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Model 4215C TEDS Guide

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Introduction

The Model 4215 is capable of handling and using TEDS sensors as an assistant to the calibration process. A listing of TEDS related features are as follows:

- TEDS Template 33 Plug & Play features.
- TEDS 40 and 41 Calibration, editing, and formatting features.
- Ability to operate TEDS functionality using the Front Panel Display and via RS232 ASCII commands.
- Full support for the DS2433 Chip family.
- Partial support for the DS2431 and DS2401 Chip family.

Note that the TEDS Read / Write features are sets of **optional** functionalities for the M4215. Any TEDS features described below will only be functional if the corresponding feature has been purchased.

Using The TEDS Features of the M4215

General Information About TEDS Templates

The Currently supported TEDS templates are Templates 33, 40, and 41.

The TEDS 33 Template contains basic information about the sensor, including the manufacturer, model number, serial number, etc. It also contains descriptions on the physical and electrical characteristics and capabilities of the sensor. The sensor is described as a straight line in this template format.

The TEDS 40 Template builds on the information contained in the TEDS 33 Template. It contains a piecewise linear set of corrections to the basic straight line provided by TEDS 33. It can be used to compensate for irregularities in the sensor's response, but only using straight lines between specific points.

The TEDS 41 Template is similar to the TEDS 40 Template. It too can build upon the information contained in the TEDS 33 Template but uses curves instead of straight lines to describe the sensor response. Whereas TEDS 40 is a series of corrections to the TEDS 33 straight line, TEDS 41 adjusts TEDS 33's straight line with a polynomial of arbitrary complexity. It also divides the response into a set of sections (called segments) that can each have their own polynomial. The math to generate the polynomial is more complex, but it can give very fine-grained corrections to the sensor output.

Enabling TEDS Features Via the System Options

If TEDS functionality is enabled on the Model 4215, then the user will gain access to multiple new commands and submenu features. Several new functions will be added to the "System Options" and "Calibration Options" menus. The "TEDS Menu" and its associated functions will additionally become accessible. The TEDS Menu functionality and new Calibration Options will be described later in this document.

The first new function added to the System Options is the “TEDS Enable” option. The TEDS Enable Option will give the user the ability to toggle TEDS functionality on or off. Turning this Option “On” will allow the M4215 to recognize any connected TEDS 33, 40, or 41 Sensors and turn on the TEDS annunciator on the front panel (denoted by the letter “T”). A flashing annunciator indicates that a TEDS sensor has not yet been recognized by the Unit on that particular channel. A solid (non-flashing) annunciator indicates that a TEDS sensor has been detected on the given channel. To access this function on the Front Panel, enter the Unit’s setup options menu by pressing the “Item” and “Unit” buttons at the same time. Scroll over to the “>System Options” and press “Enter” to enter the System Options Submenu. Scroll to “>>TEDS Enable” and enter into this submenu to view and select the current TEDS Enable setting.

The second new function added to the System Options is the “TEDS Basic Only” function. TEDS sensors are able to store and configure basic information that is not directly associated with any template. This information includes a Manufacturer ID, Model Number, Version Number, Version Letter, and Serial Number. The TEDS Basic Only toggleable option will give the user the ability to configure TEDS such that only the basic header information of a TEDS sensor is viewable. While in this state, non-basic TEDS templates will not be recognized by the unit. Therefore, any TEDS 33, 40, or 41 related information will be unviewable until the TEDS Basic Only Toggle is turned off. Accessing this setting through the front panel will be done in a very similar fashion to the “TEDS Enable” setting described above. Enter the “>System Options” Submenu through the same steps described above, then scroll over to the “>>TEDS Basic Only”. Press the enter key to view and select the current TEDS Basic Only setting.

Using TEDS33/40/41 with a New Sensor or TEDS Chip

When a sensor that has no currently-saved template is used, there is a first step that must be completed in order to allow the sensor to handle TEDS functionality. The M4215 must be told what type of TEDS template the user plans to set up in the cell.

The M4215 contains functionality that has the ability to overwrite the contents of a TEDS-capable device with any of the three supported templates. To give a starting point, a default set of values is written into the TEDS parameters. For a different set of default values, please contact the factory. The parameters can then be updated using the front panel or via RS232.

Using the TEDS Format Function Via the Calibration Menu

To set up a new sensor, use the TEDS Format Function. For this example, we will format a sensor to TEDS Template 33. Formatting a sensor to 40 and 41 can be done by a similar process to Template 33 by selecting the appropriate choice within the Calibration menu.

The first step is to plug in the sensor with the TEDS-capable device to be formatted.

The Format T33 function can be accessed from the front panel menus. Press the Item and Unit buttons together to enter the setup menu, then scroll to the “>Calibration” menu and press Enter. Scroll through the Calibration Menu until the “>>Format TEDS B/33” selection appears, and press “Enter” to enter the submenu.

Once “Enter” is pressed, the channel selection screen will appear. This will ask the user to select which channel the TEDS device to be formatted is connected to. You may select which channel using the Item, Unit, +, and – buttons. When the channel you wish to format is selected, press Enter.

The next screen will bring up a prompt asking if you want to format TEDS to this device. Pressing Enter will erase and overwrite the currently selected TEDS device with the default TEDS data for that particular format. Pressing the Escape button will exit the procedure and will not overwrite TEDS.

Once it is confirmed that the TEDS device is to be overwritten, the M4215 will show a notification that the TEDS chip is actively being written to. After a few seconds, the unit will prompt that the chip has been formatted. The unit will then automatically attempt to process the newly formatted device and parse its associated template information. Normal operation will resume using the data in the newly formatted TEDS sensor.

TEDS 40 and 41 templates are formattable using the same steps as described above for TEDS 33 with their respective submenus within the Calibration menu. Note that, given the nature of the TEDS 40 and 41 Templates building off of TEDS 33, T33 data may also be overwritten and reformatted if the T40 or T41 format function is used.

Copying and Erasing TEDS Data

Within the Calibration Menu of the front panel, the user will also find the submenu commands related to Copying and Erasing TEDS Data.

The Copy function may be used in cases where the user wishes to pass the calibration settings of one TEDS sensor to another. While in the Calibration menu, scroll to the setting that reads “Copy TEDS Data” and press the Enter button. First the unit will prompt the user to insert the TEDS device that contains the TEDS settings to be copied. After a short period of time, the 4215 will temporarily save the TEDS settings to its internal memory. The user will then be prompted to disconnect this TEDS device and insert the TEDS-capable device. After the user does so, the M4215 will automatically attempt to detect and begin writing to the TEDS-capable device. Once a short period of time has elapsed, the unit will notify that the copy operation is completed.

The Erase function may be used when the user wants to erase all TEDS data currently saved to the TEDS device. This function will clear all calibration settings on the TEDS sensor and erases the data associated with its current template.

TEDS Submenu

The TEDS Submenu contains the majority of the TEDS Read / Write functionality for the three major templates. To access this submenu, go to the Setup Menu by pressing the Item and Unit buttons at the same time. Scroll over to the ">TEDS Menu" selection and press the Enter button. Here the user will be able to read TEDS Basic, 33, 40, and 41 information, as well as write to these fields depending on which submenu is selected.

TEDS B/33 Read / Write

TEDS 33 Data contains information related to the physical and electrical characteristics of the sensor. On a graph, its associated data will typically represent a straight line.

>TEDS 33 Read

The TEDS 33 Read Submenu will allow the user to view all TEDS 33 settings currently associated with the attached device. This submenu additionally can be used to view the current TEDS Basic settings saved to the attached device. This information includes the following:

TBasic Data:

1. Manufacturer ID
2. Model Number
3. Version Letter
4. Version Number
5. Serial Number

T33 Data:

1. Physical Measurand Case
2. Minimum Physical Value
3. Maximum Physical Value
4. Full Scale Electric Value Precision
5. Minimum Electrical Output
6. Maximum Electrical Output
7. Bridge Type
8. Bridge Impedance
9. Bridge Response Time
10. Excite Level Nominal
11. Excite Level Minimal
12. Excite Level Maximum
13. Calibration Date
14. Calibration Initials
15. Calibration Period
16. Measurement Location ID

Each of the above items can be individually viewed in the TEDS B/33 Read menu. To change the currently observed item on the front panel, press the Item and/or unit buttons to scroll through the list.

>TEDS 33 Write

The TEDS 33 Write Submenu will allow the user to change any and all TEDS Basic/33 settings currently saved to the attached TEDS device. Similar to T33 Read,

this submenu can be navigated using the Item and Unit buttons. Pressing the Enter button will allow you to begin editing the selected field. While editing a specific field, using the + and – buttons will change the character that the cursor is highlighting, and the Item/Unit buttons will change the position of the cursor. Pressing the Enter button in this state will confirm any changes made. Once all changes have been set, the user can press the Escape button. If the 4215 detects that settings have been altered, then the unit will request the user to confirm that TEDS should be updated. Pressing the Enter button will confirm that the changes should be saved, whereas escape will exit the write function. After confirmation and a short pause, the unit will notify the user that the new TEDS settings have been written. The M4215 will then automatically attempt to read the current attached TEDS sensor and return to normal operation.

TEDS 40 Read / Write

TEDS 40 Data contains correctional data in the form of piecewise linear sets that is then applied onto the TEDS 33 Data. It is typically used to compensate for irregularities in a particular sensor's response.

TEDS 40 programming information is typically found on a calibration certificate as a table of values marked "Domain Calibration Point %FS" and "Range Calibration Deviation". With these values in hand, you can enter them into your sensor. To begin, format the TEDS sensor as a TEDS40 (if you have not done so already) and enter the required TEDS 33 information. Then, you will be able to begin reading and editing the TEDS 40 data.

>TEDS 40 Read

The TEDS 40 Read Submenu will allow the user to view all TEDS 40 settings currently associated with the attached device. This information includes the following:

T40 Data:

1. Domain Parameter
2. Correction Pairs
3. Domain Calibration Point %
4. Range Calibration Deviation %

Each of the above items can be individually viewed in the TEDS 40 Read menu. To change the currently observed item on the front panel, press the Item and/or unit buttons to scroll through the list. Note that the quantity of Domain and Range values will scale directly with the Correction Pairs setting.

>TEDS 40 Write

The TEDS 40 Write Submenu will allow the user to change any and all TEDS 40 settings currently saved to the TEDS device. The user should reference the information found on the calibration certificate when inputting these values. Using the Item and Unit buttons will allow the user to navigate this submenu similar to all other TEDS R/W submenus. Pressing the Enter button will allow you to begin editing

the selected field. While editing a specific field, using the + and – buttons will change the character that the cursor is highlighting, and the Item/Unit buttons will change the position of the cursor. Pressing the Enter button in this state will confirm any changes made.

If the user wants to add or remove any correction pairs, then they may do so by changing the value of the “Correction Pairs” setting. Increasing the number of pairs will add new points to the end of the TEDS 40 data list with a domain value of 0%. Decreasing the number of correction pairs will remove points from the end of the list. The total number of correction pairs allowed to be entered on the M4215 will vary depending on the size of the chip being used for TEDS. The M4215 will support 20 correction pairs for DS2433 chips and 15 correction pairs for DS2431 chips.

TEDS 40 points do not need to be entered in order, but the data may be automatically sorted by the M4215 before a write is able to occur. If a sort is required, a message will appear alerting the user to this.

Corrections are not used for the 0% and 100% domain points because the underlying TEDS33 covers those points. On a calibration certificate these points typically are both listed as zero deviation. If the user wants to enter the 0% and 100% points, they may do so, but the deviation must be zero. If the user decides to enter these points, the count must include them. For example, if there are range corrections listed for 0%, 20%, 40%, 60%, 80% and 100% and the user plans to enter them all, the count would be 6 points. If the user is going to enter the 20%, 40%, 60%, and 80% points, the count would be 4.

Once all of the necessary changes have been set, the user can press the Escape button. If the M4215 detects that settings have been altered, then the unit will request the user to confirm that TEDS should be updated. Pressing the Enter button will confirm that the changes should be saved, whereas escape will exit the write function. After confirmation and a short pause, the unit will notify the user that the new TEDS settings have been written. The M4215 will then automatically attempt to read the current attached TEDS sensor and return to normal operation.

TEDS 41 Read / Write

TEDS 41 programming information is typically found on a calibration certificate as a list of coefficients, labeled as IA0, IA1, and IA2. They are sometimes referred to as “Inverse Coefficients”. More complex TEDS 41 calibrations will have more coefficients and may break up the calibration into segments. To begin, format the TEDS sensor as a TEDS41 (if you have not done so already) and enter the required TEDS 33 information. Then, you will be able to begin reading and editing the TEDS 41 data.

>TEDS 41 Read

The TEDS 41 Read Submenu will allow the user to view all TEDS 41 settings currently associated with the attached device. This information includes the following:

T41 Data:

1. Domain Parameter
2. Curve Segments
3. Segment Start %
4. Segment Number of Polynomial Terms
5. Segment Exponent
6. Segment Coefficient

Each of the above items can be individually viewed in the TEDS 41 Read menu. To change the currently observed item on the front panel, press the Item and/or unit buttons to scroll through the list. Note that the quantity of Segment-related settings will scale directly with the “Curve Segments” setting. Additionally, the total quantity of exponent and coefficient settings per segment will scale directly with the “Segment Number of Polynomial Terms” setting.

>TEDS 41 Write

The TEDS 41 Write Submenu will allow the user to change any and all TEDS 41 settings currently saved to the TEDS device. The user should reference the information found on the calibration certificate when inputting these values. Using the Item and Unit buttons will allow the user to navigate this submenu similar to all other TEDS R/W submenus. Pressing the Enter button will allow you to begin editing the selected field. While editing a specific field, using the + and – buttons will change the character that the cursor is highlighting, and the Item/Unit buttons will change the position of the cursor. Pressing the Enter button in this state will confirm any changes made.

If the user wants to modify the quantity of polynomial curves affecting the sensor, then the “Curve Segments” setting should be adjusted accordingly. Each segment is a region covered by a curve equation. Typically, TEDS 41 will have one or two segments, though using more than two segments is possible. At present the M4215’s write functionality can handle up to 20 Curve segments under certain conditions (See TEDS 41 Terms Section Below).

Modification of the Segment Start % will modify what region of data will be affected by the corresponding segment’s curve. For example, if the second segment of a two-segment region has a Segment Start % of 50%, then the first segment will cover the first half of the entire region, and the second segment will cover the second half of the entire region.

Changing the “Segment Number of Polynomial Terms” setting will increase or decrease the degree of polynomial being used for the particular segment. At present, the M4215 can handle up to a max value of six Polynomial Terms, or fifth order polynomial segments (See TEDS 41 Terms Section Below).

The “Segment Exponent” and “Segment Coefficient” settings are the values that correspond to each individual term within a particular segment’s polynomial.

TEDS 41 Terms

The quantity of terms that the M4215 is able to support when writing to a TEDS 41 chip will vary depending on the family of chip being used. Generally, DS2433 chips will be able to handle and store significantly more polynomial terms than the DS2431 chips. The following table highlights the general constraints that the M4215 will enforce when writing to the “Curve Segments” and “Number of Polynomials” settings.

Note that “Maximum Number of Total Polynomial Terms Allowed” refers to the number of polynomials that can be written to TEDS across the entire region of segments. For example, a fifth-order polynomial contains six terms, so two fifth-order polynomials combine to a total of twelve terms. In the same way, four second-order polynomials will also combine to a total of twelve terms.

		Maximum Number of Total Polynomial Terms Allowed (DS2431)	Maximum Number of Total Polynomial Terms Allowed (DS2433)
		1	6
Number of Segments	2	10	12
	3	10	18
	4	10	24
	5	10	30
	6	10	30
	7	10	30
	8	10	30
	9	10	30
	10	10	30
	11	N/A	30
	12	N/A	30
	13	N/A	30
	14	N/A	30
	15	N/A	30
	16	N/A	30
	17	N/A	30
	18	N/A	30
	19	N/A	30
	20	N/A	30

A “term” can be defined by the following:

For the polynomial $(a_1 + a_2x + a_3x^2 + a_4x^3 \dots + a_nx^{(n-1)} = y)$, the number of terms in said polynomial may be described as “n”.

Remote Communications

Most features in relation to TEDS can also be accessed via a remote ASCII command set.

Communications can be established via RS-232/RS-485 protocols through the serial port on the rear panel of the unit or via USB communications through the USB port on the rear panel of the unit in conjunction with the USB driver installed on the host PC. The Commands and Command Formats are the same for each method of communication.

Pinouts for the RS-232/RS-485 Serial Port Communications are listed in Appendix B of the manual. For older computers, USB communication may require the installation of the USB driver located on the CD-ROM that accompanies this product. If the host PC can communicate with the Model 4215 via USB, no driver is needed. Please see the manual for further information on communications and baud rate settings.

All the Commands use the following format:

@123XYZ<CR>

- The @ symbol initiates the Command.
 - All Commands must begin with this symbol.
- The number 123 is the address of the Model 4215 which should respond to this command.
 - The address MUST be 3 digits so type 001 for unit one and 026 for unit twenty-six.
- The Command itself will be a sequence of letters such as the XYZ shown above.
 - If the Command requires a number as one of its parameters, the number must be followed by the pound sign "#". Numbers that are less than one should include a leading zero so you should type 0.123# to enter one-hundred twenty-three thousandths.
- Commands are not processed until a carriage return <CR> is sent.

Notes:

No Model 4215 will respond to address 000.
All Model 4215's will respond to address 255.

Throughout the rest of this Section, it will be assumed that the address in use is 123.

Whenever a Model 4215 executes a Remote Command, it will issue an acknowledgment that includes the address and any required data.

TEDS Features Command Summary

@(addr)	O	D		System Options TEDS Enable
	J	F	C (Channel Letter)	TEDS Options TEDS 33 Settings
		V	(1-21)	Change Current Settings
		W	(Channel Letter)	View current settings
				Change Parameter (1-21)
				Write TEDS to (Channel Letter)
		G	C (Channel Letter)	TEDS 40 Settings
		V	(1-n)	Change Current Settings
		W	(Channel Letter)	View current settings
				Change Parameter (1-n)
				Write TEDS to (Channel Letter)
		H	C (Channel Letter)	TEDS 41 Settings
		V	(1-n)	Change Current Settings
		W	(Channel Letter)	View current settings
				Change Parameter (1-n)
				Write TEDS to (Channel Letter)

Remote TEDS commands

The commands listed in this section mirror the TEDS functions that are available from the front panel of the Model 4215 when it is in Run Mode.

Each entry in this section will include the name of the Command, followed by a short description that includes the command format and any additionally helpful information.

Option TEDS Enable Command (OD)

The Option TEDS Enable (OD) command is used to turn TEDS on or off. The format is OD(0 or 1), where 0 turns TEDS off, and 1 turns TEDS on.

Example (User Entered):

@123OD1

Acknowledgment:

@ 123 TEDS Feature is Enabled

TEDS 33 Change Channel Command (JFC)

The TEDS 33 Change Channel Command (JFC) is used to specify which channel is currently being observed for the purposes of TEDS functionality. This function will only operate if the M4215 has more than one channel active.

Example (User Entered):

@123JFC B

Acknowledgment:

@ 123 TEDS parameter accepted

TEDS B/33 View Command (JFV)

The TEDS Basic / 33 View Command (JFV) can be used to view all current TEDS Basic and 33 template settings.

Example (User Entered):

@123JFV

Acknowledgment:

TEDS BASIC

- 1) *Mfg ID: 59*
- 2) *Model Number: 1*
- 3) *Version Letter: A*
- 4) *Version Number: 1*
- 5) *Serial Number: 1*

TEDS 33

- 6) *Physical Measurand Case: 5 (lbf)*
- 7) *Minimum Physical Value: 0 lbf*
- 8) *Maximum Physical Value: 20000 lbf*
- 9) *Full Scale Electric Value Precision: 2 (32 Bits)*
- 10) *Minimum Electrical Output: 0 mV/V*
- 11) *Maximum Electrical Output: 4 mV/V*
- 12) *Bridge Type: 2 (Full)*
- 13) *Bridge Impedance: 350 Ohms*
- 14) *Bridge Response Time: .001 mSecs*
- 15) *Excite Level Nominal: 10 Volts*
- 16) *Excite Level Minimal: 9 Volts*
- 17) *Excite Level Maximum: 11 Volts*
- 18) *Calibration Date: 01/22/18*
- 19) *Calibration Initials: LRS*
- 20) *Calibration Period: 365*
- 21) *Measurement Location ID: 1*

TEDS B/33 User Data Entry (JF)

This set of commands is used to enter information for programming a TEDS device. Note that percentages are represented as floating point numbers between 0 and 100. For example, 25% is entered as 25.0, NOT as 0.25. Segment numbers, polynomial numbers, and coefficient numbers start at zero. Additionally, entering this information does not automatically write to the TEDS sensor, but rather saves the data to be used during the TEDS write operation. To finish a TEDS Basic/33 write operation, see the usage of the TEDS B/33 Write Command (JFW).

JF1 (manufacturer code)# valid range 17 – 16381

JF2 (model number)# valid range 0-32767

JF3 (Version letter)# valid range A-Z, space, comma, period, right slash, underscore. Note that the @ symbol is a legal character but cannot be sent over the serial line because it is a command terminator. If the @ symbol is required, it can be entered through the front panel.

JF4 (version number)# valid range 0-63

JF5 (serial number)# valid range 0-16777215

JF6 (Template 33 physical measurand case)# valid range 0-45. See Template 33 documentation.

JF7 (minimum physical value)# any floating point value, for tension load cells typically 0, for compression cells typically the rated load of the sensor

JF8 (maximum physical value)# any floating point value, for compression load cells typically zero, for tension cells this is the rated load of the sensor

JF9 (electrical precision case)# valid range is 0-2. This command sets the resolution of the minimum and maximum electrical values of the sensor. Value 0 gives only 1mV resolution and is too coarse for most load cell uses. Selection 1 offers approximately 25nV resolution, and selection 2 offers standard IEEE-754 (float32) resolution. Either choice 1 or 2 is suitable for use with the M4215. Command JF9 must be issued before JF10 or JF11 if the setting is being changed.

JF10 (minimum electrical value)# Command JF9 must be issued before JF10. For a tension-only load cell, the value would be zero. The values that are valid in the field depend on the excitation voltage and the electrical precision case. For electrical precision case 0, the value can be between -1000 and +1000 in steps of 1mv, which is too coarse a setting for most cases. For case 1 valid values are -6.55 to +6.55mV. For case 2 any floating point value can be used. The M4215 can only operate with electrical values below 4.5mV/V with 10V excitation, and below 6mV/V for 5V excitation. Settings outside of this range will result in the TEDS device being rejected.

JF11 (maximum electrical value)# Command JF9 must be issued before JF11. For a compression-only load cell, the value would be zero. See details in command JF10.

JF12 (bridge type case)# valid range is 0-2, but for the M4215 only value 2, full bridge, is appropriate.

JF13 (bridge impedance in ohms)# valid range is 0-26200, but a typical value is 350 ohms, which would be sent as @123JF13 350#

JF14 (bridge response time in milliseconds)# valid range is 0.001 to 7900 ms, but this value is not used inside the instrument so it is typically set to 0.001 like this: @123 JF14 .001#

JF15 (normal excitation level)# Valid values are 0.1v to 51.1V. The M4215 can provide 5v or 10v excitation to the load cell. Nominal excitation should be set to either 5v or 10v for use with the M4215. If the excitation voltage is set within 10% of 5V, 5V is used. If the excitation voltage is set within 10% of 10V, 10V is used. If the min-max range includes 5V, 5V is used. If the min-max range includes 10V, 10V is used. For example:
@123JF15 10#

JF16 (minimum excitation value)# Valid values are 0.1v to 51.1V. The M4215 can provide 5v or 10v excitation to the load cell. Minimum excitation should be set to either 5v or 10v for use with the M4215. For example: @123JF16 10#

JF17 (maximum excitation value)# Valid values are 0.1v to 51.1V. The M4215 can provide 5v or 10v excitation to the load cell. Maximum excitation should be set to either 5v or 10v for use with the M4215. For Example: @123JF17 10#

JF18 (calibration date)# Date is in the format mm/dd/yy. For example, the calibration date of January 2, 2018 would be entered as JF18 01/02/18#. Dates before 2000 cannot be entered.

JF19 (3 calibration initials)# There must be 3 characters. Valid range A-Z, space, comma, period, right slash, underscore. Note that the @ symbol is a legal character but cannot be sent over the serial line because it is a command terminator. If the @ symbol is required, it can be entered through the front panel. For example: @123JF19 LRS# or @123JF19 LS #

JF20 (cal period)# The calibration period is in days, and can be up to 4095.

JF21 (measurement location)# This is an arbitrary number to indicate cal location. It could be a building number, technician number, or any other number chosen by the user. It is limited to the range of 0-2047 by the TEDS spec

TEDS B/33 Write Command (JFW)

The TEDS B/33 Write Command is used to write any changed settings from the TEDS B/33 User Entry commands (JF) to the memory of the TEDS sensor. Upon calling the command, the M4215 will begin its write operation to the TEDS Chip. The Front Panel will acknowledge this with a message that notifies the user that A TEDS write operation has begun. Upon successful completion, the M4215 will send acknowledgements both through the front panel and RS232 reflecting the successful operation. The format of the command is JFW(Channel).

Example (User Entered):

@123JFWA

Acknowledgment:

@ 123 Writing TEDS...

@ 123 Write operation passed.

TEDS 40 Change Channel Command (JGC)

The TEDS 40 Change Channel Command (JGC) is used to specify which channel is currently being observed for the purposes of TEDS functionality. This function will only operate if the M4215 has more than one channel active.

Example (User Entered):

@123JGC B

Acknowledgment:

@ 123 TEDS parameter accepted

TEDS 40 View Command (JGV)

The TEDS 40 View Command (JGV) can be used to view all current TEDS 40 template settings.

Example (User Entered):

@123JGV

Acknowledgment:

- 1) *Template ID: 40*
- 2) *Domain Parameter: (Electrical) 0*
- 3) *Correction Pairs: 1*
- 4) *Cal Domain Pt (%): 50*
- 5) *Range Cal Dev (%): 0*

TEDS 40 User Data Entry (JG)

This set of commands is used to enter information for programming a TEDS device. Note that percentages are represented as floating point numbers between 0 and 100. For example, 25% is entered as 25.0, NOT as 0.25. Entry numbers start at zero. For example, if the count of calibration points is set to 3, then entry numbers are 0, 1, 2.

JG1 (Domain)# Sets the TEDS40 domain to electrical (0), or physical (1). Only electrical is valid for the M4215. Example: JG1 0#

JG2 (Count)# Sets the number of calibration points. Example: JG2 5#

JG3 (EntryNumber) (DomainPercentage)# Sets the domain percentage for this correction point. To indicate 20%, use the 20, not 0.20. The entry point numbers start at zero. For example, if there are 4 calibration points, then they are numbered 0, 1, 2, 3. An example of command syntax would be: JG3 3 20.0#

JG4 (EntryNumber) (RangeCorrectionPercentage)# sets the range correction for this point. To indicate .02%, use .02, not .0002. For example: JG4 3 0.013#

TEDS 40 Write Command (JGW)

The TEDS 40 Write Command is used to write any changed settings from the TEDS 40 User Entry commands (JG) to the memory of the TEDS sensor. Upon calling the

command, the M4215 will begin its write operation to the TEDS Chip. The Front Panel will acknowledge this with a message that notifies the user that A TEDS write operation has begun. Upon successful completion, the M4215 will send acknowledgements both through the front panel and RS232 reflecting the successful operation. The format of the command is JGW(Channel). Note that the data points will be automatically sorted if needed during this write operation.

Example (User Entered):

@123JGWA

Acknowledgment:

@ 123 Writing TEDS...

@ 123 Write operation passed.

TEDS 41 Change Channel Command (JHC)

The TEDS 41 Change Channel Command (JHC) is used to specify which channel is currently being observed for the purposes of TEDS functionality. This function will only operate if the M4215 has more than one channel active.

Example (User Entered):

@123JHC B

Acknowledgment:

@ 123 TEDS parameter accepted

TEDS 41 View Command (JHV)

The TEDS 41 View Command (JHV) can be used to view all current TEDS 41 template settings.

Example (User Entered):

@123JHV

Acknowledgment:

- 1) Template ID: 41
- 2) Domain Parameter: 0 (Electrical)
- 3) Number of Calibration Curve Segments: 1
- 4) Start of Segment: 0
- 5) Number of Polynomial Terms: 4
- 6) Polynomial Exponent: 0
- 7) Polynomial Coefficient: 0
- 8) Polynomial Exponent: 1
- 9) Polynomial Coefficient: 2
- 10) Polynomial Exponent: 2
- 11) Polynomial Coefficient: 9
- 12) Polynomial Exponent: 3
- 13) Polynomial Coefficient: 3

TEDS 41 User Data Entry (JH)

This set of commands is used to enter information for programming a TEDS device. Note that percentages are represented as floating point numbers between 0 and 100. For example, 25% is entered as 25.0, not as 0.25. Segment numbers, coefficient numbers, and exponent numbers start at zero. For example if the number of segments is set to 3, then the segment numbers are 0, 1, 2.

Here is a complete example: a TEDS41 with 2 segments. Segment 0 goes from 0 to 50%, segment 1 goes from 50% to 100%. Segment 0 has equation $y=0.1x^2 + 0.3x - 5$ and segment 1 has equation $y= 0.00033x^3 + 0.002x^2- 0.5x + 3$.

In this case, the segment count is 2, and they are numbered 0 and 1. Segment 0 has starting percentage 0 (JH3 0 0#), and three polynomial terms (JH4 0 3#). Its coefficients and exponents are numbered 0, 1, 2. Coefficient 0 has value -5, exponent 0 has value 0, coefficient 1 has value 0.3 and exponent 1 has value 1, and coefficient 2 has value 0.1 and exponent 2.

Segment 1 has a starting value of 50% (JH3 1 50#), and 4 polynomial terms (JH4 1 4#). Its coefficients and exponents are numbered 0, 1, 2, 3. Coefficient 0 has value 3, exponent 0 has value 0. Coefficient 1 has value -0.5 and exponent 1 has value 1. Coefficient 2 has value 0.002 and exponent 2 has value 2. Coefficient 3 has value 0.00033 and exponent 3 has value 3.

JH1 (Domain)# Sets the TEDS41 domain to electrical (0), or physical (1). Only electrical is valid for the M4215. Example: JH1 0#

JH2 (Segment Count)# Sets the number of curve segments. This must be set before any further entry is done. Note that the quantity of segments available for the write operation may be limited depending on the total quantity of Polynomial terms being created and depending on the type of TEDS Chip in use (See TEDS 41 Terms Subsection). Example: JH2 2#.

JH3 (Segment Number) (Start Percentage)# For the given segment number, set the start domain percentage. Example JH3 1 50#

JH4 (Segment Number) (Number of Polynomial Terms)# For the given segment number, set the total number of polynomial terms. This command must be issued before commands JH5 and JH6. Note that the total number of polynomial terms available across the entire T41 template is limited. Since this command will change the current tally of total polynomial terms, this over-arching boundary will need to be kept in mind while adjusting the polynomial degree (See TEDS 41 Terms Subsection).

JH5 (Segment Number) (Exponent Number) (Value)# The exponent may be 0, 1, 2, or 3. To add a constant to the equation, use exponent zero and set the corresponding coefficient to the constant value. For example, in segment 3's first polynomial, to set the exponent to 2 use the following command: JH6 3 0 2#. Please note: the exponent must match the exponent number. For example, if the equation is $5x^3 + 2x + 1$, the exponents from 0 to 3 are: 0 1 2 3, and the coefficients are 1, 2, 0, 5. There must be an entry for each exponent, and it must match the entry number.

JH6 (Segment Number) (Coefficient Number) (Value)# To add a constant to the equation, use exponent zero and set the corresponding coefficient to the constant value. For example, to set the first constant in segment 3 equal to 5 use the following command: JH5 3 0 5#.

TEDS 41 Write Command (JHW)

The TEDS 41 Write Command is used to write any changed settings from the TEDS 41 User Entry commands (JH) to the memory of the TEDS sensor. Upon calling the command, the M4215 will begin its write operation to the TEDS Chip. The Front Panel will acknowledge this with a message that notifies the user that A TEDS write operation has begun. Upon successful completion, the M4215 will send acknowledgements both through the front panel and RS232 reflecting the successful operation. The format of the command is JHW(Channel). Note that the data points will be automatically sorted if needed during this write operation.

Example (User Entered):

@123JHWA

Acknowledgment:

@ 123 Writing TEDS...

@ 123 Write operation passed.

TEDS 41 Terms

The quantity of terms that the M4215 is able to support when writing to a TEDS 41 chip will vary depending on the family of chip being used. Generally, DS2433 chips will be able to handle and store significantly more polynomial terms than the DS2431 chips. The following table highlights the general constraints that the M4215 will enforce when writing to the “Curve Segments” and “Number of Polynomials” settings.

Note that “Maximum Number of Total Polynomial Terms Allowed” refers to the number of polynomials that can be written to TEDS across the entire region of segments. For example, a fifth-order polynomial contains six terms, so two fifth-order polynomials combine to a total of twelve terms. In the same way, four second-order polynomials will also combine to a total of twelve terms.

Number of Segments		Maximum Number of Total Polynomial Terms Allowed (DS2431)	Maximum Number of Total Polynomial Terms Allowed (DS2433)
	1		6
2		10	12
3		10	18
4		10	24
5		10	30
6		10	30
7		10	30
8		10	30
9		10	30
10		10	30
11		N/A	30
12		N/A	30
13		N/A	30
14		N/A	30
15		N/A	30
16		N/A	30
17		N/A	30
18		N/A	30
19		N/A	30
20		N/A	30

A “term” can be defined by the following:

For the polynomial $(a_1 + a_2x + a_3x^2 + a_4x^3 \dots + a_nx^{(n-1)} = y)$, the number of terms in said polynomial may be described as the value “n”.