

Rockwell Automation Library of Process Objects: Pressure/Temperature Compensated Flow (P_PTComp)

Version 3.5

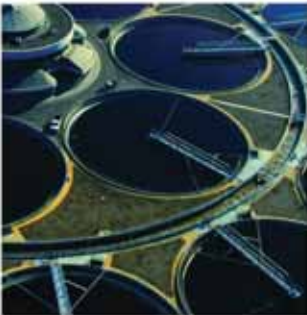
IMPORTANT

This manual applies to the Rockwell Automation Library of Process Objects version 3.5 or earlier.
For Rockwell Automation Library of Process Objects version 5.0, see

- [PROCES-RM200](#)

For Rockwell Automation Library of Process Objects version 4.0 or later, use the following manuals:

- [PROCES-RM013](#) contains logic instructions
- [PROCES-RM014](#) contains display elements



Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.



ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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Notes:

This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

Software Compatibility and Content Revisions

Table 1 - Summary of Changes

Topic	Page
Changed software version from 3_1 to 3_5	8

For the latest compatible software information and to download the Rockwell Automation® Library, see the Product Compatibility and Download Center at <http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page>.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

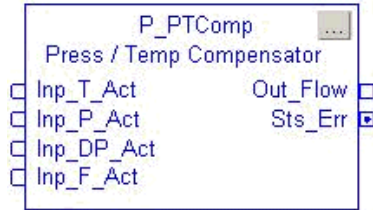
Resource	Description
PlantPax® Distributed Control System Selection Guide, publication PROCES-SG001	Provides information to assist with equipment procurement for your PlantPax system.
PlantPax Distributed Control System Reference Manual, publication PROCES-RM001	Provides characterized recommendations for implementing your PlantPax system.
Rockwell Automation Library of Process Objects, publication PROCES-RM002	Provides general considerations for the PlantPax system library of process objects.
FactoryTalk® View Machine Edition User Manual, publication VIEWME-UM004	Provides details on how to use this software package for creating an automation application.
FactoryTalk View Site Edition User Manual, publication VIEWSE-UM006	Provides details on how to use this software package for developing and running human-machine interface (HMI) applications that can involve multiple users and servers, distributed over a network.
Logix5000™ Controllers Add-On Instructions Programming Manual, publication 1756-PM010	Provides information for designing, configuring, and programming Add-On Instructions.
Rockwell Automation Library of Process Objects: Basic Analog Input (P_Aln) Reference Manual, publication SYSLIB-RM001	Provides details on the P_Aln instruction for a Logix-based controller.

You can view or download publications at <http://www.rockwellautomation.com/literature/>. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

Pressure/Temperature Compensated Flow (P_PTComp)

Add-On Instruction



The Pressure/Temperature Compensated Flow (P_PTComp) Add-On Instruction is used to calculate a flow at standard temperature and pressure, essentially a mass flow rate, given a volumetric flow rate or differential pressure measurement. This instruction also requires measurements of the actual temperature and pressure of the flowing gas.

Guidelines

Use this instruction in these situations:

- You are measuring the flow of a gas, or the differential pressure of a gas that behaves (approximately) as an Ideal Gas across a flow element such as an orifice plate.
- You are measuring the temperature and pressure of the gas.
- You want to express the flow as a Flow at Standard Temperature and Pressure (STP), such as Standard Cubic Feet per Minute (SCFM).

Do **not** use this instruction in these situations:

- You are measuring the flow of steam. You need to use the methods defined by ASME (or other standard or authority having jurisdiction), including the use of steam tables, to determine the properties of the steam to accurately calculate a mass flow.
- You are measuring the flow of natural gas. You need to use the methods defined by AGA (or other standard or authority having jurisdiction), to accurately calculate a mass flow.
- You are measuring the flow of solids or liquids, or of gases that do not behave (approximately) as an Ideal Gas. The P_PTComp Instruction uses the Ideal Gas Law ($PV = nRT$) to calculate flow at standard conditions.

Functional Description

The P_PTComp Add-On Instruction is intended as a calculation function only, between other blocks, and no HMI components are provided. If a faceplate and/or alarms are needed, the calculated output from the instruction can be sent to a P_AIn (analog input) Instruction for alarming and display.

The P_PTComp Instruction provides the following capabilities:

- Takes as its primary input either a volumetric flow rate or a differential pressure across a flow element, such as an orifice plate or pitot tube. When a differential pressure is used, the P_PTComp instruction allows configuration of the volumetric flow rate for a given differential pressure.
- Accepts a temperature in common units (Fahrenheit or Celsius degrees) or in absolute units (Rankine degrees or Kelvins).
- Accepts a pressure in common units (PSIG, kPa Gauge, or MPa Gauge) or in absolute units (PSIA, kPa Absolute, MPa Absolute).
- Has user-configurable 'standard' conditions, such as 14.696 PSIA and 60 °F, or 101.325 kPa and 0 °C.
- Determines flow at the specified 'standard' conditions by using the Ideal Gas Law ($PV = nRT$) to adjust from the given temperature and pressure to the 'standard' temperature and pressure.

Required Files

The P_PTComp_3_5-00_AOIL5X Add-On Instruction, must be imported into the controller project to use the instruction in the project. The service release number (boldfaced) can change as service revisions are created.

The import file is available from the Product Compatibility and Download Center at

<http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page>.

There are no visualization files because the P_PTComp object does not have display elements or faceplates.

Controller Code

This section describes the parameters of this Add-On Instruction.

Pressure/Temperature Compensated Flow Input Structure

Input parameters include the following:

- Input data elements (Inp_) are typically used to connect field inputs from I/O modules or signals from other objects.
- Configuration data elements (Cfg_) are used to set configurable capabilities and features of the instruction.

Table 2 - P_PTComp Input Parameters

Input Parameter	Data Type	Alias For	Default	Description
EnableIn	BOOL	None	1	<p>Ladder Diagram: If the rung-in condition is true, the instruction's Logic routine executes. If the rung-in condition is false, the instruction's EnableInFalse routine executes.</p> <p>Function Block Diagram: If true, or not connected, the instruction's Logic routine executes. If the parameter is exposed as a pin and wired, and the pin is false, the instruction's EnableInFalse routine executes.</p> <p>Structured Text: No effect. The instruction's Logic routine executes.</p>
Inp_T_Act	REAL		0.0	Actual (measured) temperature, can be absolute or common units (for example, Fahrenheit or Celsius).
Inp_P_Act	REAL		0.0	Actual (measured) pressure, can be absolute or common units (for example, PSIG).
Inp_DP_Act	REAL		0.0	Actual (measured) differential pressure (for example, "WC).
InP_F_Act	REAL		0.0	Actual (measured) uncompensated flow in volumetric units (for example, CFM).
Cfg_LoFlowCutoff	REAL		0.0	If Out_Flow is less than this cutoff value, it is shown as 0.0.
Cfg_T_Std	REAL		0.0	Standard temperature in Inp_T_Act units (for example, Fahrenheit or Celsius).
Cfg_P_Std	REAL		0.0	Standard pressure in Inp_P_Act units (for example, PSIG).
Cfg_T_Offset	REAL		273.15	'Zero' input-units temperature in absolute units (for example, R or K).
Cfg_P_Offset	REAL		14.696	'Zero' input-units pressure in absolute units (for example, PSIA).
Cfg_DP_Ref	REAL		100.0	Reference (full-scale) differential pressure (for example, "WC).
Cfg_F_Ref	REAL		1.0	Reference flow in volumetric units (for example, CFM) at Reference DP.
Cfg_UseDP	BOOL		0	1 = Use Inp_DP_Act (square root curve) to calculate flow. 0 = Use Inp_F_Act (linear).

Pressure/Temperature Compensated Flow Output Structure

Output parameters include the following:

- Output data elements (Out_) are the primary outputs of the instruction, typically used by hardware output modules; however, they can be used by other application logic.
- Status data elements (Sts_) are bit outputs of the instruction for use by the HMI. Status bits also can be used by other application logic.
- Error data elements (Err_) are bit outputs of the instruction used to indicate the reason for a configuration error.

Table 3 - P_PTComp Output Parameters

Output Parameter	Data Type	Alias For	Description
EnableOut	BOOL	None	Enable Output: The EnableOut signal is not manipulated by this instruction. Its output state always reflects EnableIn Input state.
Out_Flow	REAL		Compensated flow (at standard temperature and pressure: mass flow).
Sts_Err	BOOL		1 = Invalid configuration, see Err_bits.
Err_T_Std	BOOL		1 = Invalid standard temperature (T_Std + T_Offset must be > 0.0).
Err_P_Std	BOOL		1 = Invalid standard pressure (P_Std + P_Offset must be > 0.0).
Err_DP_Ref	BOOL		1 = Invalid reference differential pressure (must be > 0.0 if DP used).
Err_F_Ref	BOOL		1 = Invalid reference flow (at reference DP) (must be > 0.0 if DP used).
P_PTComp	BOOL		Unique parameter name for auto-discovery.

Pressure/Temperature Compensated Flow Local Configuration Tags

Configuration parameters that are arrayed, string, or structure data types cannot be configured as parameters for Add-On Instructions. Configuration parameters of these types appear as local tags to the Add-On Instruction. Local tags can be configured with Studio 5000 Logix Designer® application by opening the Instruction Logic of the Add-On Instruction instance and then opening the Data Monitor on a local tag. These parameters cannot be modified by using controller logic or Logix Designer application export/import functionality.

The P_PTComp instruction does not include visualization elements (global objects or faceplates). However, these local configuration tags for descriptive strings are provided for use in custom visualization elements if desired.

Table 4 - Local Configuration Tags

Tag Name	Data Type	Default	Description
Cfg_Desc	STRING_40	'Pressure/temperature compensated flow'	Description for display on HMI. This string is shown in the title bar of the faceplate.
Cfg_Label	STRING_20	'Flow at standard conditions'	Label for graphic symbol displayed on HMI. This string appears on the graphic symbol.
Cfg_Tag	STRING_20	'P_PTComp'	Tagname for display on HMI. This string is shown in the title bar of the faceplate.

Operations

Modes

The P_PTComp Add-On Instruction performs only calculations and does not have modes or contain a P_Mode instruction instance.

Alarms

The P_PTComp Add-On Instruction does not generate any alarms.

To provide High-High, High, Low, and/or Low-Low threshold alarms for any of the variables (volumetric flow or differential pressure, temperature, pressure or the calculated Flow at Standard Conditions), use a P_AIn Analog Input instruction for each such variable.

Refer to the Process Add-On Instructions and Graphics: Basic Analog Input (P_AIn) Reference Manual, publication [SYSLIB-RM001](#), for more information.

Simulation

The P_PTComp Add-On Instruction does not have simulation capability.

Execution

The following table explains the handling of instruction execution conditions.

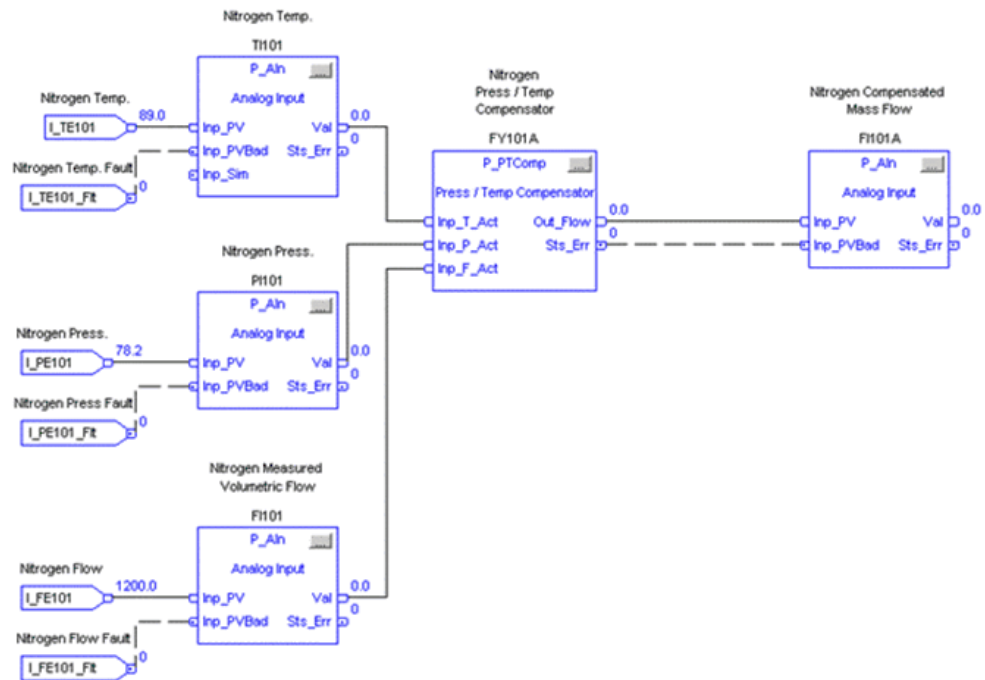
Condition	Description
EnableIn False (false rung)	No EnableInFalse logic is provided. The Instruction maintains its last state when EnableIn is false.
Powerup (prescan, first scan)	No Pre-scan or First Scan logic is provided. The P_PTComp instruction simply performs its calculation every scan when EnableIn is true.
Postscan	No SFC Postscan logic is provided.

Refer to the Logix5000 Controllers Add-On Instructions Programming Manual, publication [1756-PM010](#), for more information.

Programming Example

This example uses the P_PTComp instruction to determine the flow rate of compressed nitrogen at a standard pressure and flow. This can provide a more accurate measurement for custody transfer or control calculations where there is variability in environmental conditions and the flow transmitter is not capable of performing the compensation.

In this case, we have a measurement of flow from a dp-transmitter. The transmitter is providing the controller with a value that has been scaled to volumetric flow but not compensated for environmental temperature and pressure. We also have temperature and pressure measurements from where the flow is measured. In this example, the desired standard pressure and flow is 0 psig and 15 °C.



The measured temperature, pressure, and flow are connected into the P_PTComp instruction to the inputs Inp_T_Act, Inp_P_Act, and Inp_F_Act. In this example, these values are in units of degrees C, psig, and m³/hr.

Set Cfg_T_Std and Cfg_P_Std to 15 and 0, respectively, for the desired standard temperature and pressure. Cfg_T_Offset is left at its default of 273.15 to represent 0 °C in absolute units K (if using Fahrenheit, set this to 459.67 °F). Cfg_P_Offset is left at its default of 14.696 defining the value of 0 psi gauge pressure in absolute pressure. Cfg_UseDP is left at its default of 0, indicating we are using Inp_F_Act as the flow input as the flow transmitter is providing flow in volumetric units.

The output of P_PTComp is then connected to a P_AIn Instruction. The output is a compensated volumetric flow at standard temperature and pressure. The P_AIn could scale this flow to mass flow if desired.

The local configuration tags Cfg_Desc, Cfg_Label, and Cfg_Tag are not required to be set. The P_PTComp instruction does not include visualization elements (global objects or faceplates). However, these string parameters are provided for use in custom visualization elements if desired.

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.

At <http://www.rockwellautomation.com/support> you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at <https://rockwellautomation.custhelp.com/> for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://www.rockwellautomation.com/services/online-phone>.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page , or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication [RA-DU002](#), available at <http://www.rockwellautomation.com/literature/>.

Rockwell Automation maintains current product environmental information on its website at <http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page>.

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