



**User Manual for the  
*HE693CALKIT***

**CALKIT**

**Third Edition  
21 February 2001**

**MAN0049-03**



## PREFACE

This manual explains how to use the Horner APG CALKIT

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**Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.**

## REVISIONS TO THIS MANUAL

This version (MAN0049-03) of the **CALKIT User Manual** contains the following revisions, additions, and/or deletions:

1. Revised Section 2.4.5 by adding two thermocouple models (HE693THM894, HE693THM895).
2. Revised Section 3.4.5 by adding two thermocouple models (HE693THM894, HE693THM895).
3. Added Section 3.4.7 (HE693THM894 for Calibration for Type K).



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## CHAPTER ONE: INTRODUCTION

### 1.1 Product Description

The Horner APG HE693CALKIT calibration software is a computer program that is designed to support field and factory calibration for specific Horner APG analog modules. Each kit includes the following parts: a diskette with the calibration software, RS-232 9-pin serial cable, TTL-to-RS-232 converter, and an RS-232 ribbon cable with a 10-pin header plug. The calibration software runs on an IBM or compatible computer using DOS 3.1 or higher. It requires a text display and the use of one serial port, either COM1 or COM2. The program uses COM1 by default.

The analog module is connected to the selected serial port on the computer using the RS-232 cable and either the TTL-to-RS-232 converter or the RS-232 ribbon cable with the 10-pin header, depending upon the analog module being calibrated. The module does not have to be configured in the PLC but must have the proper power supplied to the bus pins of the module.

Listed on the following pages are the general setup conditions and steps that need to be taken to calibrate the modules correctly. The process does vary slightly for each module type. Specific conditions and procedures for each analog module are given in Section 2.2 (***Specific Module Conditions***) and section 3.2 (***Specific Module Calibration Process***), respectively.

NOTES

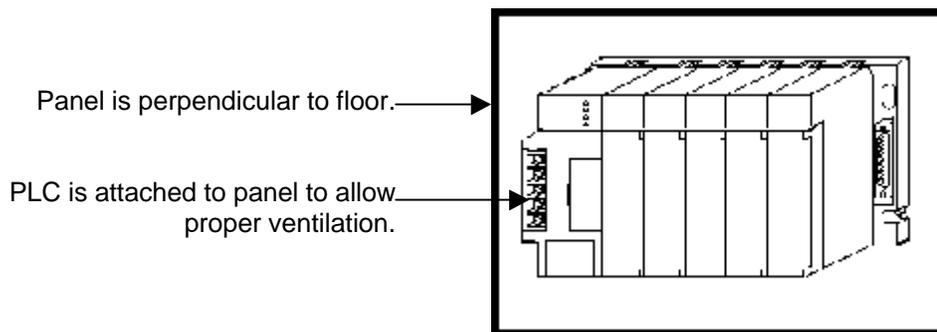
## CHAPTER 2: SETUP CONDITIONS

### 2.1 General

Several general steps need to be taken for the Horner APG analog module to be calibrated correctly. One of the most important steps that needs to be taken is the placement of the module(s) that is to be calibrated. The module(s) must be inserted in the PLC it will be used with in the application. The PLC must be powered OFF for insertion. After the module has been correctly placed in the PLC rack, the rack must be mounted in an upright position (see the *Figure 1*). The upright position of rack allows proper ventilation for the module(s). The PLC must also be in the 'STOP' mode. Once the module has been inserted into the PLC and **completely** connected for the calibration process, it must be allowed to stabilize for at least 15 minutes after power-up. This is to ensure that a proper temperature equilibrium has been established. Never expose the module, or any of the equipment involved in the calibrating process, to extreme temperature variations.

### 2.2 Setup Procedure

- *Note: An expansion rack **may** be used for the calibration process.*



**Figure 1.1 – PLC Positioning for Adequate Ventilation**

### 2.3 Equipment

Another critical step that needs to be taken to insure accurate calibration is the use of a high quality calibrator, such as the Omega CL511. The calibrator must have an accuracy better than the module by a factor of 2. For example, the THM884 would need a calibrator with an accuracy of at least +/- 0.5 degrees Celsius since the THM884 has an accuracy of +/- 1 degree Celsius. It is recommended that the calibrator also be battery-powered for use with all the Horner Electric analog modules. It is **mandatory** to have a battery-powered calibrator when calibrating any of the thermocouple modules. Another factor that must be taken into consideration is the type of wire to be used. The wire that is to be used for calibration must be the same wire that will be used in the application. The wire must be also be high quality and the length kept to an absolute minimum. Remember, wires are virtual antennas. Exposure to excessive RF or EMI during the calibration process could induce error.

## 2.4 Specific Module Conditions

The following pages contain a listing of each Horner Electric analog module and the specific setup conditions needed to ensure accurate calibration.

### 2.4.1 Analog Input Modules

#### **HE693ADC406**

- \* Use a calibrator with an accuracy better than twice that of the module.
- \* Use a calibrator that is battery-powered.
- \* Use high-grade wire for calibration process.
- \* Use the same wire for the calibration process that will be used in the application.
- \* Keep the wire lengths to a minimum.
- \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
- \* Do not expose the module(s) to extreme temperature variations.
- \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
- \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
- \* Module(s) must be in the upright position (panel-mounted position).
- \* PLC must be in 'STOP' mode.
- \* Channels not in use during the calibration process must be shorted and connected to ground.

#### **HE693ADC405, HE693ADC415**

Use a calibrator with an accuracy better than twice that of the module.

Use a calibrator that is battery-powered.

- \* Use high-grade wire for calibration process.
- \* Use the same wire for the calibration process that will be used in the application.
- \* Keep the wire lengths to a minimum.
- \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
- \* Do not expose the module(s) to extreme temperature variations.
- \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
- \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
- \* Module(s) must be in the upright position (panel-mounted position).
- \* PLC must be in 'STOP' mode.

#### **HE693ADC410, HE693ADC420**

- \* Use a calibrator with an accuracy better than twice that of the module.
- \* Use a calibrator that is battery-powered.
- \* Use high-grade wire for calibration process.
- \* Use the same wire for the calibration process that will be used in the application.
- \* Keep the wire lengths to a minimum.
- \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
- \* Do not expose the module(s) to extreme temperature variations.
- \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
- \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
- \* Module(s) must be in the upright position (panel-mounted position).
- \* PLC must be in 'STOP' mode

#### 2.4.2 Analog Output Modules

##### **HE693DAC410, HE693DAC420**

- \* Use a calibrator with an accuracy better than twice that of the module.
- \* Use a calibrator that is battery-powered.
- \* Use high-grade wire for calibration process.
- \* Use the same wire for the calibration process that will be used in the application.
- \* Keep the wire lengths to a minimum.
- \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
- \* Do not expose the module(s) to extreme temperature variations.
- \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
- \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
- \* Module(s) must be in the upright position (panel-mounted position).
- \* PLC must be in 'STOP' mode.

#### 2.4.3 Resistance Temperature Device (RTD) Modules

##### **HE693RTD600, HE693RTD601, HE693RTD660, HE693RTD665, HE693RTD666**

- \* Use a calibrator with an accuracy better than twice that of the module.
- \* Use a calibrator that is battery-powered.
- \* Use high-grade wire for calibration process.
- \* Use the same wire for the calibration process that will be used in the application.
- \* Keep the wire lengths to a minimum.
- \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
- \* Do not expose the module(s) to extreme temperature variations.
- \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
- \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
- \* Module(s) must be in the upright position (panel-mounted position).
- \* PLC must be in 'STOP' mode.
- \* Channels not in use during the calibration process must be shorted and connected to ground.
- \* Modules with a -20 suffix should use the a=d switch with the calibration software (PT100D).

#### 2.4.4 Strain Gage Modules

##### **HE693STG883, HE693STG884**

- \* Use a calibrator with an accuracy better than twice that of the module.
- \* Use a calibrator that is battery-powered.
- \* Use high-grade wire for calibration process.
- \* Use the same wire for the calibration process that will be used in the application.
- \* Keep the wire lengths to a minimum.
- \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
- \* Do not expose the module(s) to extreme temperature variations.
- \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
- \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
- \* Module(s) must be in the upright position (panel-mounted position).
- \* PLC must be in 'STOP' mode.
- \* Channels not in use during the calibration process must be shorted and connected to ground.

#### 2.4.5 Thermocouple Modules

**HE697THM160, HE693THM166, HE697THM260, HE693THM406, HE693THM409, HE693THM446, HE693THM449, HE693THM665, HE693THM666, HE693THM668, HE693THM806, HE693THM809, HE693THM884, HE693THM886, HE693THM888, HE693THM889, HE693THM894, HE693THM895.**

Use a calibrator with an accuracy better than twice that of the module.

- \* Use a calibrator that is battery-powered.
  - \* Modules with a suffix -21 should utilize the external ISOBLK for cold junction compensation.
  - \* Use high-grade wire for calibration process.
  - \* Use the same wire for the calibration process that will be used in the application.
  - \* Keep the wire lengths to a minimum.
  - \* Do not expose the module(s) to excessive EMI or RF during the calibration process.
  - \* Do not expose the module(s) to extreme temperature variations.
  - \* Module(s) should be placed in the slot(s) of the PLC that will be used in the application.
  - \* Module(s) must be allowed to stabilize for at least 15 minutes after **complete** connection.
  - \* Module(s) must be in the upright position (panel-mounted position).
  - \* PLC must be in 'STOP' mode.
  - \* Last channel must be shorted and connected to ground to optimize cold junction compensation.
- Modules with a suffix -02 should utilize "=k" switch with the executable. (Refer to Section 4.1.)

## CHAPTER 3: CALIBRATION PROCESS

### 3.1 General

The general calibration process that will be described is just that, general. Each module calibration process will vary slightly while the concept will remain constant. Please calibrate your analog module according to the specific processes described in the following sections. Table 3.1 contains a list of the analog modules and their corresponding calibration file:

Table 3.1 – Analog Modules / Calibration Files				
Product #	Software		Product #	Software
HE693ADC405 HE693ADC415	adc4x5.exe		HE693THM166	thm166.exe
HE693ADC410 HE693ADC420	adciso.exe		HE693THM665 HE693THM666 HE693THM668	thm668.exe
HE693ADC406	adc406.exe		HE693THM884 REV. A,B,C	thm884_1.exe
HE693ADC816	adc816.exe		HE693THM884 HE693THM888 REV. D,E,F,G, H, HX,J, K,L	thm884_2.exe
HE693DAC410 HE693DAC420	daciso.exe		HE693THM406 HE693THM446 HE693THM806 HE693THM886 REV.. A,B,C	thmxx6_1.exe
HE693RTD600 HE693RTD600 HE693RTD660 HE693RTD666	rtd6xx.exe		HE693THM406 HE693THM446 HE693THM806 HE693THM886 REV.. D,E,F	thmxx6_2.exe
HE693STG884	stg884.exe		HE693THM409 HE693THM449 HE693THM809 HE693THM889	thmxx9.exe
HE693STG883	stg883.exe		HE693THM884	thm884_K.bat
HE697THM260	thm260.exe		utilizing Type K only and using offsets.	
HE693THM160	thm160.exe		REV. K,L	

### 3.2 Starting the Software

Listed below are the steps that will execute the calibration software:

1. Select the appropriate executable file from the list on the diskette. For example, if you are calibrating a HE693THM884, choose the file Thm884.exe.
2. To run the calibration program, type

Thm884  
at the DOS prompt and press 'ENTER'.

If the serial port COM2 is desired, type

Thm884 =C2  
at the DOS prompt and press 'ENTER'.

3. To view a list of the command line switches and their descriptions, type

Thm884 =?  
at the DOS prompt and press 'ENTER'.

### 3.2.1 Screen Example

Once the program has been invoked, the program name and version are displayed at the top of the screen. Figure 3.1 is a sample of the initial screen:

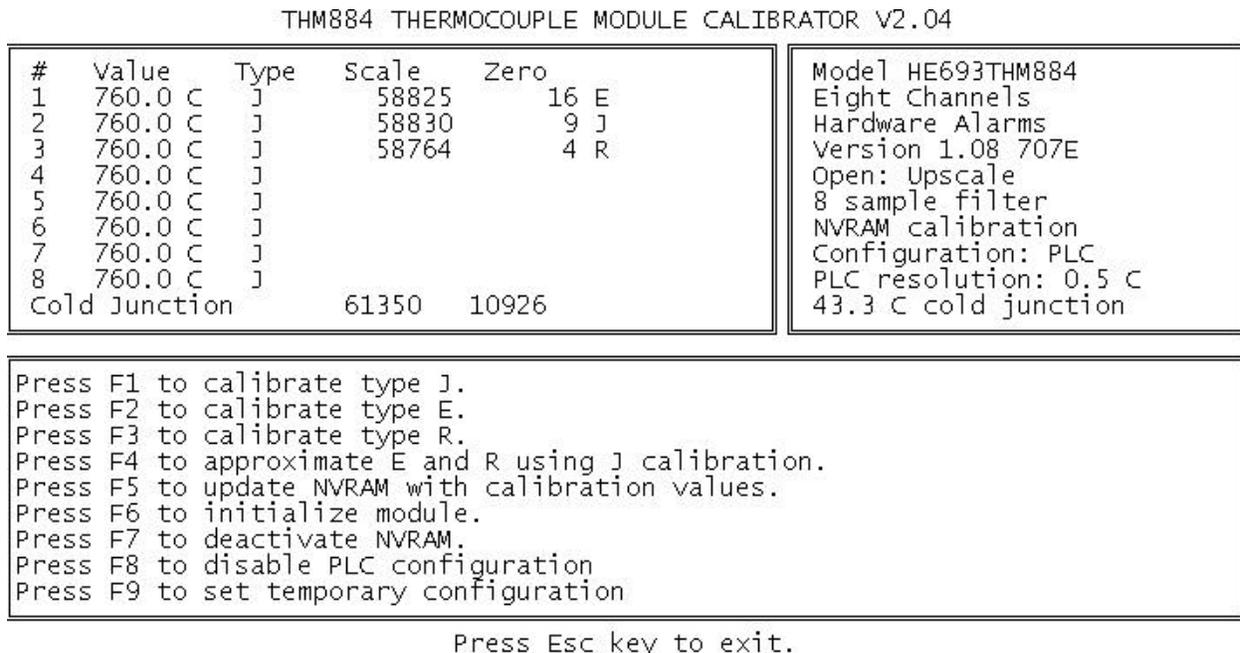


Figure 3.1 – Screen Example

### 3.3 Process Overview

The first general step in the calibration process is to deactivate the NVRAM (Non-Volatile Random Access Memory). If no 'deactivation' choice is offered, then it will be automatically deactivated. This step turns off the old calibration constants to use the defaults for a new calibration. The module must be reset to use the default values. The next step is to disable the PLC configuration. This causes the module to use the defaults since the module powers up in the PLC configuration mode. Once the PLC configuration has been disabled, the module must be initialized. After the module is initialized, the actual calibration must be performed, or if calibrating a thermocouple, choose the type of calibration required. While performing the module calibration, the software will prompt the user for several different steps during the procedure. Please follow the steps as directed. Once the calibration has been performed, the NVRAM must be updated with the new default values. This allows the user to continue to the next step, activation of the NVRAM. NVRAM activation means that the module will use the stored calibration constants the next time it is powered on. The last step to perform involves initializing the module. This causes the module to reread the calibration and filter constants from the NVRAM.

### 3.4 Specific Module Calibration Process

The following pages contain the listing of each Horner Electric analog module, its corresponding calibration file, and the specific procedures for each module.

#### 3.4.1 Analog Input Modules

##### HE693ADC406

Step	Procedure	F-key
1	Deactivate NVRAM	F5
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F3
6	Activate NVRAM	F4
7	Initialize module	F6

##### HE693ADC405, HE693ADC415

Step	Procedure	F-key
1	Deactivate NVRAM	F5
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F3
6	Activate NVRAM	F4
7	Initialize module	F6

##### HE693ADC410, HE693ADC420

Step	Procedure	F-key
1	Deactivate NVRAM	F5
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F3
6	Activate NVRAM	F4
7	Initialize module	F6

3.4.2 Analog Output Modules

**HE693DAC410, HE693DAC420**

<b>Step</b>	<b>Procedure</b>	<b>F-key</b>
1	Deactivate NVRAM	F5
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F3
6	Activate NVRAM	F4
7	Initialize module	F6

*\*Note: The PLC must be out of **RUN** mode for the analog output modules to calibrated correctly.*

3.4.3 Resistance Temperature Device (RTD) Modules

**HE693RTD600, HE693RTD601, HE693RTD660, HE693RTD665, HE693RTD666**

<b>Step</b>	<b>Procedure</b>	<b>F-key</b>
1	Deactivate NVRAM	F7
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1,F2,F3
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F5
6	Activate NVRAM	F7
7	Initialize module	F6

3.4.4 Strain Gage Modules

**HE693STG883, HE693STG884**

<b>Step</b>	<b>Procedure</b>	<b>F-key</b>
1	Deactivate NVRAM	F5
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F3
6	Activate NVRAM	F4
7	Initialize module	F6

## 3.4.5 Thermocouple Modules

**HE697THM160, HE697THM260**

<b>Step</b>	<b>Procedure</b>	<b>F-key</b>
1	Deactivate NVRAM	F7
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1,F2,F3
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F5
6	Activate NVRAM	F7
7	Initialize module	F6

**HE693THM166**

<b>Step</b>	<b>Procedure</b>	<b>F-key</b>
1	Deactivate NVRAM	F5
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F3
6	Activate NVRAM	F4
7	Initialize module	F6

**HE693THM406, HE693THM409, HE693THM446, HE693THM449, HE693THM665, HE693THM666,  
HE693THM668, HE693THM806, HE693THM809, HE693THM884, HE693THM886, HE693THM888,  
HE693THM889, HE693THM894, HE693THM895**

<b>Step</b>	<b>Procedure</b>	<b>F-key</b>
1	Deactivate NVRAM	F7
2	Initialize module	F6
3	Disable PLC configuration	F8
4	Perform calibration - Follow the steps as directed by the software	F1F2,F3
5	Update NVRAM - Store new constants? ( <u>Y</u> es)	F5
6	Activate NVRAM	F7
7	Initialize module	F6

3.4.6 *HE693THM884 for Calibration for Type K + Channel offsets*  
Executable batch file: (THM884\_K.bat)

<u>Step</u>	<u>Procedure</u>	<u>F-Key</u>
1	Insert module in 90-30 PLC	
2	Apply Power to PLC	
3	Deactivate NVRAM	F7
4	Initialize Module	F6
5	Disable PLC Configuration	F8
6	Perform Calibration for Type K (Follow steps as directed by the software)	F1 only
7	Update NVRAM	F5, Y
8	Activate NVRAM	F7
9	Initialize Module	F6
10	Enable PLC Configuration	F8
11	Set Offsets	F4
12	Transmit Offsets	F4
13	Update NVRAM	F5, Y
14	Initialize Module	F6
15	Disable power to PLC before removing the THM884.	

3.4.7 *HE693THM894 for Calibration for Type K*  
Executable batch file: (THM894\_K.bat)

<u>Step</u>	<u>Procedure</u>	<u>F-Key</u>
1	Insert module in 90-30 PLC	
2	Apply Power to PLC	
3	Deactivate NVRAM	F7
4	Initialize Module	F6
5	Disable PLC Configuration	F8
6	Perform Calibration for Type K (Follow steps as directed by the software)	F1 only
7	Update NVRAM	F5, Y
8	Activate NVRAM	F7
9	Initialize Module	F6
10	Enable PLC Configuration	F8
11	Set Offsets	F4
12	Transmit Offsets	F4
13	Update NVRAM	F5, Y
14	Initialize Module	F6
15	Disable power to PLC before removing the THM894.	

## CHAPTER 4: SWITCHES

### 4.1 Switches

Many of the analog modules have an option to set temporary configurations and use software switches. This option gives the user the ability to set up a temporary configuration and observe how a thermocouple module would react with, for instance, type T thermocouple wire instead of the more usual J, E, or R types. It is important to note that the =T, =K, and =C switches are volatile and do not make any permanent changes in the module, unlike the NVRAM commands such as =S.

The following is a list of the switches available and their descriptions:

Usage:	Thm884	[=C1]	[=C2]	[=T]	[=K]	[=Snnnn.n,nnnn.n,nnnn.n,...]
=C		used to select the serial port. An example would be =C1 or =C2, which refer to COM1 and COM2, respectively.				
=T		indicates test mode. Command messages are still transmitted but internal values are used for variables received messages are simulated. This is a software emulation mode. The module does not need to be connected.				
=K		sets the calibration type to K instead of J.				
=S		sets the calibration scale points separated by commas but <i>no</i> spaces. The order for scale setting is K (or J) mid, K high, E mid, R high. A zero value will result in the default. For less than six entries, the defaults will be used for the remaining items. No values less than 25 degrees Celsius can be used. This low calibration point is necessary to optimize for cold junction compensation. Scale point order: =S K(or J) mid, K high, E mid, E high, R mid, R high				

### 4.2 Examples

The examples below show each switch being used and their function.

Thm884 =C1	indicates COM1 as the desired serial port. COM1 is the default serial port setting.
Thm884 =C2	sets COM2 as the desired serial port. Must be invoked if COM2 is to be used.
Thm884 =T	invokes the test mode. Commands are transmitted but the messages are simulated only. The values are not stored.
Thm884 =K	sets the calibration type to type to K instead of the default of type J. Type K is used for special applications and European calibration.
Thm884 =S600.0,700.0,0.0,0.0	sets the calibration scale points. Type J has been set for calibration to points 600.0 and 700.0 degrees Celsius. Type E has been set to use the default values. Type R has not been specified in the command line but will revert to its default values.

### 4.3 Utilizing the Switches

The software switches can be utilized by creating a DOS batch file. To create the batch file in Windows 95/98, open the directory window where the software executable is stored. Select a new text document from the File menu located at the upper left of the window. Rename the new document using a **.BAT** extension. Right Click on the icon and select edit from the pull down menu. Type the desired executable followed by a space, then an equal sign, then the desired switch needed for the calibration application. Save and close the edit screen. Open the calibration program using the batch file.

Example:

```
THM884_3.exe =K
```