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Synergy Controller Pressure Applications Vacuum Ovens, Altitude and Thermal Vacuum Chambers



Introduction

This application note covers Synergy Controller pressure control features including vacuum ovens, altitude chambers and thermal vacuum (space simulation) chambers.

Tidal Engineering's Synergy Controllers, including the Synergy Micro 2, Synergy Quattro, and the ¼ DIN Synergy Nano provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functions of a chamber controller and a data logger. They are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards. Offering the flexibility of multiple communication ports including Ethernet, GPIB, and RS-232 make these controllers perfect for today's changing testing environments.

The Synergy Controller software can process a range of transducer types for a variety of applications and units of measure as follows:

- 1. Granville Philips ion gauge for space simulation chambers.
- 2. Virtual Pressure Sensor; aggregates a High and Low Pressure transducer into one measurement.
- 3. Virtual Kft. Sensor; converts pressure; for example Torr to Kft. using NOAA equation.
- 4. Configurable pressure units including Torr, PSIG, mmHg, etc.

The Pressure Feature Registration Key (also known as the Altitude Key), P/N TE2013 is required to enable the pressure feature of the Synergy Controller. Contact Tidal Engineering for the Pressure Feature Registration Key for your controller.

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Synergy Controller setup for pressure applications requires up to 5 steps as follows:

- 1. Enter the Pressure Feature registration key.
- 2. Load the chamber type; for example "Generic Temperature Pressure" or custom CDF.
- 3. Setup the input scaling for the sensor.
- 4. Set the pressure channel or channels to the sensor(s)
- 5. If required, load the Unit of Measure settings file to change units of measure from Torr or Kft. to another type such as mmHg, PSIG, etc.

Enter the Pressure Feature Registration Key.

Setup - TELEPHONICS	Open the Setup screen and browse to the \Calibration\Altitude folder as shown at left.
Calibration Channel 1 Guaranteed Soak Calibration Channel 2 Channel 2 Channe	
Alam, Internal Comm 25.0 C 50.	Contact Tidal Engineering with the S/N of
Register Altitude	your controller; press on the Registration Key field to open the Keypad.
Your serial number needed to register Altitude is: 02/0105. You must provide this number to get your registration key. Registration Key: Register Cancel	

Setup - TELEPHONICS ALARM Register Altitude Your serial number needed to register Altitude is: 02/0105. You must provide this number to get your registration key. Registration Key: Sbc1652f Register Cancel	Enter the 8 digit Registration key and press Accept to close the keypad. Check the number in the Registration Key field and press Register as shown on the left.
Setup - TELEPHONICS ALARM Register Altitude Your seria 02/0105; registrati The Altitude key was successfully registered. Regi 5bc1652f Register Cancel	The Synergy Controller dialog "The Altitude key was successfully registered" will appear when the Registration key is accepted. Press OK to close the dialog. If there was a problem with the Registration key, check the number and try again or contact Tidal Engineering.
Setup - TELEPHONICS Image Image Altitude Value -1 Altitude Key 5BC1652F Description: Help is not available for this item. Change 25.0 C 50.0 G	Select the Altitude Value parameter and press the Change button. Set the value using the number pad to 0 for Vacuum Ovens and Altitude chambers. For Thermal Vacuum chambers that utilize logarithmic voltage scaling (for Granville Phillips Ion Gauge), set the Altitude value according to the scaling as shown in the next section. When the Altitude Value is set to -1, the process value will read Off indicating "Off-Scale".

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Setup the Virtual KFt. Sensor Option

Setup - TELEPHONICS ALARM	Browse to the Virtual KFt. folder in the
Calibration/Virtual Sensors)	Setup screen as shown on the left.
Back	
Wet Bulb Dry Bulb	
Alarm, Internal Comm 25.0 C 50.0 G	
Setup - TELEPHONICS ALARM	Select the Torr Sensor parameter and press
Calibration\Virtual Sensors\Virtual KFt\	Change button.
Torr Sensor Analog I	
I Description: The 'Torr Sensor' picks which sensor	
to use in the Virtual KFt equations	
Change	
Alarm, Internal Comm 25.0 C 50.0 G	
Setup - TELEPHONICS ALARM	Select the sensor for the pressure Sensor
Torr Sensor	from the Sensor Select Screen.
Module Sensor	
UUT's RTD 2	
Actuals Analog 3	
Accept Cancel	
Alarm, Internal Comm 25.0 C 50.0 G	

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Setup - TELEPHONICS	Virtual Pressure	Browse to the Virtual Pressure folder in the Setup screen as shown on the left.
Alarm, Internal Comm	25.0 C 50.0 G	
Setup - TELEPHONICS Calibration\Virtual Sensors\ Std. Range Pres. Sensor ID High Alt. Pres. Sensor ID Transfer Pres. Threshold Transfer Pres. Hysteresis	ALARM /irtual Pressure\ Analog 2 Analog 3 9.00 1.00	Select the pressure sensors for the Std. Range (high pressure) and High Alt. (low pressure) sensors. Then select the Transfer Pressure at which the virtual sensor switches to the High Alt. (Low Pressure). Enter a Hysteresis value to prevent chatter near the threshold.
Description: Help is not ava	ilable for this item.	
Alarm, Internal Comm	25.0 C 50.0 G	

Virtual Pressure Sensor Setup Option

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Setup and Wiring for Thermal Vacuum chambers with Granville Philips Ion Gauge transducer



CAUTION! : The Analog inputs on the controller will be damaged if the 10 V transducer output is attached without a voltage divider.

1. Wire the Granville Philips 10 Volt output thru a 2:1 voltage divider as shown below. (Analog inputs 2, 3, or 4 may also be used) Note: 1K/1K ohm resistor divider must be used. A precision 1% metal film resistor suitable for this application is the Panasonic ERO-S2PHF1001 available from Digikey.



Signal	Olympic Board Connector-Pin	Reference
Analog Input 1	P2-1	P2-7
Analog Input 2	P2-5	P2-7
Analog Input 3	P2-6	P2-7
Analog Input 4	P2-11	P2-7

2. Select the chamber setup for Temperature Pressure as shown below and reboot as instructed.

Setup Screen	ALARM	SETUP/Chamber Setup/ Select Generic
		remperature, pressure
Back (Chamber Setup)		
	14.8	
Chamber Type:		
Synergy Temperature, Pressure TP248d	.CDF	
Chamber Description		
Synergy Temperature, Pressure TP248d	.CDF	
1		
	Chapte	
2		
Alarm, Internal Comm (D.OC 0.OT	
Setup Screen	ALARM	Setup the Hi Res input calibration for the
		input used as shown below.
Calibration\Input\High Res\An	alog 1\	
		SETUP\Calibration\Input\Hi Res\Analog 1
Raw Calibration (m,b)	100.00, 0	(P2-1 to P2-7)
High Eng. Scale 1	LO.00	
Low Eng. Scale 0).00	Set High Eng. Scale to 10 Volts
High Volts Scale 5	5.000	Set Low Eng. Scale to 0 Volts
Low Volts Scale 0).000 💽	Set High Volts Scale to 5 Volts
Description		Set Low Volts Scale to 0 Volts
Help is not available for this ite	em.	
Change		
Alarm, CH2 Low	467.3C 0.0 %	
Setup Screen		Setup the Type to "Other" as shown
		below. Selecting a Temperature or Vaisala
Calibration\Input\High Res\An	alog 1\	type would be inappropriate and would
		create erroneous readings.
High Eng. Scale 1	LO.OO 🔺	
Low Eng. Scale 0).00	
High Volts Scale 5	5.000	
Low Volts Scale 0).000	
Type	Other 💽	
Description		
Help is not available for this its	em.	
Change		
Alarm, CH2 Low 4	467.3C 0.0 %	

Setup Screen 11:36:53 PM	
Rack \Calibration\Input\High Res\Analog 1\Type	
Available Options	
Vsla-An3	
Vsla-Ch1	
Vsla-Ch2 Vsla-Ch3	
Vsla-Ch4	
Other 🔽	
Accept	
Steady State 467.3C 47.2 %	
Setup Screen ALARM	Select the channel sensor
(Calibration\Calibration Channel 2)	SETUP\Calibration\Calibration
Back	Channel 2
CH2 Sensor Select 130	
Pressure Calibration 0.00	Select Analog 1 for sensor (CH2
Low Alarm. Channel 2 -10.00	Serisor Select code (130)
High Alarm, Channel 2 104.00	
Help is not available for this item.	
Change	
Alarm, Internal Comm 0.0 C 0.0 T	
Setup Screen	Setup the Altitude calibration constant
	based on the Emission setting for the
Back (Calibration)	Granville Philips ION gauge as follows:
	n = 12 for 10 mA
	n = 11 for 1 mA
Collection Collection Collection	n = 10 for 0.1 mA
Calibration Calibration Calibration Calibration Channel 1 Channel 2 Channel 3	
Calibration Mittude Valuet Guaranteed Soak	
Alarm, Internal Comm U.U.C. 1.0e-10	

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2 The Ion Gauge Electrometer Module

The UHV electrometer option (307016) switches in a preamplifier as pressure decreases at an ion (collector) current of 10⁻¹⁰ A. For example, this corresponds to a pressure of 10⁻⁹ Torr with 10 mA emission current. When this switching occurs, there will be a brief (about 2 s duration) drop in the analog output signal. After the electrometer has settled out, the signal is, again, proportional to the common logarithm of pressure as shown by the UHV ONLY area of Figure 2-4.



A standard 1/8 in. miniature phono jack connector and plug are supplied.

The characteristics of this type of analog output voltage are ideal for applications requiring closed loop control. The voltage signal is smooth and continuous throughout all the decades of pressure measurement. This format is useful for computerized data acquisition because a simple equation (finding the common antilogarithm) may be programmed to calculate pressure from the voltage output.

The equation is:

 $P = 10^{(V-n)}$

Where V = analog output voltage;

n = 12 for the 10 mA emission current range;

n = 11 for the 1 mA emission current range;

n = 10 for the 0.1 mA emission current range.

For example, if emission current is set to the 1 mA range and the analog output voltage is 3.25 volts, the pressure (in units selected) may be determined by raising 10 to the power (V-11) or

 $P = 10^{(3.25-11)} = 1.8 \times 10^{-8}$ (Torr, for example)

Series 307 Vacuum Gauge Controller November, 2001

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Pressure is displayed on Chan. 2 in scientific notation as shown below.

6. The log file also records pressure in scientific notation in units of Torr.

7. Now that the controller is setup, confirm displayed values using the table below.

Output in Torr is 10^{((Voltage*2)-n)}

With n = 12 and 5 volts on the Olympic board input, the controller will show 1.0e-2 With n = 11 and 5 volts on the Olympic board input, the controller will show 1.0e-1 With n = 10 and 5 volts on the Olympic board input, the controller will show 1.0e-0

With n = 12 and 0 volts on the Olympic board input, the controller will show 1.0e-12 With n = 11 and 0 volts on the Olympic board input, the controller will show 1.0e-11 With n = 10 and 0 volts on the Olympic board input, the controller will show 1.0e-10

With n = 12 and 2.1 volts on the Olympic board input, the controller will show 1.6e-8 With n = 11 and 2.1 volts on the Olympic board input, the controller will show 1.6e-7 With n = 10 and 2.1 volts on the Olympic board input, the controller will show 1.6e-6

Note: Software version 2.4.81 or higher is required for Granville Phillips features.

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Setup for Alternative Units of Pressure

The Synergy controller family is capable of controlling virtually any environmental test chamber including a variety of altitude chambers and vacuum ovens.

The two built-in (Generic) configurations for these systems are:

- 1. Generic Temperature Pressure
- 2. Generic Temperature Humidity Pressure

The default unit of measure for pressure for these configurations is Torr. These Generic configurations can also be setup for alternate units of measure including PSIG and mbar (millibar) using configuration files such as "Generic_THP_mbar_over-rides.CFG" which are available from the factory and are easily loaded using the \File Utilities\Config Utilities function in the Maintenance screen as shown in the steps below:

Maintenance - 1ceadg1 Image: Setting state Image: Setting state Restore Setting state Image: Setting state Alarm. Multiple Alarms 25.0 C 50.7 Kft	Put the appropriate Settings File on the USB flash drive and place the drive in the controller's USB port. Then Browse to the Restore Settings folder.
Select Source File - 1ceadg1 Drive List USB Hard Disk # 828 start # 874 # 875 # THP # Generic_THP_mbar_over-rides # Generic_THP_PSIG_over-rides # File: Generic_THP_mbar Select Cancel	Restore the "Generic_THP_mbar_over- rides.CFG" to change the displayed units from Torr to mBar.

Setup - LabviewRampTH		Set the High Engineering scale for the appropriate Synergy Controller High Res Analog input (for the pressure transducer input) to
High Eng. Scale Low Eng. Scale High Volts Scale Low Volts Scale Type Description: High maximum value to	1333.20 ▲ 0.00 5.000 ↓ 0.000 0ther ▼ Engineering Sacle is the scale this input to	1333.2 in the Setup\Calibration\Input\High Res\Analog screen. 1000 Torr = 1333.22 millibars
Main - LabviewRampT Chan. 1 - Temp. C Setpoint 50.0 Temp. C Actual 99.0 Chamber Off	2:20:01 PM ≦ Chan. 2 - Press. mbar Setpoint 90.0 Press. Actual 99.0 C Off mbar	The Main Screen of the Synergy Controller on the left is displaying pressure in units of millibar.

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Synergy Controller Pressure control setup for KFt. Units of Measure.

In addition to displaying pressure in units of Torr, PSIG, and millibars, to display pressure in units of K feet (Kft.), you can load the THP KFT and TP KFT Chamber Definition Files (CDF).

Maintenance - 1ceadg1 3:57:28 PM Import Source File: Import Cancel Steady State 25.0 C 50.7 Kft	Insert the USB Flash Disk in the controllers USB port and browse to the Maintenance Screen\File Utilities Folder as shown on the left.
Select Source File - 1ceadg1 3:58:22 PM Drive List USB Hard Disk File List THP_KFT_D TP_KFT File: TP_KFT Select Cancel	Select the chamber type TP_KFT from the Chamber Setup Folder on the Setup Screen, the reboot the controller as instructed.
Setup - 1ceadg1 3:59:40 PM Image: Setup - 1ceadg1 3:59:40 PM Image: Setup - 1ceadg1 3:59:40 PM Image: Setup - 1ceadg1 Available Options Image: Setup - 1ceadg1 Image: Setup - 1ceadg1 Image: Setup - 1ceadg1 Image: Setup - 1ceadg1	Browse to the Chamber Setup Folder on the Setup Screen, select the new CDF file, and then reboot the controller as instructed.

Setup - 1ceadg1 Calibration\Altitude\ Altitude Value Altitude Key	∎ 0 5BC1652F	Check the Setup\Calibration\Alt folder and to make sure that the Altitude Value is set to 0. You may need to re-enter the Altitude Key (Pressure Feature Registration) value to access this screen.
Description: Help is not ava	ilable for this item.	
Change Alarm, Multiple Alarms	25.0 C Off Kft	
Setup - 1ceadq1	3:56:30 PM 📓	Setup the Analog Input
Calibration\Input\High Res\/ High Eng. Scale Low Eng. Scale High Volts Scale	Analog 1\ 1000.00 0.00 5.000 0.000	Browse to the Setup Screen and Open the Calibration\Input\High Res\Analog1\ Folder and adjust to the appropriate High Engineering and Low Engineering Scale for your transducer
Low Volts Scale	U.UUU Torr-Kft	output in units of Forr.
Description: High Engineering Sacle is the maximum value to scale this input to Change Steady State 25.0 C 50.7 Kft		Scroll to the bottom of the screen and set the Type to Torr-Kft. as shown on the left.
Setup - 1ceadg1	3:55:45 PM 📓	Setup the pressure channel as shown at the left.
CH2 Sensor Select	130	
Pressure Offset (b)	0.00	
High Alarm, Channel 2	100.00	
Low Alarm, Channel 2	0.00	
Change Steady State	eter to assign the r for this Channel. sensor list. 25.0 C 50.7 Kft	

	1
Setup - 1ceadg1 3:53:50 PM 📱	Check the Output 18 control Type,
Special Europions) Output 18 Control Type	
Back	
Available Options	
Vent	
Boost Cool	
Accept Cancel	
Steady State 25.0 C 50.7 Kft	
Main - 1ceadg1 3:55:03 PM 📓	And finally, go to the Main screen using the Main
rChan, 1 - Temp, C rChan, 2 - Press, Kft	button and verify the units of display.
Setpoint Setpoint	
Temp.C Press.Kft	
artural artural	
Accual	
Steady State 25.0 C 50.7 Kft	
Events - 1ceadg1	The Raw Reading for the Analog Voltage input
	and the scaled value in Kft. can be verified in the
High Res Analog	Events\High Res Analog folder against the
	spreadshaat;
Analog Input Raw Reading Scaled	
PTD 1 (obres) 109 730 24 992	
RTD 2 (ohms) 109,730, 24,992	Synergy Controller Forr to Altitude conversion Rev B.xls
Analog 1 (volts) 0.400, 50.651	
Analog 2 (volts) 1.000, 2.000	
Analog 3 (volts) 2.000, 40.000	
Analog 4 (volts) 3.000, 60.000	
TC1 (microvolts) 0, 0.000	
1C2 (microvolts) 0, 0.000	
Chamber Off 25.0.C 50.7.Kft	

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🛛 Microsoft Excel - Syn	ergy Controller Torr	When 0.40 volts is entered, the calculated value		
Elle Edit View Insert Format Iools Data Window Help - 🗗 for Torr and feet are 80 and 50561 (50.7 Kft.) as				
* × shown at the left				
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A B	C D	E	F 🗖	
	alt (calc)			
32	(Torr) NOAA	Volts		
33 Enter Torr Here>	80.0000 5065	1 0.40		
34				
35	Volto Torr	feet		
36 Enter Volts Here> 0.40 80 50651				
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38	feet Torr	Volts		
39 Enter Feet Here>	<mark>⊳ 50651.00 8</mark>	0 0.40	~	
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Notes:

1. The convention for Synergy Controller CDF files is that THP_KFT and TP_KFT CDFs are for full sized controllers including Synergy Micro, Synergy Micro 2, Synergy Quattro and Synergy Nano TE1858-4 (Expanded mode versions). NANO_THP_KFT and NANO_TP_KFT are for the standard ¼ DIN Versions (the TE1858-1, TE1858-3, and TE1858-3).

2. KFT capabilities are available on controller versions 2_8_6_Build_683 and newer. Contact the factory for information regarding upgrades.

3. Contact Tidal Engineering for the spreadsheets, CDF files, and the CFG files described in this application note.

4. Different Chamber Definition Files (CDF) are required because the Altitude/Pressure channel loop direction is inverted when we switch from Torr to KFt. because altitude is inversely related to pressure.

5. The Synergy Controller implements the Torr to Kft. conversion algorithm from noaa.gov as follows:

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The Synergy Controller implements the Torr to Kft. conversion algorithm from noaa.gov follows:



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About the Synergy Controller Family

Tidal Engineering's Synergy Controllers; the ¼ DIN Synergy Nano, the Synergy Micro 2, and the Synergy Quattro provide state-of-the-art usability and connectivity for environmental test control and data acquisition. They combine the functions of a chamber controller and a data logger and are designed to improve test efficiency by supporting both factory automation and test and measurement protocols and standards.

Synergy Controller feature highlights includes:

- ➔ Color touch screen
- → Ethernet, RS-232 and GPIB communications
- → Built in 100 MB Data logger with USB drive support
- → Data Acquisition, up to 64 T-type thermocouples (Optional)
- → Built-in Web Server for remote control; WebTouch Remote ™
- → Compatible with Synergy Manager for PC based control, monitoring and programming.
- → Built-in FTP Server for factory automation and test and measurement applications

For more information regarding these controllers please see the full Synergy Controller Technical Manual on our website at <u>http://www.tidaleng.com/synergy.htm</u>

About Tidal Engineering

Headquartered in Randolph, NJ, Tidal Engineering Corporation has been designing and building awardwinning embedded hardware and software for test and measurement and data acquisition applications since 1992. The company is recognized for technical expertise in such areas as Embedded IEEE 488, and turnkey SCADA (Supervisory Control and Data Acquisition) systems.

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