill commands ("DYNA", "STAT", "HALT" or "ABORT") to change the fill command value in the infrared data message. (see below)

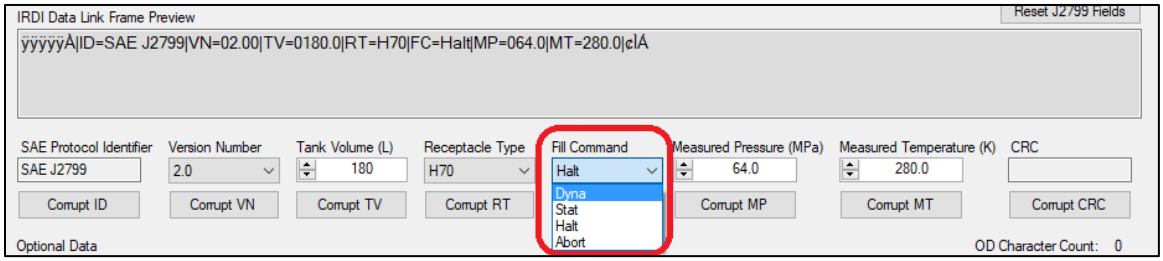

FIGURE 6-13 HHT TEST PATTERN GENERATOR SOFTWARE - FILL COMMAND INPUT

Changing the Measured Pressure "MP" Value

To change the pressure sensor value manually, do the following:

Action	
STEP 1	Click on the "MP" window and use the keyboard to enter a new value OR click on the "up" or "down" arrows to the left of the "MP" window, to change the measured pressure value in the infrared data message. (see below)
NOTES	The user must include the decimal place when entering a value in the window. Each "up" or "down" arrow click will increment or decrement the "MP" value by 0.1.

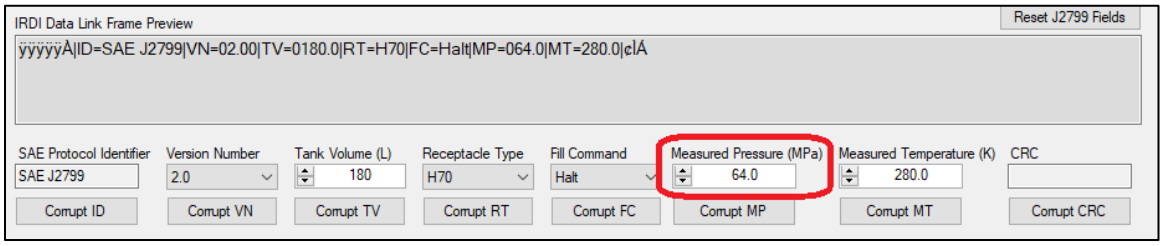

FIGURE 6-14 HHT TEST PATTERN GENERATOR SOFTWARE - PRESSURE INPUT

Changing the Measured Temperature "MT" Value

To change the temperature sensor value manually, do the following:

Action	
STEP 1	Click on the "MT" window and use the keyboard to enter a new value OR click on the "up" or "down" arrows to the left of the "MT" window, to change the measured temperature value in the infrared data message. (see below)
NOTES	The user must include the decimal place when entering a value in the window. Each "up" or "down" arrow click will increment or decrement the "MT" value by 0.1.

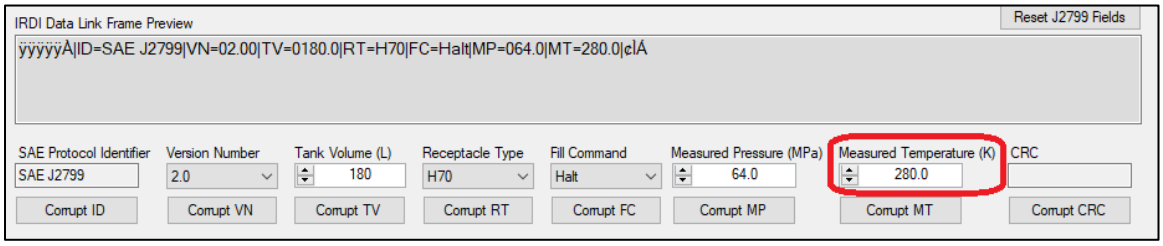

FIGURE 6-15 HHT TEST PATTERN GENERATOR SOFTWARE - TEMPERATURE INPUT

Changing the Optional Data ("OD") Value

To change the optional data ("OD") value manually, do the following:

	Action
STEP 1	Click on the "OD" display window and use the keyboard to enter a new value. (see below) As an example, if the user wants to transmit three parameters, "A", "B" and "C", with values 1, 2, and 3 respectively, the user can enter "A=1;B=2;C=3", or "A1B2C3", or some other similar format, in the "OD" display window. The data format for the "OD" data is defined by the user.
NOTES	The user may enter up to 16 characters for J2799 v1.0, 74 characters for J2799 v1.1, or 240 characters for J2799 v2.0. If more than 240 characters are entered, the characters will be truncated automatically. The user may not use the character "|" (ASCII), or "$7C" (hexadecimal)

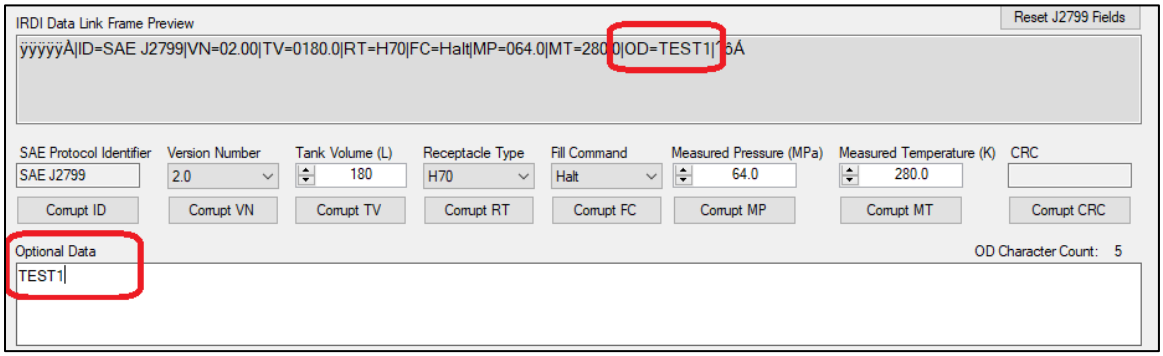

FIGURE 6-16 HHT TEST PATTERN GENERATOR SOFTWARE – OPTIONAL DATA INPUT

6.4.2 Deleting Test Pattern Lines

To delete one or more test pattern lines, do the following:

Action	
STEP 1	Click in the "# of Lines to Insert/Delete" field at the bottom left of the screen, and enter the number of lines that you wish to delete. (see Figure 6-17)
STEP 2	Click on the "Delete Line(s)" button to delete the last line (or the last X number of lines) of the test pattern shown in the top right area of the screen. In the example below, the last line, line # 14, will be deleted. (see Figure 6-17)

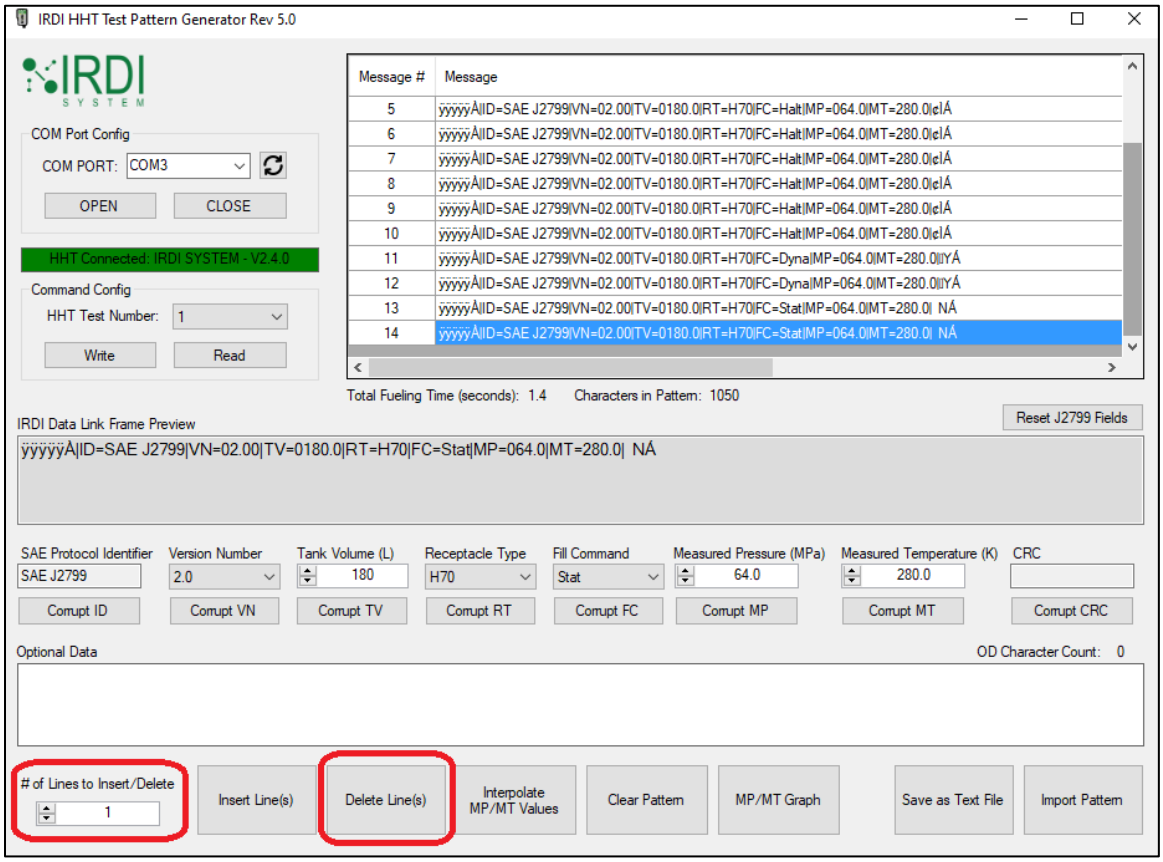

FIGURE 6-17 HHT TEST PATTERN GENERATOR SOFTWARE – DELETING LINES

6.4.3 Clearing a Test Pattern

To clear the entire test pattern, do the following:

	Action
STEP 1	Click on the “Clear Pattern” button at the bottom of the screen – see Figure 6-18. The pattern shown in the top right area of the screen will disappear.

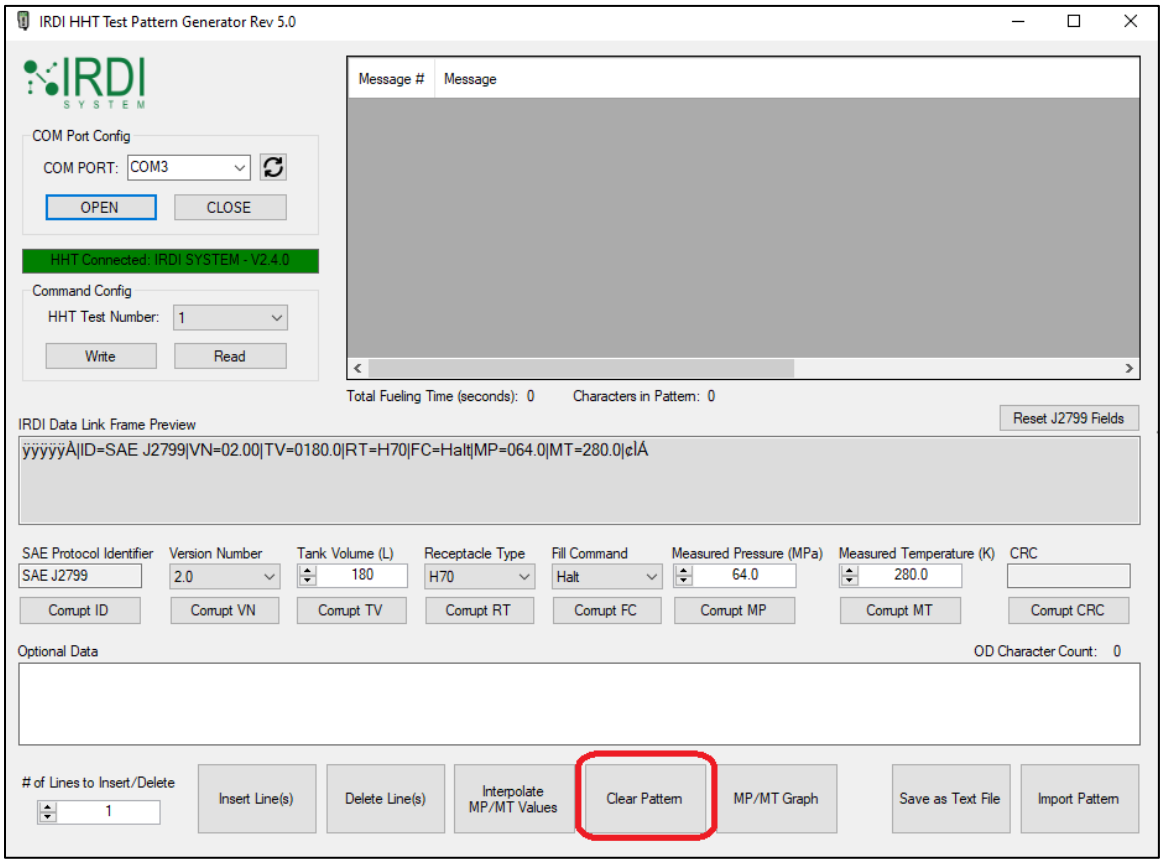

FIGURE 6-18 HHT TEST PATTERN GENERATOR SOFTWARE – CLEARING A TEST PATTERN

6.4.4 Creating and Adding a Corrupted Test Pattern Line

Each field in the data message can be “corrupted”, in order to test the hydrogen station’s ability to detect and react to issues of data corruption in the IRDI data message. The message fields may be corrupted using the corresponding **“corrupt”** buttons.

The following fields can be “corrupted”:

- ID field;
- VN field (version);
- TV field (total volume);
- RT field (receptacle type);
- FC field (fill command);
- MP field (measured pressure);
- MT field (measured temperature); and,
- CRC field (cyclic redundancy check – used to check for errors in the message).

When a field is “corrupted”, its current value is replaced with the invalid value shown in the following table:

TABLE 6-2: INVALID (CORRUPT) DATA VALUES

Data Field	SAE J2799 Tag	Valid Data Values (in range)	Preset Invalid (Corrupt) Data Value
Protocol Identifier	ID=	SAE J2799	SAE J2779
Data Communications Software Version Number	VN=	00.00 to 99.99	99.99
Total Volume	TV=	0000.0 to 5000.0	6000.0
Receptacle Type	RT=	H25, H35, H50, H70	H35
Fueling Command	FC=	Dyna, Stat, Halt, Abort	Boart
Measured Pressure	MP=	000.0 to 100.0	110.0
Measured Temperature	MT=	16.0 to 425.0	999.9
CRC			ÁÁ

As an example, to corrupt the “TV” field, do the following (see Figure 6-19):

Action	
STEP 1	Click on the “Corrupt TV” button. Note that the “TV” field in the “IR Data Link Frame Preview” window now shows an invalid (or corrupt) value of “6000.0”, and the “Corrupt TV” button becomes a blue shade, while the “Total Volume” field is greyed out.
STEP 2	Click on the “Insert Line(s)” button, to insert this line, with the corrupted “TV” value, into the file – this line is now shown as a new line in the test pattern area at the top right of the screen.
STEP 3	Click on the “TV CORRUPT” button again, to turn off the corruption of the “TV” field. The button now changes from blue to lighter grey, indicating that the “TV” field has resumed, allowing only valid values.

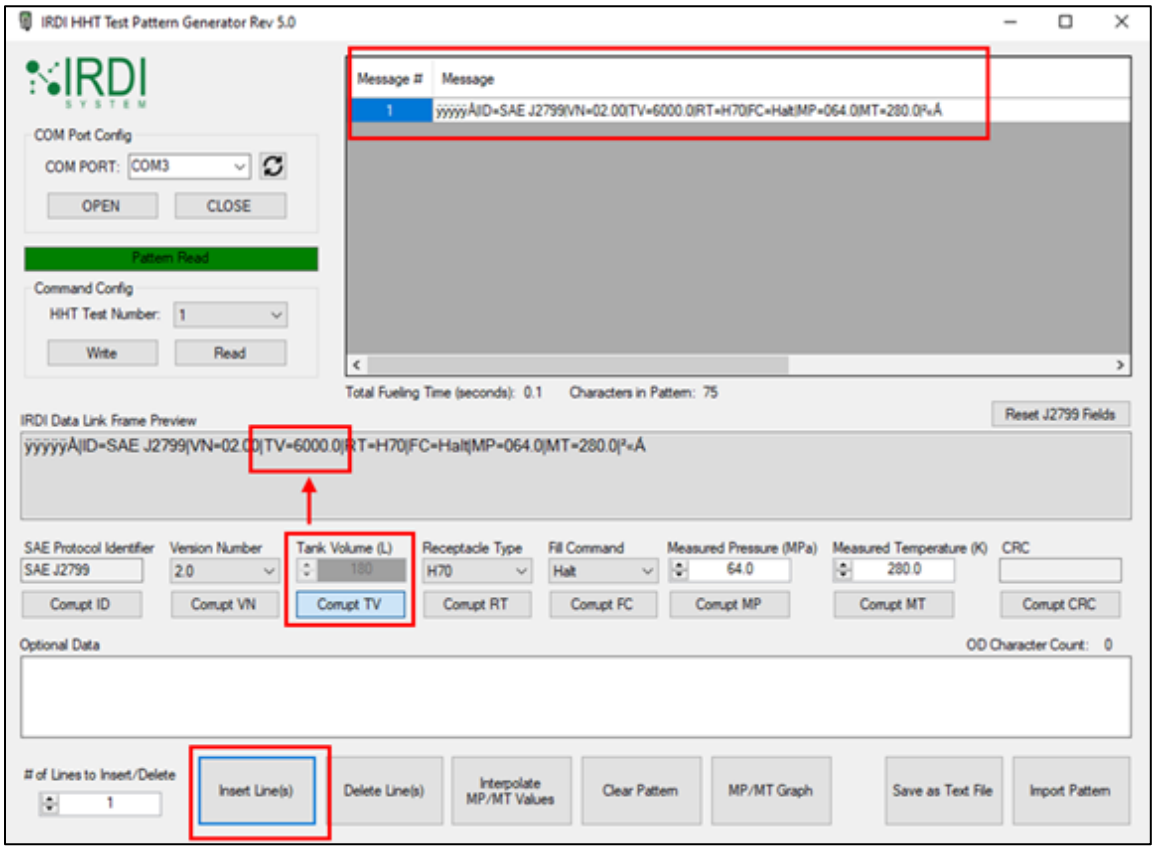

FIGURE 6-19 HHT TEST PATTERN GENERATOR SOFTWARE – CORRUPTING A TEST PATTERN

6.4.5 Saving the Test Pattern File

Once the test pattern lines are defined, **save the test pattern** with a user-defined file name. To save the file, do the following (see Figure 6-20):

Action	
STEP 1	Click on the “Save as Text File” button.
STEP 2	A browser window will appear - – see the following figure. Browse to the directory where you want to store the file.
STEP 3	In the “File Name” field of the browser window, enter the file name you want to use for this test pattern file.
STEP 4	Click on the “Save” button to save the file.

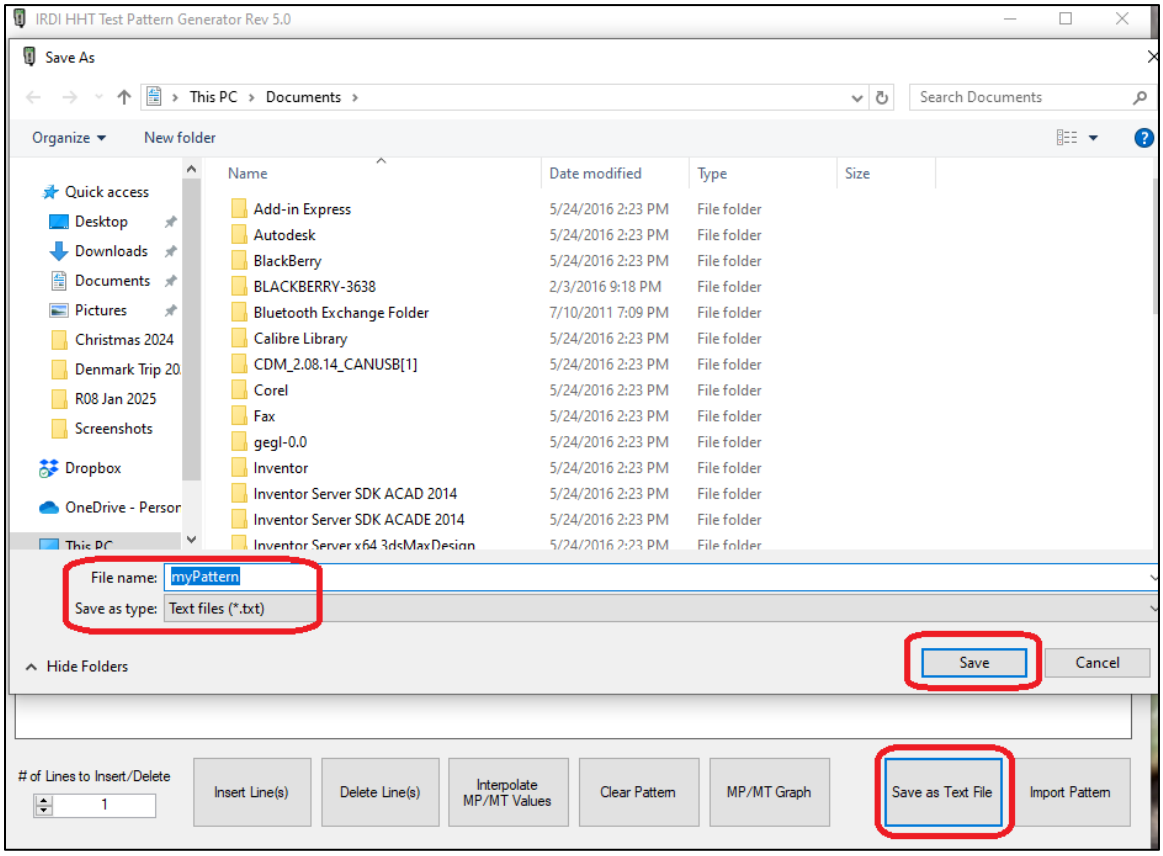

FIGURE 6-20 HHT TEST PATTERN GENERATOR SOFTWARE – SAVING THE FILE

6.5 PROGRAMMING THE HHT WITH A TEST PATTERN FILE

To program the HHT with a test pattern file, do the following (see Figure 6-21):

	Action
STEP 1	Open or create a test pattern file.
STEP 2	Under “HHT Test Number”, use the drop-down menu to select a number (1 through 4) to write this test pattern file to.

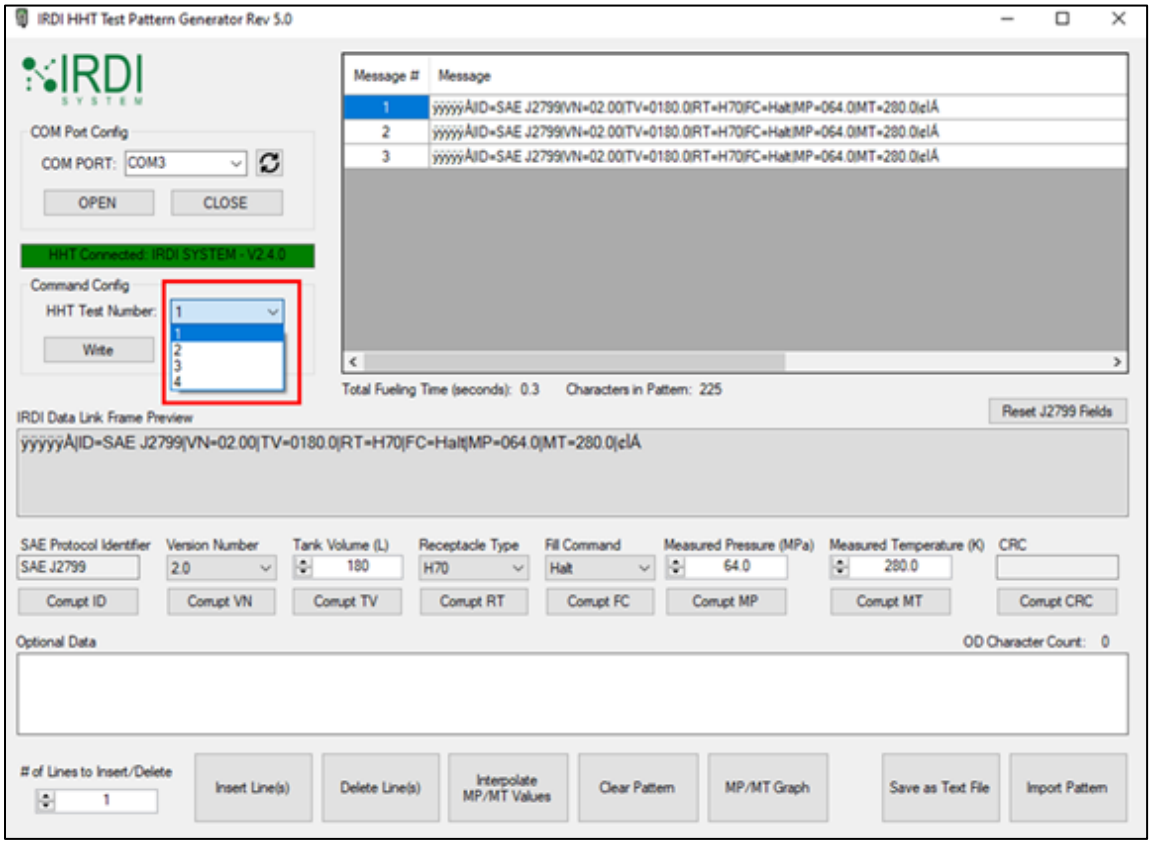

FIGURE 6-21 HHT TEST PATTERN GENERATOR SOFTWARE – SELECT TEST NUMBER

	Action
	NOTE: The file number corresponds to test patterns 1 through 4. For example, if you program file number 4, you must then select “T4” on the HHT to transmit that test pattern.
STEP 3	Click on the “Write” button. In the “HHT Status” window, the message “Writing Pattern” will be displayed – see Figure 6-22 below. Wait while the HHT is programmed.

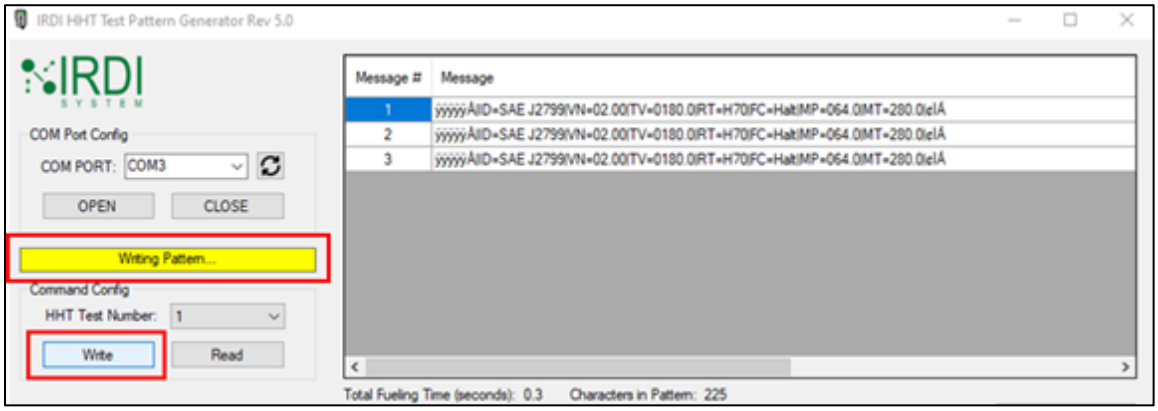

FIGURE 6-22 HHT TEST PATTERN GENERATOR SOFTWARE – HHT PROGRAMMING IN PROGRESS

	Action
STEP 4	The “HHT Status” message will display “Pattern Written” when the HHT programming is completed – see Figure 6-23 below.

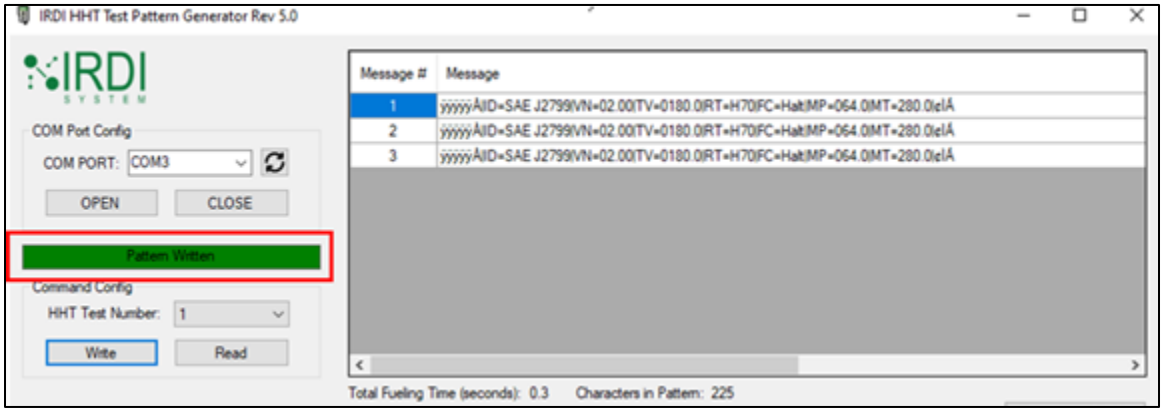

FIGURE 6-23 HHT TEST PATTERN GENERATOR SOFTWARE – HHT PROGRAMMING DONE

6.6 READING A TEST PATTERN FILE FROM THE HHT

> There is a known issue associated with using the “Read” command for test patterns longer than 8,000 characters.

To read the HHT’s current test pattern files, do the following:

Action	
STEP 1	Open or create a test pattern file.
STEP 2	Under “HHT Test Number”, use the drop-down menu to select the number (1 through 4) of the test file to read from the HHT – see Figure 6-24.

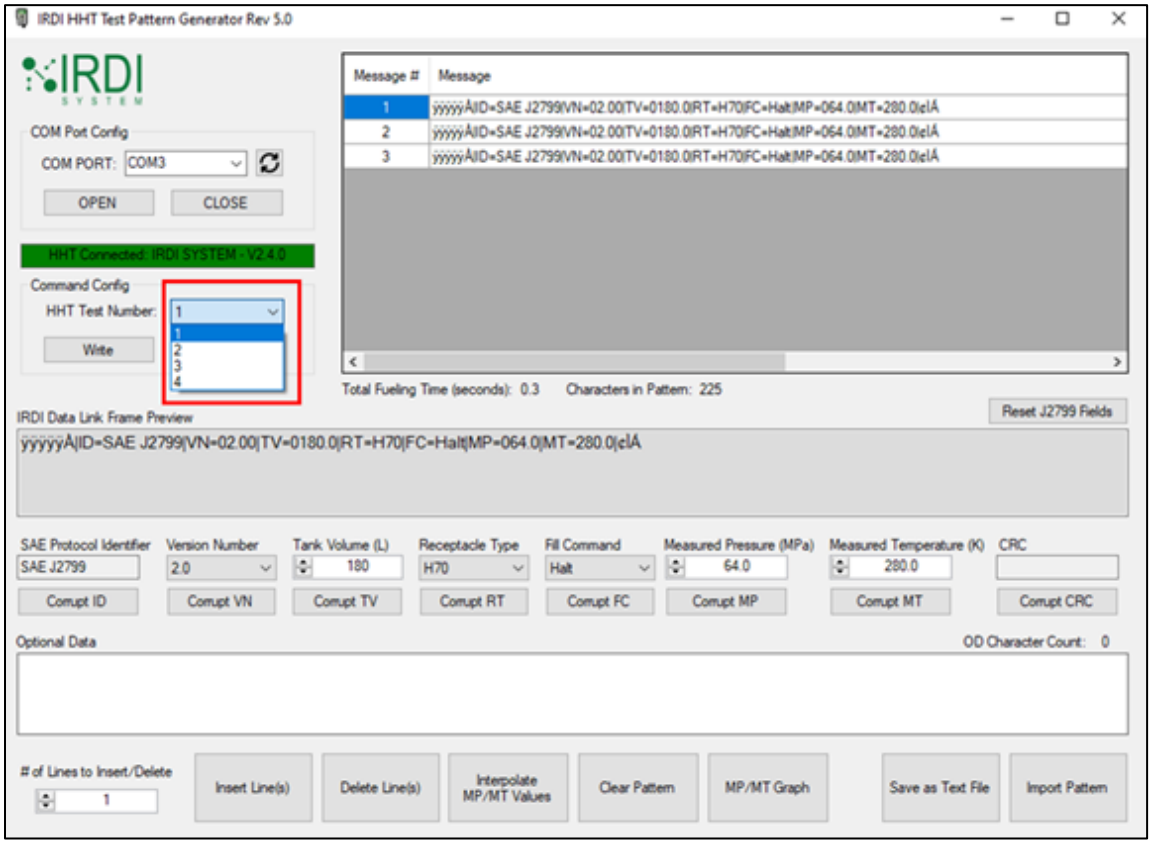

FIGURE 6-24 HHT TEST PATTERN GENERATOR SOFTWARE – SELECT TEST NUMBER

Action	
	NOTE: The file number corresponds to test patterns 1 through 4. For example, file number 4 is accessed on the HHT by selecting “T4”.
STEP 3	Click on the “Read” button. In the “HHT Status” window, the message “Reading Pattern” will be displayed. Wait while the HHT is read. The “HHT Status” message will display “Pattern Read” when the HHT read is completed – see Figure 6-25 below. The contents of the file that was read will be shown in the top right area of the screen.

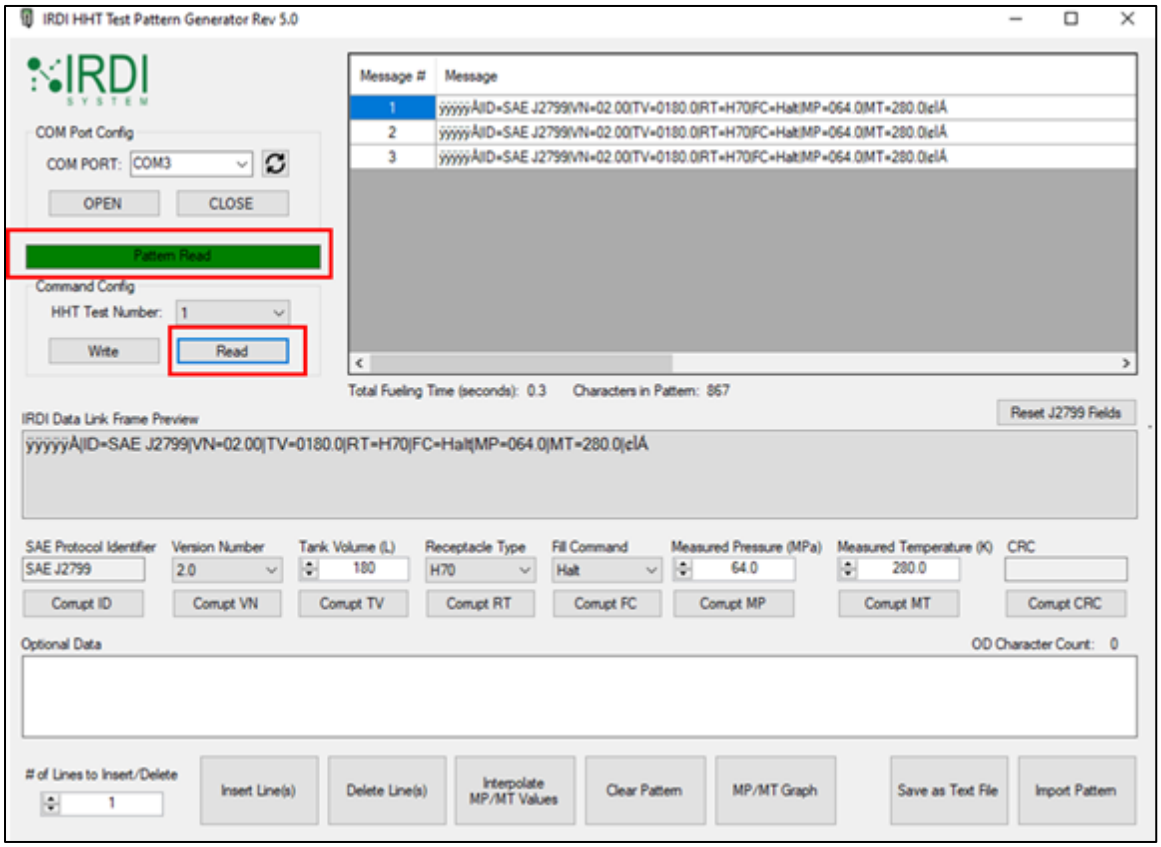

FIGURE 6-25 HHT TEST PATTERN GENERATOR SOFTWARE – HHT FILE READ

6.7 INTERPOLATING A TEST PATTERN

The HHT software includes a feature to allow the user to create dynamic data, by interpolating pressure and/or temperature values automatically, and creating a set of IRDI messages from the interpolated data. To create a test pattern using the "interpolation" feature, do the following:

	Action
STEP 1	Click on the "Interpolate MP/MT Values" button – see Figure 6-26.

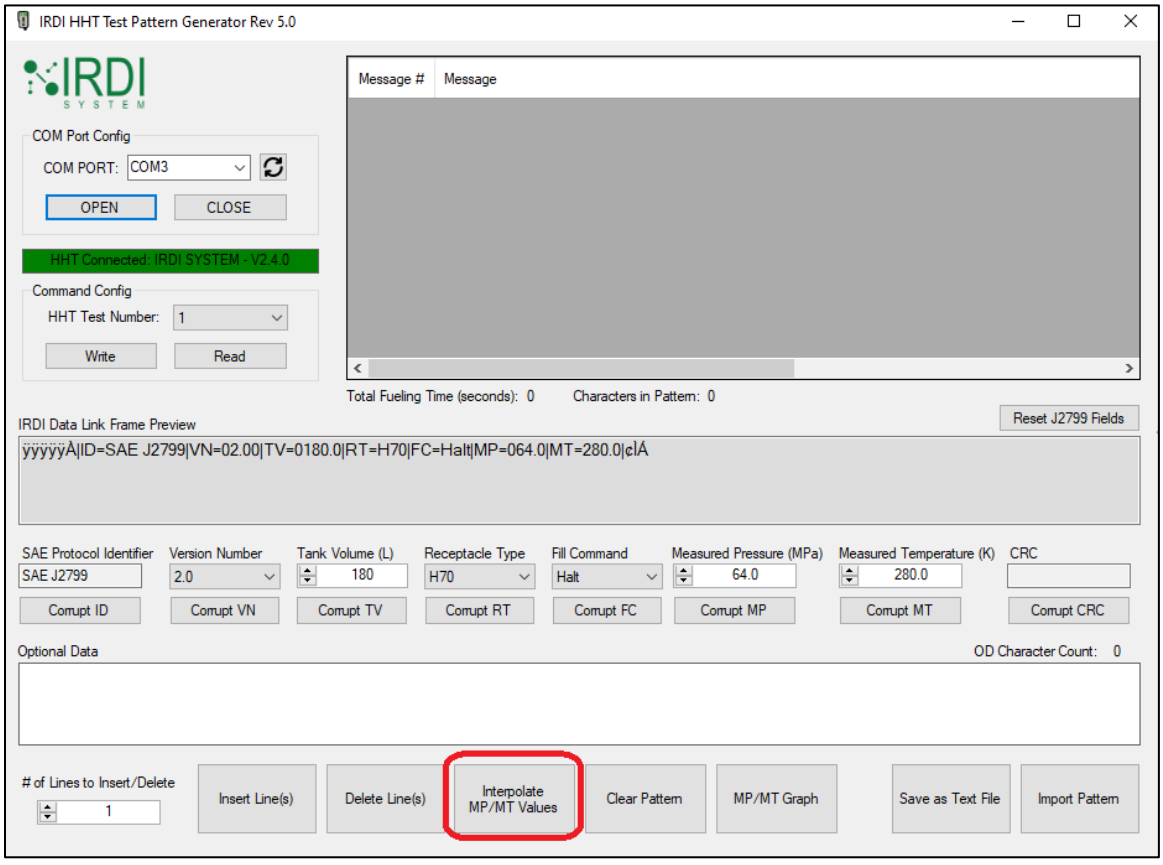

FIGURE 6-26 HHT TEST PATTERN GENERATOR SOFTWARE – INTERPOLATE

There are several options for interpolating data:

- Interpolate only pressure values (MP)
- Interpolate only temperature values (MT)
- Interpolate both pressure and temperature (MP and MT)

There are two methods for calculating the interpolated data:

- Select the number of messages to create
- Select the step value (either pressure steps or temperature steps) between each message – the number of messages is then calculated automatically

6.7.1 Interpolating One Value, Using "Number of Lines" Method

To interpolate one value, using the "# of Lines" method for calculating the IRDI messages, do the following. This example shows how to interpolate the pressure (MP) value. The procedure is identical for interpolating the temperature (MT) value.

	Action
STEP 1	To select the number of IRDI messages to be calculated, do the following – see Figure 6-27 below: a. Click on the "Interpolate Measured Pressure" button – the button will turn blue b. Click on the "Start Value" field, and enter a value at which to start the interpolation c. Click on the "End Value" field, and enter a value at which to end the interpolation d. Click on the "Number of Lines" field, and enter the number of IRDI messages (lines) that you would like to generate
NOTE	The first IRDI message will contain the "Start Value" for pressure, and each message after that will contain an interpolated new value for pressure, calculated based on the "Start" and "End" values. The last IRDI message will contain the "End Value" for pressure.

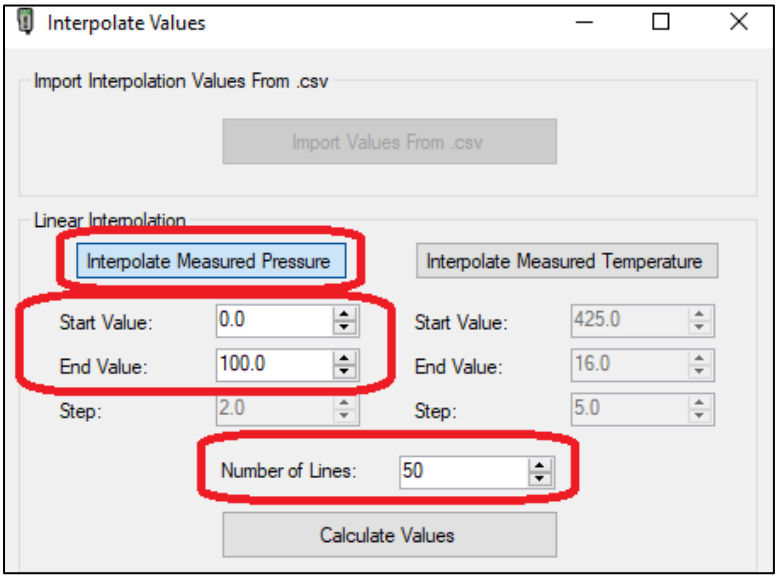

FIGURE 6-27 HHT TEST PATTERN GENERATOR SOFTWARE – INTERPOLATE MP (# OF LINES)

	Action
STEP 2	Click on the "Calculate Values" button, to generate the set of IRDI messages – see Figure 6-28 below.

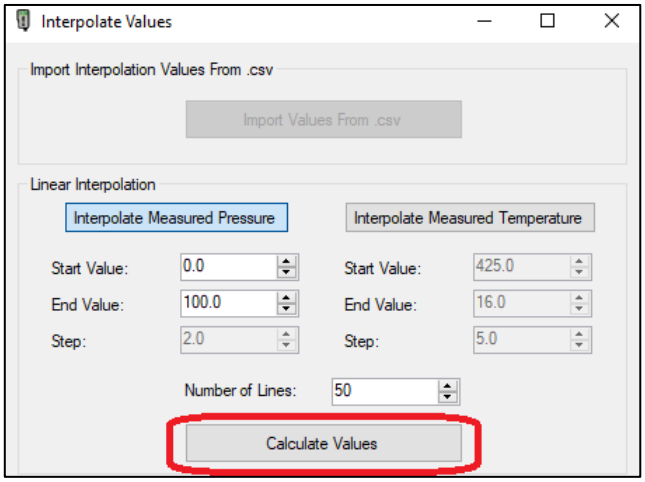

FIGURE 6-28 HHT TEST PATTERN GENERATOR SOFTWARE –MP INTERPOLATION (# OF LINES)

Action	
STEP 3	A popup window will appear (see below), to remind the user that the other value (in this example, temperature) will not be interpolated, and will remain static. Click on the “OK” button to continue.
NOTE	To set the static value (in this example, temperature), return to the main screen and set the value using the “MT” field.

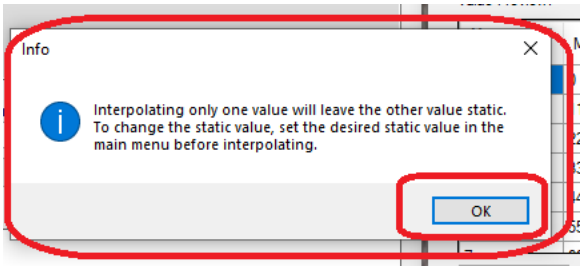

FIGURE 6-29 HHT TEST PATTERN GENERATOR SOFTWARE – INTERPOLATE WARNING NOTE

Action	
STEP 4	The interpolated IRDI messages will now appear in the “Value Preview” area at the bottom of the screen – see Figure 6-30.
NOTE	The step value between each interpolated value is automatically calculated, and is shown in the “Step” field. In this example, since the number of lines selected was 50, the step value for pressure, between each IRDI message, is 2.

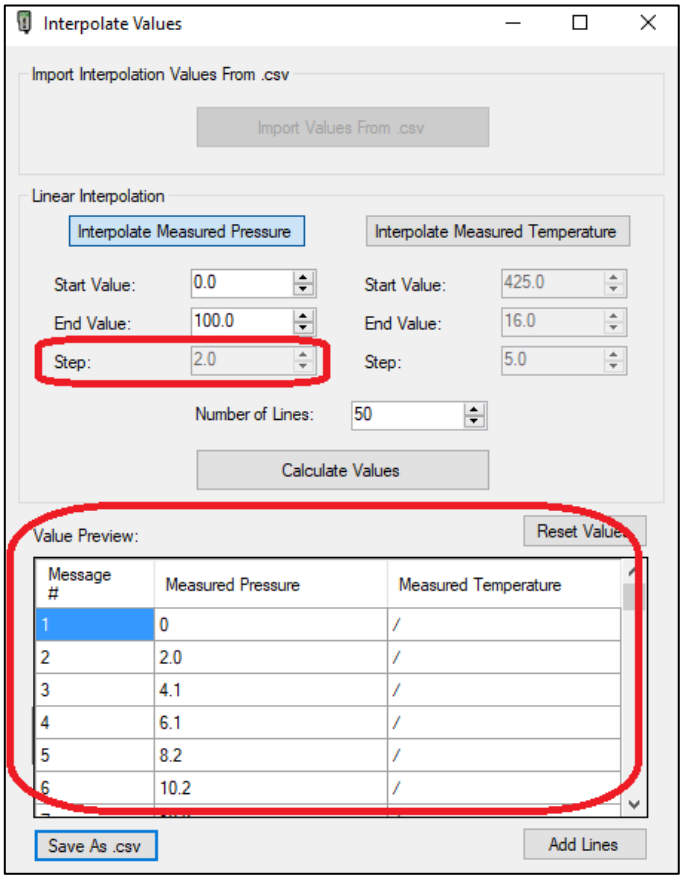

FIGURE 6-30 HHT TEST PATTERN GENERATOR SOFTWARE – MP RESULTS (# OF LINES)

	Action
STEP 5	To save this interpolated test pattern to a file, click on the “Save as csv” button – see Figure 6-31. A browser window will pop up – see Figure 6-32. Browse to the folder where you want to save the file, enter a file name for this test pattern, and click on the “Save” button, to save the file.

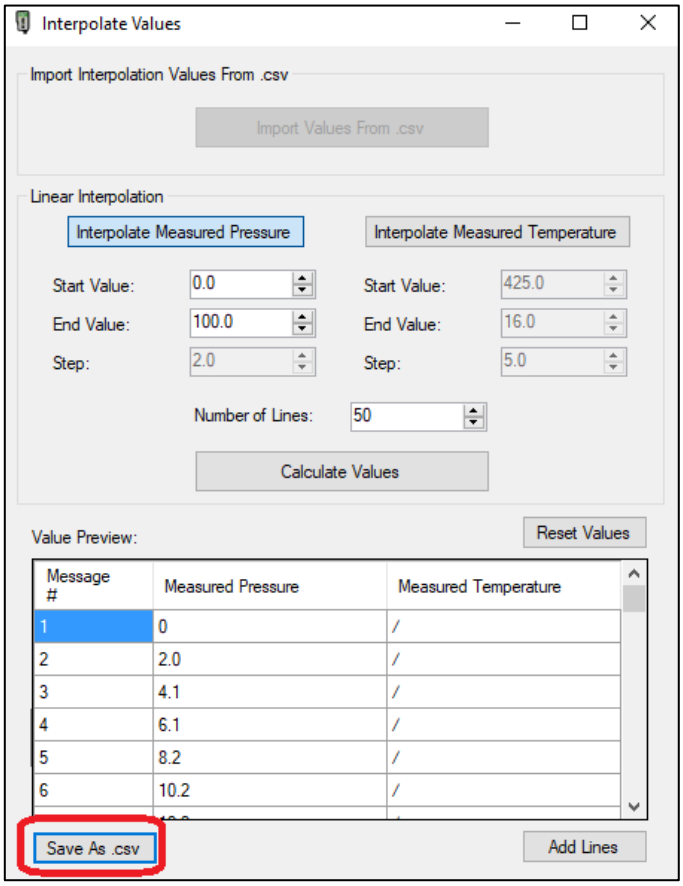

FIGURE 6-31 HHT TEST PATTERN GENERATOR SOFTWARE – SAVE RESULTS (# OF LINES)

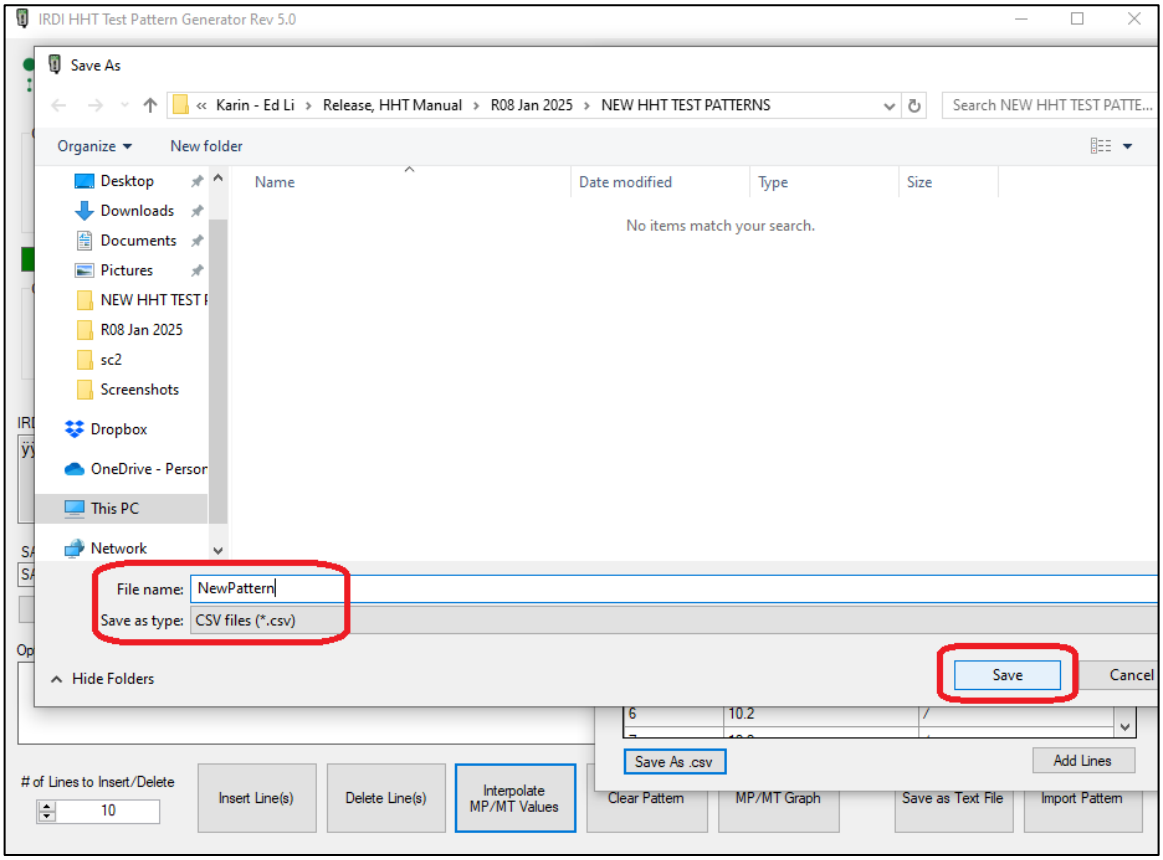

FIGURE 6-32 HHT TEST PATTERN GENERATOR SOFTWARE – SAVE FILE (# OF LINES)

	Action
STEP 6	To copy this interpolated test pattern to the main screen, so that you can program the HHT, click on the “Add Lines” button – see Figure 6-33. Close the “Interpolate Values” window by clicking on the “X” at the top right corner.

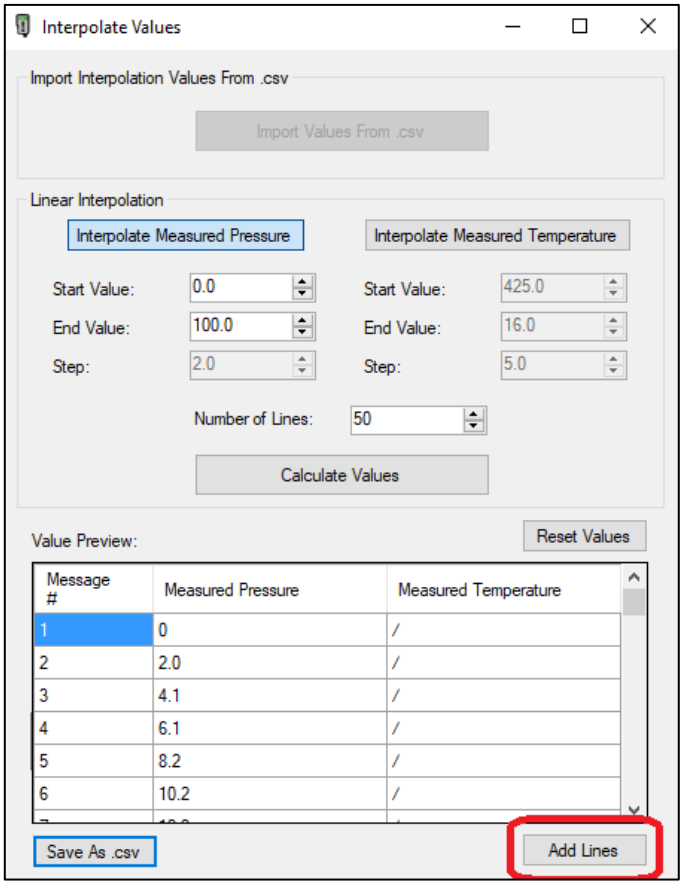

FIGURE 6-33 HHT TEST PATTERN GENERATOR SOFTWARE – ADD MP LINES (# OF LINES)

	Action
STEP 7	View the interpolated test pattern on the main screen, in the top right area – see Figure 6-34. You can now program the HHT with this test pattern – refer to Section 6.5 for details.

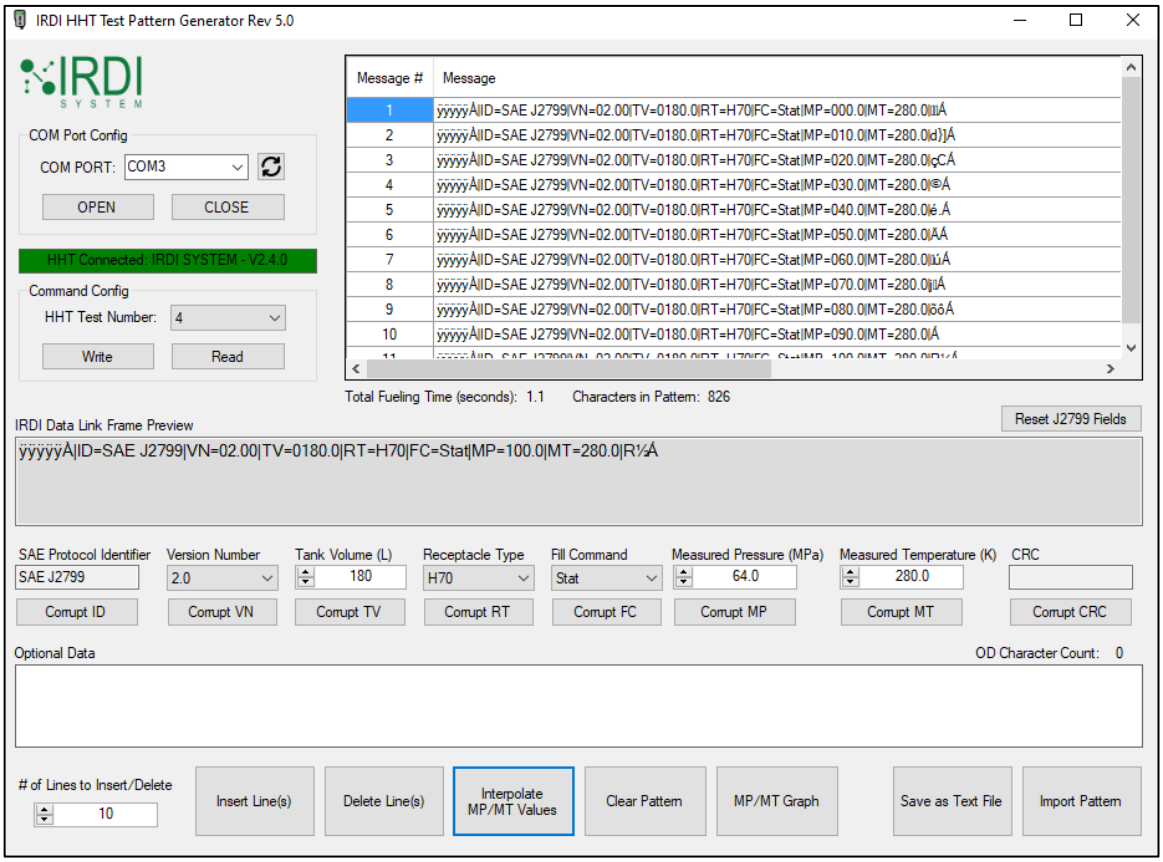

FIGURE 6-34 HHT TEST PATTERN GENERATOR SOFTWARE –MP LINES ADDED (# OF LINES)

6.7.2 Interpolating One Value, Using Step Value Method

To interpolate one value, using the "Step" value method to calculate the IRDI messages, do the following. This example shows how to interpolate the pressure (MP) value. The procedure is identical for interpolating the temperature (MT) value.

	Action
STEP 1	To select the step value (pressure, in this example) between each calculated IRDI message, do the following – see Figure 6-35. a. Click on the "Interpolate Measured Pressure" button – the button will turn blue b. Click on the "Start Value" field, and enter a value at which to start the interpolation c. Click on the "End Value" field, and enter a value at which to end the interpolation d. Click on the "Step" field, and enter the step amount (in MPa) to use between each calculated IRDI message that you would like to generate e. Click on the "Number of Lines" field, and enter zero.
NOTE	The first IRDI message will contain the "Start Value" for pressure, and each message after that will contain an interpolated new value for pressure, based on the "Start" and "End" values, and using the "Step" value. The last IRDI message will contain the "End Value" for pressure.

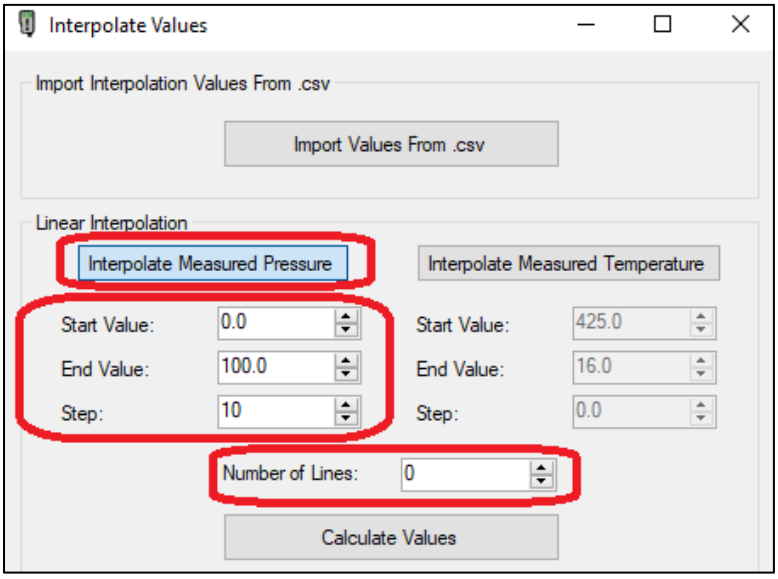

FIGURE 6-35 HHT TEST PATTERN GENERATOR SOFTWARE –INTERPOLATE MP (STEP)

Action	
STEP 2	Click on the “Calculate Values” button, to generate the set of IRDI messages – see Figure 6-36.

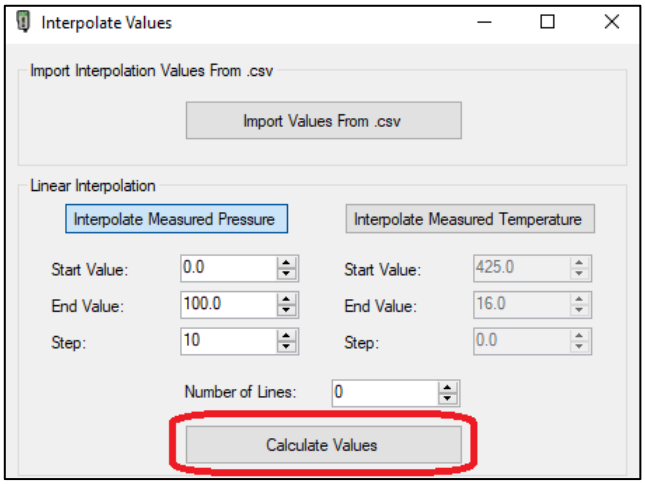

FIGURE 6-36 HHT TEST PATTERN GENERATOR SOFTWARE –MP INTERPOLATION (STEP)

Action	
STEP 3	A popup window will appear (see below), to remind the user that the other value (in this example, temperature) will not be interpolated, and will remain static. Click on the “OK” button to continue.
NOTE	To set the static value (in this example, temperature), return to the main screen and set the value using the “MT” field.

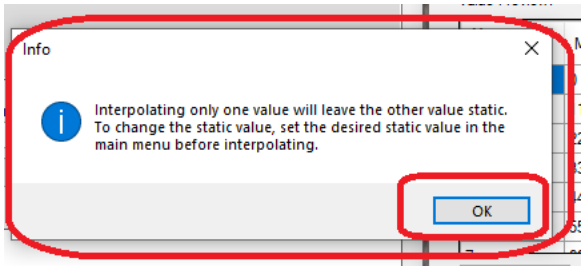

FIGURE 6-37 HHT TEST PATTERN GENERATOR SOFTWARE –INTERPOLATION WARNING NOTE

Action	
STEP 4	The “Number of Lines” value will update automatically to show the number of IRDI messages that were generated. In this example, the number of IRDI messages generated was 11 – see Figure 6-38.
NOTE	With this interpolation option, the IRDI messages **do not display** in the “Value Preview” area.

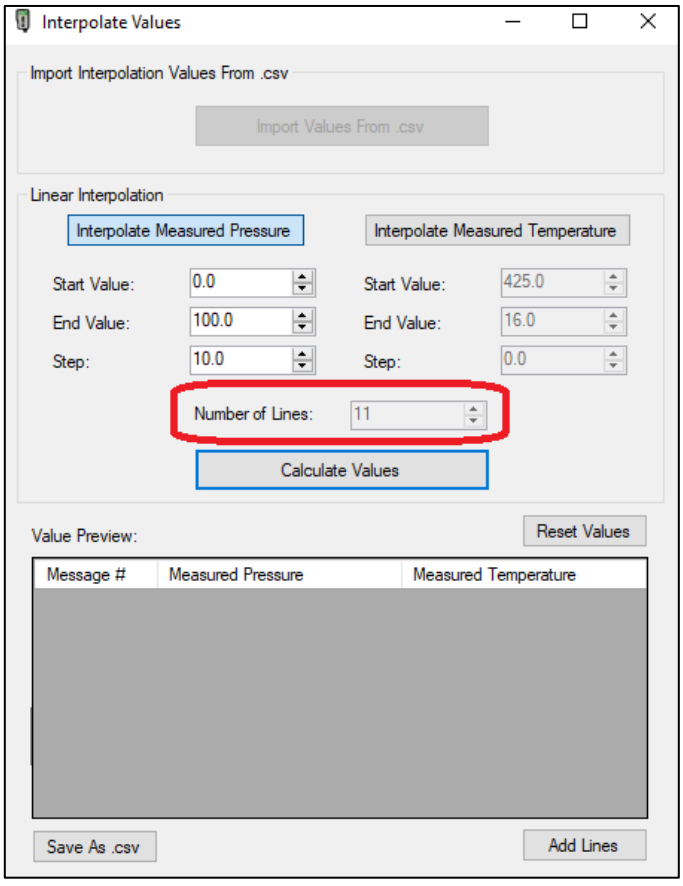

FIGURE 6-38 HHT TEST PATTERN GENERATOR SOFTWARE –MP RESULTS (STEP)

	Action
STEP 5	To save this interpolated test pattern to a file, click on the “Save as csv” button – see Figure 6-39. A browser window will pop up – see Figure 6-40. Browse to the folder where you want to save the file, enter a file name for this test pattern, and click on the “Save” button, to save the file.

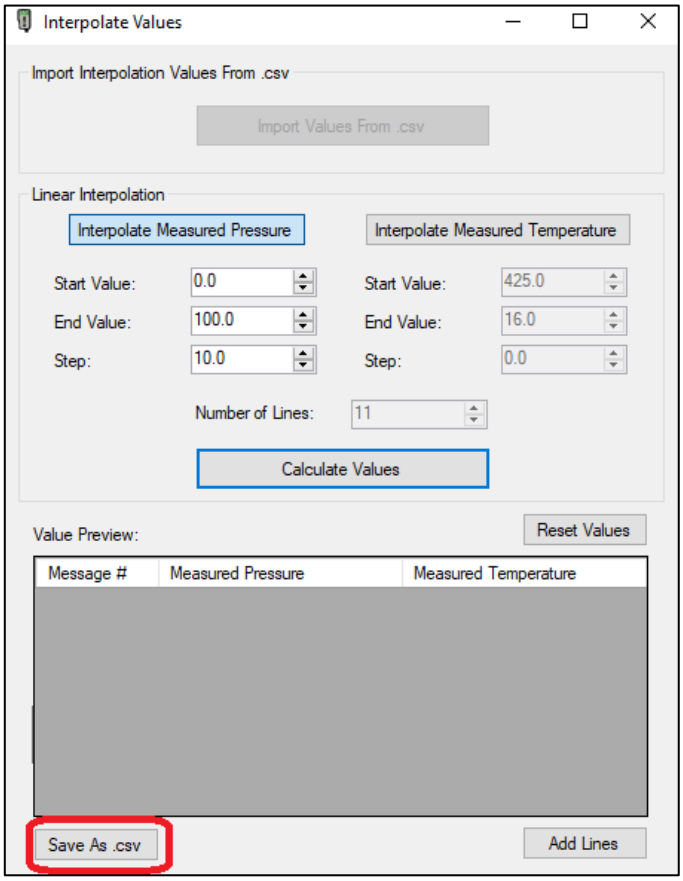

FIGURE 6-39 HHT TEST PATTERN GENERATOR SOFTWARE –SAVE INTERPOLATION (STEP)

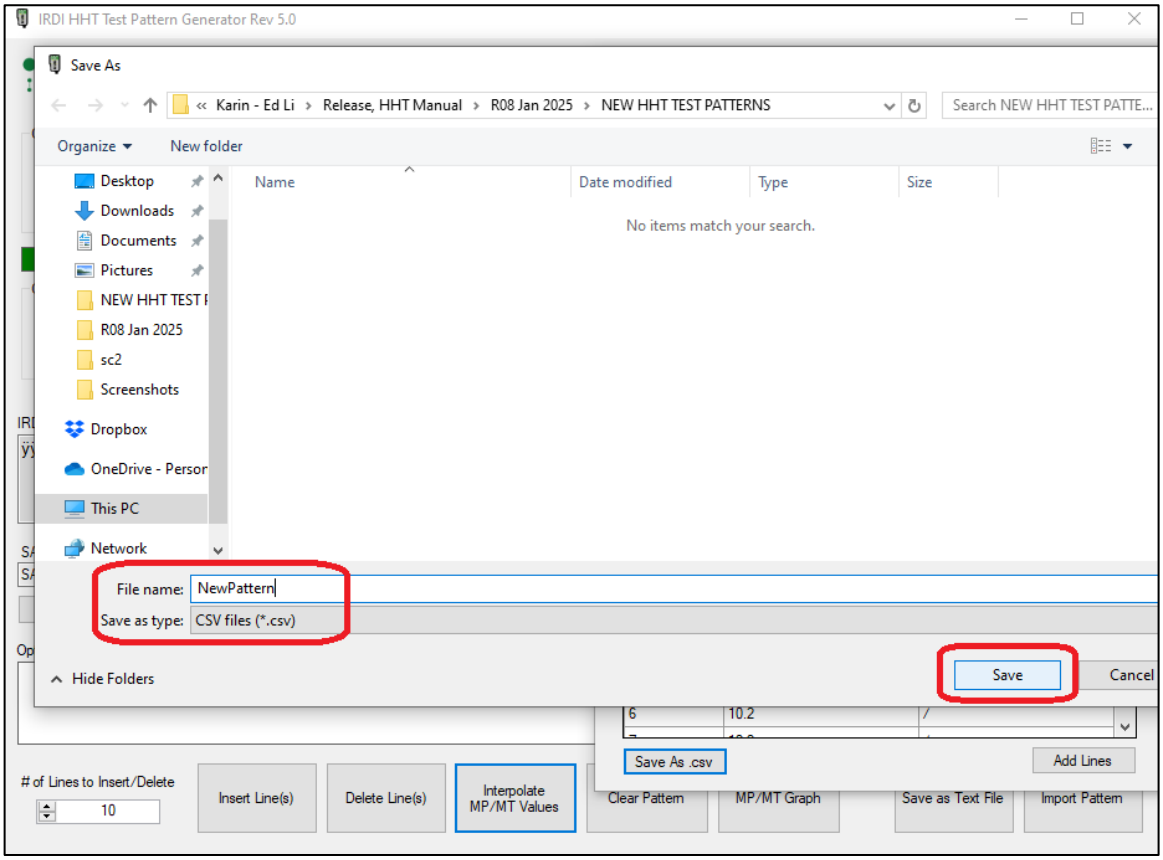

FIGURE 6-40 HHT TEST PATTERN GENERATOR SOFTWARE –SAVE FILE (STEP)

	Action
STEP 6	To copy this interpolated test pattern to the main screen, so that you can program the HHT, click on the “Add Lines” button – see Figure 6-41. Close the “Interpolate Values” window by clicking on the “X” at the top right corner.

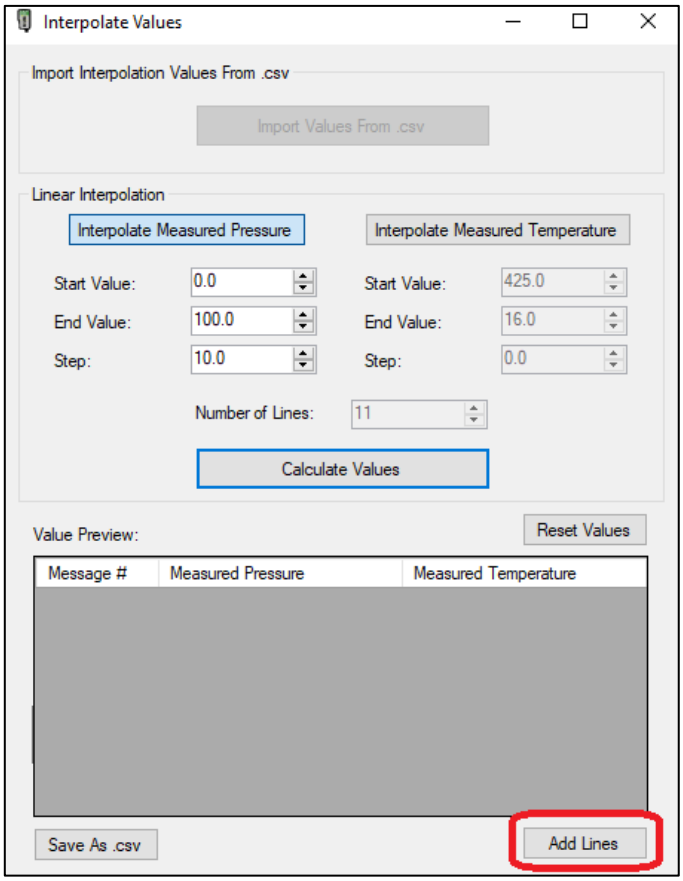

FIGURE 6-41 HHT TEST PATTERN GENERATOR SOFTWARE –ADD MP LINES (STEP)

Action	
STEP 7	View the interpolated test pattern on the main screen, in the top right area – see Figure 6-42. You can now program the HHT with this values – refer to Section 6.5 for details.

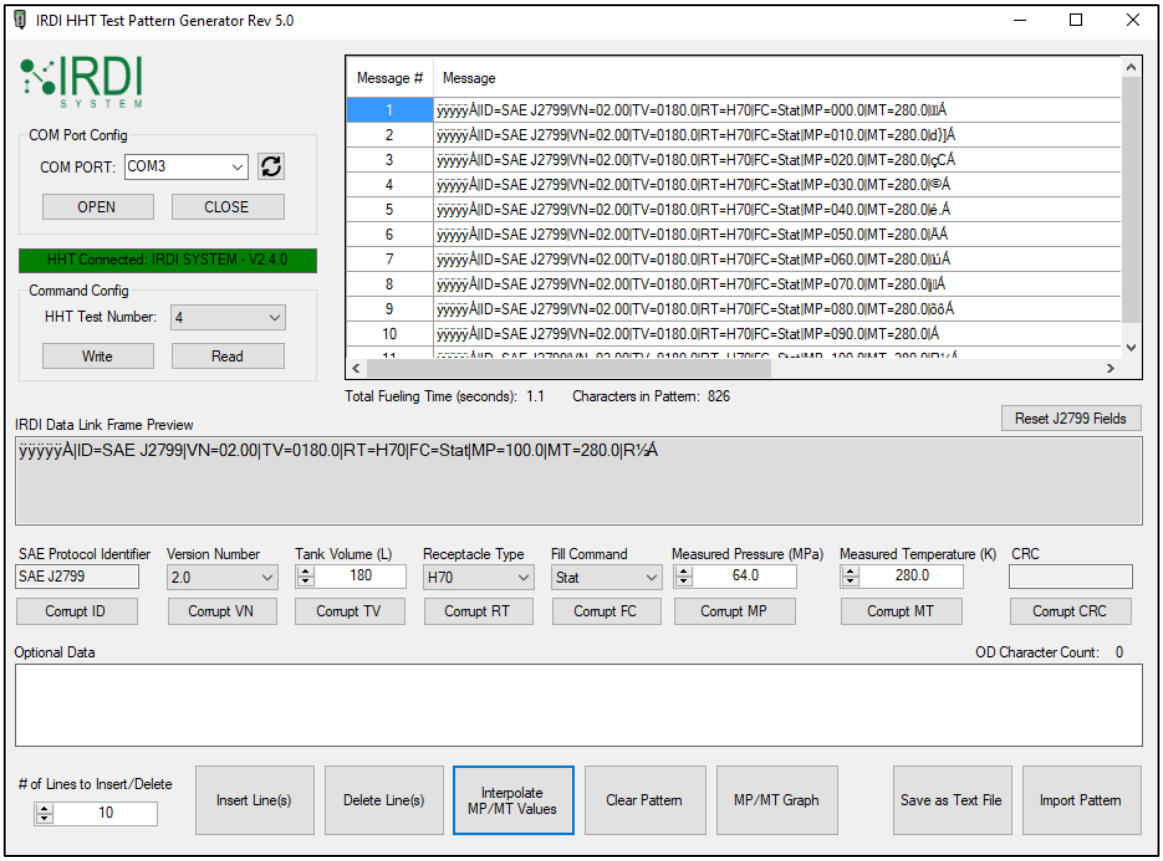

FIGURE 6-42 HHT TEST PATTERN GENERATOR SOFTWARE –MP LINES ADDED (STEP)

6.7.3 Interpolating Both Values (MT and MP)

To interpolate both values – temperature and pressure - do the following. This example uses the “number of lines” procedure. Refer to Figure 6-43.

	Action
STEP 1	a. Click on the “Interpolate Measured Pressure” button – the button will turn blue. b. Click on the “Start Value” field, and enter a value at which to start the interpolation. c. Click on the “End Value” field, and enter a value at which to end the interpolation.
STEP 2	a. Click on the “Interpolate Measured Temperature” button – the button will turn blue. b. Click on the “Start Value” field, and enter a value at which to start the interpolation. c. Click on the “End Value” field, and enter a value at which to end the interpolation.
STEP 3	Click on the “Number of Lines” field, and enter the number of IRDI messages (lines) that you would like to generate.
NOTE	The first IRDI message will contain the “Start Value” for pressure and temperature, and each message after that will contain interpolated new values for pressure and temperature, based on the “Start” and “End” values. The last IRDI message will contain the “End Value” for pressure and temperature.

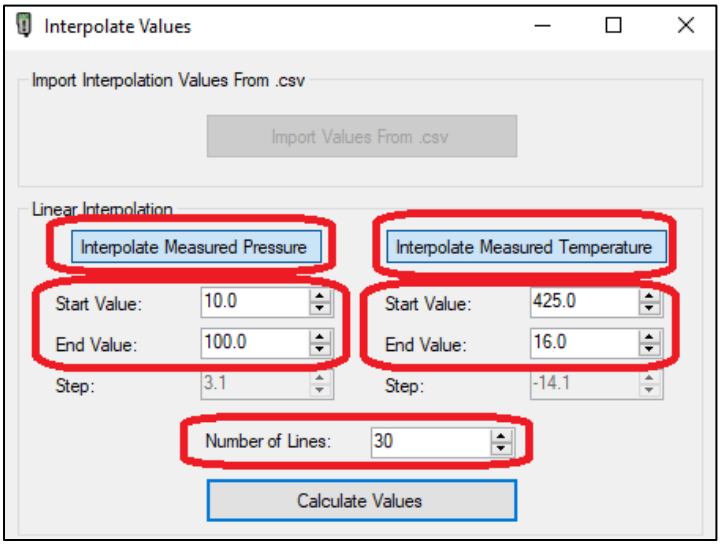

FIGURE 6-43 HHT TEST PATTERN GENERATOR SOFTWARE –INTERPOLATE MP AND MT

Action	
STEP 4	Click on the “Calculate Values” button, to generate the set of IRDI messages – see Figure 6-44. The interpolated IRDI messages will now appear in the “Value Preview” area at the bottom of the screen.
NOTE	The step value between each interpolated value is automatically calculated, and is shown in the “Step” field, for temperature and pressure. In this example, since the number of lines selected was 30, the step value for pressure was 3.1, and the step value for temperature was -14.1, between each IRDI message.

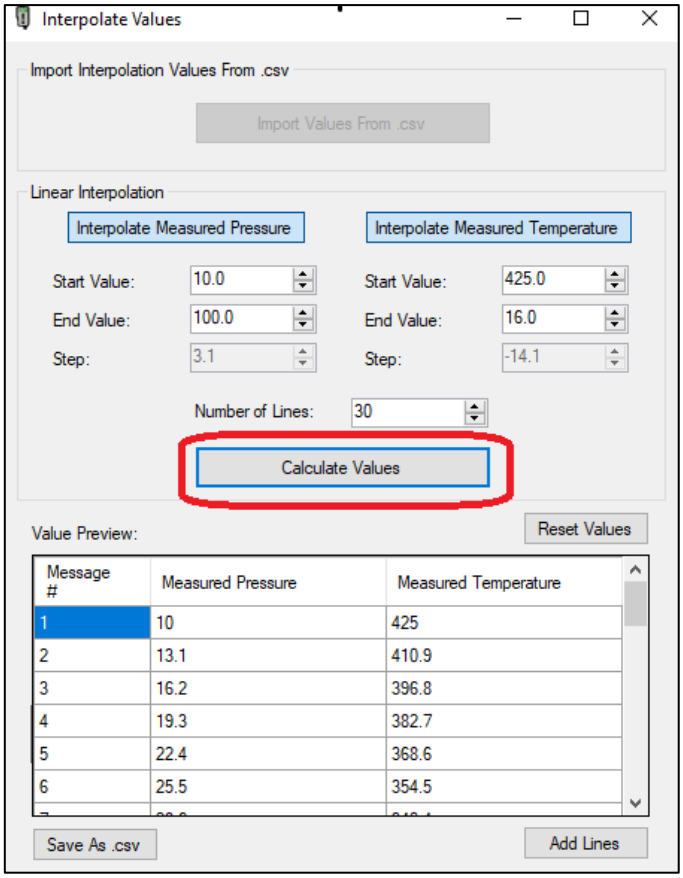

FIGURE 6-44 HHT TEST PATTERN GENERATOR SOFTWARE –MP AND MT INTERPOLATION

Action	
STEP 5	To save this interpolated test pattern to a file, click on the “Save as csv” button at the bottom of the screen. See Section 6.7.1 or Section 6.7.2 for details.
STEP 6	To copy this interpolated test pattern to the main screen, so that you can program the HHT, click on the “Add Lines” button at the bottom of the screen. See Section 6.7.1 or Section 6.7.2 for details.

6.7.4 Importing an Interpolated Pattern File

To import an interpolated pattern from an existing file, do the following:

	Action
STEP 1	At the top of the “Interpolation” popup window, click on the “Import Values from csv” button – see Figure 6-45.

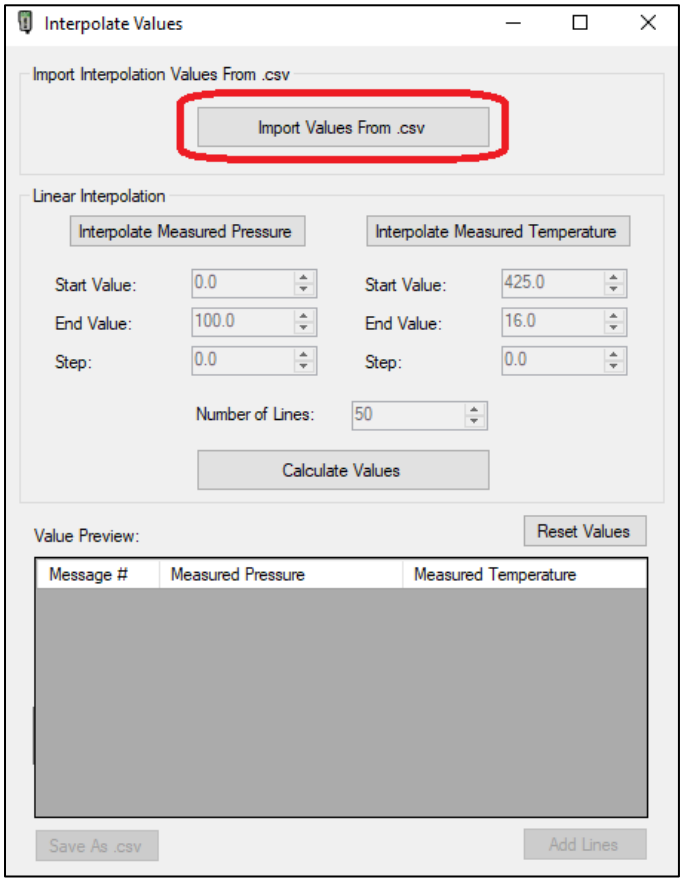

FIGURE 6-45 HHT TEST PATTERN GENERATOR SOFTWARE – IMPORT INTERPOLATED VALUES

	Action
STEP 2	A browser window will pop up – see Figure 6-46. Browse to the folder where the interpolation data file is located, select the file, and click on the “Open” button, to open the file.

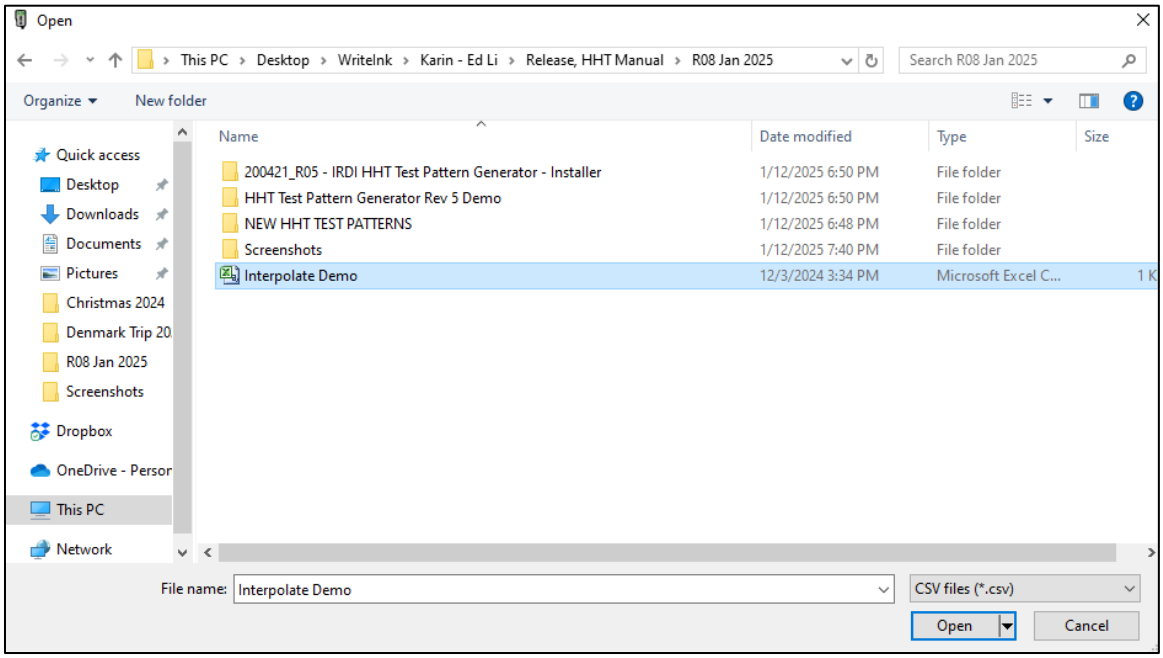

FIGURE 6-46 HHT TEST PATTERN GENERATOR SOFTWARE –INTERPOLATED VALUES FILE

	Action
STEP 3	View the imported interpolation data in the “Value Preview” section of the Interpolation window – see Figure 6-47.

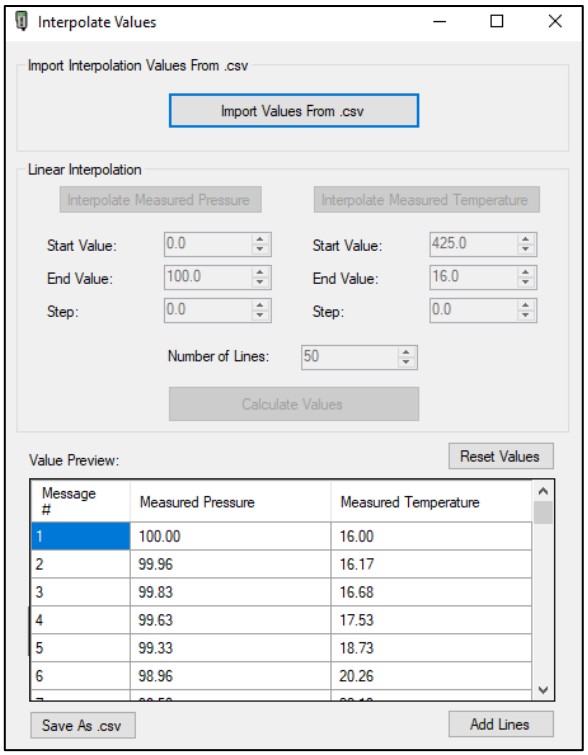

FIGURE 6-47 HHT TEST PATTERN GENERATOR SOFTWARE –IMPORTED FILE CONTENTS

	Action
STEP 4	To copy this interpolated test pattern to the main screen, so that you can program the HHT, click on the “Add Lines” button at the bottom of the screen. See Section 6.7.1 or Section 6.7.2 for details.

6.8 GRAPHING A TEST PATTERN

The HHT software includes a feature to allow the user to graph the test pattern data, as a means of checking that the test pattern is correct. To graph a test pattern, do the following:

	Action
STEP 1	Add a set of IRDI messages, to create a test pattern, or import an existing test pattern. For details on creating a test pattern, see Section 6.4. For details on importing an existing test pattern, see Section 6.3. The example below shows an imported test pattern.

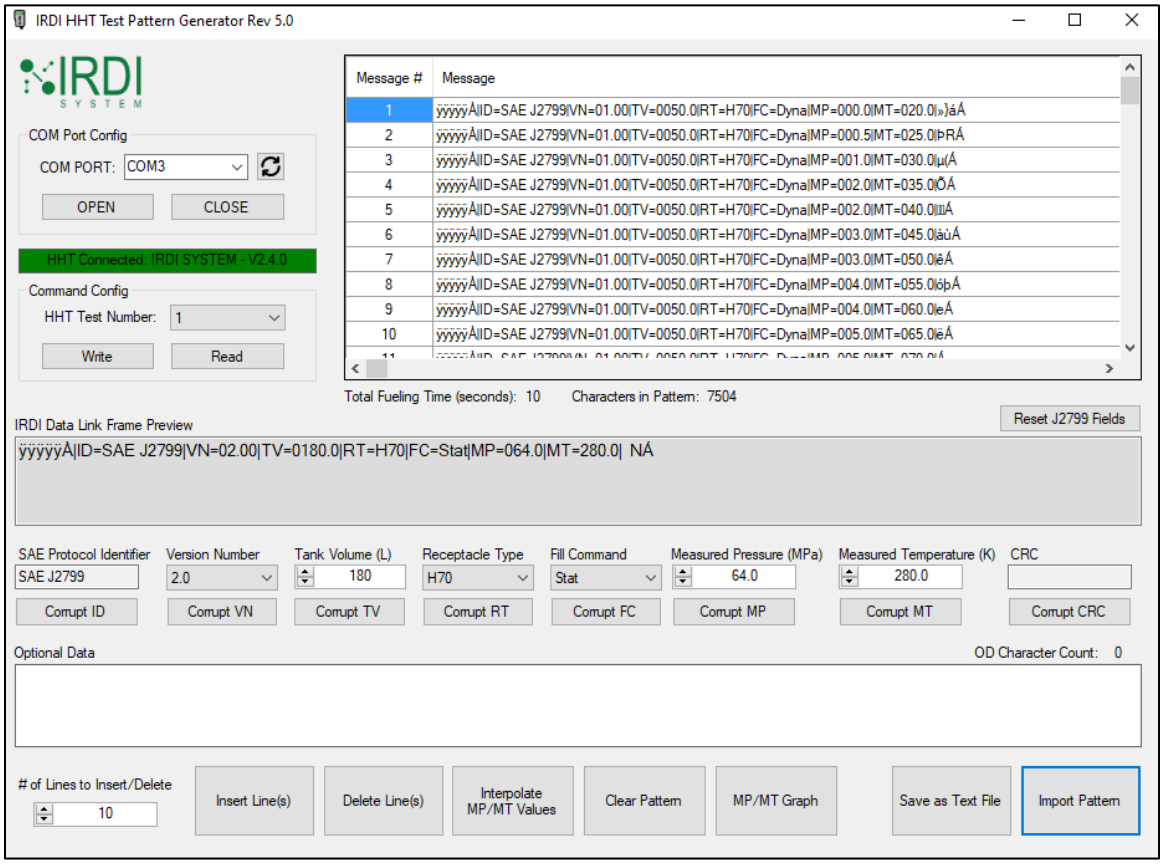

FIGURE 6-48 HHT TEST PATTERN GENERATOR SOFTWARE –IMPORTED TEST PATTERN EXAMPLE

	Action
STEP 2	Click on the “MP/MT Graph” button – see Figure 6-49.

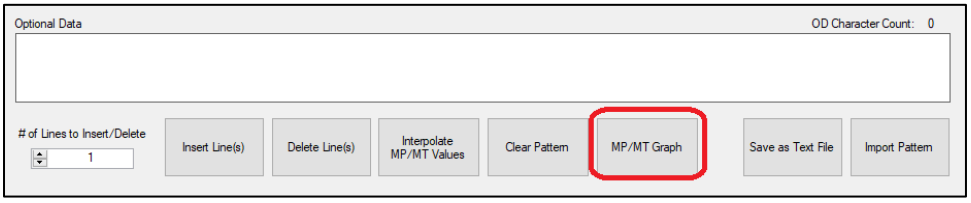

FIGURE 6-49 HHT TEST PATTERN GENERATOR SOFTWARE –MP/MT GRAPH BUTTON

	Action
STEP 3	A popup graph screen will appear – see Figure 6-50.

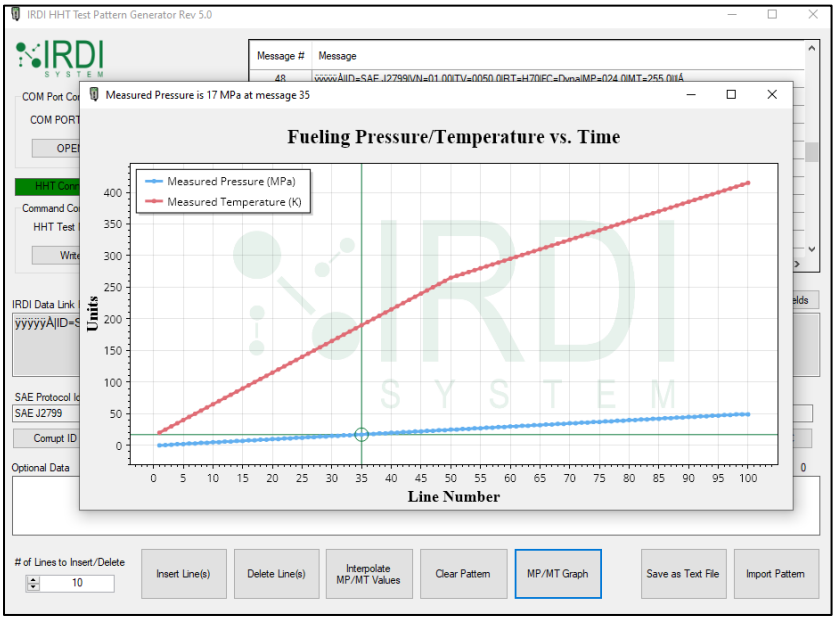

FIGURE 6-50 HHT TEST PATTERN GENERATOR SOFTWARE –MP/MT GRAPH SCREEN

Th	
STEP 4	The graph screen shows the temperature and pressure values for all IRDI messages in the test pattern. To check the value of pressure at any point in the graphed data, use your mouse to hover the cursor over the blue line on the graph, and click the mouse at the location you want to check – a circle will appear at that location on the blue line – see Figure 6-51. The pressure value at the point where the cursor is located will be displayed at the top left of the popup window, along with the associated IRDI message number.

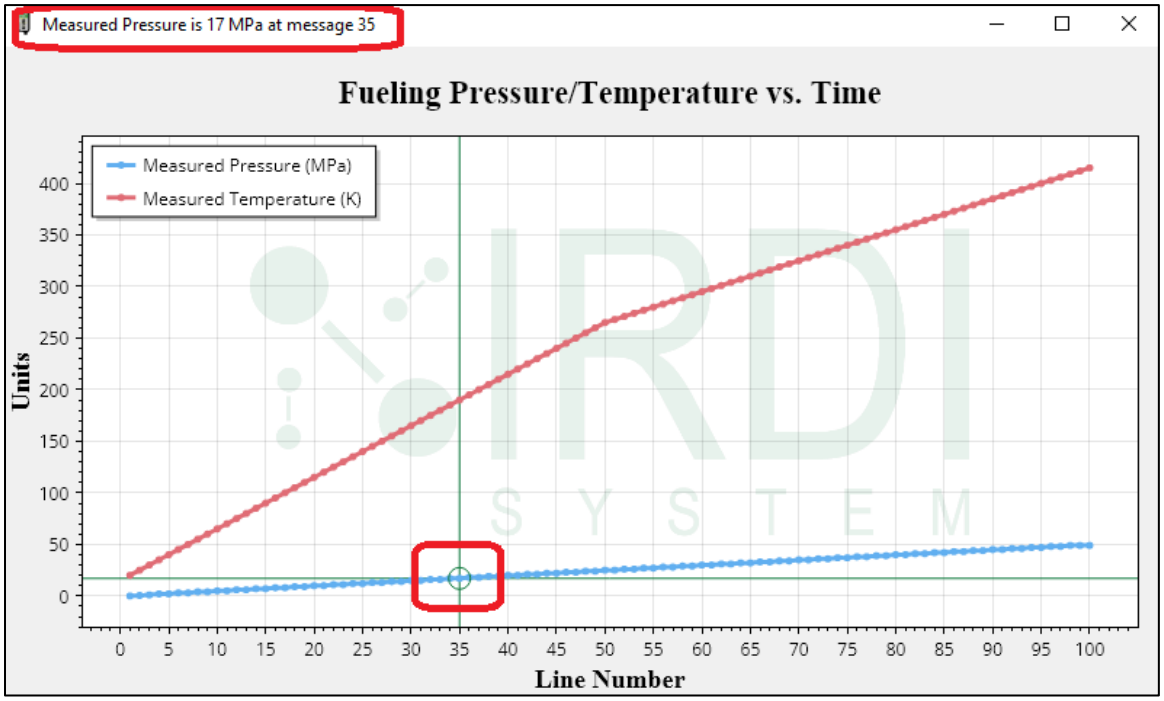

FIGURE 6-51 HHT TEST PATTERN GENERATOR SOFTWARE –CHECKING GRAPHED PRESSURE

Th	
STEP 5	To check the value of temperature at any point in the graphed data, use your mouse to hover the cursor over the red line on the graph, and click the mouse at the location you want to check – a circle will appear at that location on the red line – see Figure 6-52. The temperature value at the point where the cursor is located will be displayed at the top left of the popup window, along with the associated IRDI message number.

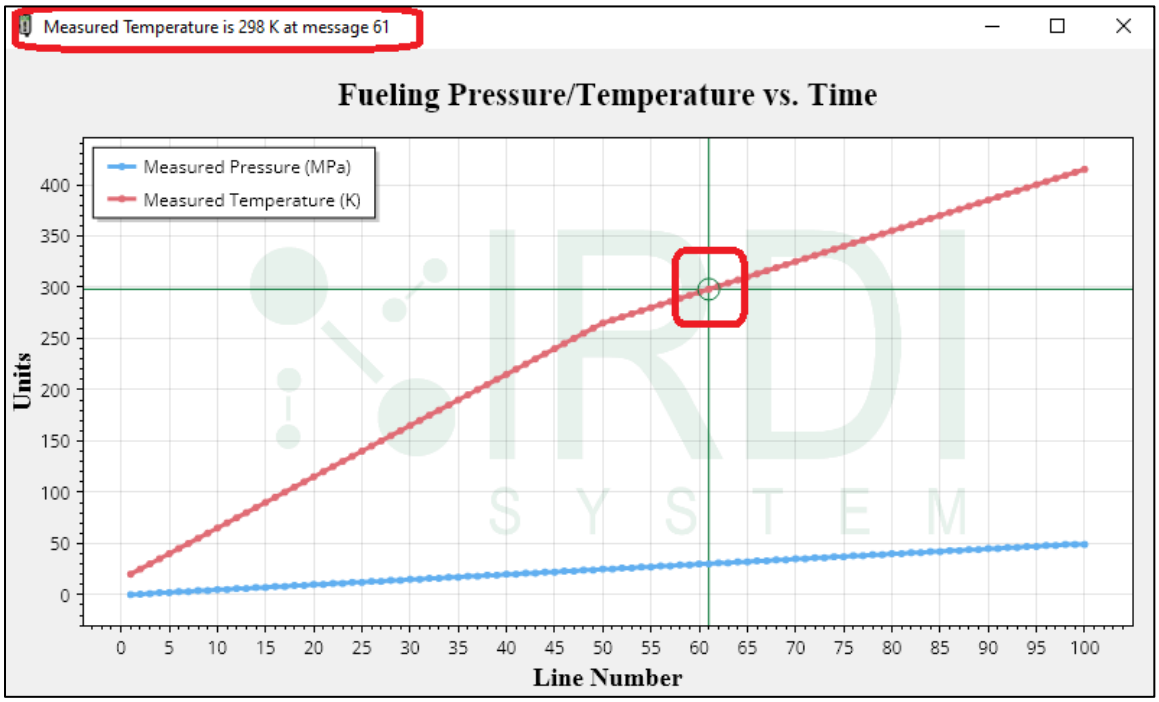

FIGURE 6-52 HHT TEST PATTERN GENERATOR SOFTWARE –CHECKING GRAPHED TEMPERATURE

7 TROUBLESHOOTING

This section provides guidance on troubleshooting any issues the user may have when using the HHT or the HHT test pattern generator software.

7.1 PROBLEM: "POWER" LIGHT NOT TURNING ON

POSSIBLE ROOT CAUSE #1	
The battery power is too low to allow the HHT to power up.	
TROUBLESHOOTING STEPS	
1. Replace the batteries as per Section 4.2.	

7.2 PROBLEM: INFRARED DATA NOT BEING TRANSMITTED/RECEIVED

If the "Power" light is on, but there is no infrared data being transmitted (hydrogen station is not receiving data):

POSSIBLE ROOT CAUSE #1	
The battery power is too low to allow the transmitter to work.	
TROUBLESHOOTING STEPS	
1. Check the "Battery" light – if the light is on, replace the batteries as per Section 4.2.	
POSSIBLE ROOT CAUSE #2	
Data is not getting from the transmitter to the receiver.	
TROUBLESHOOTING STEPS	
1. Check that the HHT is properly inserted into the end of the nozzle.	
2. Check that the surfaces of the transmitter and receiver are dust-free and not obstructed.	

7.3 PROBLEM: HHT TEST PATTERN GENERATOR SOFTWARE NOT COMMUNICATING

If the "HHT Status" window indicates "Not Connected":

POSSIBLE ROOT CAUSE #1	
The USB cable is not connected properly.	
TROUBLESHOOTING STEPS	

1. Check that the USB cable is connected properly to the HHT's USB port, and to a USB port on the computer running the HHT Test Pattern Generator software. 2. Unplug the USB cable from the computer, and plug it in again – the computer should auto-detect the HHT and automatically set the port number and communications parameters. 3. Quit and restart the HHT Test Pattern Generator software.	
POSSIBLE ROOT CAUSE #2	
The HHT is in "sleep" mode.	
TROUBLESHOOTING STEPS	
1. On the HHT Test Pattern Generator software screen, check the "HHT Status" window – if the message reads "HHT in Sleep Mode.", the HHT is in a mode that does not allow it to communicate. 2. Alternatively, check the "Power" light on the front of the HHT – if it is off, the HHT is off. 3. Press the "Power" button on the front of the HHT for at least 3 seconds, to turn on the HHT. 4. Make sure that the "Power" light is now on. 5. Run the HHT Test Pattern Generator software, and recheck the "HHT Status" window – the message should now read "HHT Connected and Ready.".	
POSSIBLE ROOT CAUSE #3	
The FTDI drivers were not installed correctly.	
TROUBLESHOOTING STEPS	
1. Re-install the FTDI drivers, as per Appendix A.	

8 APPENDIX A: UPDATING THE HHT FIRMWARE

Occasionally, a firmware upgrade will be provided for the HHT. This upgrade will consist of a firmware (HEX) file.

To program the HHT firmware, do the following:

Action	
STEP 1	Make sure that the HHT has batteries, or that it has a 3.6 VDC power supply attached.
STEP 2	Start up the computer, and make sure it is connected to the internet.
STEP 3	Connect the HHT USB to a computer USB port, and wait while the FTDI drivers install automatically. If the drivers do not install automatically, manually install the drivers following the instructions at this link: http://www.ftdichip.com/Drivers/VCP.htm **NOTE:** You may need to restart your computer afterwards if the com port does not show up in your list of ports (under Windows Control Panel).
STEP 4	Install the “Serial Bootloader AN1310 v1.05r” program.
STEP 5	Open the Serial Bootloader program – see Figure 8-1.
STEP 6	Go to “Program -> Settings”. Choose the correct com port for the HHT and click on “OK” – see Figure 8-1 and Figure 8-2. Make sure that the COM port is connected – see Figure 8-3.

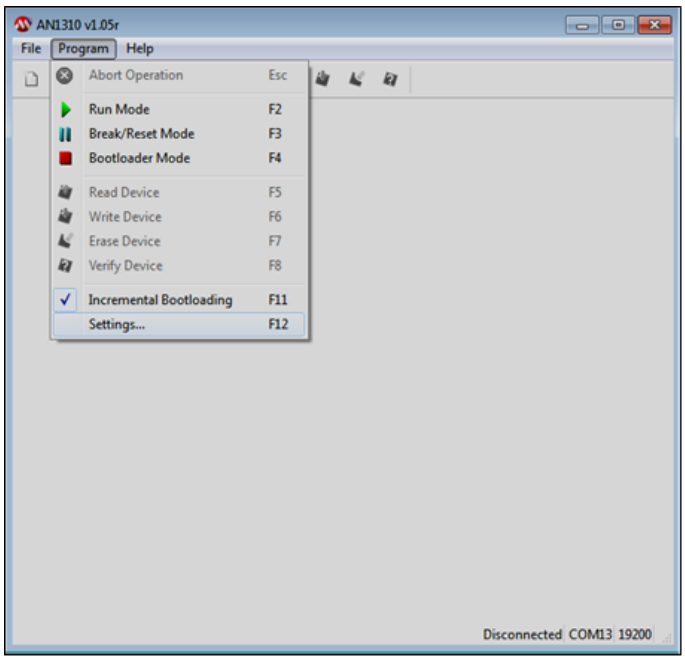

FIGURE 8-1 SERIAL BOOTLOADER PROGRAM – SELECTING "SETTINGS"

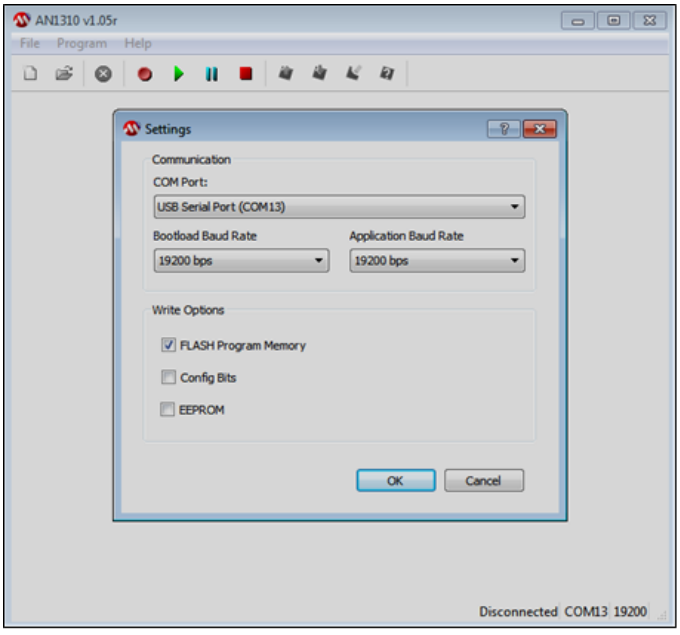

FIGURE 8-2 SERIAL BOOTLOADER PROGRAM – SELECTING COM PORT

Action	
STEP 7	Click on the red square button to enter bootloader mode – see Figure 8-3. Make sure that the bottom toolbar indicates that the HHT is connected.
STEP 8	In the “File” menu, click on “Open”, and open the HEX file provided by IRDI.
STEP 9	Click on the “Write Device” button, to program the firmware – see Make sure that the bottom toolbar indicates that the programming was successful – see Figure 8-5.
STEP 10	Click on the green arrow to run the firmware and exit bootloader mode. **NOTE:** Alternatively, you can power cycle the HHT to run the firmware, or unplug the USB connector from the HHT, then plug it back it, which forces a reset of the HHT via the RTS line.
STEP 11	Make sure that the power light and the “Test 1” light on the front of the HHT are both on.

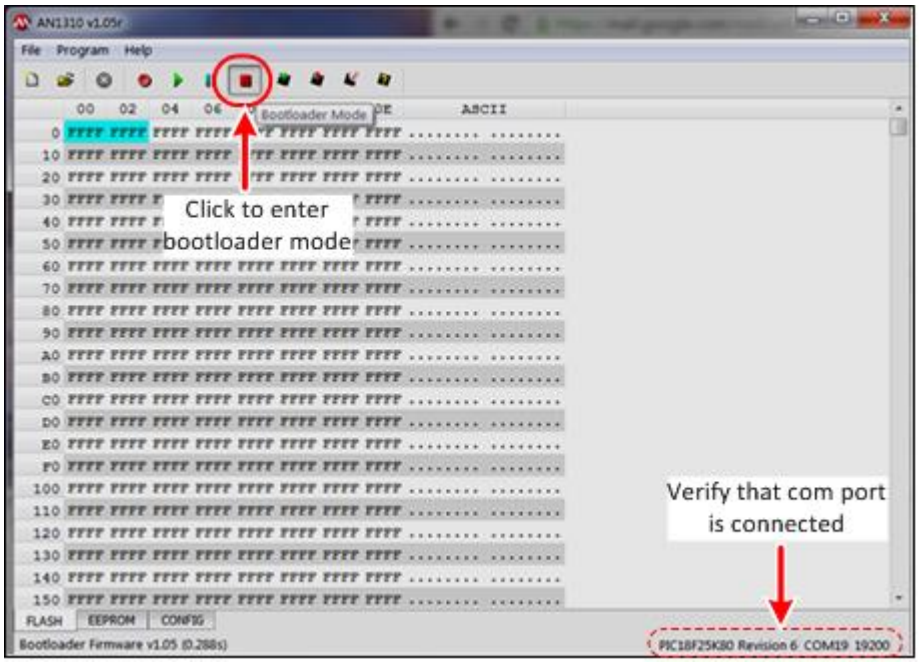

FIGURE 8-3 SERIAL BOOTLOADER PROGRAM – CONNECTING TO HHT

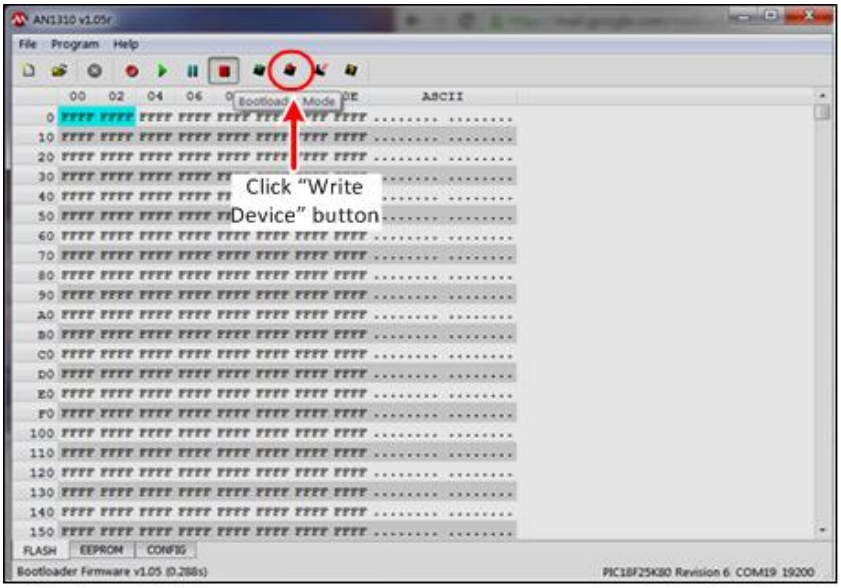

FIGURE 8-4 SERIAL BOOTLOADER PROGRAM – CLICK ON "WRITE DEVICE"

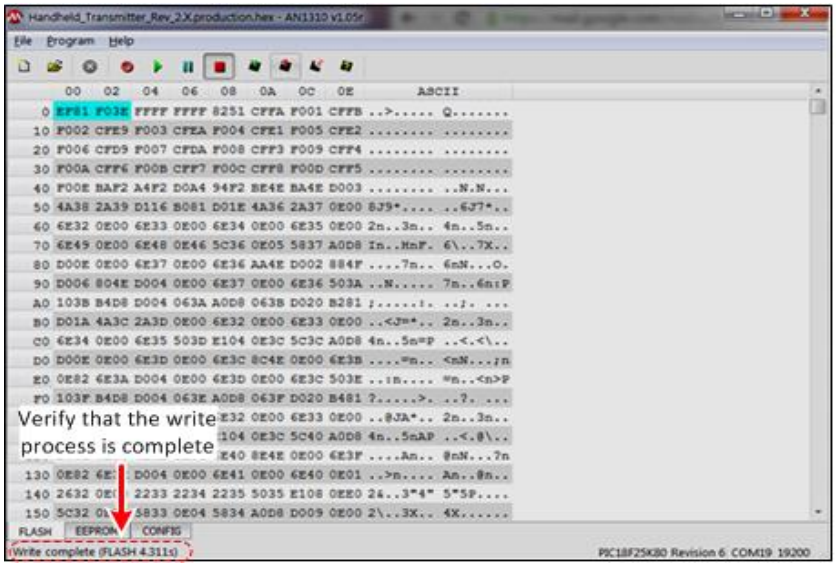

FIGURE 8-5 SERIAL BOOTLOADER PROGRAM – PROGRAMMING FIRMWARE