

# *Flex-TC*

**BENCHTOP TEMPERATURE FORCING SYSTEM  
FOR THERMAL CYCLING OF DUT'S  
FROM **-55°C** TO **+155°C****



**For FlexTC firmware 1.4.23 and higher**

**User Guide October 2015**

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## FlexTC Overview

FlexTC Temperature Forcing System is used for stimulating case temperature (T case) by direct contact between a thermal head's plunger and DUT.



FlexTC Temperature Forcing System's main components:

1. Thermal head
2. Thermal head hose
3. Touchscreen user interface
4. Front panel purge
5. Device plunger
6. Mechanical interface: Thermal head makes direct mechanical contact with soldered or socketed DUT using one of the following interface options:
  - a. Universal adapter plate (suitable for socketed, open-top, soldered DUTs)
  - b. Custom adapter plate (suitable for socketed and soldered DUTs)
  - c. Boom stand arm (suitable for open-top, soldered DUTs)
  - d. Thermocouple inserted lid (suitable for open-top, socketed DUTs)
  - e. Open frame thermal lid (suitable for socketed, soldered DUTs)
  - f. Pneumatic head assembly (for quick replacement of devices in sockets)
  - g. Vacuum quick connect mechanism (for quick replacement of devices in sockets)

## Basic information about the FlexTC system

### Thermal Head

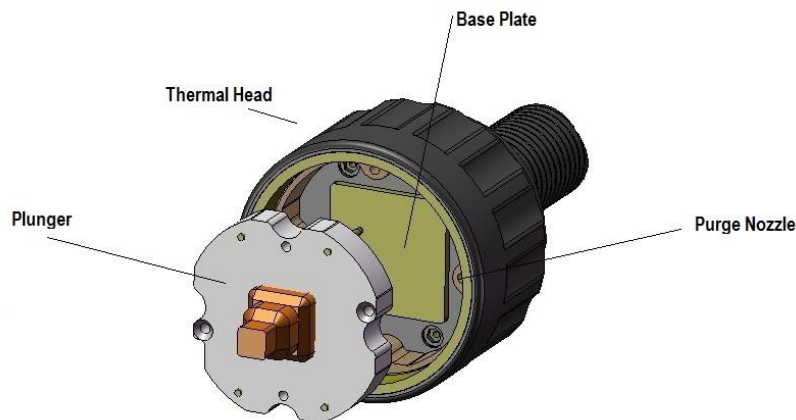
Temperature stimulation of the DUT is accomplished by plunger installed into the thermal head of the FlexTC. The plunger is installed into the thermal head with the help of four mounting pins and two retaining screws. The thermal head with the plunger inside is then positioned to be in direct contact with the DUT. The changes in temperature are passed from plunger to DUT by direct conduction. The plunger contains a **Thermal Sensor (PT100)** which makes 30 measurements per second. The sensor data is further transmitted to the FlexTC system which, in turn, makes 30 adjustments per second to the heating/cooling of the plunger in order to guarantee the  $\pm 0.2^{\circ}\text{C}$  temperature accuracy on the DUT.

The thermal head also has **4 Purge Nozzles** for the purpose of introduction of Nitrogen or dry air in the thermal head via the access line connected to the unit's back panel. The constant supply of Nitrogen or dry air flow creates a frost and humidity free shield around the DUT. A software operated **solenoid** automatically activates the dry air purge when the testing temperature drops below  $16^{\circ}\text{C}$ . The dry air flow is diverted away from the test area in order to avoid unwanted thermal loss.

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**Note:** Heating coils prevent condensation on the Thermal Head cover.

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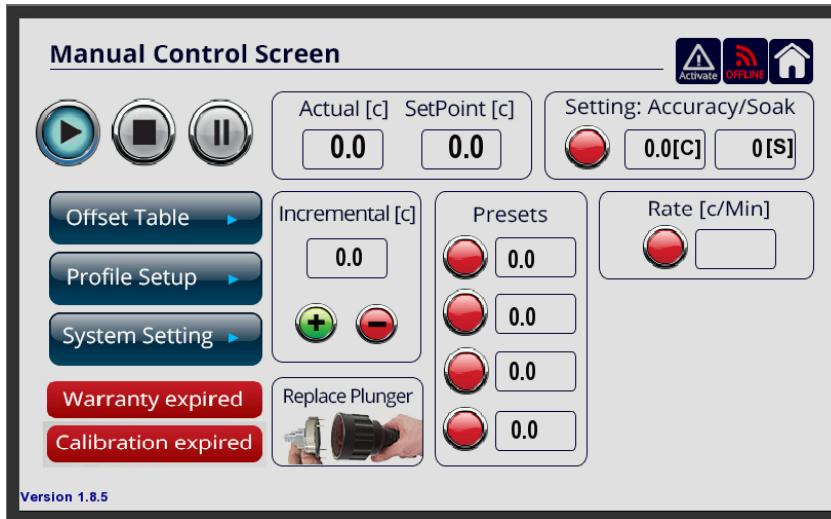


### FlexTC Thermal head

For testing devices in sockets the thermal head is mounted using the adapter plate. For soldered and open-top DUT's the thermal head is mounted directly onto the board.






## FlexTC User Interface

FlexTC operations are controlled by an LCD touchscreen located on the front of the unit.






### FlexTC touchscreen

Commands are entered to the unit by pressing the appropriate input field. There are four user screens. To activate press one of the following:

	<b>Home</b> – Displays the <b>Manual Control Screen</b> for entering system parameter settings
	<b>Activate</b> – Displays the screen for activating the unit
	<b>Offline</b> - not connected to the LAN cable
	<b>Online</b> - the system is communicating with PC
	<b>LAN cable</b> - connected to LAN cable through the rear panel

The

**Manual Control Screen** has three sub-screens that can be accessed by selecting buttons located on the left:

	Displays the Offset Window. You may program up to 3 offset tables.
	Display a screen for entering the settings of the Ramp/Soak routine.
	Activates a screen for entering certain screen parameters.






## Number Keypad

A number keypad is displayed on an input field:







### Number Keypad

Numbers are entered by pressing the appropriate key. In addition the following keys are available:

	Clear all input.
	Clears last digit entered.
	For negative numbers enters a minus sign.
	Accepts the number into the input field and clears the number keypad.
	Closes the number keypad without entering any value.

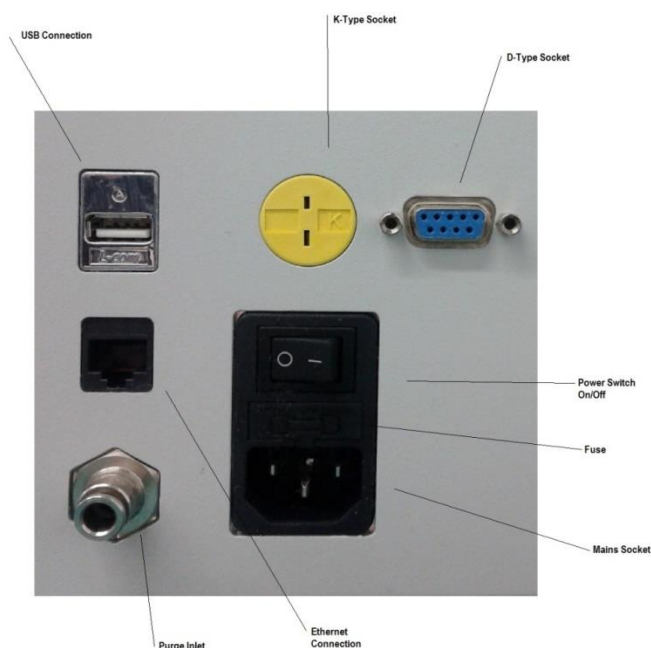
## Operational Buttons

	Play Button: FlexTC is in operational mode.
	Stop Button: Acts as a Standby mode. FlexTC is off but it can be activated immediately via touchscreen or PC.
	Pause Button: FlexTC continues to operate at ambient temperature (25°C). This mode is used for switching devices.
	Return Button: It appears when you are in one of the sub- screens. Pressing this button returns you to the TC Control Screen.

**Please note** – It is recommended to switch off the FlexTC at the back panel if not used daily, but if you are going to use it the next day you can switch the unit to standby mode (Stop button).

## FlexTC System Back Panel

The FlexTC back panel contains the following components:



### FlexTC Back Panel

- ☐ **Power switch On/Off** – for turning the unit on and off.
- ☐ **Fuse** – contains 8A fast fuse for protection against overcurrent.  
(In 110V system for USA market the fuse is 15A.)
- ☐ **Mains socket** – for plugging in the power cord.
- ☐ **Ethernet Connection** – for connecting to **Ethernet LAN**
- ☐ **USB Port** – For software updates only.
- ☐ **Purge inlet** – for connecting the unit to the Nitrogen/Dry Air source. The purge inlet is connected via a 6mm OD tube.
- ☐ **D-Type Socket-Female (DE-9) Input (VGA Connector Port)** - Operational Junction control (reads the temperatures from the embedded thermal diode)
- ☐ **Thermocouple K type Connector.**

## Supplied Accessories

Check that you have the following items:

- User Manual
- First Time user guide
- Syringe with thermal grease and screws



- Pressure Regulator

Connect 6 mm tube from dry air supply in the laboratory to the left side of the pressure regulator.

Connect 6 mm tube from the rear panel of the system to the right side of the pressure regulator.

Recommended pressure for dry air purge: 0.2 [bar]



- 6 mm diameter pipeline connecting air supply (2m)



- Tube holder with a screw





## FlexTC – Interface Options

There are several interface options for the testing of soldered devices and devices in sockets.



### 1. Custom Adapter Plate (For Soldered/Socketed devices)

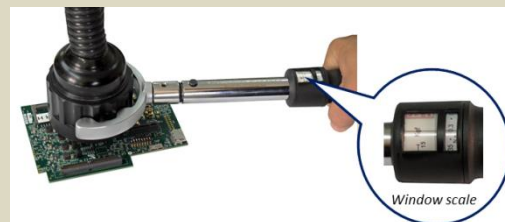
Custom adapter plates attach to the socket guide, they are designed for operation with a specific socket (from all manufacturers) on existing boards. The mounting holes locations are determined by the corresponding holes in the customer supplied socket board.

### 2. Universal Adapter Plate (For Soldered/Socketed devices)

Universal adapter plates attach to test boards that comply with Mechanical Devices board design rules. For costs savings, the same universal adapter plate can be used for many different projects.



## Torque Wrench (for DUT force control)



The Torque wrench is especially designed for applying torque to the Thermal Head nut of Flex-TC/ Max-TC and precisely adjusting the plunger force from 15kgf and up to 72kgf to connect the DUT.

Efficient operation is achieved due to the rigid and precise design.

The torque wrench comes with a window scale, fine increment operation and lock knob to enable fine force setting in kgf.

The handle is comfortable to use due to Ergonomic soft TPR grip.

The user simply, removes the lid, connects the socket adapter, places the IC into the socket and applies torque to thermal head nut to connect the IC.

### 3. Boom Stand Arm (For Soldered/ Open-top Sockets devices)

The Boom Stand is specially designed for holding the thermal head of the FlexTC and positioning the plunger above the DUT. The vertical fine tuning movement ensures a steady pressure and precise contact with the DUT. The boom stand is portable and is easy to setup for use with soldered and open socketed devices.



side head option available:

### 4. Thermocouple Inserted Lids (Transferring Temperatures through the socket Lid)

**WARNING: PLEASE READ THIS IMPORTANT NOTICE WITH REFERENCE TO THERMOCOUPLE INSERTED LIDS.**

**ALWAYS ALLOW THE LID TO RETURN TO ROOM TEMPERATURE BEFORE PROCEEDING.**

Thermocouple inserted lids are used for conducting temperatures from the device plunger to the DUT and they act as an intermediate substance. The thermocouple is connected to the FlexTC rear panel port for reading the temperatures of the device case and closing loop. Thermocouple inserted lids are available either from Mechanical Devices or can be purchased directly from your sockets manufacturer.

### 5. Open Frame Thermal Lid (For Socketed devices)

Open frame screw down thermal lids allow device plungers to contact the DUT through the opening of the lid. The thermal heads is fixed in place on top of the socket opening using a boom stand arm. Open frame thermal lids are available from Mechanical Devices or they can be purchased directly through your sockets manufacturer.

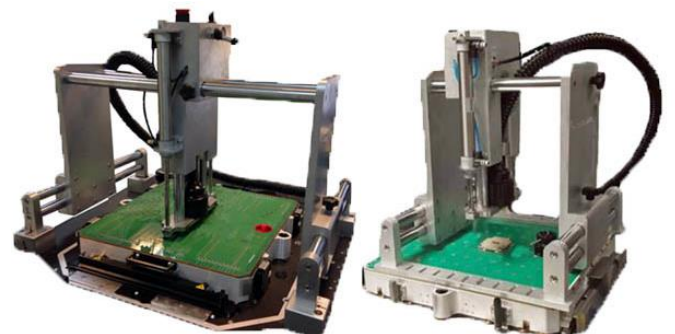
### 6. Pneumatic Head Assembly (For Soldered/Socketed devices)

The mini tabletop single site test station is a manual pick and place system ideal for engineering and test development of IC system level testing (SLT). The system is capable to test a vast variety of device types and sizes from 2x2mm to 45mm. The system maximizes the engineering test capability saving cost and time. It is perfectly designed to be used with Max TC and the FlexTC systems Device and the setup is quick and easy. The pneumatic system is portable and stable with adjustable direct contact force [Kgf]: **10@1Bar to 80@8Bar**



#### Pneumatic Tabletop Station for Testers

The Pneumatic Tabletop Station for Testers is a manual pick and place system ideal for engineering and test development of IC system level testing (SLT). The system is capable to test a vast variety of soldered or socketed device types and sizes up to 45mm. Designed for simple integration with testers by means of screws. The system maximizes the engineering test capability saving cost and time. The size of the PTS for testers can be customized to fit your tester. The PTS for testers is portable; it can be removed and used with another tester. Stable with adjustable direct contact force [Kgf]: **10@1Bar to 80@8Bar**



## 7. Vacuum Quick Connect Mechanism (For Socketed devices)

Pneumatic interfaces enable the quick replacement of devices in sockets, suitable for operators who test many devices on a daily basis. Require compressed air facilities for operation.

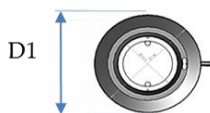
For full solution the Vacuum system consists of three components



Quick Connect Vacuum Generation Unit P/N - VGU485	Quick connect P/N QCV485-30	Vacuum Adapter plate P/N – VBA485-30
System Enclosure (mm/inch): 140(L) x140(W)x 63.5 (H) 5.5(L) x 5.5(W) x 2.5(H) Fluid admitted – compressed Air, (6mm hose) Service pressure range: 87-130 psi (0.6-0.9Mpa) Vacuum level: -26.5 in.Hg (-90 kPa;0.9Bar)	100/140/160mm deep cyclone vacuum pad. Vacuum hose m/(ft): 1.0meter (3.25ft) DUT pressure force: 0-13.9Kg/ Force.	Custom designed to match customer specified test socket/board Peek base with round edge aluminum plate.

The quick Connect Vacuum Mechanism comes in 3 different sizes:

1. D1 – 100mm/up to 4.8Kg
2. D1 – 140mm/up to 9.6Kg
3. D1 – 160mm/up to 13.9Kg



Example: Calculation of pressure  $P = \frac{F}{A} [Pa]$



## Specifications

The FlexTC technical specifications are provided in **Error! Not a valid bookmark self-reference..**

General	
Maximum Temperature	+155 °C
Minimum Temperature	-55°C
Temperature Accuracy	< 0.2° C
Typical Transition Rates	25°C to -40°C in < 3 minutes
Temperature Sensor	<input type="checkbox"/> Tcase PT100 Thermistor <input type="checkbox"/> Thermal-Diode through the Ethernet port <input type="checkbox"/> Thermocouple K type Connector
Remote Interface Ports	Ethernet (TCP / IP)
DUT (Device Under Test) Pressure Force	2 - 100 Kg / Force
DUT Dimensions	From 2x2 mm to 100x100mm
DB (Decibels). Rating	40 dBA
MTBF (Mean Time Between Failures)	70,000hr
Mechanical Dimensions	
System Enclosure mm / (inch)	L 420 (16.5) x W 320 (12.5) x H 220 (8.5)
System Weight	22 Kg (48.4lb) (3.46 Stone)
Thermal Head (mm)	80 mm Diameter
Thermal Head Hose	2 meter (6.5 ft) standard
System Requirements	
Electrical	100/115/120/220/230/240 VAC ±10% 50/60 Hz, single phase, 15A Max
Ambient Operating Temperature	5°C to 35°C (40 to 95°F)
Ambient Operating Humidity	20% to 65% RH (Relative Humidity)
Compressed Dry Air	<0.5cfm (1.2-3.0 PSI)
Dew Point	>-70°C (-100F)
Connection	6mm Industrial Standard Quick Disconnect

## Operation

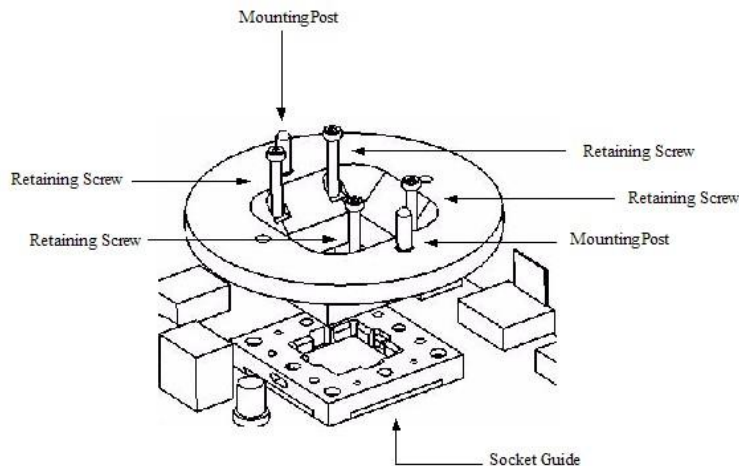
This chapter provides step-by-step instructions for operating the FlexTC.

Please check the Mechanical Devices [YouTube](#) channel for more in depth instructions:

<http://www.youtube.com/user/FlexTCMd?feature=mhee>

### Connecting an Adapter Plate

The Adapter plate is attached to the socket base, centered on the chip, and held in place by four retaining screws.



**Note:** *Two mounting posts, on either side of the plate, allow for centering the plunger on the chip.*

### Installing a Custom Adapter Plate

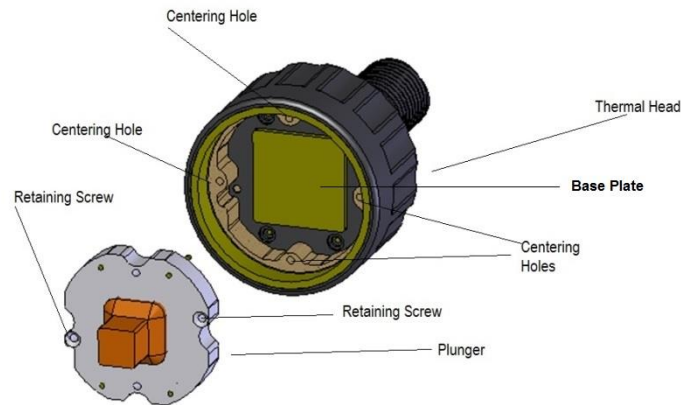
Remove socket lid and replace it with a customized adapter plate that matches dimensions of the device. The **custom adapter plate** is mounted onto the socket base. The FlexTC head is tightened onto the adapter plate to create pressure force and planarity on the device. The two mounting posts help guide the thermal head down on the Z-Axis and prevent shear force when screw-tightening the head to the adapter. Every custom adapter plate must match the device dimensions. In addition, every custom adapter plate requires a matching plunger with the same dimensions W x L x H in order to fit complete setup. The custom adapter plate creates a closed environment that keeps the purged air in close proximity of the DUT thus preventing formation of frost and humidity in cold testing.

### Installing a Universal Adapter Plate

Remove the socket lid and mount the **universal adapter plate** onto the board over your socket, not onto the socket base as you would with the **custom adapter plate**. This allows you to use one adapter for several different socket sizes and applications. It allows you to fix the FlexTC thermal head exactly like with the custom adapter plate application. Mounting requires only 4 holes in your board around your socket. For cold testing, an **Armaflex ring** (aircon-insulating-sponge) should be used around the adapter, thus creating a closed environment around the socket to prevent frost formation. A custom size plunger is required for a socket fit.

## Installing Plunger in the Thermal Head

The base of the plunger is designed in such a way that it allows only one correct way of installation into the thermal head.



### Plunger installation into the thermal head

**IMPORTANT: READ THESE INSTRUCTIONS VERY CAREFULLY IN ORDER TO AVOID POTENTIAL DAMAGE TO YOUR PLUNGER**

#### Plunger Installation Instructions:

In order to ensure good contact between the plunger and the base plate of the thermal head, coat the inside of the plunger (area between four pins) with a thin layer of **thermal grease**.

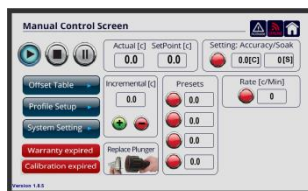
1. Slide the plunger into the thermal head housing.
2. Continue pressing on the plunger with your fingers. **(If the thermal grease layer is too thick (that is, if you see excess grease coming up from around the sides of the plunger), pull the plunger out and remove the excess grease. Then slide the plunger back in into the thermal head housing.)**
3. Gently secure the plunger with two retaining screws (See **Error! Reference source not found.**1).
4. Please note that minimal force should be applied when screwing and unscrewing screws while securing plunger in its position **(Note that electric screwdrivers should not be used in the final stages of tightening the screws into position and in the early stages of unscrewing).**

The plunger's internal four pins are fragile; therefore they need to be protected when not installed in thermal head.

**Note: Repeat this procedure once every few months in order to ensure the most optimal performance of the unit.**

## Changing Plungers

To replace the plunger with a different one, please follow the steps below:



1. On the **Manual Control Screen** press Replace Plunger Button.




2. "Please wait" screen will appear



3. Please wait until "Please remove plunger" message will appear on screen.
4. Now you can remove the plunger and insert a different one into the head.



5. If you would like to cancel replacing the plunger procedure at any point, press Cancel  button and follow further instructions on screen.




6. To continue working with the system press  in the Continue screen.
7. Please wait until the "Warming up" screen will disappear and you are back in the **Manual Control Screen**.

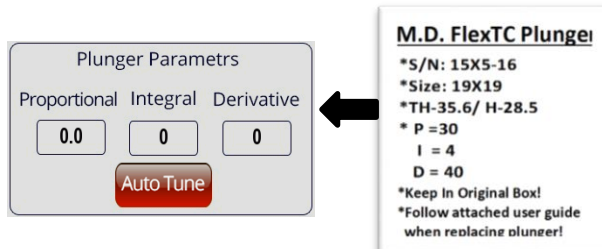


## Setting Plunger Parameters

Plungers come in different sizes and shapes, and they are made of different materials, such as Copper or Aluminum. These differences in plungers have direct impact on the offset values of the system.

1. For best performance of the plunger please follow these steps and fill in the unique plunger parameters for each plunger.

2. In **Manual Control Screen** press , located at the bottom bar.
3. You will be taken to the **System Setting** Screen. On the right side you will see Plunger Parameters box. Fill in the Proportional, Integral, Derivative (P I D) values found on the label of the original plunger box.



4. Return back to **Manual Control Screen** by pressing Home button .

## Auto Tune Procedure

When P I D values of the plunger are not available, you can use Auto Tune Procedure and let the FlexTC system automatically detect plunger's P I D values.

- Using the same method as shown above for **Installing Plunger in Thermal Head**, insert your plunger into the thermal head.

- On the **Manual Control Screen** select Set Point box and set the temperature to 60.0 (C) then proceed to System Setting.

Actual [c]	SetPoint [c]
0.0	0.0

- System Setting ▶

In System Setting screen on the right of this screen you will see the **Plunger Parameters**

Plunger Parameters

Proportional	Integral	Derivative
20.0	4	40

Auto Tune

box. Select red **Auto Tune** button located on the bottom of the box.

- A dialog box "Are you sure you want to do this operation?" will appear. Press the **Yes** button.

Are you sure you want to do this operation?

Yes Cancel

- The **Auto Tune** button will become green. **Plunger Parameters** box values will reset based on the plunger type and

Plunger Parameters

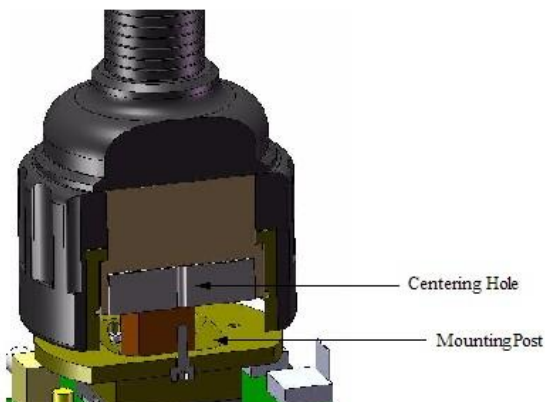
Proportional	Integral	Derivative
0.0	0	0

Auto Tune

size.

- You can return to **Manual Control Screen** by pressing the corresponding button.

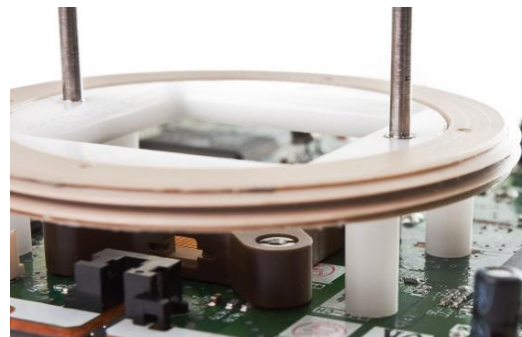
## Installing the Thermal Head on the Adapter Plate



### Installing the Thermal Head on the Adapter

To install the thermal head on the adapter:

- Place the thermal head over the adapter and align the centering holes with the mounting posts  
*Note – Quick connect vacuum adapter plates do not have alignment pins.*
- Press down on the adapter plate and turn the thermal head clockwise thereby screwing it to the adapter.





## Activating the FlexTC

### Initial Activation of FlexTC and Temporary Activation Code Instructions

Plug the FlexTC system to the power socket and verify that the system screen is on. When in Manual Control Screen please make sure that the FlexTC system is **not in Standby mode (Stop button)**.

When you first purchase the FlexTC system, it will arrive with 3 months temporary activation code. Towards the end of the initial 3 month period Mechanical Devices will contact you with your permanent activation code. Please **DO NOT** press **Activate** button unless you received the permanent activation code from Mechanical Devices or your sales agent. If incorrect code is entered, the FlexTC system will lock up, and you will need to receive the correct code in order to operate the system.

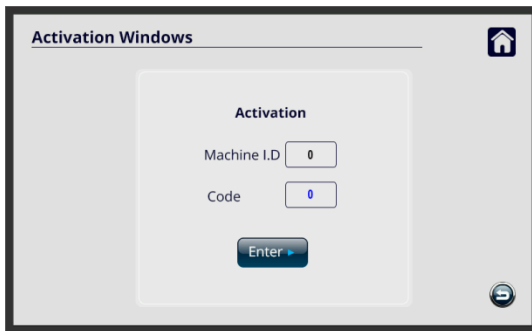
#### Manual Control Screen



### Permanent Activation Code

When the Temporary code is due to expire (normally after a 3 month period) a warning message '**System Lock Within 72**

**HR'** **System Lock Within 72 HR** will appear on the screen. If you have not yet received the permanent code for the system, please contact Mechanical Devices with the Machine ID and Serial number, and request the permanent activation code to be issued to you. Once you have the permanent activation code ready, please proceed to the activation procedure.




1. Press the **Activate** button. Please verify that Machine ID information has not been accidentally reset and it is the same Machine ID number to which you had activation code issued.
2. Please input the new 3 to 5 digit permanent activation code in the **Code** box. **(Make sure to input the code very carefully as the system will lock up if the wrong code is inputted).**



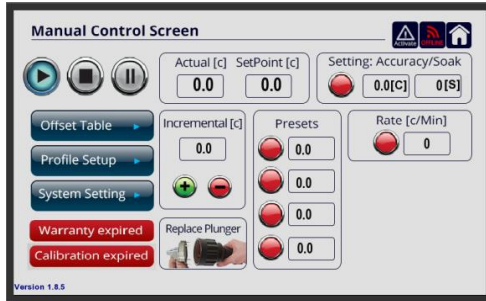
3. Press **Enter**



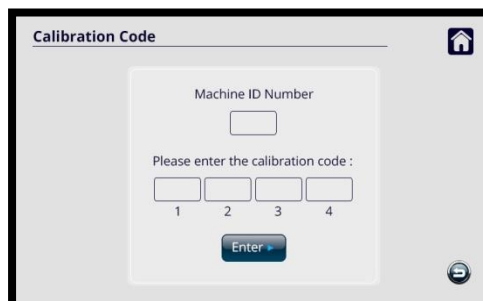
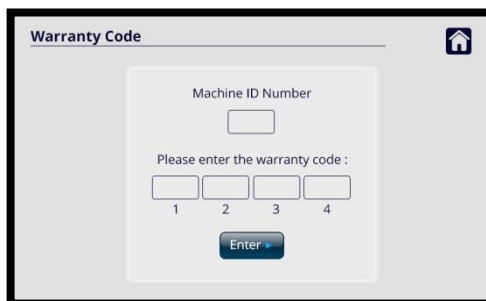
4. Press **Return** button to return to the **Manual Control Screen**. Your FlexTC is now permanently activated.

## Warranty / Calibration Codes

When you first purchase the FlexTC system, it will come with one year warranty and calibration. At the end of the first year Warranty Valid / Calibration Valid buttons will change to red Warranty expired / Calibration expired buttons. Do not worry, the system continues to be fully operational. The red buttons are only a reminder that the system is no longer covered by manufacturer's warranty and that the last calibration was done over a year ago. If you decide to purchase additional warranty coverage, or to do a system calibration, please contact Mechanical Devices or your sales agent and request a quote.



If for any reason you need to reenter valid Warranty and Calibration code, you can obtain it from Mechanical Devices by submitting Machine ID and serial number of the system. Please make sure the Machine ID hasn't changed from the number you submitted to Mechanical Devices. Warranty code and Calibration code is a multi-digit code, therefore pay attention when entering the values.



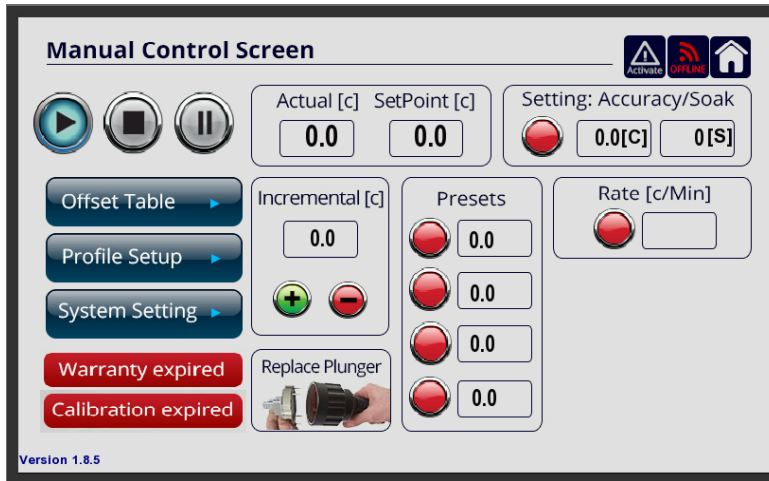
After entering the new Warranty / Calibration codes the Warranty valid / Calibration valid buttons will turn back to green.



## Setting Temperature


### Setting Temperature


Press , the **Manual Control Screen** is displayed. This screen is used for setting temperatures.

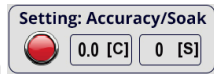



### Set Point Temperature

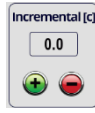
To set a Set Point temperature:

1. Press the **Set Point [C]** field: . The Number Keypad is displayed.
2. Enter the desired temperature by pressing the number keys, followed by pressing **Enter**.



Note that the measured temperature at any given time is displayed in the  field.

3. The **Setting: Accuracy/Soak** is a **settling time function**  which allows you to define a function in two variables, soak and accuracy. Enter both values. When the accuracy [C] value is met the soak clock [S] will start ticking. When the clock reaches its value the red light will turn green indicating that the soak time is completed at the set point and testing can be started. When using remote control operation a bit will be raised to your tester indicating that the two variables have been met at Set Point temperature, and the tester will start testing.
4. The **Rate [C/Min]**  controls the rate of °C/Min. When the indicator button is red it means that the system is operates at its maximum performance and it can even reach 70°C/min rate. When the indicator button is green the operator has the option to change the rate from 1°C/min to 50°C/min. **Note** - If the Rate is set to 0°C the system will not function.

## Setting Incremental Rates



Setting **Incremental [C]** means setting \*Marginal/Additional rates. You use this option to set the FlexTC to achieve the Set Point temperature in stages.

In the **Incremental[C]** field; set the increment value in the box. Then either by pressing  or  you can increase the set point by the increment or decrease temperatures respectively.

### Max Temp

0.0


Set the **maximum temperature** in the **Max Temp** field via the Number Keypad. This prevents the FlexTC from over-shooting the maximum defined temperature. **Note** – be aware user cannot input a higher value in the set point box than what is defined as the max temperature in the Max temperature box.

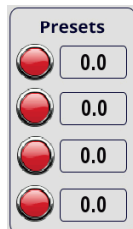
## Setting Presets

You can use the Presets panel to enter preset temperatures. You can set up to four preset temperatures.


To set up a Preset:

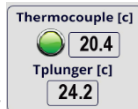
1. Press the field into which you want to set the preset. The Number Keypad will get displayed.
2. Set the desired temperature, press **Enter**. The temperature is now displayed in the temperature field.

To activate a preset temperature, press the red button associated with the desired preset, for example . Once the button turns green the temperature is displayed in the set point box.

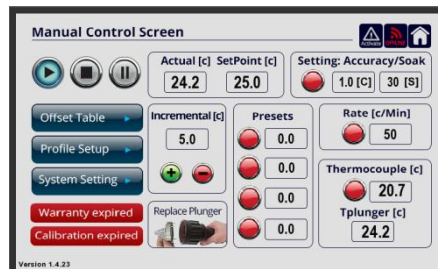
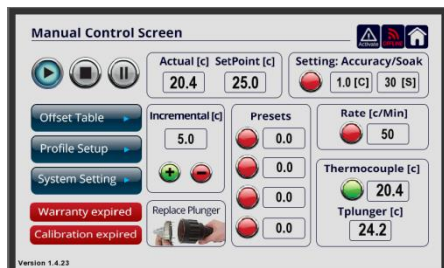


## Setting Thermocouple [K-Type]

The system acts like a thermometer and reads the temperature of the thermocouple. Insert the thermocouple cable  in to the K-Type socket located on the rear panel of the FlexTC. Automatically on the Manual Control Screen a **Thermocouple [C]**



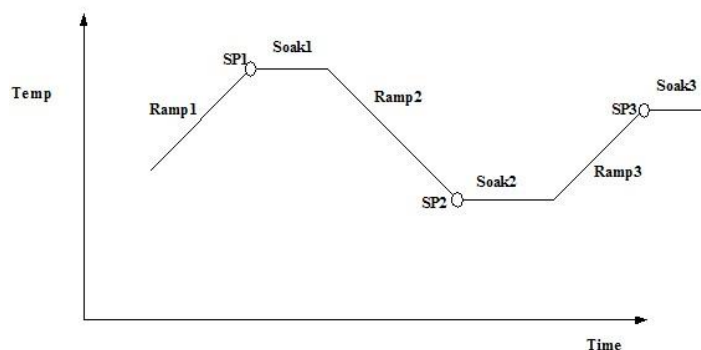
window will appear



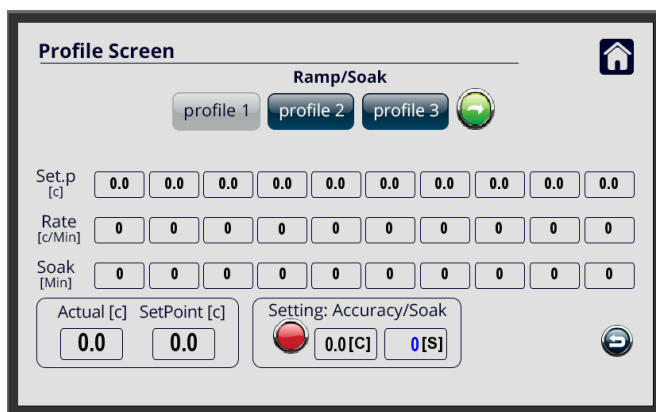
## Setting a Ramp/Soak Sequence






The Ramp/Soak panel enables you to preset a number of temperature points that are to be actuated for specified times.

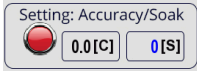
A Ramp/Soak sequence looks like this:







- From the **Manual Control Screen** press the **Profile Setup:**  button. The Ramp/Soak screen will get displayed:

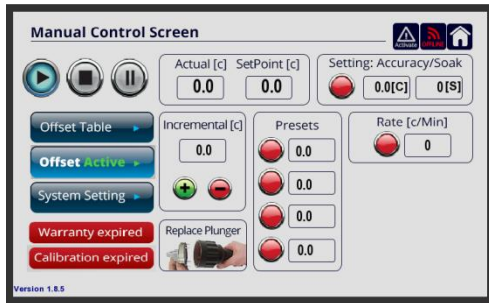


- Press the first **Set.P:**  field and enter the value using the Number Keypad.
- Press the associated **Rate:**  field and enter the desired rate, C/Min. This is the **Rate** at which the temperatures to reach the **Set.P** setting.
- Press the associated **Soak:**  field and enter the desired time (in minutes) that temperature of the **Set.P** temperature setting is to be kept.
- Repeat steps 2, 3 and 4 for each point in the Ramp/Soak sequence.
- To activate a Ramp/Soak sequence, press the Profile:  button in the Ramp/Soak panel. Note that the button turns blue , indicating that the sequence has started.

7. Use the settling time function  to define a function in two variables, soak and accuracy for every step in the sequence. When the accuracy value is met and the clock reaches its value the red light will turn green indicating that the sequence step soak/clock started.
8. When the user has programed the sequence it is highly advisable to finish the routine with **+25°C** as the plunger will remain at the last sequence step temperature after the sequence has completed.

**IMPORTANT: PLEASE NOTE THE ABOVE SENTENCE IS FOR YOUR PERSONAL PROTECTION FROM HOT / COLD HAZARDS.**

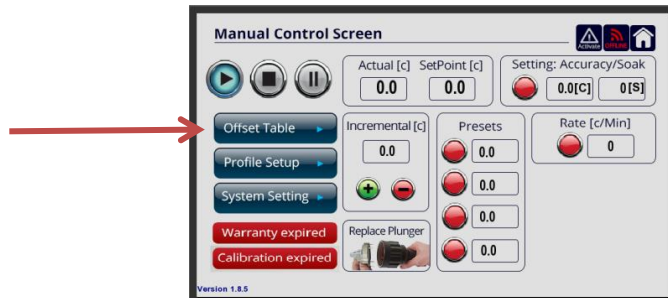
9. For programing a partial sequence (less than 10 steps) please set the last columns to zeros .
10. To have a program that goes one way use  and to set a continuous program use .
11. Press **Return**  to return to the **Manual Control Screen**. Note that in the **Manual Control Screen** the Profile is now shown to be active:



## Using the Offset Table

The Offset Table is used to offset the TJ (Temperature Junction) and to adapt the Tcase to control using the temperature offset. To use the offset table press the **Offset Table** button located on the left hand side of the Manual Control Screen.

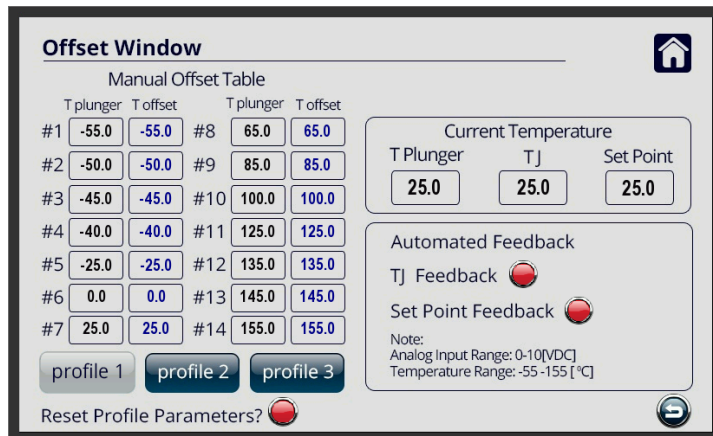
This setting is used to offset the plunger temperature and to control the junction temperature (TJ) most commonly if the DUT is a soldered device (it also works for socketed devices as well.). The user can program up to 3 temperature look-up tables which will show an empirical TJ value and offset the Tplunger (Tcase) reading accordingly.



In the **Offset Window** screen will you will see three panels:

1. **Manual Offset Table**
2. **Current Temperature**

### 3. Automated Feedback



**Offset Window**

Manual Offset Table

	T plunger	T offset		T plunger	T offset
#1	-55.0	-55.0	#8	65.0	65.0
#2	-50.0	-50.0	#9	85.0	85.0
#3	-45.0	-45.0	#10	100.0	100.0
#4	-40.0	-40.0	#11	125.0	125.0
#5	-25.0	-25.0	#12	135.0	135.0
#6	0.0	0.0	#13	145.0	145.0
#7	25.0	25.0	#14	155.0	155.0

profile 1 profile 2 profile 3


Reset Profile Parameters?


Current Temperature

T Plunger TJ Set Point

25.0 25.0 25.0

Automated Feedback

TJ Feedback 

Set Point Feedback 

Note:  
Analog Input Range: 0-10[VDC]  
Temperature Range: -55 -155 [°C]

- T Plunger


25.0


 - Plunger Temperature Monitoring
- TJ

25.0

 - Junction Temperature Monitoring
- Set Point

25.0

 - Temperature Set Point Entry (Keyboard)
- TJ Feedback 


 - Junction Temperature feedback indicator
- Set Point Feedback 

 - Temperature set point indicator

Please note that when TJ feedback or set point is activated (Pin 4 or 3 set to 24V) above indicators will be green.

In **Manual Offset Table** you have the possibility to program up to 3 profile parameters which is a time saving and convenient way to test your DUT's junction temperature. Press **Profile 1** to set up your first look-up table. Just apply the offset temp on the TJ column, for that you need to measure the junction temperature and put the value in the right T Junction temperature.

For example start with **TJ #14** and input the offset junction temp reading value can be +140C, according to the DUT junction reading). Continue setting the TJ for all fields until you reach the lowest temperature desired. (**Note that you do not have to use the entire table, you may only need to test the TJ from part of the table rather than #14 to #1**).

Once you have programmed in your values on the table press the  button to activate the profile and this button will appear. You are now clear to continue with your testing, or to program up to 2 more cycles in the remaining Profile's.

The **Reset Profile Parameters** button is used to reset the offset values If you reset the profile you change all the TJ values to the default meaning no offset.

If you select the **Automated Feedback Panel** You will need to use D-Type connector.



### Using D-Type connector

The **D-Type** connector option enables the user to set the FlexTC temperature or to change the actual temperature reading by controlling input voltage from 0 to 10 V.

This option can be used when:

- You have the junction feedback from the DUT;
- You want to make sure your DUT readings are calibrated;
- Power dissipation of the DUT is constantly changing during test.

The FlexTC is able to adjust to the junction temperature changes and to constantly modify the PID controller's values in order to minimize junction temperature fluctuations.



**D-Type connector**

The D-Type connector is located in the rear panel of the FlexTC. Currently there are 4 activated pins on the D-Type connector.

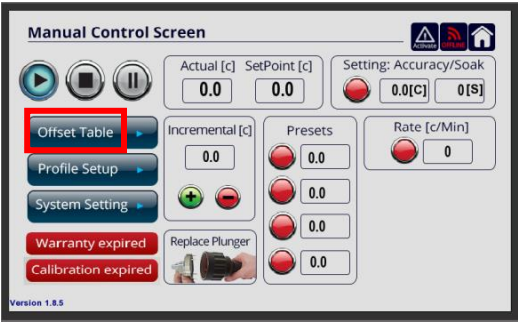
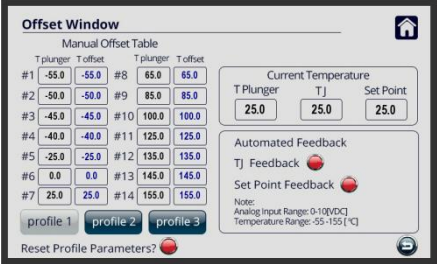



- When **Pin 3** is activated, the user can set the temperature to a certain value.
- When **Pin 4** is activated, the diode in the DUT can send an analog signal ranging from 0 to 10V

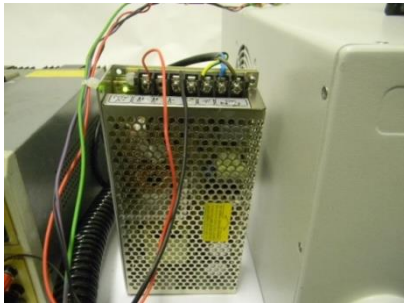
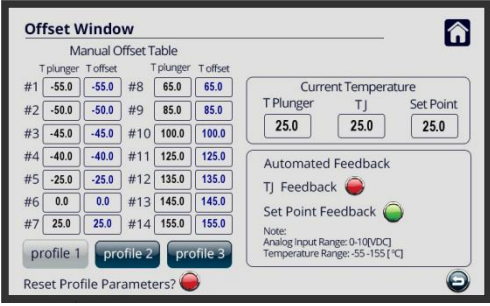
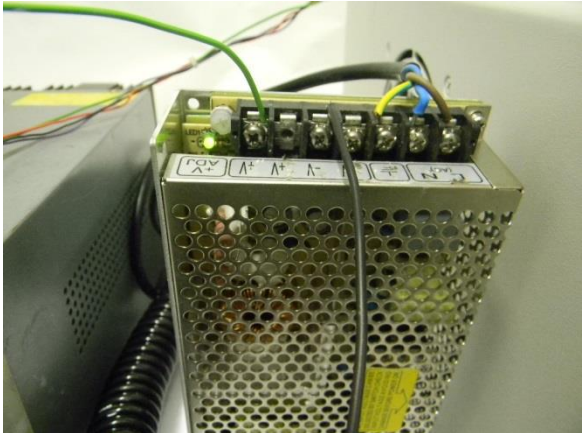
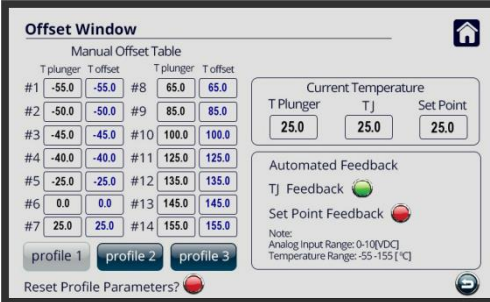
D-Type connector Pins are being used for the following functions:

- **Pin 1** : com (-)
- **Pin 2** : 0-10 V – analog value
- **Pin 3** : 24 V – trigger for "**Junction Control**"  
When Pin 3 is triggered, 0 V input automatically sets the Actual Control Value to -55C, and the 10 V input sets the Actual Control Value to 155C.
- **Pin 4** : 24 V - trigger for "**Set Point Control**".  
When Pin 4 is triggered, 0 V input sets the Set Point to -55C, and the 10V input sets the Set Point to 155C.  
(This pin allows for continuous change of temperature of the FlexTC from -55C to 155C)

Please use step-by-step instructions below for working with D-Type connector.



1	<p>On the main FlexTC screen Press <b>Manual Control Screen</b></p> <p>Press <b>Offset Table</b></p> 	<p>2</p> <p><b>Offset Table</b> window is displayed</p> <p>On this screen you will see 3 panels:</p> <ol style="list-style-type: none"> <li>1. Manual Offset Table</li> <li>2. Current Temperature</li> <li>3. Automated Feedback</li> </ol> 
3	<p>Equipment required for testing with D-type connector:</p> <ul style="list-style-type: none"> <li>• FlexTC</li> <li>• Laboratory power supply</li> <li>• 24V power supply</li> <li>• D-type male connector</li> </ul> 	<p>4</p> <p>Wiring of the D-type male connector</p> <p>Pin no 1 – Black wire</p> <p>Pin no 2 – Purple wire</p> <p>Pin no 3 – Green wire</p> <p>Pin no 4 – Red wire</p> 
5	<p>Connect the D-type male connector in to the D-type female connector on the rear panel of the system</p>	<p>6</p> <p>Connect the Black wire from the D-type in to the (-) of the Laboratory power supply</p> <p>Connect the purple wire from the D-type in to the (+) of the Laboratory power supply</p> <p>Connect black wire between the (-) of the Laboratory supply to (-) of the 24V power supply</p> 

7	<p>Plug in 24V power supply and Laboratory power supply</p> <p>Set the Laboratory power supply to 0 V</p>	8	<p>Connect the red wire (Pin 4) from the D-type to the 24V power supply</p> 
9	<p>When Pin 4 is triggered by 24V, you will see the following: The Set Point Feedback indicator button turns green Now you can set the desired Set Point temperature by voltage input:</p> <ul style="list-style-type: none"> <li>0 V sets the Set Point to -55C</li> <li>10 V sets the Set Point to 155C</li> </ul> 	10	<p>Connect the green wire (Pin 3) from the D-type to 24V power supply.</p> 
11	<p>When Pin 3 is triggered by 24 V, the will see the following: The TJ Feedback indicator button turns green Now you can set the desired Junction Temperature</p> <ul style="list-style-type: none"> <li>0 V automatically sets Actual Control Value (TJ) to -55C,</li> <li>10 V sets Actual Control Value (TJ) to 155 C.</li> </ul> 	12	<p>The table in the next page contains temperature versus input voltage correlation values.</p>

### Interpolated Temperature / Input Voltage Look-up Table

Temp (C)	Voltage (V)
-55	0
-52,9	0,1
-50,8	0,2
-48,7	0,3
-46,6	0,4
-44,5	0,5
-42,4	0,6
-40,3	0,7
-38,1	0,8
-36,1	0,9
-34	1
-31,9	1,1
-29,8	1,2
-27,7	1,3
-25,6	1,4
-23,5	1,5
-21,4	1,6
-19,3	1,7
-17,2	1,8
-15,1	1,9
-13	2
-10,9	2,1
-8,8	2,2
-6,7	2,3
-4,6	2,4
-2,5	2,5

Temp (C)	Voltage (V)
-0,4	2,6
1,7	2,7
3,8	2,8
5,9	2,9
8	3
10,1	3,1
12,2	3,2
14,3	3,3
16,4	3,4
18,5	3,5
20,6	3,6
22,7	3,7
24,8	3,8
26,9	3,9
29	4
31,1	4,1
33,2	4,2
35,3	4,3
37,4	4,4
39,5	4,5
41,6	4,6
43,7	4,7
45,8	4,8
47,9	4,9
50	5

Temp (C)	Voltage (V)
52,1	5,1
54,2	5,2
56,3	5,3
58,4	5,4
60,5	5,5
62,6	5,6
64,7	5,7
66,8	5,8
68,9	5,9
71	6
73,1	6,1
75,2	6,2
77,3	6,3
79,4	6,4
81,5	6,5
83,6	6,6
85,7	6,7
87,8	6,8
89,9	6,9
92	7
94,1	7,1
96,2	7,2
98,3	7,3
100,4	7,4
102,5	7,5

Temp (C)	Voltage (V)
104,6	7,6
106,7	7,7
108,8	7,8
110,9	7,9
113	8
115,1	8,1
117,2	8,2
119,3	8,3
121,4	8,4
123,5	8,5
125,6	8,6
127,7	8,7
129,8	8,8
131,9	8,9
134	9
136,1	9,1
138,2	9,2
140,3	9,3
142,4	9,4
144,5	9,5
146,6	9,6
148,7	9,7
150,8	9,8
152,9	9,9
155	10

## Using a Remote Computer

Mechanical Devices supplies a software interface **Hyper Terminal** which allows you to connect to the FlexTC remotely using your PC. You using this software you are able to enter certain commands using an **ASCII** format in order to control and monitor the FlexTC temperatures.

You can download **Hyper Terminal** and other remote connection data files including drivers for **C++**, **Visual Basic**, **Executable Driver**, **ASCII test command**, **Labview**, and **Java** from our website at:

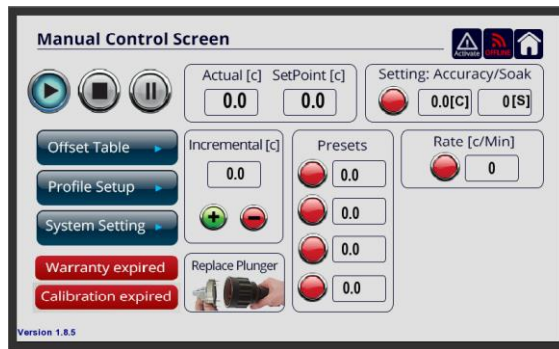
<http://www.mechanical-devices.com/homesites/PageGen2.asp?page=36490>

## Setting up Remote Connection

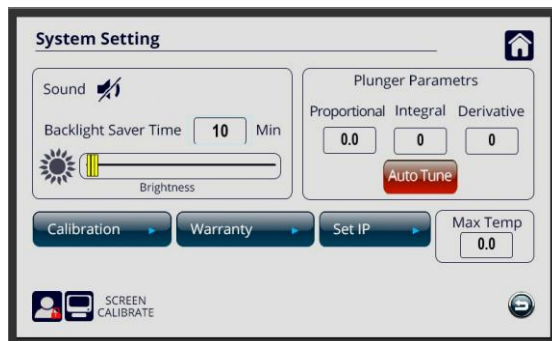
To setup a remote connection:

12. In **Manual Control Screen** Press **system settings**

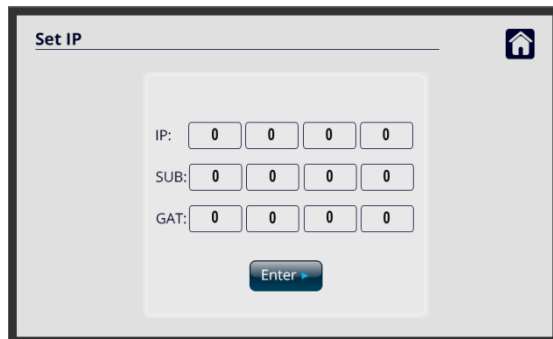
System Setting ▶




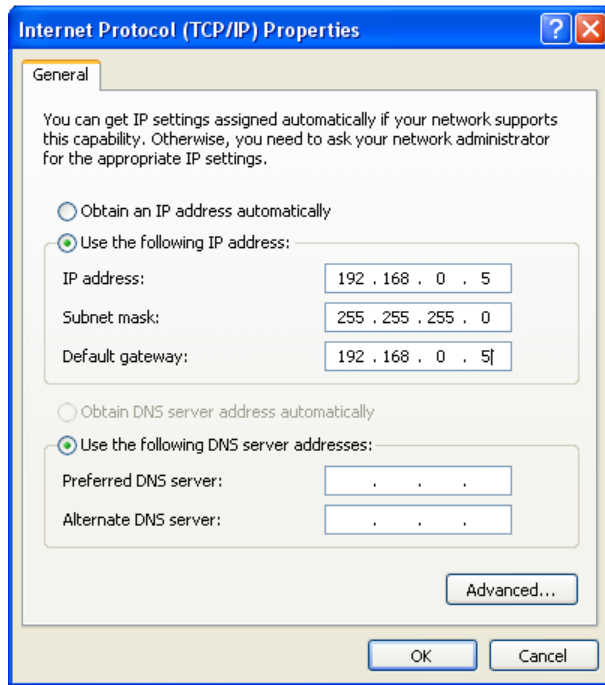
13. Press **Set IP**



14. The following screen is displayed:



15. Press the input fields for **IP** to enter the IP address.
16. Press the input fields for **SUB** to enter the Subnet mask.
17. Press the input fields for **GAT** to enter the Default Gateway.
18. Press **Home** () to return to the **Manual Control Screen**.
19. On the host computer in Windows click **Start → Control Panel → Network Connections**, the Internet Protocol Properties window is displayed:



20. Select **Use the following IP address** and type in the settings that you entered in the FlexTC screen.

**Note:** *If you have a DHCP server in your system, you could define a static IP for the FlexTC.*

21. Click **OK**.
22. Connect the FlexTC unit and the host computer with the Ethernet cable.
23. Test if you have a "PING" with the system, for example:

```

C:\Users\md-ltd>ping 192.168.0.5
'ping' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\md-ltd>ping 192.168.0.5

Pinging 192.168.0.5 with 32 bytes of data:
Reply from 192.168.0.5: bytes=32 time<1ms TTL=128
Reply from 192.168.0.5: bytes=32 time<1ms TTL=128
Reply from 192.168.0.5: bytes=32 time<1ms TTL=128
Reply from 192.168.0.5: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.5:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
  
```

24. On the host computer activate the Hyper Terminal program and do the following:

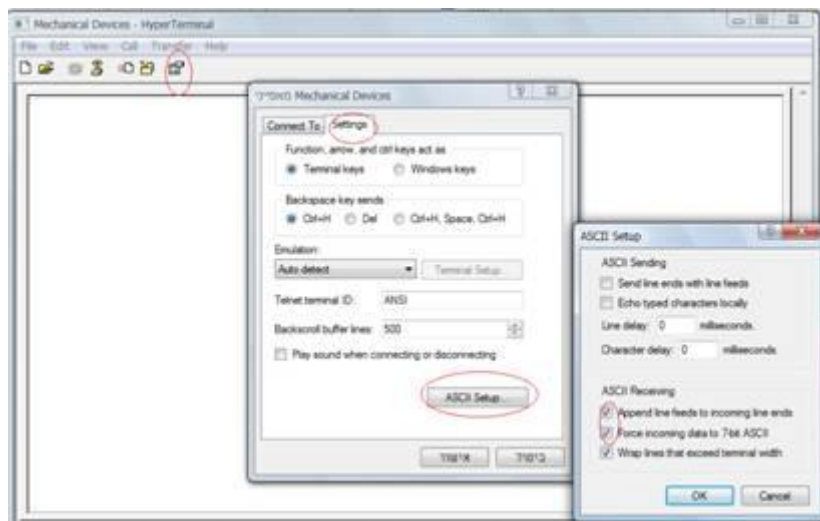
a. Add your company name



b. Use port 5000 and TCP/IP communication.



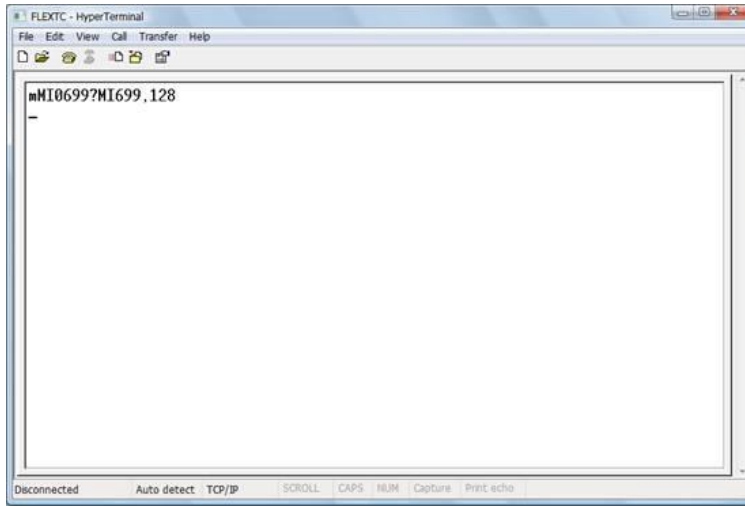
c. Go to **Properties** → **Settings** → **ASCII Setup** and select all the checkboxes for **ASCII Receiving**:



d. Click **OK**

## Entering Commands in Hyper Terminal

You enter commands by “paste to host” directly into the Hyper Terminal main screen, for example:



The formats of the commands are:

- ☐ **Read command form MI** (register cell): mMIXXXX?

Where XXXX is the MI register address.

Example: Sending the following command: mMI0699? The response is MI0699,1100, which means the controller has a value of 1100 (+110.0 °C) in MI699.

- ☐ **Write command for MI** (register cell): mMIXXXX,YYYY

Where XXXX is the MI register address, and YYYY is the register new value.

Example: Sending the following command: mMI0699,-500. The response is OK, which means the controller now has a value of -500 (-50.0°C) in MI699.

- ☐ **Read command for MB**: mMBXXXX?

Where XXXX is the MB bit cell address.

Example: Sending the following command: mMB0001? The response is MI0001,1, which means that the controller has a value of 1 in MB1.

- ☐ **Write command for MB**: mMBXXXX,Y

Where XXXX is the MB bit cell address, and Y is the bit cell new value.

Example: Sending the following command: mMB0001,1. The response is OK, which means the controller has value of 1 in MB1.

Most commonly used bits are:

**MB20** “RUN” bit. Turns the system on and off

**MI6** “ACTUAL TEMP” reading

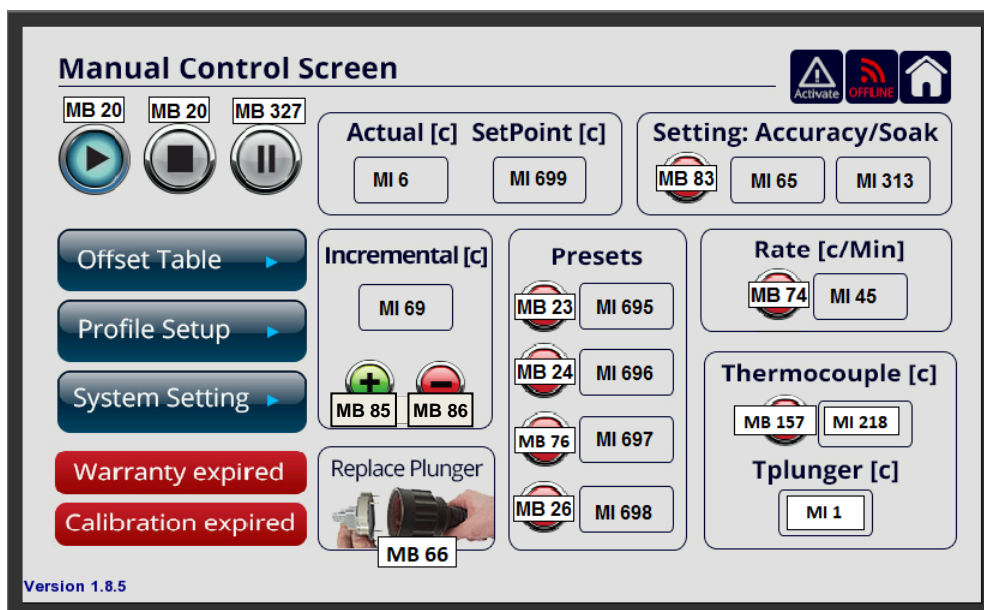
**MI699** “SET POINT” register

**MB83** “CONVERGE” bit. Tells you that the Set Point has been reached within the preset accuracy. Read only register, you can not write to MB83.



## Register Maps

### Manual Control Screen Register Map



	BIT	Description
1	MB 20	Standby / play
2	MI 6	Actual temp [C]
3	MI 699	Set point [C]
4	MB 83	Converge bit - Soak time reached within accuracy [C/s] [read only bit]
5	MI 65	Temperature accuracy [C]
6	MI 313	Soak time accuracy [s]
7	MB 74	Activate rate [C/min]
8	MI 45	Rate [C/min] value
9	MB 23	Activate Preset 1
10	MI 695	Preset 1 temp value
11	MB 24	Activate Preset 2
12	MI 696	Preset 2 temp value
13	MB 76	Activate Preset 3
14	MI 697	Preset 3 temp value
15	MB 26	Activate Preset 4
16	MI 698	Preset 4 temp value
17	MI 69	Incremental [C] - Step
18	MB 85 / 86	Incremental + / -
19	MB 327	Pause system
20	MI 218	Thermocouple Temperature [C]
21	MI 1	T Plunger [C]
22	MB 157	Thermocouple Indicator
23	MB 66	Initiate Replace Plunger sequence, change from 0 to 1
	MB 326	Auto trigger for plunger disassembly, changes automatically from 0 to 1
	MB 999	System reset after new plunger install, change from 0 to 1
	MB 321	End of Replace Plunger sequence, change from 0 to 1



## Offset Window Register Map

### Offset Window

Manual Offset Table

	T plunger	T offset		T plunger	T offset
#1	MI139	MI165	#8	MI146	MI156
#2	MI141	MI162	#9	MI147	MI155
#3	MI140	MI161	#10	MI148	MI154
#4	MI142	MI160	#11	MI149	MI153
#5	MI143	MI159	#12	MI150	MI132
#6	MI144	MI158	#13	MI151	MI133
#7	MI145	MI157	#14	MI152	MI163

profile 1

MB162

profile 2

profile 3

Reset Profile Parameters?

MB161

Current Temperature

T Plunger

MI0001

T J

MI0011

Set Point

MI0699

Automated Feedback

TJ Feedback

MB171

Set Point Feedback

MB172

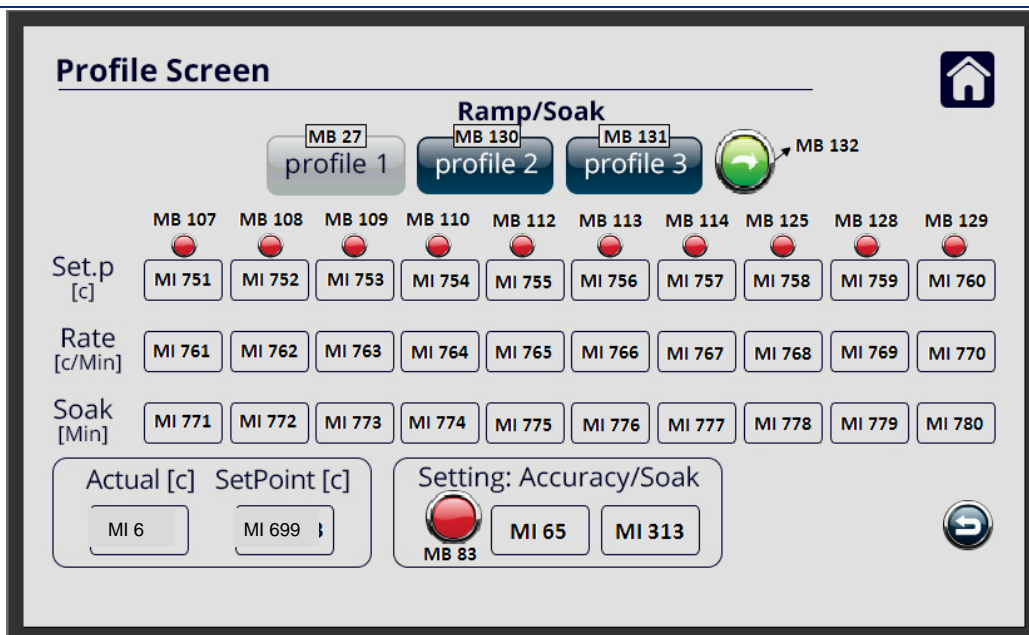
Note:

Analog Input Range: 0-10[VDC]

Temperature Range: -55 -155 [°C]

BIT	Description
1 MB 162	Profile 1– Activate
2 MB 163	Profile 2 – Activate
3 MB 164	Profile 3 – Activate
4 MB 161	Reset Profile Parameters button
5 MB 294	Indication bit for warm up mode ("1" warm up on, "0" warm up finished)
6 MI 139/141/140/142/143/144/145	T Plunger
7 MI 165/162/161/160/159/158/157	T Offset
8 MI 146/147/148/149/150/151/152	T Plunger
9 MI 156/155/154/153/132/133/163	T Offset
10 MI 1	Current Temperature - T Plunger
11 MI 11	Current Temperature - T J
12 MI 699	Current Temperature – Set Point
13 MB 171	T J Feedback
14 MB 172	Set Point Feedback

## Profile Screen Register Map



**Profile Screen**

**Ramp/Soak**

MB 27 profile 1 MB 130 profile 2 MB 131 profile 3 MB 132

MB 107 MB 108 MB 109 MB 110 MB 112 MB 113 MB 114 MB 125 MB 128 MB 129

Set.p [c] MI 751 MI 752 MI 753 MI 754 MI 755 MI 756 MI 757 MI 758 MI 759 MI 760

Rate [c/Min] MI 761 MI 762 MI 763 MI 764 MI 765 MI 766 MI 767 MI 768 MI 769 MI 770

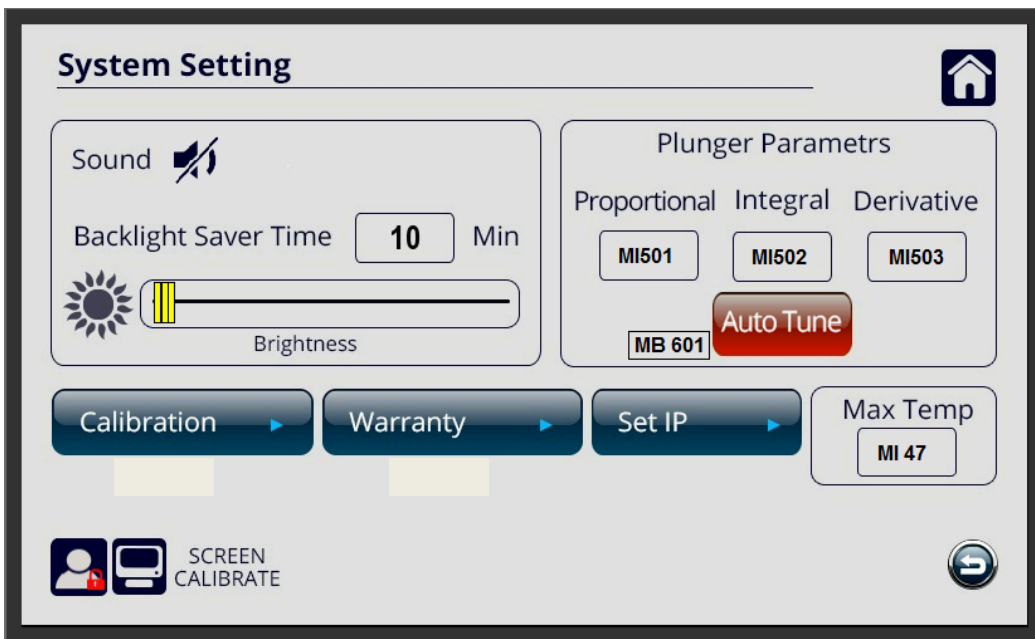
Soak [Min] MI 771 MI 772 MI 773 MI 774 MI 775 MI 776 MI 777 MI 778 MI 779 MI 780

Actual [c] SetPoint [c] Setting: Accuracy/Soak

MI 6 MI 699 MI 83 MI 65 MI 313

BIT	Description
1 MB 27	Profile 1 - Activate
2 MB 130	Profile 2 - Activate
3 MB 131	Profile 3 - Activate
4 MB 132	One arrow: One cycle Two arrows: Repetitive profile
5 MB 107/108/109/110/112/113/114/125/128/129	Profile step indication
6 MI 751/752/753/754/755/756/757/758/759/760	Set Point [C]
7 MI 761/762/763/764/765/766/767/768/769/770	Rate [C/min]
8 MI 771/772/773/774/775/776/777/778/779/780	Soak [min]
9 MI 6	Actual [C]
10 MI 699	Set Point [C]
11 MB 83	Soak Time Reached
12 MI 65	Settling: Accuracy/Soak ---- +/- Temperature [C]
13 MI 313	Settling: Accuracy/Soak ---- [s]

## System Setting Register Map



BIT	Description
1 MB 601	Activate Auto Tune
2 MI 501	Plunger Parameters [PID]: Proportional value
3 MI 502	Plunger Parameters [PID]: Integral Gain value
4 MI 503	Plunger Parameters [PID]: Derivative Gain value
5 MI 47	Set Max Temp [C]

## Troubleshooting

This chapter covers FlexTC fault handling. There are four faults that may occur:

- ☐ Hot Side
- ☐ Cold Side
- ☐ High Pressure
- ☐ Fan

### Fault Indication



**Note:** *The tolerances that trigger the fault warnings are set in the factory.*

If a fault occurs, indications are displayed in the upper left corner of the touchscreen. In case of fault the FlexTC automatically goes into Standby mode.

### FlexTC Fault Handling

#### Fan \*\*

The Fan fault indicates a problem with the system's fans.

#### Hot Side \*\*

The Hot Side fault indicates that the temperature is overshooting the set point for more than 3 seconds. It is often caused by a temporary problem between the Plunger and the Thermal Head Base Plate.

1. Set **Set Point** to 25°C.
2. Press the Fault Message field. It should disappear.
3. Restart the unit.

#### Cold Side \*\*

The Cold Side fault indicates that the temperature is overshooting the set point for more than 3 seconds. It is often caused by a temporary problem with the Plunger.

1. Set **Set Point** to 25°C.
2. Press the Fault Message field. It should disappear.
3. Restart the unit.

#### High Pressure \*\*

The High Pressure fault indicates a problem with the internal refrigerant unit.

1. Set **Set Point** to 10°C.
2. Press the Fault Message field. It should disappear.
3. Wait 3 minutes and then restart the unit.

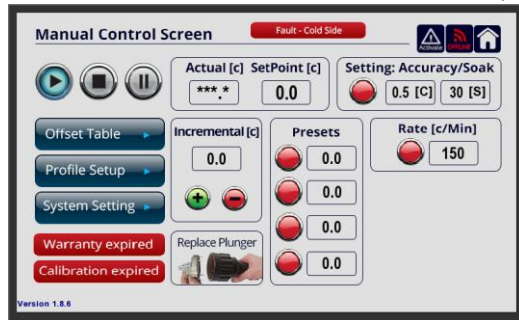
## Plunger Troubleshooting

When the FlexTC's **Actual** temperature does not reach the **Set Point** temperature, please perform the following tests.

**Note:** *As you go through the procedure, be ready to take screenshots of the plunger and the FlexTC as per instructions.*

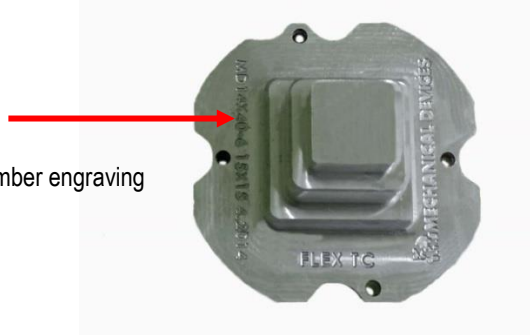
### 1<sup>st</sup> scenario

1. In the **Manual Control Screen**, if the **Actual** box displays \*\*\*\* it is an indication the plunger is malfunctioning.



2. Carefully remove the plunger from the thermal head of the FlexTC.
3. Insert a different plunger (if available) into the thermal head.
4. Place the faulty Plunger at a safe warm dry place, for about 24 hours, until the humid effect has worn off.
5. **Take a photo** of the faulty/non-functioning plunger. Make sure you're looking at the plunger from above and the engraving of the serial number is fully visible:

Serial Number engraving

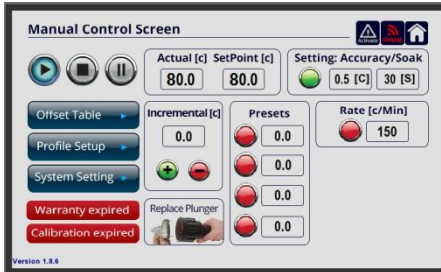



6. After 24hrs please reinsert the "faulty plunger" once again into the FlexTC thermal head and see how it functions.
7. If the plunger continues to malfunction, please contact Mechanical devices support at [sales@mechanical-devices.com](mailto:sales@mechanical-devices.com)

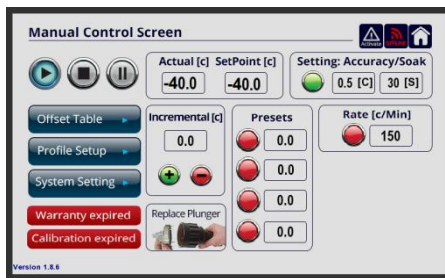
## 2<sup>nd</sup> scenario


When system is not heating or cooling, please do the following test.

1. In **Manual Control Screen** set **Set Point** temperature to **80C**.
2. In **Settling: Accuracy/Soak** box enter **0.5C** in the first box and **30s** in the second box.



3. Wait until the system settles and Accuracy/Soak indicator turns green .
4. **Take a screenshot** of the **Manual Control Screen**.
5. Enter **-40C** in **Set Point** box.

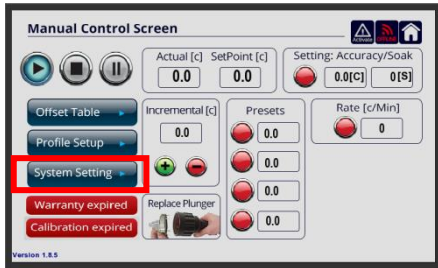


6. Wait until the system settles and Accuracy/Soak indicator turns green .
7. **Take a screenshot** of the **Manual Control Screen**.
8. Enter **25C** in the **Set Point** box.
9. Carefully remove the plunger from the thermal head of the FlexTC.
10. **Take a photo** of the faulty/non-functioning plunger. Make sure you're looking at the plunger from above and the engraved serial number is fully visible.
11. Insert a different plunger (if available) into the thermal head.
12. Send all photos to Mechanical Devices support team at [sales@mechanical-devices.com](mailto:sales@mechanical-devices.com)

## Communication Problems with FlexTC


If you do not have good connection between the FlexTC and the Ethernet network we recommend that you connect the FlexTC directly to your computer. The direct communication is intended to eliminate the possibility of server block communication.

- 1** In the **MANUAL CONTROL SCREEN** press the system setting button



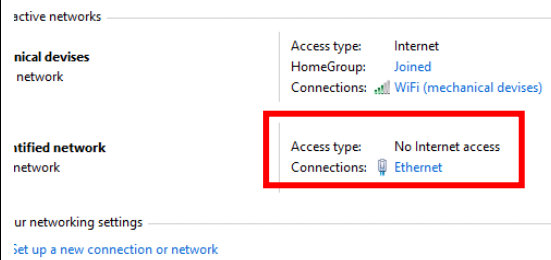
- 2** Press **Set IP**



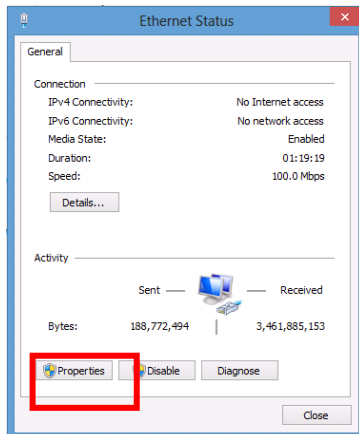
- 3** Enter the following values  
And Press  to return to the **Manual Control Screen**.



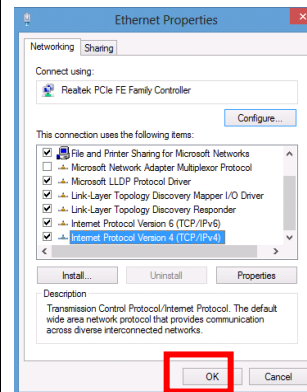
- 4** On the host computer in Windows click  
Start → Control Panel → Network and sharing center → Ethernet  
[for basic network information and set up connections](#)

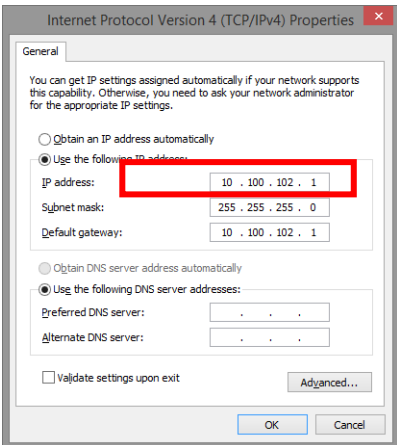

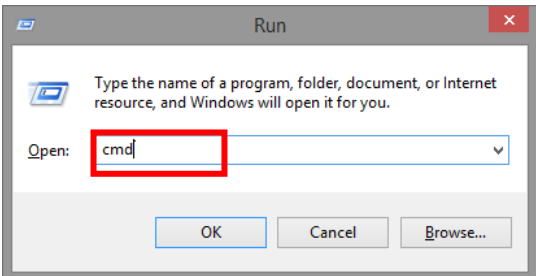
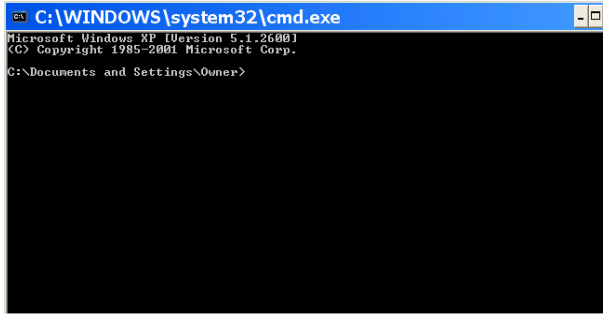
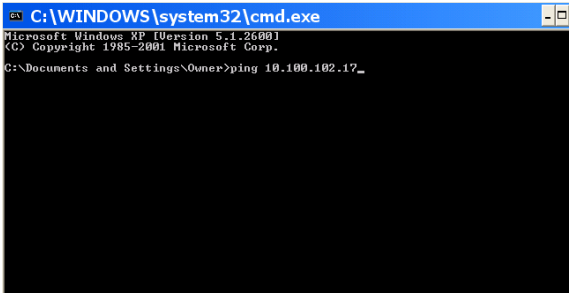
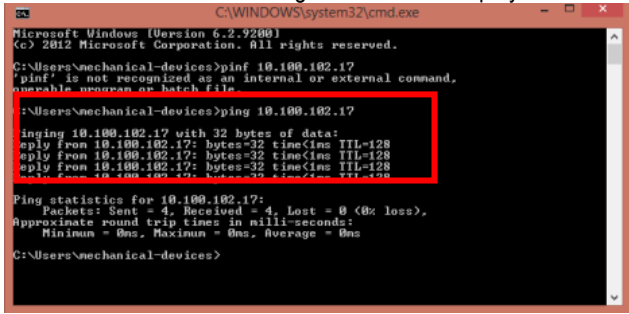
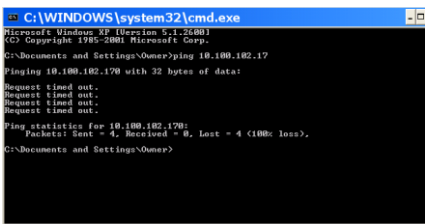


- 5** The "Ethernet Status" window is displayed  
Press properties



- 6** The Internet Protocol Properties window is displayed  
Select: "Internet Protocol Version 4 (TCP/IPv4)"  
And press properties



<p>7</p> <p>Internet Protocol Version 4 Properties is displayed</p> <p>Select "use the following IP address"</p> <p>Fill the following values and press ok</p> 	<p>8</p> <p>Exit from all the windows</p> <p>And Connect the Ethernet cable between the rear FlexTC panel unit and the host computer</p> 
<p>9</p> <p>Go to the run window.</p> <p>Type the CMD command in the run window and press ok</p> 	<p>10</p> <p>CMD window is display</p> 
<p>11</p> <p>In the CMD window type: ping 10.100.102.17 As shown in the FlexTC and Press Enter</p> 	<p>12</p> <p>If connection is ok the following screen will be displayed</p> 
<p>13</p> <p>If there is no connection the following screen is displayed:</p>  <p>Then check Ethernet connection and repeat the procedure</p>	



## FlexTC Technology

### System Overview

The FlexTC Thermal Head contains the Plunger that transmits the temperature to the DUT. The Plunger, when the Thermal Head interfaces on the DUT, is in direct contact with the chip being tested. In this way temperature is passed by direct conduction between the Plunger and the chip. The Plunger contains a thermal sensor (PT100) which makes 30 measurements per second. The sensor data is passed to the system which, in turn, makes 30 thermal corrections within a second, **Actively Heating and Cooling** the plunger to guarantee the  $\pm 0.2^{\circ}\text{C}$  accuracy on the DUT. The Thermal Head also has four purge nozzles for the introduction of nitrogen or dry air to the testing area, access line is connected to the unit's back panel. The constant nitrogen or dry air flow creates a frost and humidity free shield around the DUT. For additional Flexibility the system can be controlled remotely through the ethernet communication port.

### Benefits of Fluid-Free Operation

**FlexTC is Fluid Free – the system does not contain any fluids and it does not require external chillers for its operation.** FlexTC is a self-contained standalone system that completely eliminates the need for chillers. Chiller-based systems always run the risk of fluid leaks that can cause severe damage to the tester. FlexTC in that it is fluid free means that the thermal heads operate safely on tester heads without risks of spills or leaks.

### Facilities Free Operation

**FlexTC is self-contained and does not require compressed air or chillers for its operation.** The FlexTC is a standalone system that requires only a 10A wall outlet and purge. The unit can be operated regardless of the availability of a compressed air line and thanks to its ultra-quiet operation (40Db) can be also operated on an office desk. By acquiring FlexTC systems, newly opened laboratories can save start-up, electricity & maintenance high costs that are associated with ownership of compressed air and chiller facilities.

### Cooling Power

The FlexTC cooling power is a function of the [Device Plunger selection](#) and of the *temperature transfer coefficient* (here in after referred to as the "H factor") between the touching surfaces as shown in the power dissipation formula:

$$\dot{Q} = h \cdot A(T_{\text{env}} - T(t)) \quad (\text{Newton's law of cooling})$$

The higher the H factor is, the more powerful a thermal system can be, FlexTC systems H factor is very high,  $4000(\text{W}\cdot\text{K}^{-1}\cdot\text{m}^{-2})$  compared to the H factor of an air-stream-based systems which is only  $120(\text{W}\cdot\text{K}^{-1}\cdot\text{m}^{-2})$ . As a consequence of which FlexTC systems can effectively cool high power device while air-stream-based systems cannot.

$Q_{\text{watt}} = H \times A_{\text{surface}} (T_{\text{case}} - T_{\text{ambient}})$

$Q$  (watt) = The amount of dissipation, in watts, that a thermal system can dissipate.

$H$  ( $\text{W}\cdot\text{K}^{-1}\cdot\text{m}^{-2}$ ) = Temperature transfer coefficient.

$A$  ( $\text{m}^2$ ) = the surface area of the device

$T_{\text{case}}$  ( $^{\circ}\text{K}$ ) = the temperature of the device

$T_{\text{ambient}}$  ( $^{\circ}\text{K}$ ) = the temperature of the device plunger

### Thermal Loads

Thermal load is the entire wattage of which a thermal application consists. Thermal loads of DUT's are a function of:

- A. the application (socket or soldered).
- B. the DUT's thermal dissipation and dimensions.
- C. the board's dimensions and components wattage.
- D. the purge flow rate.

Mechanical-Devices have developed a thermal analysis software that precisely calculates thermal loads on the DUT case. By knowing the actual thermal load Mechanical-Devices can guarantee Tcase temperatures

### Settling Time

FlexTC direct conduction thermal transfer solution is characterized by very short Tcase settling time. Temperatures transfer speed is a function of the *temperature transfer coefficient* (here in after referred as the "H factor") between the touching surfaces - the higher the H factor is, the faster temperatures will transfer between substances.

FlexTC systems H factor is very high  $4000(\text{W}\cdot\text{K}^{-1}\cdot\text{m}^{-2})$  compared to air- stream-based systems H factor which is only  $120(\text{W}\cdot\text{K}^{-1}\cdot\text{m}^{-2})$  as a consequence temperatures are transferred within seconded from the device plunger to the DUT, dropping the case settling time to seconds.

Example - Jumping into a swimming pool at  $10^{\circ}\text{C}$  will feel cold in a split of a second due to the high temperature transfer coefficient of water to skin ( $H_{\text{water}}=3000$ ) which transferred the  $10^{\circ}\text{C}$  to the skin in a split of a second. However, going outdoors @  $10^{\circ}\text{C}$  will not feel cold due to the low temperature transfer coefficient of air-skin ( $H_{\text{air}}=80$ ) which will only transfers the  $10^{\circ}\text{C}$  to the skin after long duration.

### FlexTC is ideal for handler's integration in many ways

1. The unit footprint is very compact and it will not occupy expensive test production floor the FlexTC can be placed inside the handler cabinet or mounted on a shelf.
2. Due to its fluid free operation, the FlexTC does not pose risks of leaks that are associated with chiller-based systems which would severely damage expensive test and handling equipment.
3. FlexTC tri-temp-handler prices are cost effective

### FlexTC Ready Sockets Lids

Mechanical-Devices will provide socket manufacturers, free of charge, all the technical information required to manufacture FlexTC Ready Sockets Lids. Acquiring FlexTC ready sockets lids eliminates the need to purchase the mechanical Interface from Mechanical-Devices.

### Mechanical-Devices sockets support

Since the introduction of the FlexTC on the market, we have custom-designed and manufactured mechanical interfaces that enable FlexTC to operate with test sockets from over 30 different manufacturers worldwide, including: **Johnstech, Ironwood, ECT Multitest, YAMAICHI, Enplas, Winway Technologies, Paricon, 3M, Wells-CTI, Ardent Concepts, IDI Antares, Phoenix, Robson RTI, Gold Technologies, Aries Electronics, Plastronics** and more.

***Mechanical-Devices engineering group will design and manufacture mechanical interfaces for every existing socket on the market -from all brands.***

## Humidity and Frost Free Operation

FlexTC ensures frost and humidity free test environments through several prevention techniques.

### A. Test Site Frost Prevention

The FlexTC thermal head has four purge outlets for the introduction of dry air or nitrogen close to the testing area, the constant Nitrogen or dry air flow creates a frost and humidity free shield around the DUT. An access line is connected to the unit back panel and the flow goes through the unit and the hose up to the outlets. The flow is software controlled via a solenoid which, by default, automatically opens the purge when the plunger temperature cools to 16°C downwards.



Back panel purge inlet



Front Panel Purge outlet



### Installing Pressure Regulator and Purge Access Tube

The recommended dry air pressure to be used for purge is 0.2 bar. A low amount of dry air (0.2 bar) is sufficient in order to prevent condensation and ice formation on your DUT in low temperatures. In case of too much dry air purge used, it will have a negative side-effect of heating up your DUT environment, and it may become impossible to stabilize at low temperatures required for your testing.

In order to apply correct dry air pressure, please use the pressure regulator and purge access tube that was included in the shipment of your thermal testing system. Please refer to the instructions below of how to install pressure regulator and access line (0.6 mm tube) in order to prepare your thermal testing unit for operation with dry air purge.



**Step 1.** Cut a small segment of around 20 cm in length from a black plastic tube with 0.6mm diameter. Insert one end of the short tube segment into a pipe connector of the pressure regulator.



**Step 2.** Insert the other end of the short tube segment into the purge inlet located at the back of the thermal testing system.



**Step 3.** Insert one end of the long segment of the black tube into the other pipe connector of the pressure regulator.



**Step 4.** Insert the other end of the long tube segment into the valve connector or regular connector of the dry air gas balloon. Follow manufacturer instructions for connecting to the dry air balloon.

## B. Manifolds

Manifolds are used for preventing frost and humidity on the plunger and surroundings in Z up and Z down positions while using Boom Stands or Pneumatic Stations



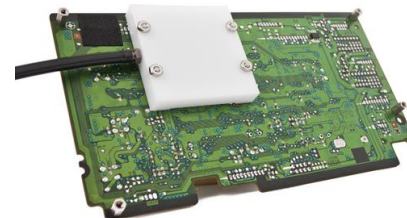
**Frost Preventing Manifold connected to thermal head**

## C. Board Backside Frost Prevention

Backside frost and humidity free environment is achieved using dry air or nitrogen purging through a Backside Frost Preventing Cover that is attached to the board backside. Using the system's Front Panel Purge Outlet Option guarantees automatic prevention of frost build up on the board backside.

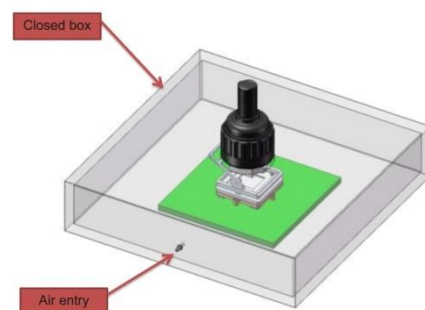


*Custom Backside Cover connected through the socket's mounting holes*



*Custom/Universal backside Cover connected through the board mounting holes*

**Or you may choose a custom box, for closed air environment**

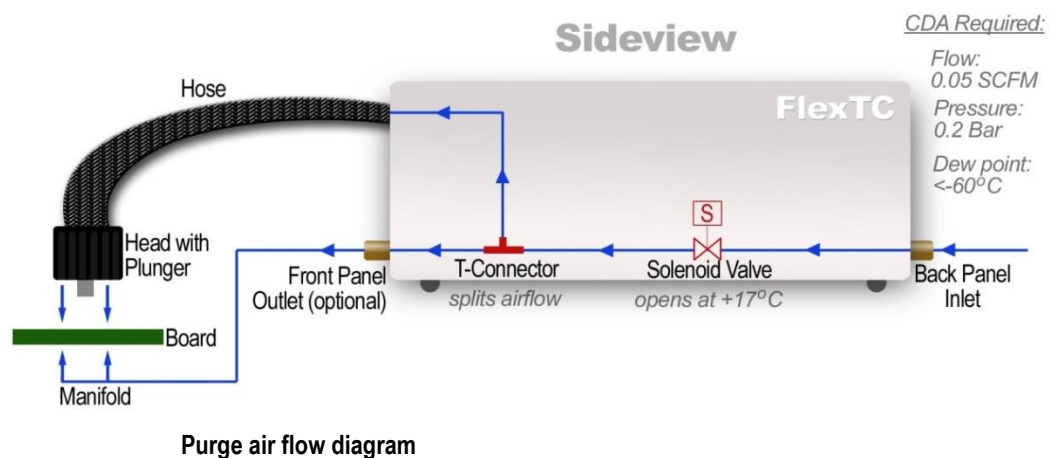


#### D. Elastomeric Frost Preventing Armaflex Ring

Frost preventing Armaflex Rings are placed between the Universal Adapter Plate bottom surface and the board, they keep the purge dry air around the DUT and are insulating between the test area and the surrounding environment.



*Elastomeric Frost preventing Armaflex Ring / Frost preventing Armaflex Ring placed between the Universal Adapter Plate and the board*





## FAQ

**Question 1:** Is the USB port only used to upgrade Firmware and not to remote control the unit?

**Answer:** This is correct. We use the USB for upgrading the HMI only.

**Question 2:** If not please provide the driver commands and some support for the software programmers. Also please give me some advice on the RS232 interface. Can we remote control the FlexTC through RS232 or only through the LAN interface?

**Answer:** The only remote interface the FlexTC has is Ethernet (LAN), other options can be used by having communication converter.

**Question 3:** How can I hold the thermal head on small/large standalone test boards?

**Answer:** All our thermal heads can be operated on both large and small test boards, using either Perspex base plates, Shelf Clips for connecting hose to shelves and prevent hose movement, or with ceiling hanging holders.

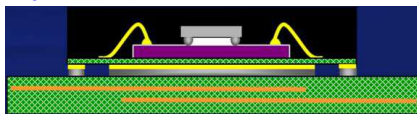


**Question 4:** Can the system be intergraded with test handlers?

**Answer:** Yes, at order level request side / square thermal head.

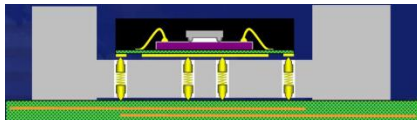
**Question 5:** Soldered vs socketed devices for thermal resistance on DUT.

**Answer:** Thermal resistance is typically given in device datasheet for the device soldered to a board in certain environment. Thermal resistance of a socketed device is expected to be higher than one soldered to a PCB in same environment. Mostly known



Soldered Heat dissipation path:

- Die – Case – Ambient
- Die – IC Pads – Board – Ambient

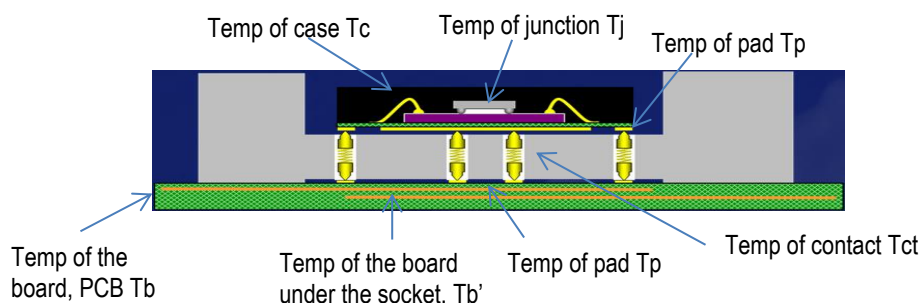


Socketed Heat dissipation path:

- Die – Case – Socket – Ambient
- Die – IC Pads – Socket – Board – Ambient

Thermal resistance is: the characterization of heat transfer between two points. The key point to get thermal stability and  $T_j$  under control functionality and reliability of the IC.

### Thermal resistance circuitry for a device in a socket



**Question 5:** where is the PT100 located in the plunger?

**Answer:** Embedded PT100 Sensor Measure T case Calibrated to surface actual temp

**Question 6:** should I use an external thermocouple linked to a thermometer?

**Answer:** it is best to use the K-type connector located at the back panel. This will open a new window at the TC control screen allowing reading and setting the temp. via the thermocouple. This reading is calibrated as a close circuit; we have no knowledge of the calibration and reading from the external thermometer.

**Question 7:** can the system be calibrated yearly / quarterly?

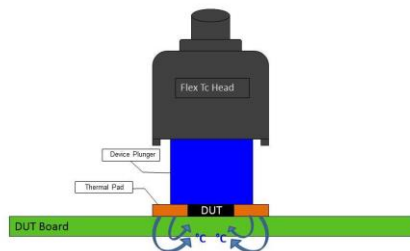
**Answer:** Yes, please turn to your representative or to Mechanical devices for calibration packages. [sales@mechanical-devices.com](mailto:sales@mechanical-devices.com)

**Question 8:** how much air pressure in Bar needed for frost free operation?

**Answer:** The recommended dry air / nitrogen pressure to be used for purge is up to 0.2 Bar. You can go a little over this but you should not exceed 0.6 Bar. Dry air purge is needed to maintain humidity and frost free environment of your application in low temperatures. The purge is software controlled in the system and it starts automatically once the temperature goes below 16°C. If you use purge at much higher pressure, you will be releasing a large amount of air which comes out at ambient temperature (20°C) directly onto your DUT. It will result in parasitic energy dissipation and your device will not be cooling as expected, or cooling at much lower rate. Your test results will be directly affected by this. Note that for very low temp. nitrogen dry air is needed

**Question 9:** What are the guidelines for cooling/heating soldered device packages?

**Answer:** Semiconductor devices are either tested in test sockets or when soldered to PCBs. in socket testing the device is thermally isolated from the PCB and the main influence on the junction temperature is from the device case (Theta JC). In soldered devices testing the junction temperature is more influenced by the surrounding PCB temperatures due to the thermal conduction via the solder leads. Managing PCB temperatures in close proximity (up to 0.5mm overlap) around soldered devices is important for ensuring minimum junction to case offsets in soldered device thermal testing. The following application note describes mini chamber environment setup for conducting temperatures to PCB area around the soldered device



**Question 10:** How to use the mini chamber setup using thermal pad material?

**Answer:** Photo 1 of PCB soldered device before mini chamber environment:



Photo 2 Thermal conductive pad materials TIM trimmed to frame shape



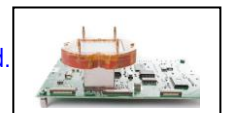
Photo 3 Thermal pad material placed around the soldered device, on top of approximate components



Photo 4 thermal grease placed on the soldered device



Photo 5 Device Plunger contacting the entire area of the soldered device and the frame shaped thermal pad.

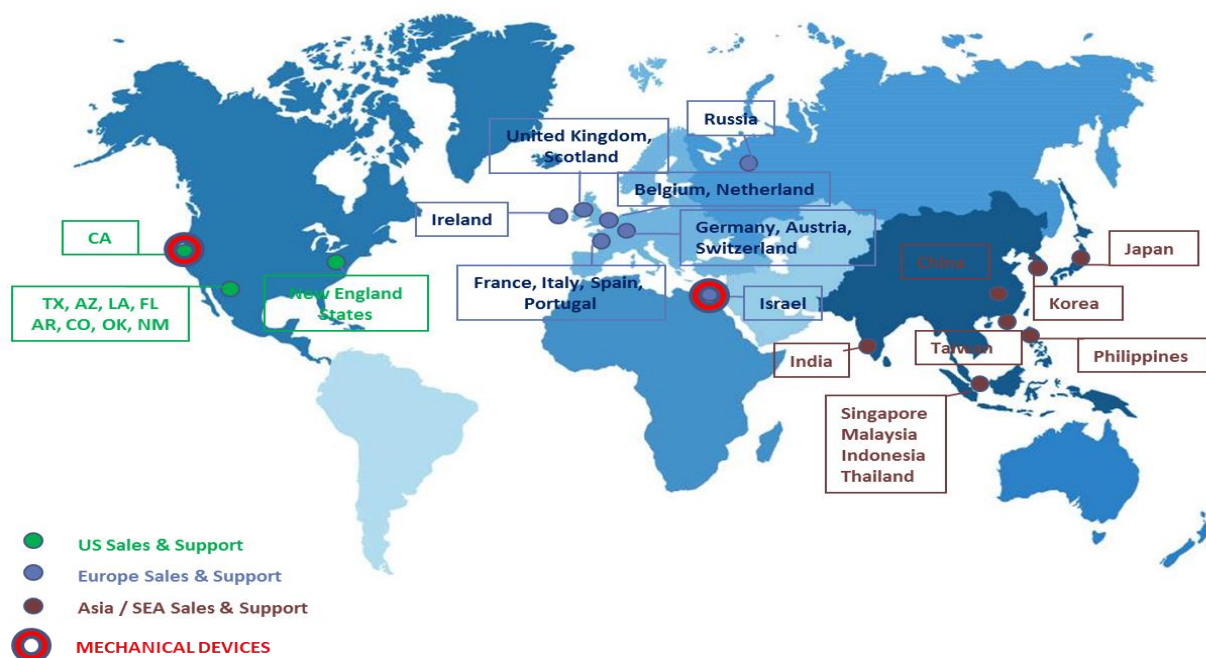


Note: instead of using thermal pad , a parker past can be used/molded on the device.





## Mechanical Devices World Map



**Mechanical Devices operates Worldwide in the above Countries**

## MECHANICAL DEVICES

Mechanical Devices – an advanced thermal solutions company is a global leader and innovator in temperature control solutions that are being used primarily by semiconductor manufacturers to test their IC and wafer processes. Mechanical Devices temperature control systems offer fast, accurate, stable and cost effective solutions, using advanced and patented technology. With the industry's state-of-the-art temperature forcing systems, FlexTC and FlexTC, Mechanical Devices is changing the way the testing and temperature control is done, enabling semiconductor manufacturers to enhance their own profitability by improving the efficiency of their IC and wafer test processes. Mechanical Devices end user customers include the world's top semiconductor Manufacturers. The company's products FlexTC and FlexTC systems can be integrated with the automatic test equipment (ATE) and handlers. Mechanical Devices is head-quartered in Haifa Bay, Israel with a branch in Santa Clara, CA, USA which includes its newest sales and service center. Mechanical Devices has a number of sales representatives at key locations throughout Asia, Europe, and the United States.

## CONTACT US

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