MAX32570 EMV DTE User's Manual

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Used for Testing

MAX32570 EVKit

5V Wall Wart Power Supply

Micro USB Cable

Test Computer Running Windows

Tera Term© VT Serial Terminal Emulator

Application Versions

Loop-Back Version: 4.2.0

Note: Screenshots may not all reflect the latest versions of the SW.

Introduction

The MAX32570 EVKit board implements an EMV PCD. It is configured with a serial UART driven DTE per *PCD-L1-Device-Test-Environment-v3.0a-version-181228*.

This manual details the following:

- Device Configuration and Power Up Procedures
- Installation of Required PC Software
- Overview of DTE Menu and Features
- Troubleshooting

Figure 1: MAX32570 EVKit

Quick Start Guide

After unpacking the MAX32570 EVKit please follow these steps to prepare for testing. NOTE: More detailed instructions for each step are found in the following sections.

- Verify the device has not been damaged in shipping, Figure 1 shows the device as shipped
- Download and install Tera Term Serial Terminal Emulator on Test PC
- Plug wall wart supply into outlet and connect barrel connector to J1
- Connect included USB cable from Test PC to USB socket CN2 (UART0)
- Re-verify connections etc. then press SW1 verify PWR EN LED lights
- Start Tera Term, and connect to the COM port the EVKit enumerated as (EX: COM5, or COM45)
- Press the space bar until main DTE menu is displayed as shown in Figure 2.
- For ease of testing, *2. Polling* from the Analogue Menu or *Begin Digital Loop Back Mode* from the Digital Menu may be used exclusively. Both implement the standard EMV Loop Back Test Mode.

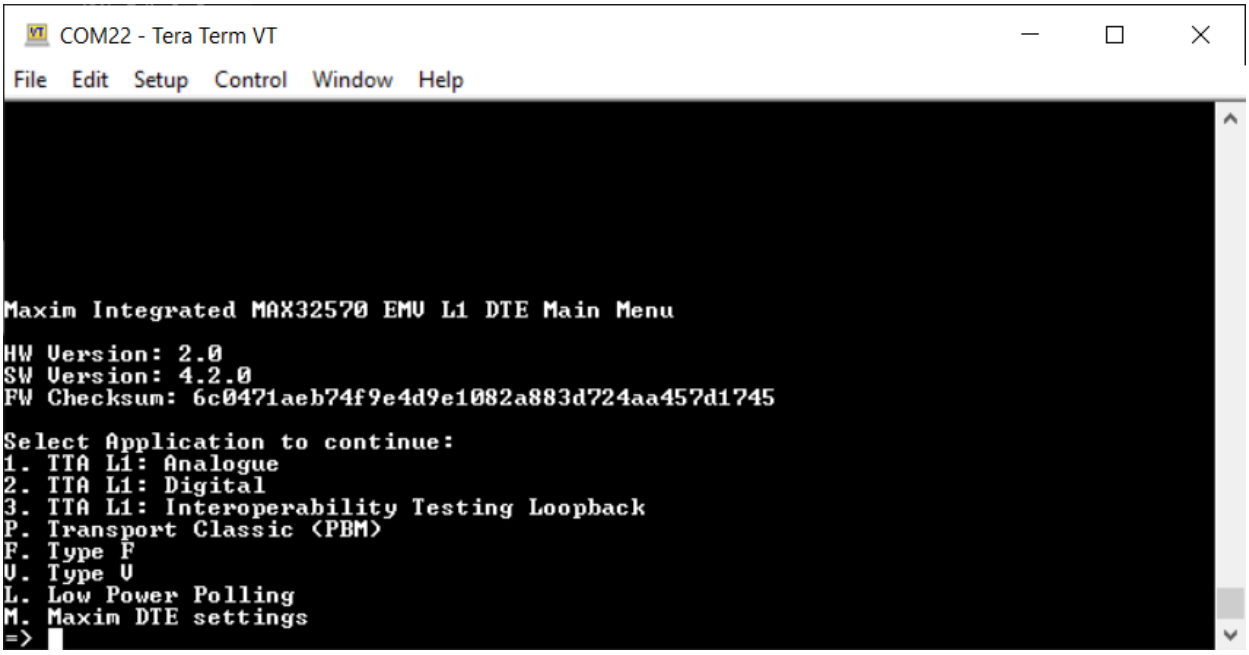

Figure 2: DTE Top Level Menu

Detailed Setup and Configuration

This section is a reference for setting up and configuring the EVKit and DTE for EMV testing.

Tera Term Serial Terminal Emulator

Tera Term is a Serial UART Terminal Emulator for windows PCs. This guide is written using version 4.102, it is available for free download here:

https://osdn.net/projects/ttssh2/releases/70691

Project home page can be viewed here: https://ttssh2.osdn.jp/index.html.en

After downloading and installing Tera Term, launch it from the Start Menu. Select *Serial Port…* from the *Setup* menu item as shown in Figure 3.

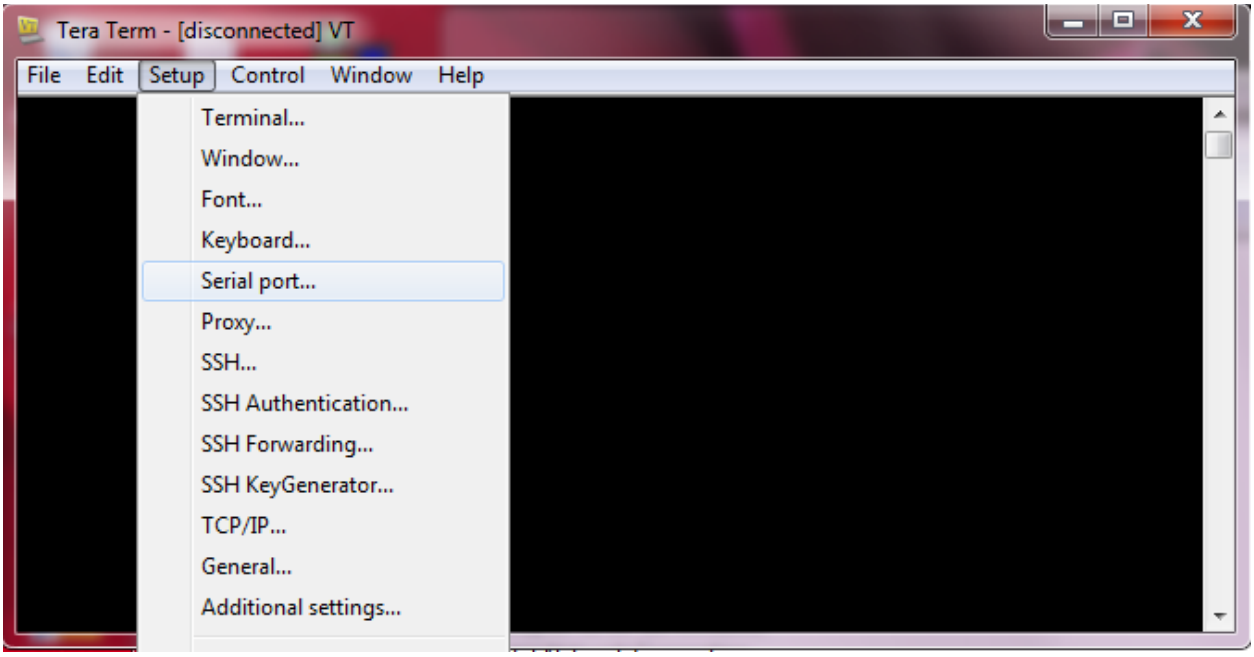

Figure 3: Tera Term Serial Port Menu

This will display the *Serial port setup* window shown in Figure 4. After the EVKit is Powered and the USB cable is connected, a COM port will show up here in the *Port* menu. It is recommended to check this menu first before connecting the DUT as other serial COM ports may be available on the test PC. When the DUT USB is connected a new COM port will be shown in the Port menu. NOTE: The *Serial port setup* window must be restarted to see newly available serial COM ports.

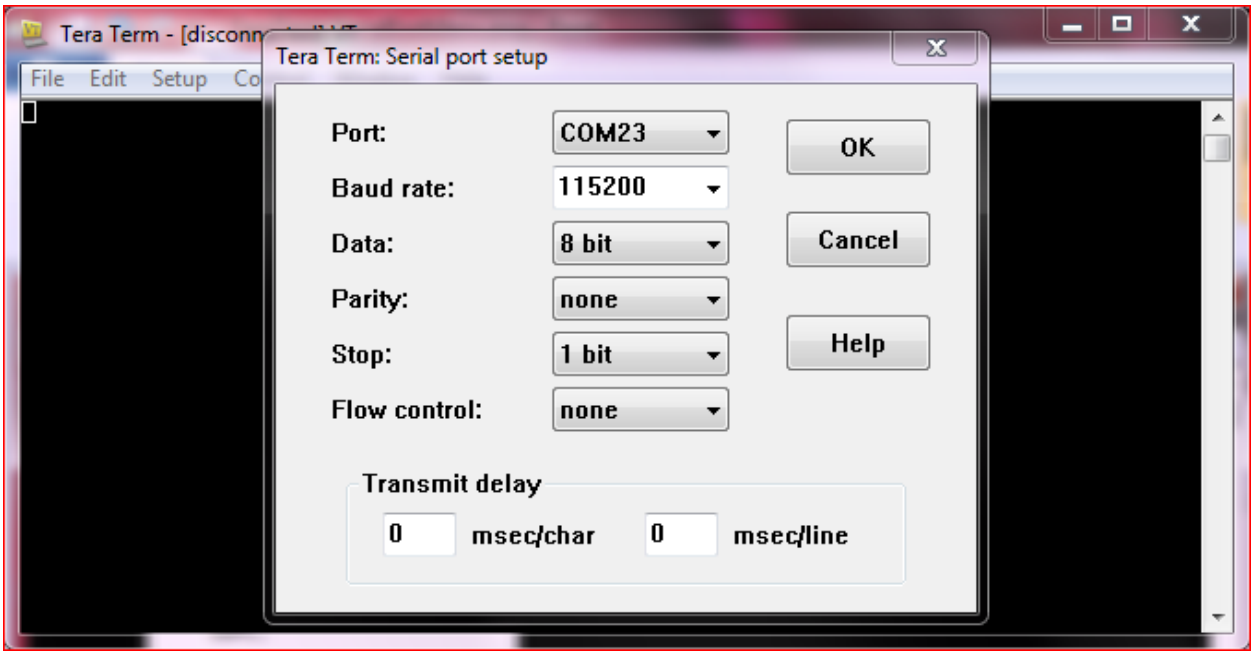

Figure 4: Tera Term Serial Port Settings

If necessary, consult the *Device Manager* from the Windows Control Panel, and observe the entries under *Ports (COM & LPT)* to determine the correct COM port number.

After identifying the correct port, and IF the DUT is powered and connected to the PC, select the COM port. In Figure 4 COM23 is selected.

Configure the baud rate to 115200 as shown in Figure 4, and verify the remaining settings match Figure 4

Finally press *OK* to exit the *Serial port setup* menu. Click in the Tera Term main window and press the space key repeatedly to cycle to the DTE Top level menu as shown in Figure 2.

If menu is not displayed consult the Trouble Shooting Section at the end of this manual.

Power Supply and USB Setup and Configuration

1. Connect wall wart supply barrel connector to J1 as shown in Figure 5
2. Plug wall wart into outlet
3. After powering the EVKit, connect the included Micro USB cable from the test PC to the EVKit connector CN2 as shown in Figure 5.
4. Press SW1 momentarily to power the board. The PWR EN LED (D5) should light as shown in Figure 6.

NOTE: The MAX32570 EVKit uses the FTDI USB to UART device. Windows comes with the driver for this device by default and after installation it should automatically enumerate as a newly available COM port.

If any issues are encountered with DTE menu access refer to the troubleshooting section.

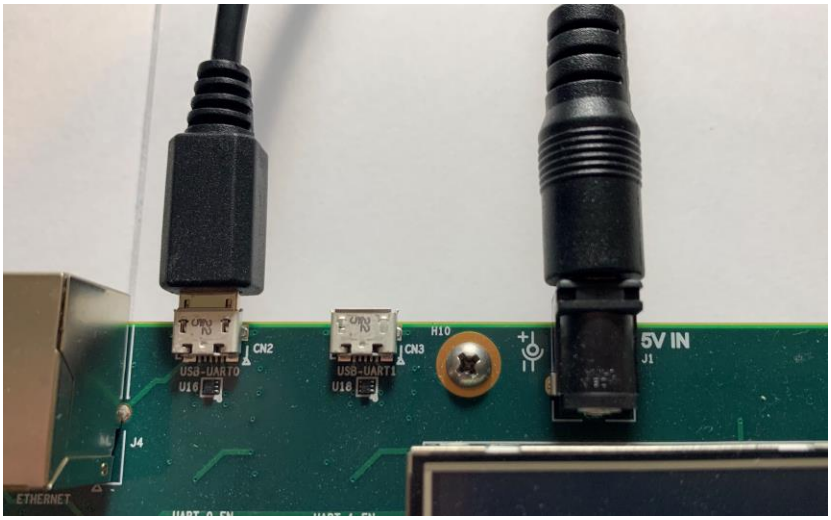

Figure 5: Power and USB Serial Connections

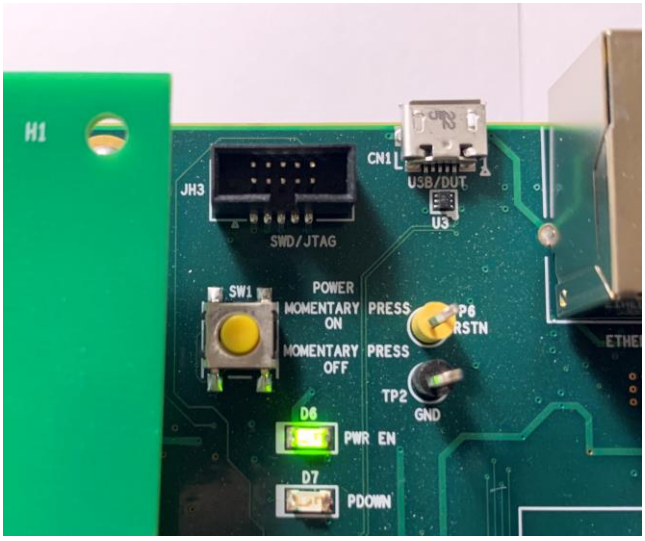

Figure 6: MAX32570 Power Button and Power Enable LED

DTE Overview

The DTE implemented for the MAX32570 is a serial UART driven menu. It supports all required test sections as detailed in *PCD_L1_Device_Test_Environment_v26b_161221*.

The main, top level menu shown in Figure 2 and Figure 7, has three entries for the required test sections of EMV Level 1. Note, the EVKit does not support any Level 2 functions. The interface is straightforward, press the key shown for each menu item to select it.

- TTA L1: Analogue
- TTA L1: Digital
- TTA L1: Interoperability Testing Loopback

Note there are also entries not required by the DTE specification.

Transport Classic (PBM, Mifare) – refer to Appendix A for details

Maxim DTE settings – refer to Appendix B for details

Type F – refer to Appendix C for details (Released AS IS in this CSP Version)

Type V – (Released AS IS in this CSP Version)

Low Power Polling – refer to Appendix D for details

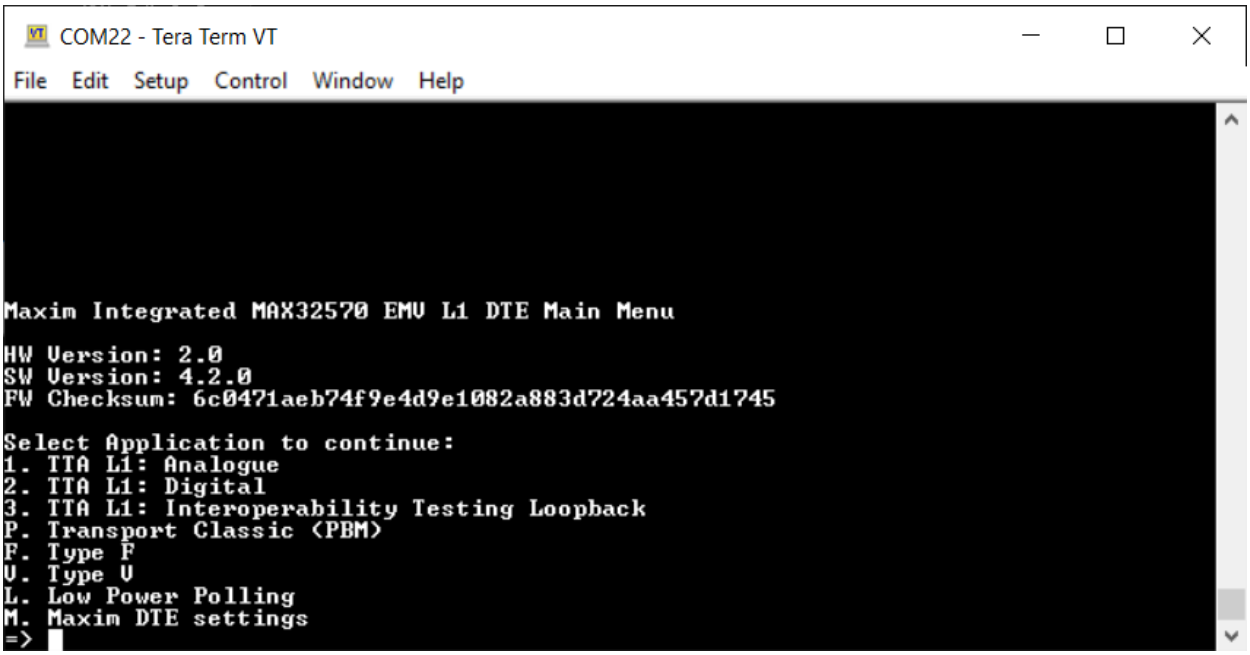

Figure 7: DTE Top Level Menu

Analogue Test Menu

The Analogue Test Menu shown in Figure 8 provides convenience functions for use by the EMV Analogue Test Engineer to send specific commands. It also provides loopback functionality if desired.

NOTE: Per *PCD-L1-Device-Test-Environment-v3.0a-version-181228* all menu options other than 1, require the Carrier to be enabled. The Carrier status is shown at the top of the Analogue Menu.

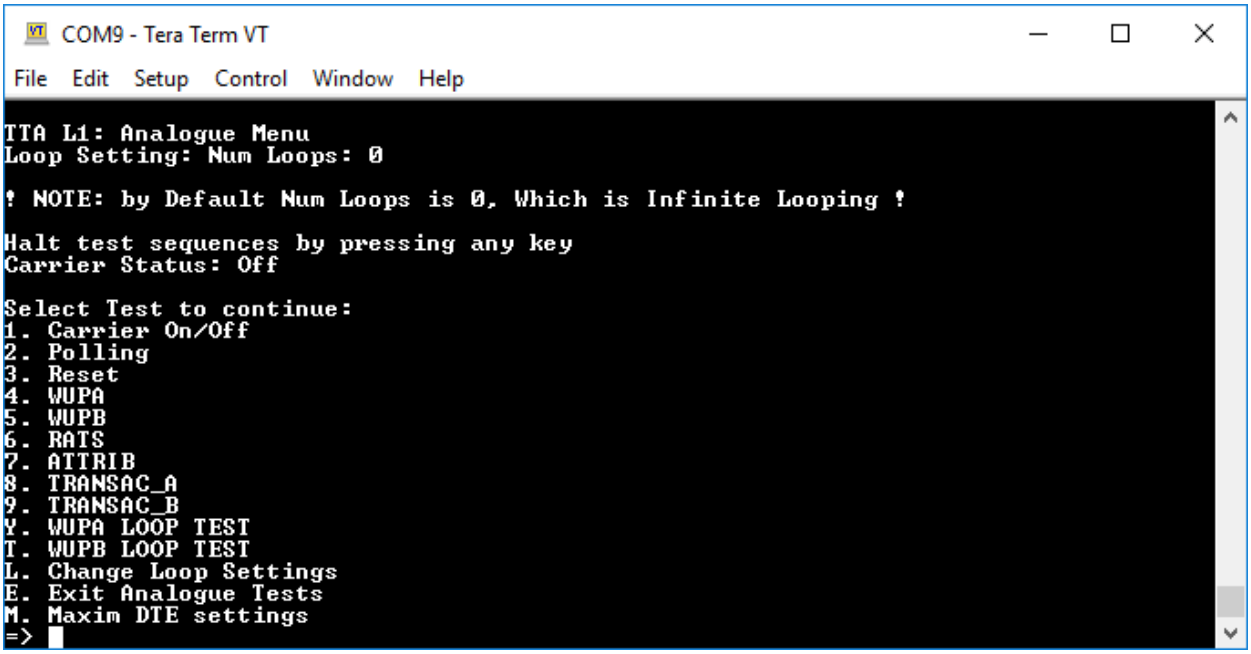

Figure 8: DTE Analogue Menu

All Analogue commands will be executed in a loop the number of times specified by the Loop Setting. This defaults to 0 at boot and may be changed in the *L. Change Loop Settings* menu. Only numbers from 0-9999 will be accepted. The current setting for number of loops is shown at the top of the Analogue Menu. By default, all commands are configured to run in an infinite mode with a Num Loops of 0. To terminate any of these infinite sequences press any key.

Table 1 shows a brief description of the functionality of each Analogue option.

Selection Key	Option Name	Description
1	Carrier On/Off	Toggles state of PCD emitted carrier/field
2	Polling	Enters standard EMV standard Loopback testing Polling Loop for the specified number of loops
3	Reset	PCD resets the operating field
4	WUPA	PCD send WUPA command and looks for ATQA Response
5	WUPB	PCD send WUPB command and looks for ATQB Response
6	RATS	PCD probes for type A card. 1. Performs Anti-collision Procedure and activation 2. Sends RATS and looks for ATS Response
7	ATTRIB	PCD probes for type B card. 1. Sends Collision detection and activation commands 2. Sends ATTRIB and looks for ATTRIB Response
8	TRANSAC_A	Sends a predefined series of Type A command without looking for responses. Refer to *PCD_L1_Device_Test_Environment_v26b_161221* for full details
9	TRANSAC_B	Sends a predefined series of Type B command without looking for responses. Refer to *PCD_L1_Device_Test_Environment_v26b_161221* for full details
Y	WUPA Loop Test	Sends 1000 WUPAs displays status and calculates passing percentage. Note: the field is reset after every WUPA. Timeout is set to 200ms.
T	WUPB Loop Test	Sends 1000 WUPBs displays status and calculates passing percentage. Note: the field is reset after every WUPB. Timeout is set to 200ms.
L	Change Loop Settings	Access the menu allowing the number of tests loops to be changed
E	Exit Analogue Tests	Exit the Analogue Tests Menu, and return to the DTE Top Level Menu

M	Maxim DTE settings	Refer to Appendix B for details

Table 1:Analogue Menu Options Descriptions

Digital Test Menu

The Digital Test Menu shown in Figure 9 provides loopback functionality and once activated will loop continuously until a key is pressed to exit the loop. Table 2 details the selection options.

Selection Key	Option Name	Description
1	Begin Digital Loop Back Mode	Enters standard EMV Loop Back Test mode. This can be terminated by pressing any key during test
E	Exit	Exit the Digital Test Menu, and return to the DTE Top Level Menu
M	Maxim DTE Settings	Refer to Appendix B for details

Table 2: Digital Menu Option Descriptions

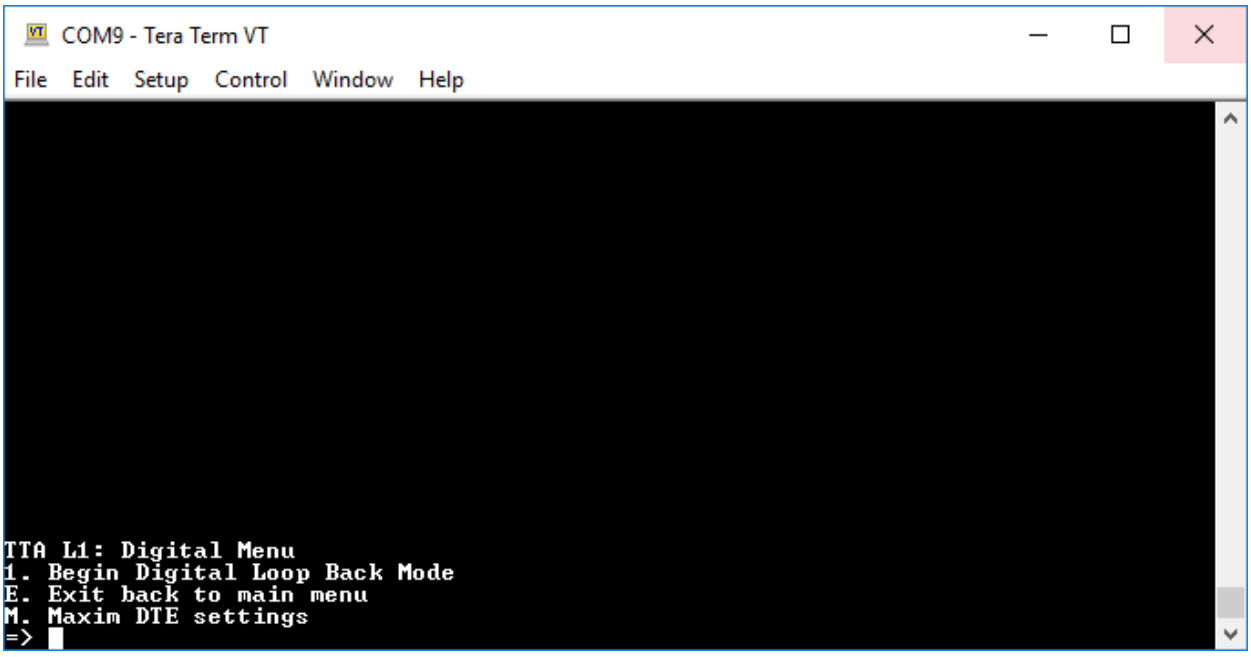

Figure 9: DTE Digital Test Menu

Interoperability Test Menu

The Interoperability Test Menu shown in Figure 10 provides the loopback, success and failure indications (Table 3) required for interoperability testing Table 4 details the selection options.

Loopback Result	Indication Description
Success	High pitched tone is emitted from buzzer BZ1 for 150ms Green LED D9 is lit for 150ms
Failure	Low pitched tone is emitted from buzzer BZ1 for 150ms Red LED D8 is lit for 150ms

Table 3: Interoperability Result Indications

Selection Key	Option Name	Description
1	Begin interoperability loopback	Enters EMV Interoperability Loop Back Test mode. This can be terminated by pressing any key during test.
E	Exit	Exit the Interoperability Test Menu, and return to the DTE Top Level Menu
M	Maxim DTE Settings	Refer to Appendix B for details

Table 4: Interoperability Test Options

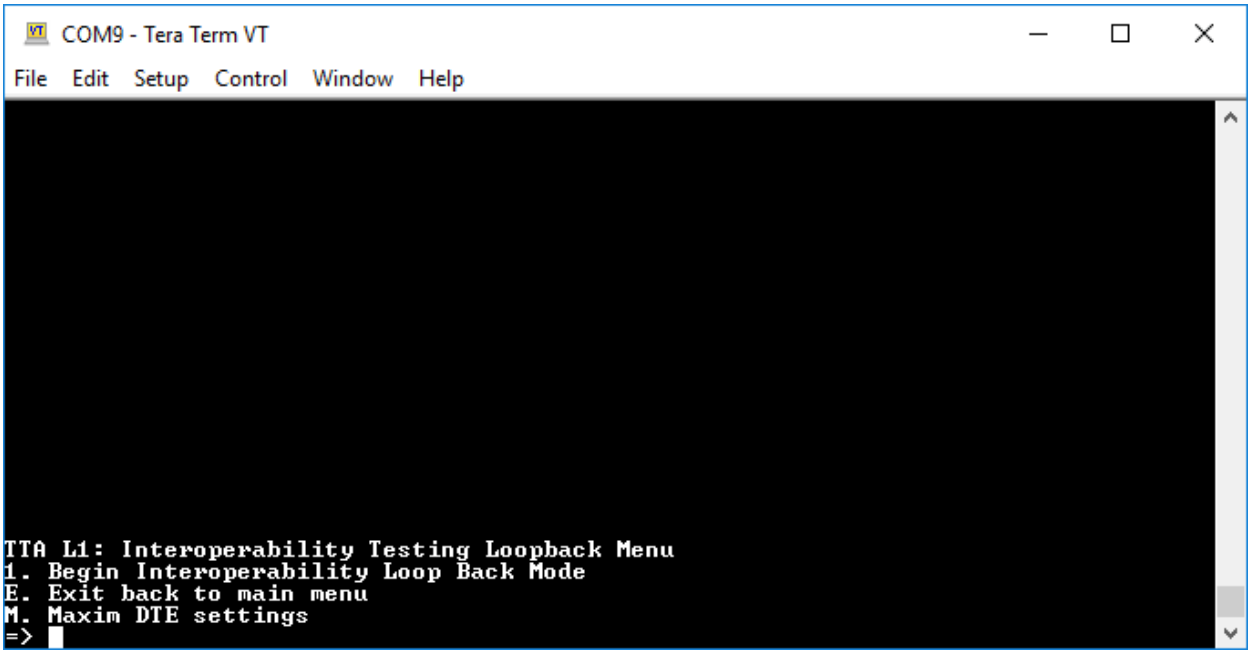

Figure 10: DTE Interoperability Test Menu

Troubleshooting

DTE Top Level Menu is Not Displayed/USB Issues

- As the USB cable is connected after the EVKit boots, the menu may be printed before Tera Term connects to the DUT. Press the space bar a few times to redisplay the DTE Top Level Menu.
- Sometimes it is necessary to unplug the USB cable, and reattach. Then press space bar to redisplay the DTE Top Level Menu.
- If the USB port fails to Enumerate, unplug cable, exit Tera Term and try again
- If COM Port does not appear in Device Manager under Port (COM & LPT), Attempt the "Scan for hardware changes" from the "Action" menu in Device Manager.
- The serial UART to USB interface chip gets a new USB handle whenever the host PC is power cycled or then EVKit board is power cycled. Any preexisting session via Tera Term may no longer be valid. Exit Tera Term then reconnect. Avoid having the Test PC sleep or reboot during test session.

Appendix A: PBM (Mifare, Transport Classic)

PBM (Parity Bypass Mode) is required to support Transport Classic (Mifare) cards. These cards are not compatible with EMV or ISO 14443-3 or 14443-4 specifications. They are typically used for transportation applications like bus or train fare, or for access control at universities or hotels.

The cards support several basic commands that are listed in Table 5. For full details on the cards, layout, commands, and their behaviors refer to the card manufacturer datasheet.

The commands operate on a block basis. Each block is protected by access control bits, and access keys (either A or B keys). To read or modify the block data this key must be known. Most cards of this type use the same default key of all 0xFFs, which this example expects and utilizes.

Figure 11 shows the PBM command menu. At the top, the current card's UID is shown along with the target block number, and the current Increment and Decrement value.

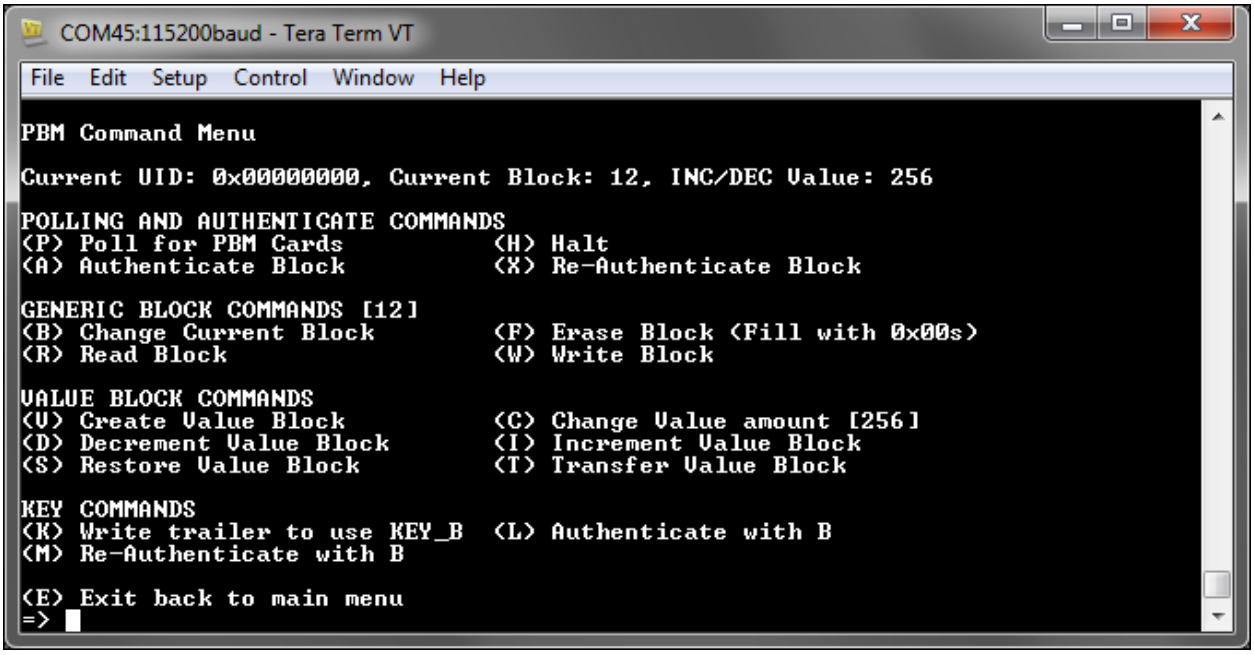

Figure 11: PBM Command Menu

Selection	Option Name	Description
Polling and Authentication Commands (for KEY_A only)		
P	Poll for PBM Card	Polls for a PBM card if potential card responds successfully, visual indication is shown, along with its UID

A	Authenticate Block	Using the selected value for KEY_A, and the UID begin a cryptographic authentication between the card and the reader. **NOTE:** this option must be used for the first authentication of a PBM card for each session. To authenticate to another block when already authenticated use command X
H	Halt	Send an encrypted HALT command to the PBM card
X	Re-Authenticate Block	Similar behavior to command A however, this command must be used when the card and reader are already in an authenticated state, to change target blocks.
Generic Block Commands (Require successful block authentication)		
B	Change Current Block	Allows the target block to be changed, default is block 12
R	Read Block	Read and display block contents.
F	Erase Block	Write the entire block with 0x00s.
W	Write Block	Write a pre-canned value into the block: 00 00 00 00 00 00 00 00 DE AD BE EF 01 23 45 67
Value Block Commands (Require successful block authentication)		
V	Create Value Block	Convert the target block into value block format using the current value amount. Default: 256
C	Change Value amount	Change the value amount used by all value block commands.
D	Decrement Value Block	Load the current value block into card's internal working register and subtract the current value amount from it. **NOTE:** this command does not write back to the block, use command T for this operation.
I	Increment Value Block	Load the current value block into card's internal working register and add the current value amount from it. **NOTE:** this command does not write back to the block, use command T for this operation.
S	Restore Value Block	Load the current value block into the card's internal working register but perform no operations.
T	Transfer Value Block	Write card's current internal working register contents into target block.
Key B Commands		

K	Write Trailer to use KEY_B	Use with caution, this example command overrides the current sector trailer, to allow KEY_B to be used for authentication of blocks in this sector and cannot be changed. Explanation of the function and format of the access bits modified by this command are beyond the scope of this document. Refer to the card manufacture's datasheet for details.
L	Authenticate with B	Like command A, except using KEY_B
M	Re-Authenticate with B	Like command X, except using KEY_B
E	Exit	Exit the Pre-validation Menu, and return to the DTE Top Level Menu

Table 5: PBM Command Overview

Basic Read Write Procedure

To read and write a block on a PBM card, the following procedure may be used.

1. Place target card on antenna
2. Verify correct key and block selection (Default key is 0xFFFFFFFFFFFF, and block num is 12)
3. Use the 'P' (Poll) command to begin polling for PBM cards. If a valid card is found its UID will be displayed with messages.
4. Next use the 'A' (Authenticate) command to authenticate the block using the selected key. Success or failure message will be displayed.
5. Use 'R' (Read Block) command to read and display the contents of target block.
6. Use 'W' (Write Block) command to write preset contents to target block.
7. Finally use 'R' (Read Block) command to read and display the contents of updated block.

Basic Value Block Procedure

1. Place target card on antenna
2. Verify correct key and block selection (Default key is 0xFFFFFFFFFFFF, and block num is 12)
3. Use the 'P' (Poll) command to begin polling for PBM cards. If a valid card is found its UID will be displayed with messages.
4. Next use the 'A' (Authenticate) command to authenticate the block using the selected key. Success or failure message will be displayed.
5. Use 'R' (Read Block) command to read and display the contents of target block.

6. Use 'V' (Create Value Block) command to configure target block as a value block.
7. Use 'R' (Read Block) command to read and display the contents of updated block.
8. Use 'I' (Increment Value Block) command to add the current value to this block.
9. Use 'T' (Transfer Value Block) command to write the incremented value block back to the target block.
10. Finally use 'R' (Read Block) command to read and display the contents of updated block.

Appendix B: Maxim Settings Menu

To enter the Maxim Settings Menu press **"M"** from any menu it is shown in Figure 12.

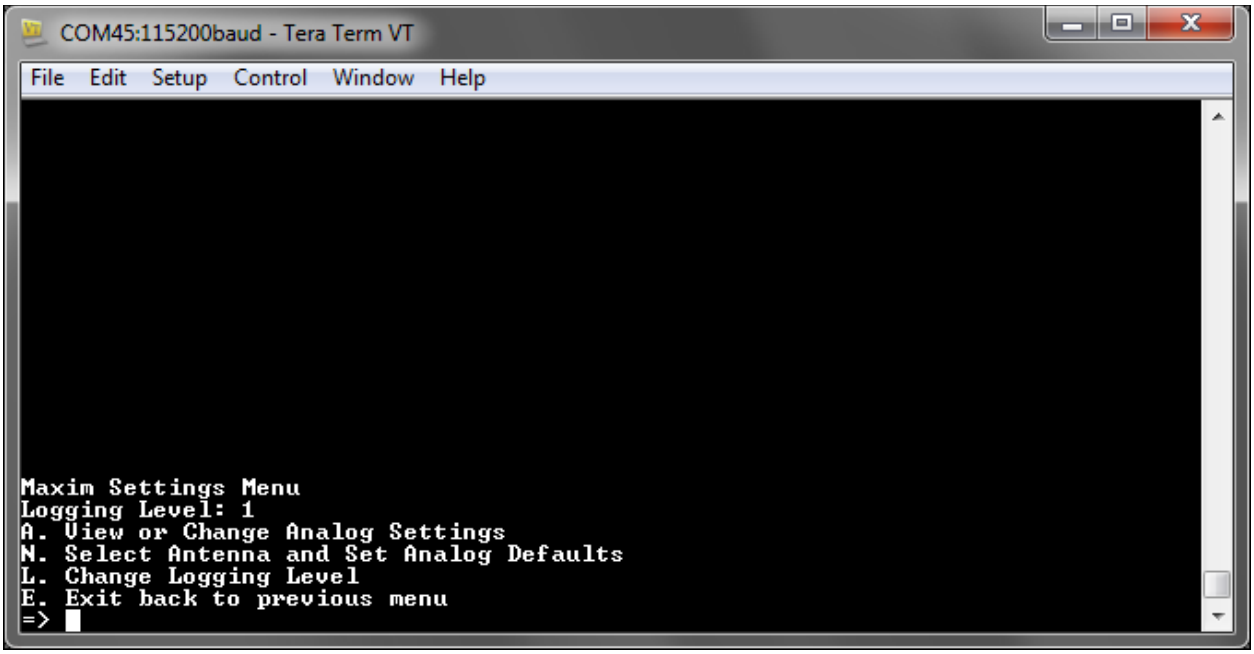

Figure 12: Maxim Settings Menu

From this menu, the Analog Settings Menu, Antenna Selection Menu and the Logging Settings Menu can be selected, they are shown in Figure 13, Figure 14 and Figure 15 respectively.

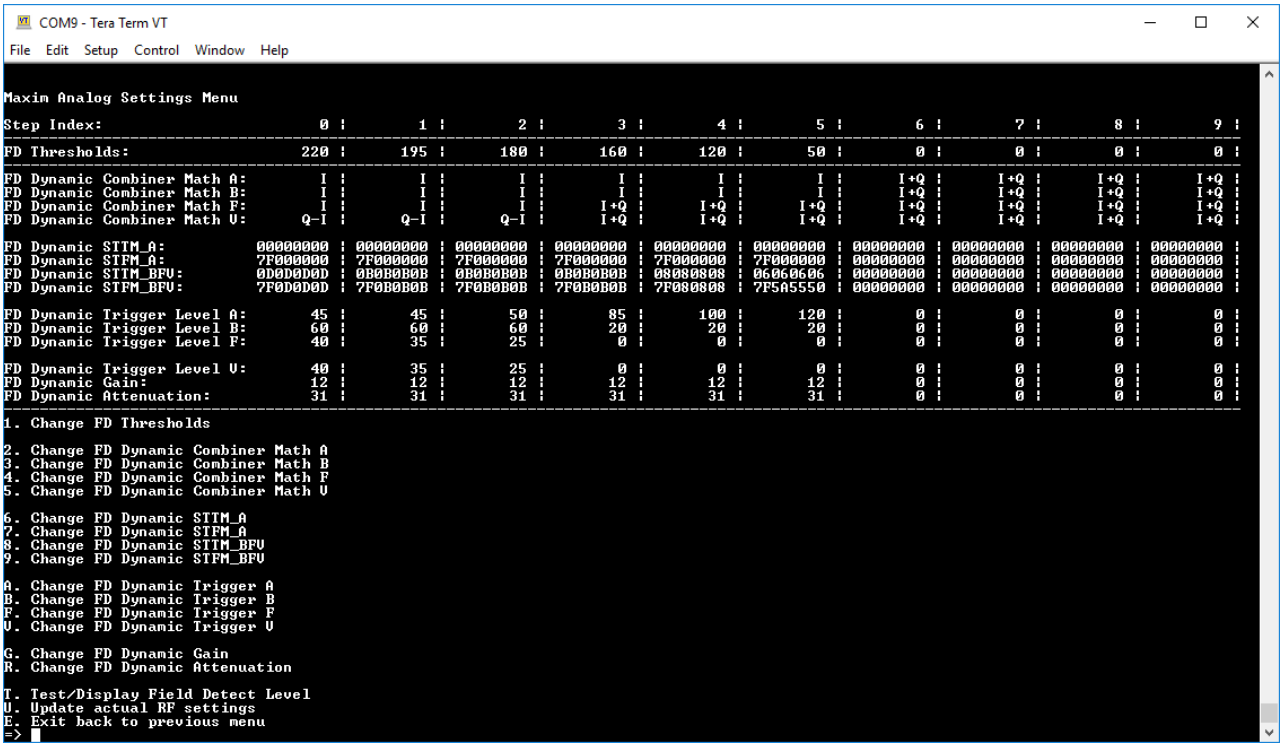

Figure 13: Analog Settings Menu

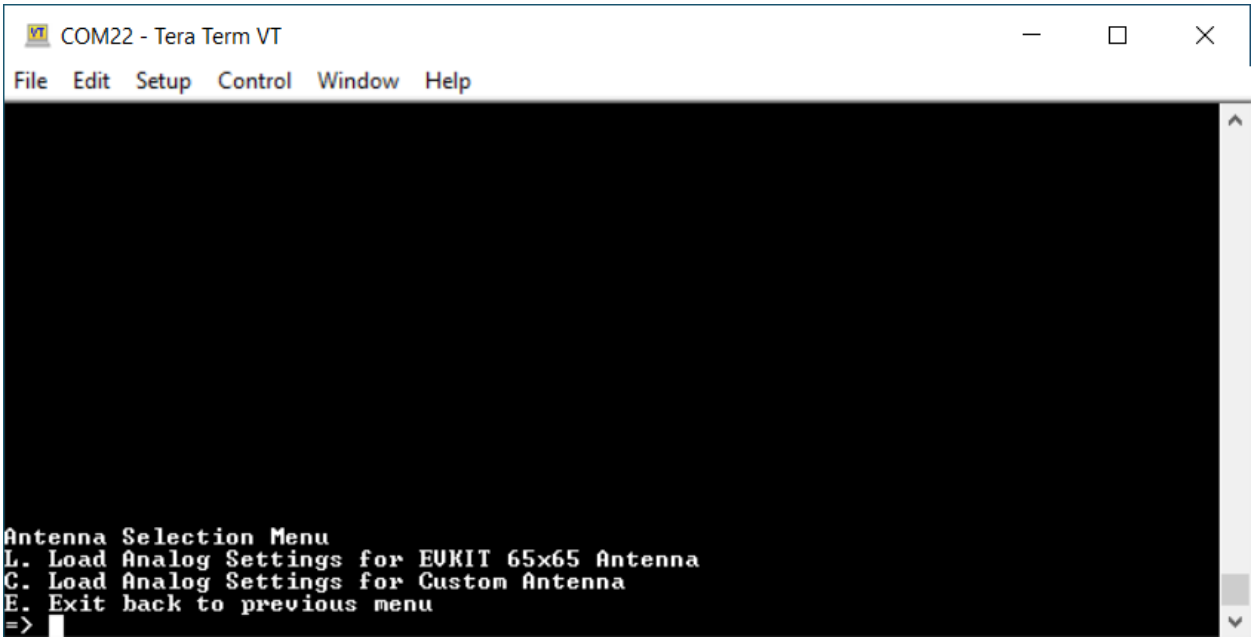

Figure 14: Antenna Selection Menu

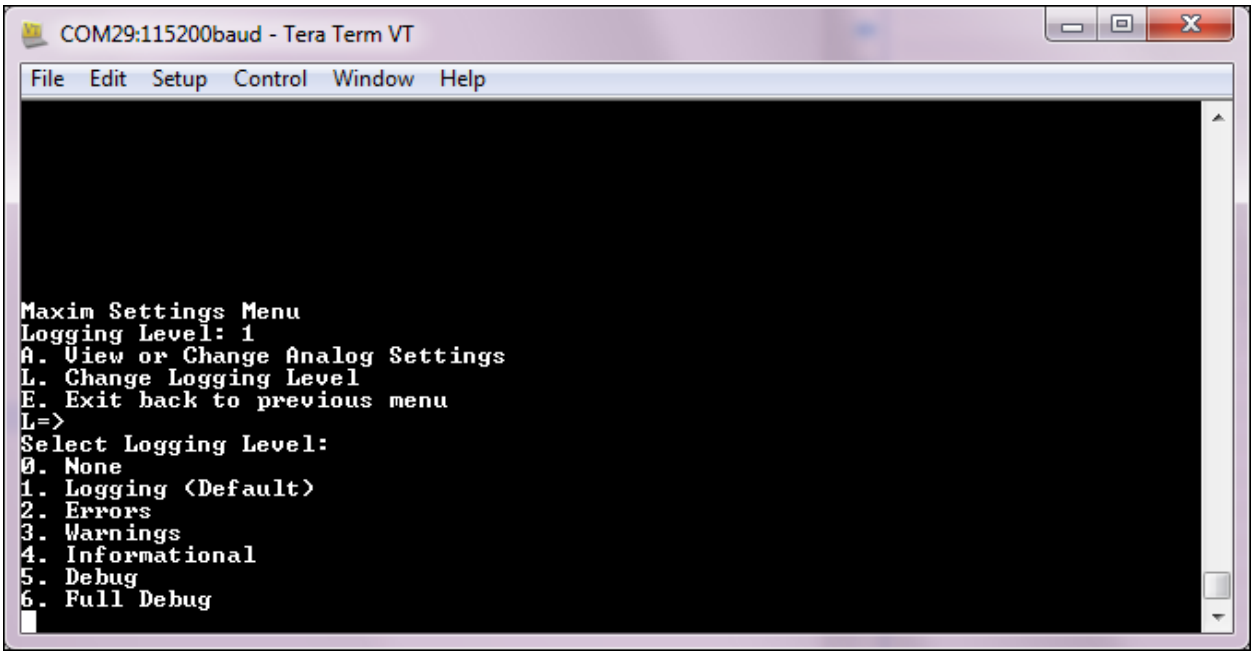

Figure 15: Logging Settings Menu

Analog Settings Menu

This menu support trimming of various analog parameters detailed in Table 6. Refer to the MAX32570 AFE Tuning Guide for an in-depth discussion of these parameters, and how to tune them.

Antenna Selection Menu

After an antenna is tuned and all the required analog settings are decided, they may be saved in a structure and passed to the RF driver to configure the MAX32570 for different antennas. The EVKIT comes by default with a 112x76mm antenna and uses the recommended settings for this antenna. If, however, the DTE application is overwritten to use a different antenna, perhaps one used in a custom design, its analog settings defaults can be loaded using this menu. This is primarily provided as an example for how this is done in the application software.

Logging Settings Menu

This menu allows changes to the L1 stack logging. The default setting "Logging", shows CAPDU and RAPDU messages. This is the required logging for EMV certification session. However, the stack supports several additional levels of error, and debug information. Each level outputs progressively more information than the previous. Note: at higher levels, some EMV tests fail due to printing latency.

For normal operation level 1 or 0 should be used. **However,** for speed critical test, level 0 should always be used. Otherwise, significant time will be used for serial output and data conversion.

Selection Key	Function Name	Description
1	FD Thresholds	Change the currently selected Field Detection Thresholds
2	Type A Combiner Math	Combiner Math for Type A signaling, (I, Q, I – Q, Q – I, I + Q)
3	Type B Combiner Math	Combiner Math for Type B signaling, (I, Q, I – Q, Q – I, I + Q)
4	Type F Combiner Math	Combiner Math for Type F signaling, (I, Q, I – Q, Q – I, I + Q)
5	Type V Combiner Math	Combiner Math for Type V signaling, (I, Q, I – Q, Q – I, I + Q)
6	STTM for Type A	Configure field driver output and steps for Type A (100% mod) **ST**eps **T**o **M**odulation. These steps allow for tuning the slew rate and amplitude when moving from the unmodulated or idle field state to modulated field.
7	STFM for Type A	Configure field driver output and steps for Type A (100% mod) **ST**eps **F**rom **M**odulation. These steps allow for tuning the slew rate and amplitude when returning from the modulated state to the idle or unmodulated field.
8	STTM for Type A	Configure field driver output and steps for Type B, V and F (10% mod) **ST**eps **T**o **M**odulation. These steps allow for tuning the slew rate and amplitude when moving from the unmodulated or idle field state to modulated field.
9	STFM for Type A	Configure field driver output and steps for Type B, V and F (10% mod) **ST**eps **F**rom **M**odulation. These steps allow for tuning the slew rate and amplitude when returning from the modulated state to the idle or unmodulated field.
A	Type A Trigger Level	RX threshold for Type A signaling (0 – 127)
B	Type B Trigger Level	RX threshold for Type B signaling (0 – 127)
F	Type F Trigger Level	RX threshold for Type F signaling (0 – 127)
V	Type V Trigger Level	RX threshold for Type V signaling (0 – 127)
G	Analog Gain	RX gain setting (0 – 12)
R	Receiver Attenuation	Receiver attenuation setting (0-31)
T	Test/Display Field Detect Level	Displays the current Field Level (0 – 255), and what threshold index this level is in.
U	Update actual RF settings	This is used to execute a dummy transaction. It will update the current analog config to this display one. Normally, these settings only take effect when the next transaction of that protocol type happens. This is useful when tuning field levels etc.

P	Print current matrix as C structure	To avoid any data entry issues in the application this options prints a formatted C structure with the current analog settings, that may be copy and pasted into the desired application.
E	Exit to previous menu	

Table 6: Analog Settings Menu Functions

Appendix C: Type F

NOTE: This is provided in an AS IS condition for this CSP release, which was focused on EMV A and B

The Type F menu supports cards complying with JIS X 6319-4, and Reader Only ISO18092.

Only low-level support is provided for Type F in the current release. REQC can be sent, and ATQC received. Also loop testing capabilities as required by *FeliCa Reader/Writer RF Performance Certification Specification Ver. 1.44* is supported. Support for other JIS X 6319-4 commands and operations may be implemented on top of this low-level support.

Figure 16 shows the Type F Command Menu. Figure 17 shows example output of polling for Type F card. Finally, Figure 18 shows example output when the loop test is used.

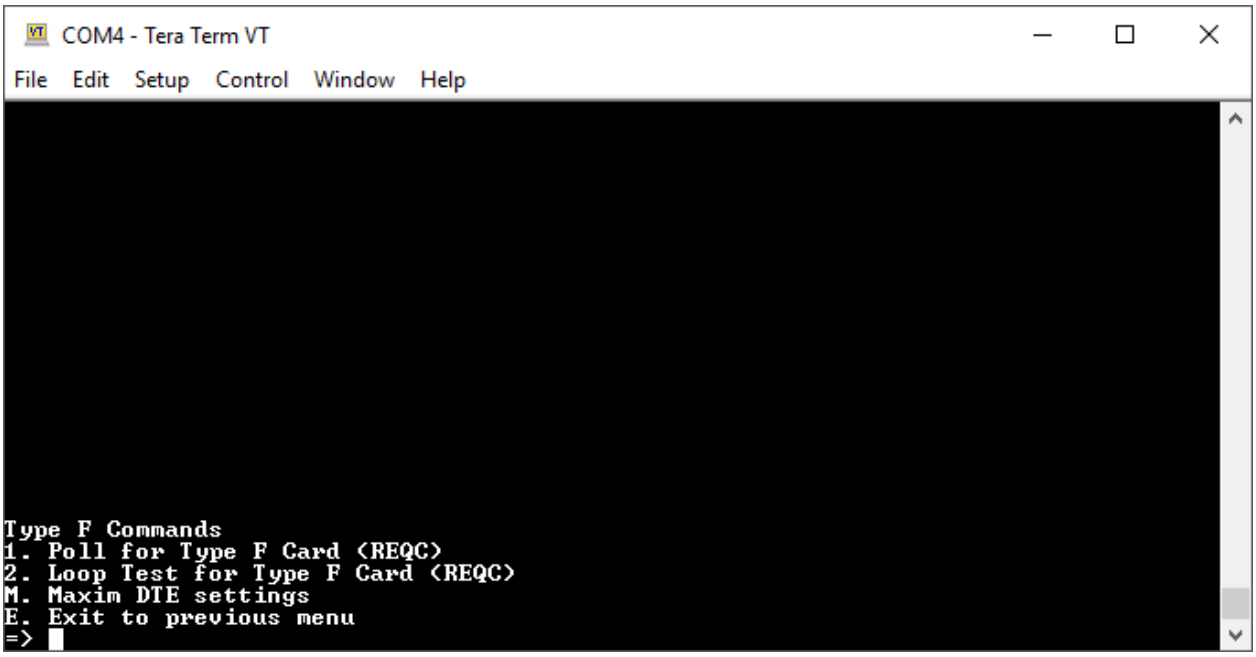

Figure 16: Type F Command Menu

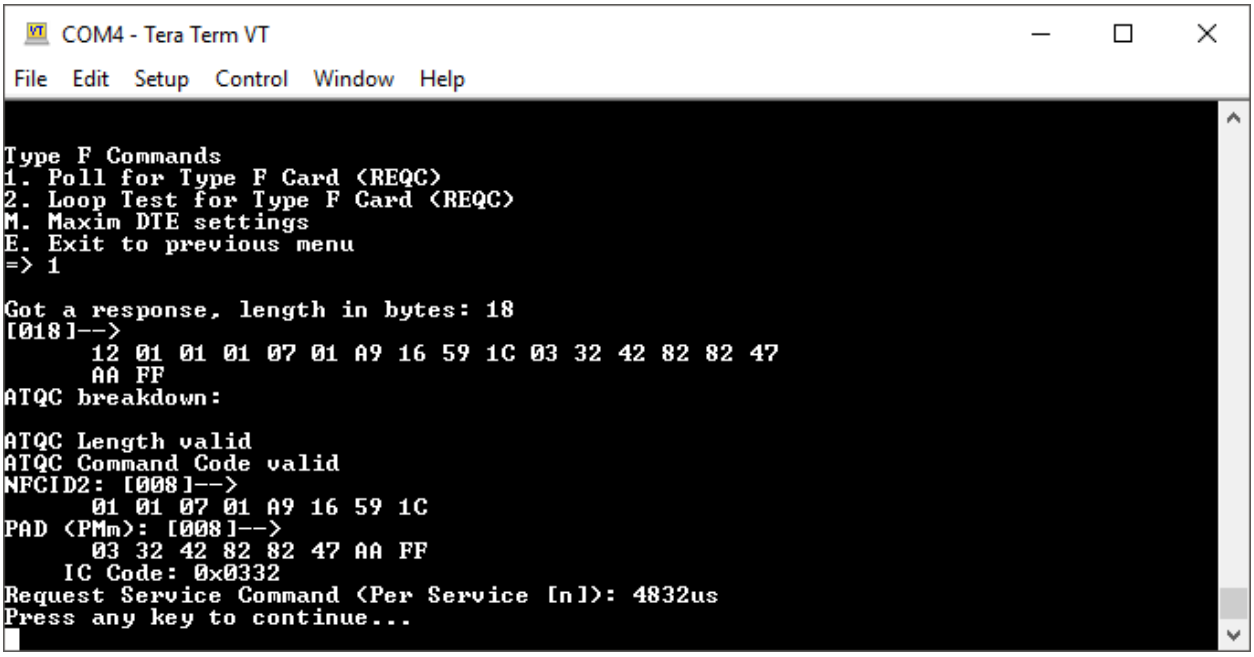

Figure 17: Type F Polling Result

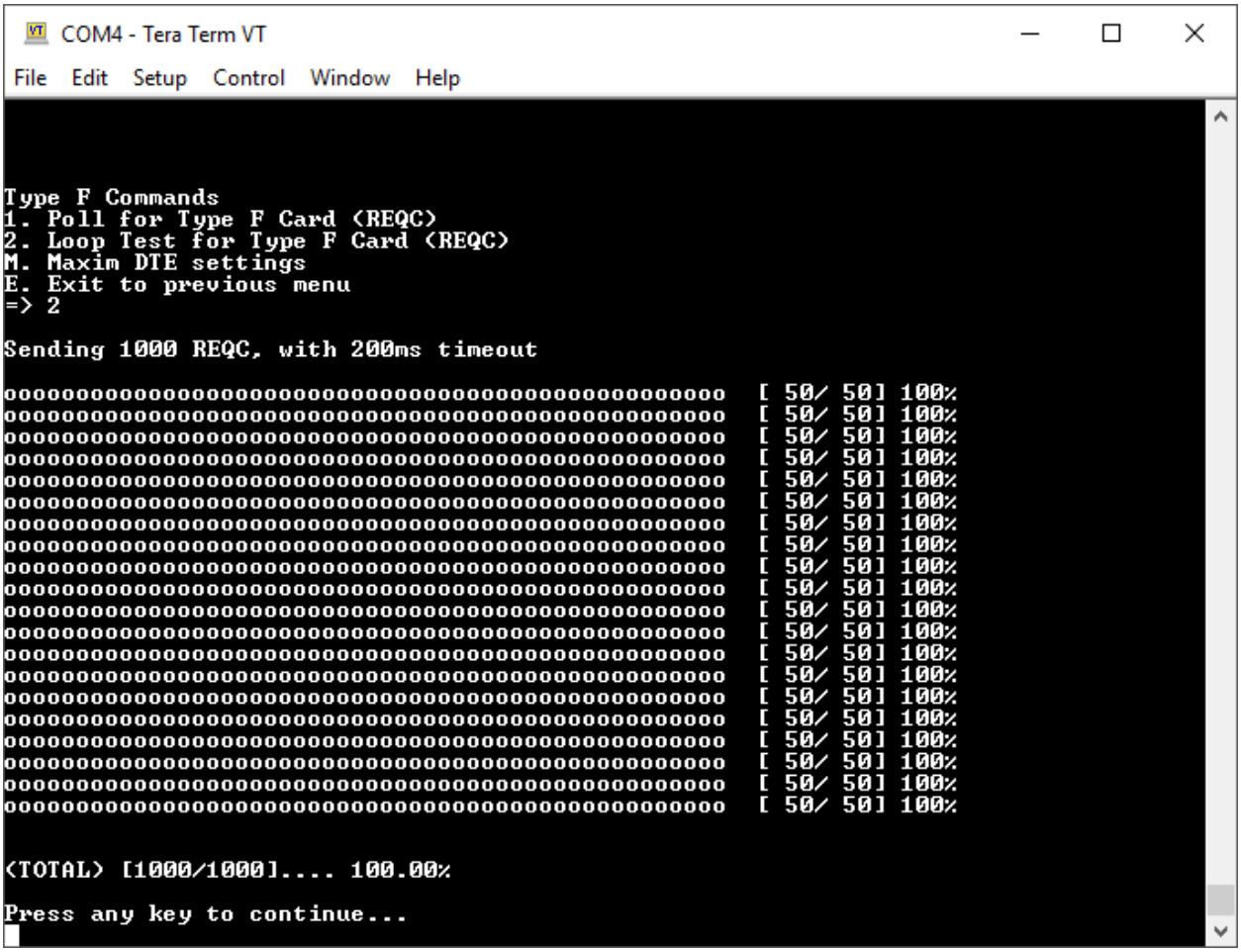

Figure 18: Type F Loop Test Output

Appendix D: Low Power Polling

This is an implementation example of the methods described in *Low Power Polling with Maxim Secure NFC Microcontrollers* Application Note. Note, this application note can also be found from the MAX32570 product page.

Figure 19 shows the low power polling menu and Table 7 details the included command options. Four different polling methods are shown in the example, each performing the same card detection followed by query of the AID (Application Identifier). The only difference being the ratio of active time to inactive time.

Option 4 is not directly covered in the Application Note, but uses the mentioned future version dedicated card sensing routine. This routine approximately halves the time required to measure the field level reducing the overall average power even more.

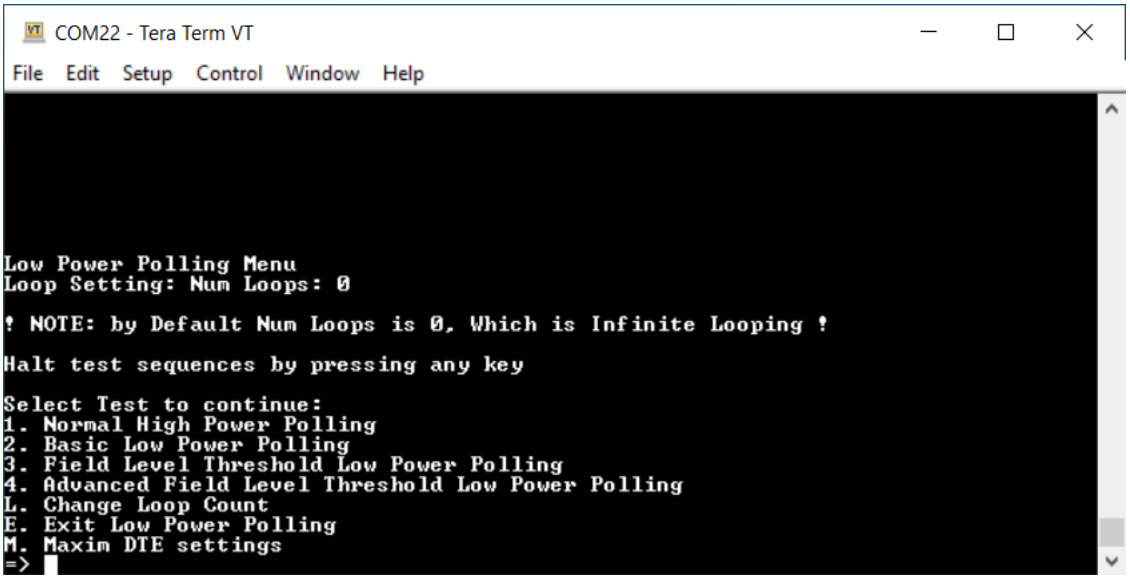

Figure 19: Low Power Polling Menu

Selection Key	Option Name	Description
1	Normal High Power Polling	EMV Style Constant Polling. Reset is the only inactive time (~5.1ms) active time (~12.4ms)
2	Basic Low Power Polling	Sleeps with the field deactivated for 400ms between EMV polling attempts. Inactive time (~400ms) active time (~12ms)
3	Field Level Threshold Low Power Polling	Sleeps with the field deactivated for 400ms between field level samplings, using legacy RF driver API routines. Inactive time (~400ms) active time (~.65ms)
4	Advanced Field Level Threshold Low Power Polling	Sleeps with the field deactivated for 400ms between field level samplings, using new RF driver API routine: mml_nfc_pcd_pres_sense(). Inactive time (~400ms) active time (~.33ms)
5	Change Loop Count	Change number of loops for each polling style from 0 (Infinite) to 9999
E	Exit	Exit the Interoperability Test Menu, and return to the DTE Top Level Menu
M	Maxim DTE Settings	Refer to Appendix B for details

Table 7: Low Power Polling Menu Items