P/N 1223 | REV. L 05/23

NT™ Integrated Flow Controller, Model 6500

User Guide

Entegris

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Introduction

This manual is for use with standard NT™ Integrated Flow Controllers, Model 6500. These instruments have been designed for use in high-purity applications in the semiconductor industry. The wetted parts are constructed with PTFE, PFA or other similar high-purity inert materials.

WARNING! Attempting to install or operate standard NT Integrated Flow Controller, Model 6500 without reviewing the instructions contained in this manual could result in personal injury or equipment damage.

IDENTIFYING NON-STANDARD PRODUCT CONFIGURATIONS

This User's Guide applies to product manufactured as the standard NT Integrated Flow Controller, Model 6500. Entegris also manufactures nonstandard product to meet the needs of specific applications. Non-standard product may have different materials of construction, accuracy specifications, performance and other specifications that differentiate the non-standard product from the standard offering.

NOTE: Nonstandard NT Integrated Flow Controller, Model 6500 may be identified by the model number found on the product label. Specifications for nonstandard NT Integrated Flow Controller, Model 6500 are available by contacting Entegris.

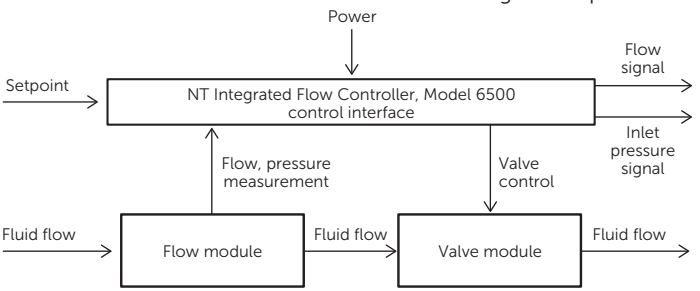
Nonstandard NT Integrated Flow Controllers, Model 6500 product line, are identified with an "**M**" followed by a number code.

Example part number:
6500-T2-F03-B12-A-P7-U3-M02

The "M02" designates the product as a nonstandard product manufactured to certain specifications designated under the "M02" code.

PRINCIPLE OF OPERATION

The user provides a setpoint signal that corresponds to the desired amount of flow. The standard NT Integrated Flow Controller, Model 6500 compares the setpoint to the actual flow signal from the flow module. If the actual flow is greater than the setpoint, the unit closes the valve. If the actual flow is less than the setpoint, the unit opens the valve. The flow controller does this in a precise manner until the actual flow signal is equal to the setpoint.



FACTORY CONFIGURED

The standard NT Integrated Flow Controller, Model 6500 is pre-configured from the factory for the flow range specified by the user. The specified flow range is found on the label of the unit. The unit control algorithm uses pressure and flow measurements to ensure proper operation within specification.

CONTINUOUS VERSUS BATCH CONTROL

The standard NT Integrated Flow Controller, Model 6500 may be ordered as a continuous type controller or a batch type controller. Refer to page 25 for part number information.

The continuous controller type is for applications requiring continuous flow rate control, where the valve module is never required to fully close.

The batch controller type is for applications that require the valve module to fully close between batch dispense cycles. The batch controller will form a leak-tight seal from 414 kPa (0 to 60 psig) inlet pressure.

SUSPEND CONTROL FEATURE

CONTINUOUS controller type only:
The unit functions will be suspended when the setpoint is below 5% of the full scale range. The unit valve position is locked when the control is suspended. Locking the valve position allows the unit to reach the desired flow faster when the setpoint is reactivated.

Controller type	CONTINUOUS	BATCH
Input type	A (4–20 mA)	K (4–20 mA)
	B (0–10 VDC)	L (0–10 VDC)
	C (0–5 VDC)	M (0–5 VDC)

General Considerations

NOTE: The flow controller has been factory sealed. Do not attempt to remove the cover of the unit. Any attempt at removal of the unit cover will void the warranty.

LINE PRESSURE

The system line pressure (measured at the inlet of the unit) must be between 69 to 414 kPa (10 to 60 psig). The minimum operating pressure is 69 kPa (10 psig).

PRESSURE DROP

The minimum operating pressure is 69 kPa (10 psig). The minimum pressure drop (differential pressure) required for the unit is 69 kPa (10 psid).

For example, if the flow controller is operating at an inlet pressure of 103 kPa (15 psig) and outputs the flow to a pressurized canister, which is pressurized to 69 kPa (10 psig), the pressure available to the unit will be 5 psid (103 kPa [15 psig] inlet pressure minus 69 kPa [10 psig] canister pressure). This scenario does **not** meet the pressure drop requirement of 69 kPa (10 psid) and the unit may not perform within specification. For this example, either increase the inlet pressure or decrease the canister pressure to obtain a 69 kPa (10 psid) pressure drop.

POWER SUPPLY REQUIREMENTS

The power supply range for the standard NT Integrated Flow Controller, Model 6500 is 24 VDC ±10%.

The power supply to the flow controller must provide *clean* power to the unit and must be used only to power similar measurement-type devices. The power supply must not be used to power other inductive loads, such as motors, relays or solenoids. These devices may produce electrical transients that may affect unit measurements. An induced power spike, creating an interruption in power greater than 10 msec in duration, may cause the unit to reset.

In addition to providing clean power, the instrumentation signals and power return lines must not be run within the same conduit or cable along with heavy current demands from motors, charging capacitors or other inductive loads. This may cause a voltage change within the instrumentation signal line, causing erroneous output readings from the flow controller. Loss of power will not cause the loss of any system parameters or calibration values.

Supply Current

The power supply must provide continuous 1.0 ADC service for each flow controller installed.

Input Impedance of the Voltage Setpoint

The input impedance of the voltage setpoint is 20 kOhm.

Voltage Drop at the 4–20 mA Setpoint Input

The 4–20 mA input will drop 2.5 volts at 20 mA. Input impedance is 125 ohms.

Lift-off Voltage of the 4–20 mA Output Loops

The minimum lift-off voltage of the 4–20 mA output loops (flow, pressure measurements) is 12 VDC. The minimum lift-off voltage is the voltage required at the unit for proper operation. The maximum load resistance for a 24 VDC supply is 600 ohms and includes the resistance of measurement devices and the interconnecting cable.

Output Load Resistance Effects

Using a 24 VDC power supply, the two 4–20 mA output loops (flow and pressure) will experience no shift if the load resistance is 0–600 ohms.

Reverse Polarity Protection

The flow controller is reverse polarity protected; connecting the 24 VDC power to the incorrect positive and ground wires will not harm the unit. To operate properly, the polarity must be correct.

Over-Voltage on any Wire (DC)

The flow controller will withstand the continuous application of 30 VDC on any wire without compromising the unit.

Over-Voltage on any Wire (AC)

The flow controller is **not** designed to withstand the accidental application 110/220 VAC to any wire. Application of AC voltage will damage the unit.

Short Protection

The flow controller will not be damaged or compromised in any way if any combination of wires are shorted together.

Circuit Protection

Fuse the three input power lines to each individual NT Integrated Flow Controller, Model 6500. The three lines are:

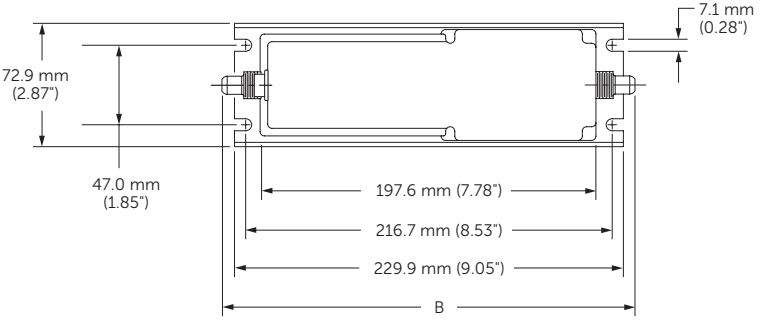
- 2-Red/Pin R, +24 VDC (main power, 1.0 Amp nominal)
- 3-Orange/Pin M, Flow output, +24 VDC supply
- 4-Yellow/Pin T, Pressure output, +24 VDC supply

Use a 2 Amp rated, time lag fuse. A single fuse can be used for all three input power lines combined, or individually, as preferred. Place the fusing on the input power lines to the unit at the equipment electrical enclosure to ensure that both the wiring to the unit and the unit itself are protected from any over-current condition. Best practice is to locate the fuse away from the typical liquid exposure or harmful vapor areas. Locating it within the electrical enclosure shared by the power supply enables accessibility for troubleshooting or replacement.

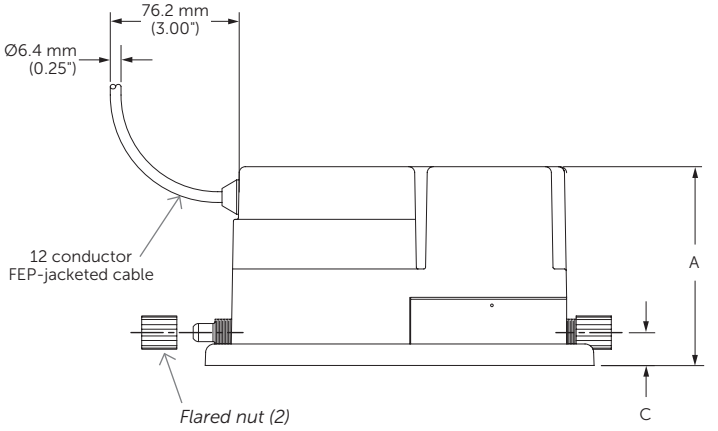
NOTE: Do not power down the unit until the homing cycle is complete.

DIMENSIONS

Top View



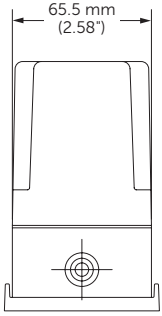
Side View (Pigtail Electrical Cable Shown)



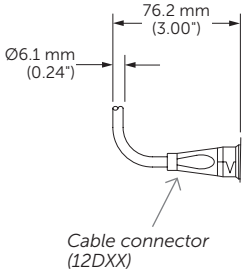
FITTING	A	B	C
¼" F02	123.4 mm (4.86")	244.1 mm (9.61")	19.6 mm (0.77")
⅜" F03	123.4 mm (4.86")	247.7 mm (9.75")	19.6 mm (0.77")
½" F04	127.0 mm (5.00")	251.7 mm (9.91")	21.6 mm (0.85")
¾" F06	134.9 mm (5.31")	257.8 mm (10.15")	25.7 mm (1.01")

DIMENSIONS (CONTINUED)

End View

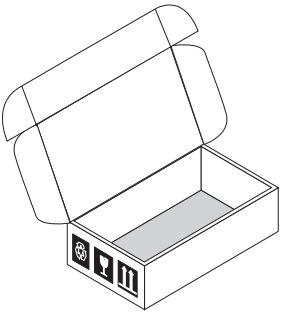


D-series Electrical Connector

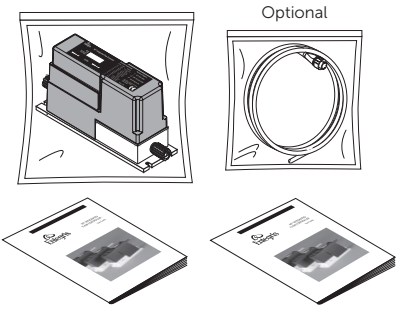


Installation

PROVIDED EQUIPMENT

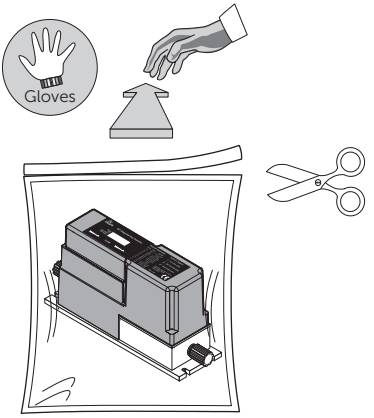


NOTE: This unit has been assembled and double-bagged under cleanroom conditions. To maintain purity, only open under cleanroom conditions.



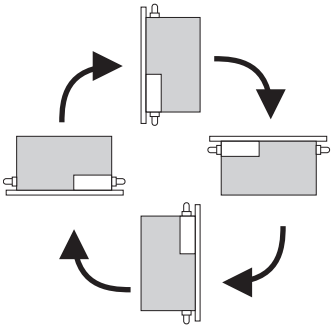
CAUTION!
Do not tighten the nuts that protect the flared tube connections during shipment. (See Prepare Fluid Lines on page 10). Tightening these nuts without the proper tubing installed may damage the unit's flared tube onnections.

Remove Unit from the Bag



MOUNTING REQUIREMENTS

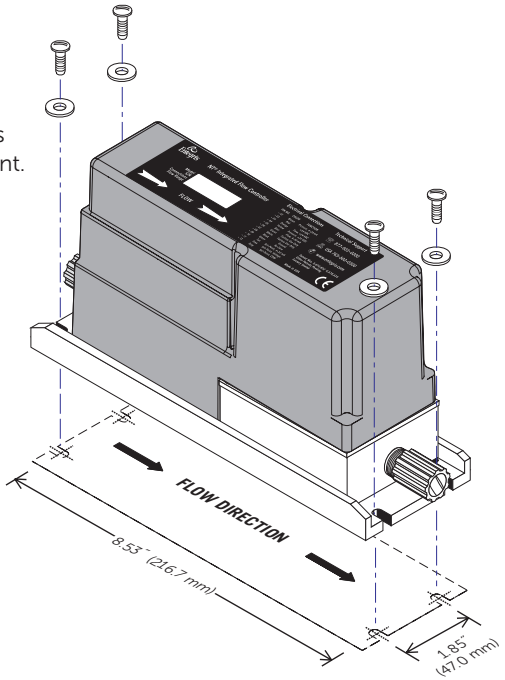
The flow controller may be mounted in any orientation. The unit does not require straight lengths of tubing at the inlet or the outlet connection.



Mount the Unit

The flow controller and base bracket assembly must be mounted to a solid surface to ensure stability. Verify the valve and the electrical cable are free from mechanical stress from the surrounding equipment.

NOTE: The flow controller requires mounting in the direction of the fluid flow.



Recommended Hardware

#10 (M4)
Pan head

#10 (M4)
Flat washer

MECHANICAL INSTALLATION

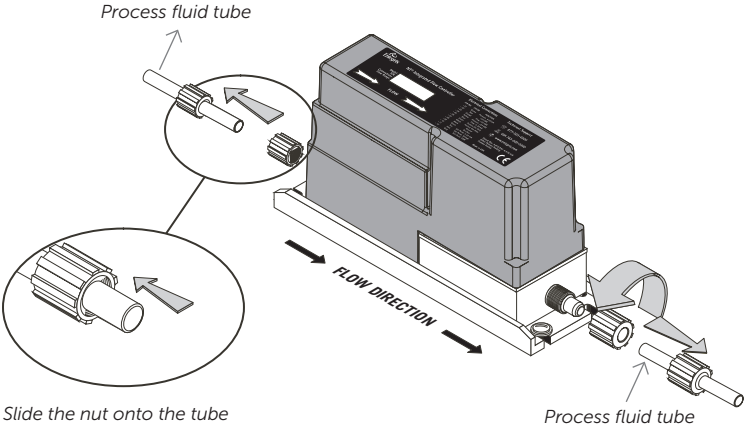
The standard NT Integrated Flow Controller, Model 6500 must be used with the proper tubing size and fittings.

To prepare the fluid lines, begin by sliding the supplied nuts onto the fluid tube.

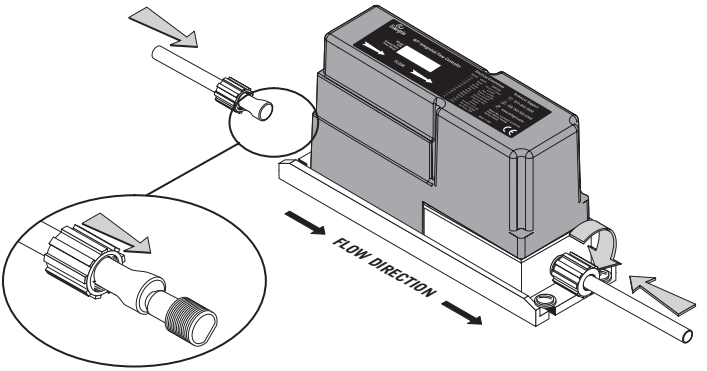
CAUTION! Overtightening of the nuts will result in damage to the fitting.

NOTE: Flare each tube end prior to installation onto the valve fitting.

Prepare Fluid Lines



Connect Fluid Lines



When installing flared tubing to the flow controller, the flared tube is pushed over the valve's fitting until the fitting reaches the smaller tube diameter. The amount of torque required to tighten the nut is dependent upon the size of the fitting.

FITTING SIZE	¼"	⅜"	½"	¾"
Torque (in•lbs)	5	8	11	14
Torque (N•m)	0.56	0.90	1.24	1.58

Care should be taken when installing the flow controller to avoid fluid leaks. Do not use excessive torque or subject the unit to high heat during installation. The unit and base bracket assembly must be mounted to a solid surface to ensure stability. Verify the body and the electrical cable are free from mechanical stress from the surrounding equipment.

PROPER INSTALLATION AND OPERATION WITH ON/OFF VALVES

The NT Integrated Flow Controller, Model 6500 often is installed between upstream and/or downstream on/off valves. However, precautions must be taken during the re-zero function to ensure proper operation of the flow controller with the on/off valves.

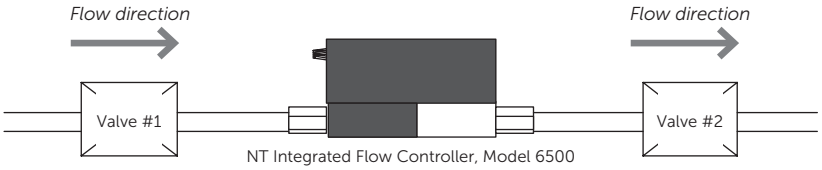
The valve module in the flow controller will close under two conditions:

1. Manual re-zero using the green wire (see the *Maintenance Section* on p. 22).
2. When zero flow is requested while using a BATCH unit.

If the flow controller closes while either the upstream or downstream valve is closed, this will cause pressure to increase above 414 kPa (60 psig) due to compression of the volume of "trapped" fluid in the flow controller. The subsequent pressure increase inside the flow controller can lead to inaccurate re-zeroing, and possible unit damage. Thus, the NT Integrated Flow Controller, Model 6500 should **NEVER** be closed when an upstream on/off valve is closed.

To address this issue, one possible solution is to keep the on/off valves upstream and downstream of the flow controller open at all times. If this is not possible, the flow controller should be closed first, allowing adequate time before either the upstream or downstream valves are closed.

Installation and Operation Example with Two On/Off Valves



ELECTRICAL CONNECTIONS

Pigtail Electrical Cable

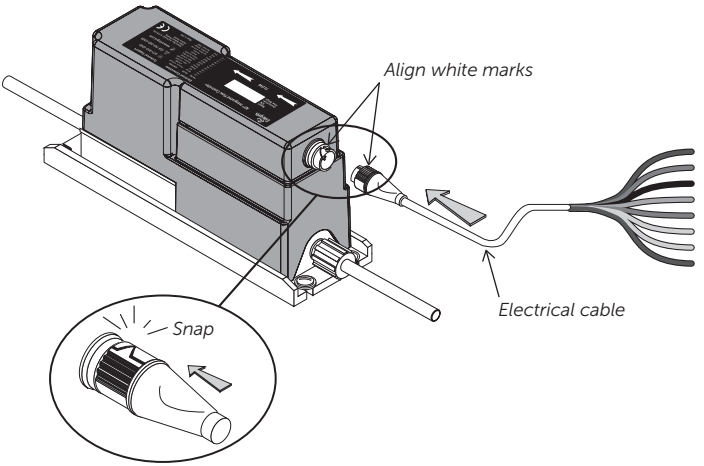
Units specified with a **Pigtail** electrical connection are manufactured with a permanently attached FEP-jacketed cable.

D-Series Electrical Connector

The connector and mounting receptacle of the **D-series** connector are constructed of polypropylene. The connector is over-molded onto an electrically shielded, PVC-jacketed cable. The mounting receptacle uses a Viton® gasket seal at the mounting panel. The pin contacts for the electrical connection are gold plated for performance and corrosion resistance.

Connect D-series Electrical Cable to Unit

The **D-series** electrical connector is physically "keyed" in two locations, making it impossible to insert the connector improperly. White markings are also printed onto the connector to visually align the connector into the correct position. Pressing it into the mounting receptacle locks the connector in place. To remove the connector, rotate the coupling ring in the direction of the printed white arrow.



WIRE CONNECTIONS

The following Pin Diagram details the wire connections for the flow controller electrical cable:

Plug Orientation

Front View

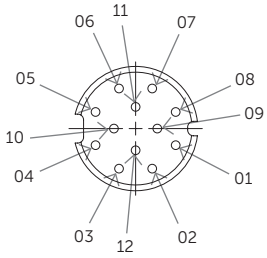


Table: Pin DIAGRAM

PIN NO.	COLOR	FUNCTION
01	Brown	Pressure, 4–20 mA
02	Red	+24 VDC
03	Orange	Flow, +24 VDC
04	Yellow	Pressure, +24 VDC
05	Blue	Flow, 4–20 mA
06	Violet	Factory Use Only
07	White	Factory Use Only
08	Black	Ground
09	Green	Re-zero
10	Tan	Setpoint, 4–20 mA
11	Pink	Setpoint, Voltage
12	Gray	Setpoint, Com

Mandatory Connections

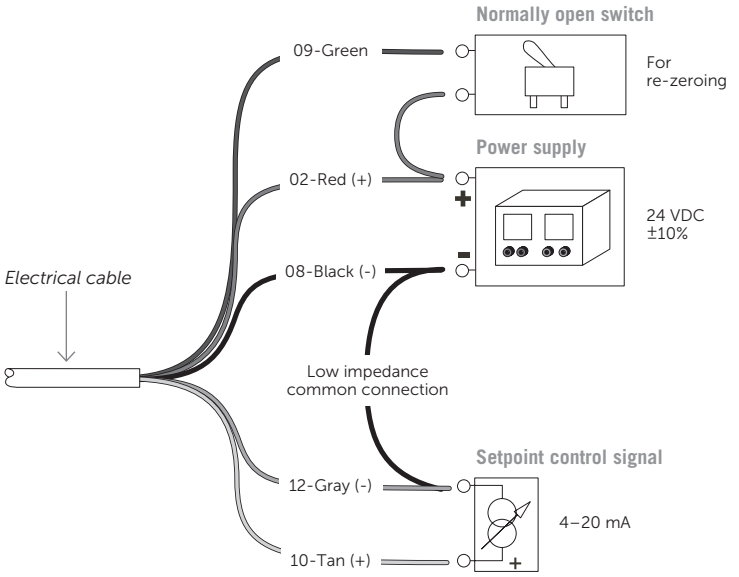
Pin 02 (red) and pin 08 (black) must be connected according to the Pin Diagram Table. The setpoint must also be connected, pin 10 (tan, 4–20 mA setpoint) and pin 12 (gray, com setpoint); or to pins 11 (pink, voltage setpoint) and 12 (gray, com setpoint). **To ensure proper operation, there must be a low impedance connection between pin 08 (black, ground) and pin 12 (gray, Com setpoint).** Further, if the setpoint input is 4–20 mA, the setpoint control signal must be from a source type, not a sink type. Consult Entegris with any questions about electrical installation. See the *Wiring Diagram* on page 14.

To perform a **periodic re-zero**, connect pin 09 (green) as indicated in the *Wiring Diagram* on page 14. **DO NOT CONNECT CONTINUOUS VOLTAGE** to this pin. If continuous is applied, the flow controller valve will remain in a closed position. Only apply voltage when the re-zero function is required.

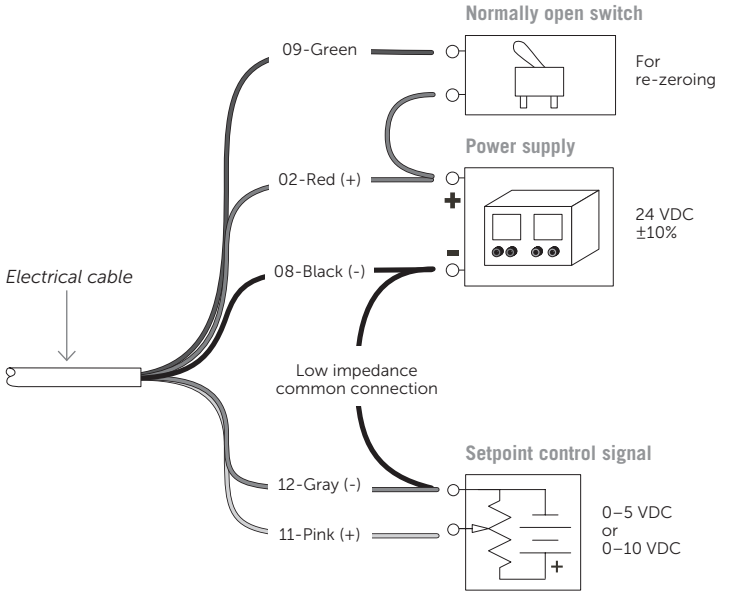
Unused Connections

Pin 06 (violet) and pin 07 (white) are for factory use only. Do not connect to power supply or ground. These wires must remain disconnected.

WIRING DIAGRAM



OR

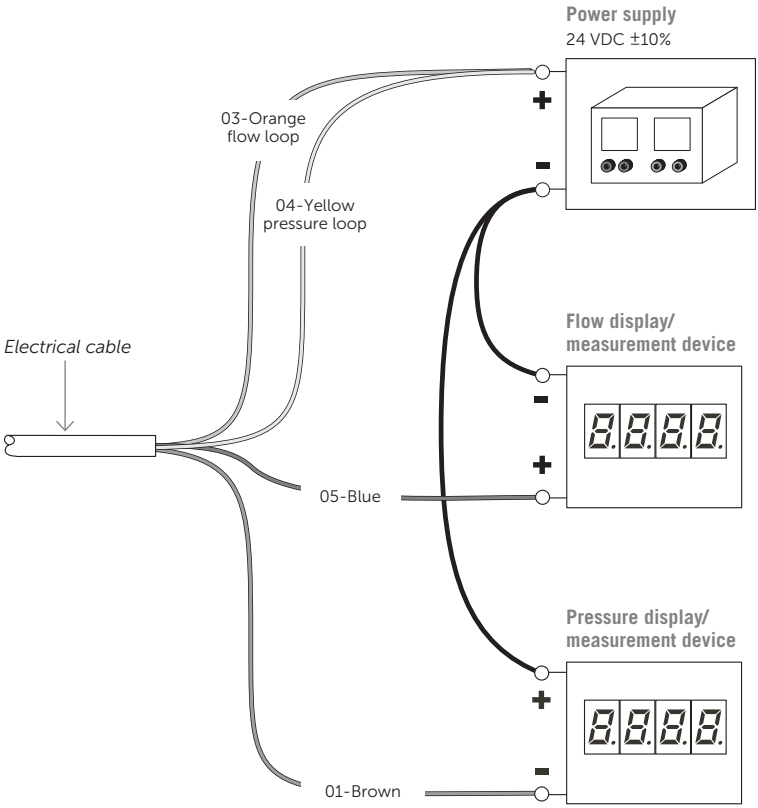


OPTIONAL CONNECTIONS

To **monitor flow rate**, apply +24 VDC to pin 03 (orange) and measure the 4–20 mA flow output signal from pin 05 (blue).

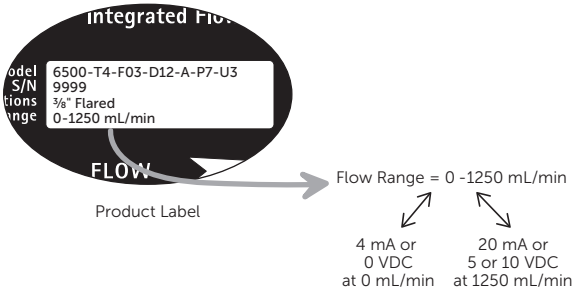
To **monitor inlet pressure**, apply 24 VDC to pin 04 (yellow) and measure the 4–20 mA pressure output signal from pin 01 (brown).

The outputs are optically isolated. Using a separate power supply is possible.



SETPOINT SIGNAL SETUP

Use the following formulas to adjust your setpoint signal output device to match the flow range of the unit. Repeat the calculations for multiple control points.



Formulas and Example Calculations

F = Desired flow (mL/min / L/min) FS = Full scale flow (mL/min / L/min) Span = Range of the output signal

4–20 mA Setpoint Control Signal

$$\text{Setpoint}_{mA} = \frac{F \times \text{Span}}{FS} + 4\ mA$$

Range of Product = *0-1250 mL/min*
F = *125 mL/min*
Span = *20 mA - 4 mA = 16 mA*
FS = *1250 mL/min*

$$\text{Setpoint}_{mA} = \frac{(125\ mL/min) \times (16\ mA)}{(1250\ mL/min)} + 4\ mA$$

$$\text{Setpoint}_{mA} = 5.6\ mA$$

0–5 VDC or 0–10 VDC Setpoint Control Signal

$$\text{Setpoint}_{VDC} = \frac{F \times \text{Span}}{FS}$$

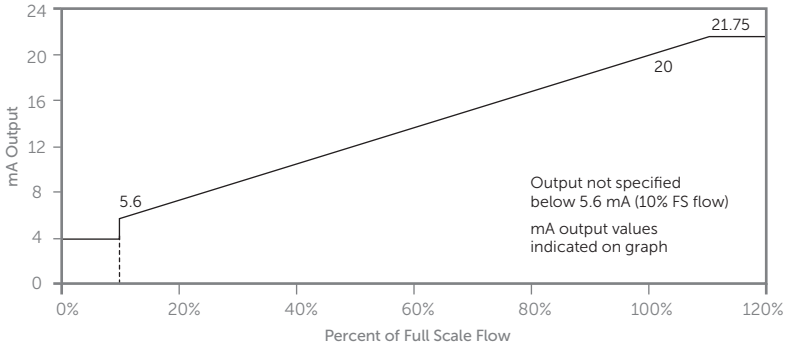
Range of Product = *0-1250 mL/min*
F = *500 mL/min*
Span = *10 VDC - 0 VDC = 10 VDC*
FS = *1250 mL/min*

$$\text{Setpoint}_{VDC} = \frac{(500\ mL/min) \times (10\ VDC)}{(1250\ mL/min)}$$

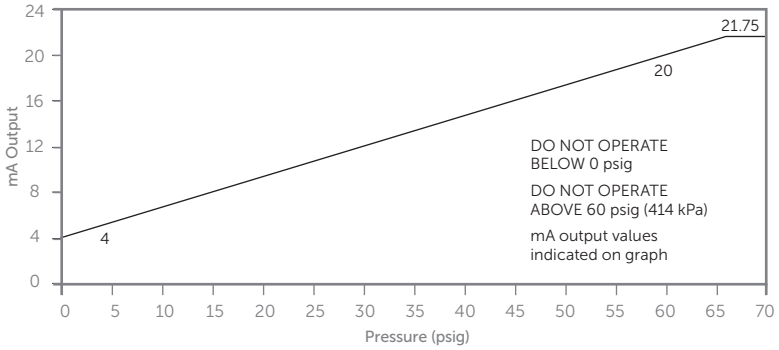
$$\text{Setpoint}_{VDC} = 4.0\ VDC$$

CALIBRATION GRAPHS

mA Output vs. Full Scale Flow



mA Output vs. Pressure



NOTE: Specifications are subject to change without notice. Please consult Entegris for the most current information.

Unit Operation

OPERATING ENVIRONMENT

Operating Temperature

The flow controller is designed to operate in ambient temperature, cleanroom environments. The unit is specified to operate at temperatures between 10° and 65°C (50° and 149°F). PFA sensor isolators are recommended for process temperatures above 40°C (104°F). Contact Entegris for recommended materials of construction for applications involving hydrofluoric acid (HF) with temperatures above 30°C (86°F).

When the process fluid is above ambient temperatures 23°C (73°F), the system will experience slight accuracy errors due to instrument warm-up and changes in viscosity and specific gravity of the liquid. The unit **must** be re-zeroed after any temperature change. Please see the *Maintenance Section* on page 22 to perform the re-zero.

Effects of Fluid Viscosity and Specific Gravity

The flow controller has been factory calibrated using deionized water. Fluids with viscosities and/or specific gravity different from the calibration fluid (water) will cause slight accuracy errors. Correction factors for viscosity and specific gravity changes may be obtained from Entegris by calling or following the process monitoring product links at *www.entegris.com.*

Storage Temperature

The flow controller will withstand storage temperatures between -15° and 40°C (5° and 104°F) with no permanent effect on the performance of the device.

Unit Enclosure

The standard NT Integrated Flow Controller, Model 6500 cover is factory sealed and should not be tampered with or opened. Spray-down or temporary immersion will not compromise the performance of the unit.

NOTE: Any attempt to remove, tamper or open the flow controller cover will void the warranty.

PERFORMANCE

Operating Pressure Requirements

The flow rate is calculated using Entegris' differential pressure flow technology. The minimum operating pressure is 69 kPa (10 psig). The minimum pressure drop (differential pressure) required for the flow controller is 69 kPa (10 psid).

⚠ **CAUTION! The flow controller may be damaged if it is subjected to any level of vacuum pressure (less than atmospheric pressure).**

NOTE: To perform within specification, the available inlet pressure must be 69 kPa (10 psid) greater than the outlet pressure (69 kPa [10 psid] differential pressure).

Flow Accuracy

The accuracy of the analog flow measurement is ±1% of full scale from 20–100% of the full scale flow range. The accuracy of the analog flow measurement is ±2.5% of full scale from 10–20% of the flow range. The accuracy specification includes the effects of linearity, hysteresis and repeatability, using deionized water at 23°C (73°F). The accuracy between 0–10% of full scale flow range is not specified.

Flow accuracy is verified by testing the unit at stable conditions for a period of 20 seconds or longer using deionized water at 23°C (73°F).

Response Time

Response time is defined as the length of time required for the measured flow rate to be within the full scale (FS) accuracy specification. The typical response time is within 3 seconds from 10% to 95% SP.

The flow controller will respond to setpoint changes within 50 msec of receiving the new setpoint value.

Suspend Control Feature

CONTINUOUS controller type only:

The flow controller functions will be suspended when the setpoint is below 5% of the full scale (FS) range. The unit valve position is locked when the control is suspended. Locking the valve position allows the unit to reach the desired flow faster when the setpoint is reactivated.

Pressure Accuracy

The accuracy of the analog pressure output is ±1% of full scale. These calculations include the effects of linearity, hysteresis and repeatability, measured at 23°C (73°F).

Minimum Operating Pressure

The unit will operate within specification at any inlet pressure within the range of 69 to 414 kPa (10-60 psig) and a minimum pressure drop of 69 kPa (10 psid).

Diagnostic Guide

SYMPTOM	POSSIBLE CAUSES	SUGGESTIONS
1. Flow output reads 4 mA when fluid flow is present.	The unit is installed backwards.	Install the unit so the inlet flow is plumbed on the same side as the electrical connection and flow is in the direction of the arrow.
	Insufficient line pressure/insufficient pressure drop.	Verify the inlet pressure is adequate as described in the Minimum Operating Pressure on page 19. Verify the pressure drop meets the requirements according to the Minimum Operating Pressure on page 19.
	The unit needs to be re-zeroed.	Perform the re-zeroing procedure.
2. Flow output reads above 4 mA when there is zero flow.	The unit needs to be re-zeroed.	Perform the re-zeroing procedure.
3. Flow output does not change with changing flow.	The pressure output is being monitored instead of the flow output.	Check the wiring to ensure the flow output is wired correctly.
4. Current output is extremely high (>25 mA).	The incorrect wires are connected to the flow monitoring device.	Confirm wiring. Wire functions are printed on the unit label.
	The 4–20 mA flow signal is shorted to power (+24 V).	Examine all electrical connections. Please note, if wires are stripped back too far before insertion in a terminal block, they may cross and short together.
5. Flow output is extremely noisy (spiking above and below 20 and 4 mA).	The actual fluid flow conditions are noisy.	Flow turbulence may be caused by "noisy" pumps used in a system. Examples of noisy pumps are diaphragm pumps without pulsation dampeners and peristaltic pumps operating at low flow rates. Please contact Entegris for additional information.
	The supply power (+24 V) is noisy.	If the power supply is shared with other systems, components such as solenoids, DC motors, valves, etc., the unit may be receiving "dirty" power. The noise spikes on the power supply will cause the unit output to be noisy or cause the unit to enter a reset mode.
6. Flow output does not correspond to setpoint for high flow rates.	Insufficient line pressure/insufficient pressure drop.	Verify the inlet pressure is adequate as described in the Minimum Operating Pressure on page 19. Verify the pressure drop meets the requirements according to the Minimum Operating Pressure on page 19.
	Viscosity and specific gravity offsets.	Correct for viscosity and specific gravity.

Diagnostic Guide (continued)

SYMPTOM	POSSIBLE CAUSES	SUGGESTIONS
7. Flow rate is not meeting desired setpoint within 10 seconds or longer.	The unit is receiving a setpoint signal with no fluid flow present. The unit valve is moved to the full-open position. Depending upon flow range, the unit may require 10-15 seconds or more to move from the full-open position to the correct setpoint position.	Do not send a setpoint signal to the unit when no fluid flow is available. (see Symptom 6).
	Insufficient line pressure/insufficient pressure drop.	Verify the inlet pressure is adequate as described in the Minimum Operating Pressure on page 19. Verify the pressure drop meets the requirements according to the Minimum Operating Pressure on page 19.
8. Flow output is not responsive to changes in setpoint signal.	Incorrect wiring of setpoint signal.	Review Wiring Diagram on page 14. Ensure the ground connections are connected properly. The setpoint common and power common must be connected via a low impedance connection (short). Confirm the presence of the setpoint signal. Confirm the unit is configured for the proper setpoint signal (i.e., 4–20 mA, 0–5 VDC, 0–10 VDC) by reading part number on the label.
	Valve in full open position. If the unit is plumbed between two closed valves, the unit may stall in the full open position when the unit is commanded to close. Since a fixed volume of fluid is incompressible, the unit may stall when attempting to close if upstream and downstream valves are closed.	Avoid conditions of simultaneously closed valves upstream and downstream of the unit. The unit can be returned to normal operation by performing a re-zero or by cycling power.
9. Unit not responding to a setpoint.	24 VDC is continuously applied to 9-Green re-zero input line.	Re-zero input line should only be energized when re-zero is needed.
10. Unit opens (port-to-port leak) when power is turned off.	Line pressure can push the motorized valve open.	Keep power applied to unit. Do not pressurize unit while powered off.

Maintenance

NORMAL OPERATION

During normal operation, the standard NT Integrated Flow Controller, Model 6500 requires no maintenance, other than a periodic re-zero of the unit.

RE-ZERO PROCEDURE

The no flow calibration of the flow controller can be re-zeroed, meaning that the flow output that corresponds to zero flow may be reset.

NOTE: When executing the re-zero function, there must be at least 7 to 414 kPa (1 to 60 psig) of static pressure. Best results when re-zero is performed at the operating pressure.

NOTE: The following procedure must be followed precisely to ensure proper flow controller re-zero.

1. The unit re-zero function requires the same power supply of 24 VDC (±10%) as is used to power the unit.
2. Using the pressure signal of the unit, verify that there is **AT LEAST** 7 kPa (1 psig) of **stable** static line pressure.
3. Apply 24 VDC (±10%) to the green electrical wire for a minimum of one (1) second. The power for re-zero needs to have the same ground as the power going to the flow controller red and black wires.

In most applications, the re-zero procedure may be automated using switches, a PLC or other logic controller devices.

When the re-zero function is activated, the flow controller valve module will close fully to ensure that fluid is not flowing. The unit will verify the no-flow condition, and then re-zero the flow module. The entire re-zero function is completed in ten (10) seconds.

In order to obtain best performance, the re-zero function should be performed, at minimum if possible, every day of service when operating at ambient temperature conditions. The re-zero function should be performed more often if operating at higher temperature. It is also recommended to perform a re-zero after start-up and after fluid temperature changes of greater than 5°C (41°F). Best performance will be achieved by re-zeroing between each dispense cycle.

Automatic Re-zero (Auto-zero)

For flow controllers configured as batch controllers, the re-zero function is automatic. Batch controllers will automatically re-zero when the setpoint is below 5% of full scale for six (6) seconds or longer. If the setpoint is below 5% of full scale for less than six seconds the system will not perform the re-zero. Of course units configured in batch mode may be manually re-zeroed (as discussed above) at any time.

Auto-zero applies to the flow module only. The manual re-zero will zero the flow module and valve position.

PROPER INSTALLATION AND OPERATION WITH ON/OFF VALVES

The NT Integrated Flow Controller, Model 6500 often is installed between upstream and/or downstream on/off valves. However, precautions must be taken during the re-zero function to ensure proper operation of the flow controller with the on/off valves.

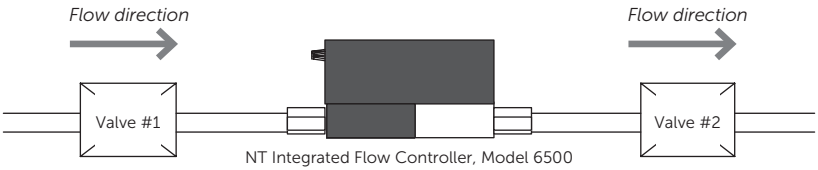
The valve module in the flow controller will close under two conditions:

1. Manual re-zero using the green wire (see the *Maintenance Section* on p. 22).
2. When zero flow is requested while using a BATCH unit.

If the flow controller closes while both the upstream and downstream valves are closed, this will cause pressure to increase above 414 kPa (60 psig) due to compression of the volume of "trapped" fluid in the flow controller. The subsequent pressure increase inside the flow controller can lead to inaccurate re-zeroing, and possible unit damage. Thus, the NT Integrated Flow Controller, Model 6500 should **NEVER** be closed when an upstream on/off valve is closed.

To address this issue, one possible solution is to keep the on/off valves upstream and downstream of the flow controller open at all times. If this is not possible, the flow controller should be closed first, allowing adequate time before the upstream valves are closed.

Installation and Operation Example with Two On/Off Valves



Reference

Physical specifications

PART		CONSTRUCTION MATERIALS
Wetted parts	Body	PTFE
	Diaphragms	PTFE
	Sensor interface	PFA or CTFE
	O-rings	Perfrez® PXC Ultra
Non-wetted parts		Polypropylene, FEP, PVDF, and Viton (in addition to the materials listed above)
Connection type		Flaretek® tube fitting
Enclosure		IP54

Electrical specifications

Input voltage	24 VDC, ±10%
Input current	1.0 A nominal
Impedance of setpoint input (voltage)	20 kOhm
Voltage drop, current setpoint input	<2.5 Volts at 20 mA
Electrical output	Two 4-20 mA current loops
Lift-off voltage for current loops	12 VDC
Load effect on 4–20 mA outputs	RLoad 0–600 ohms, no effect
Electrical connection	Pigtail connector: 12′ FEP-jacketed cable 12 Pin connector (without mating cable) 12 Pin connector: 12′, 30′ PVC-jacketed cable

Performance specifications

Flow accuracy	±1.0% FS at 20% to 100% of full scale, ±2.5% at 10–20% of full scale Accuracy defined for 20 seconds average, using DI water at 23°C (73.4°F) Accuracy not specified 0% to 10% of full scale
Pressure accuracy	±1.0% FS (full scale is 414 kPa [60 psig] – includes the combined effects of linearity, hysteresis and repeatability)
Repeatability	±0.5% FS at 20% to 100% of full scale ±1.0% FS at 10% to 20% of full scale
Pressure measurement range	0–414 kPa (0–60 psig)
Response time	<3 seconds from 10–95% of full scale flow range
Process temperature	10° to 65°C (50° to 149°F)
Storage temperature	-40° to 65°C (-40° to 149°F)
Operating pressure	69–414 kPa (10–60 psig)
Over-pressure limit	690 kPa (100 psig)

Note: Specifications are subject to change without notice. Please consult Entegris for the most current information.

Ordering Information

The part number represents the configuration. For example, part number 6500-T2-F02-D12-A-P7-U3 represents the following configuration:

- NT Integrated Flow Controller, Model 6500
- Flow range of 0–250 mL/min
- ¼" Flaretek tube fitting
- PVC-jacketed 12' electrical cable
- 4–20 mA setpoint input
- CTFE sensor interfaces
- Perfrez PXC Ultra/Viton for primary/secondary seal

The flow controller is available in the following fitting size and flow range combinations:

PART NUMBER	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9
¼" F02	Yes	Yes	Yes	Yes	Yes	—	—	—	—	—
⅜" F03	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—	—
½" F04	—	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
¾" F06	—	—	—	—	—	—	—	Yes	Yes	Yes

Ordering Information (continued)

NT Integrated Flow Controller, Model 6500: part number

6500–___–____–_____–_–_–___–U3

Primary/secondary seal
U3 = Perfrez PXC Ultra/Viton

Sensor interface
P7 = CTFE (for acid, bases and oxidants, typically)
P8 = PFA (for solvents and temperatures >40°C [104°F], typically)*

Setpoint input signal, controller type
A = 4–20 mA, continuous
B = 0–10 VDC, continuous
K = 4–20 mA, batch
L = 0–10 VDC, batch
M = 0–5 VDC, batch

Electrical connector type
B12 = FEP-jacketed 12' pigtail electrical cable
D00 = Polypropylene connector (cable not included)
D12 = Polypropylene connector and 12' PVC cable
D30 = Polypropylene connector and 30' PVC cable

Inlet/outlet port connection
F02 = ¼" Flaretek tube fitting
F03 = ⅜" Flaretek tube fitting
F04 = ½" Flaretek tube fitting
F06 = ¾" Flaretek tube fitting

Flow range**

T0 = 0–50 mL/min	T5 = 0–2.5 L/min
T1 = 0–125 mL/min	T6 = 0–5 L/min
T2 = 0–250 mL/min	T7 = 0–10 L/min
T3 = 0–500 mL/min	T8 = 0–20 L/min
T4 = 0–1250 mL/min	T9 = 0–40 L/min

**Selection is dependent on application and chemical media. Please contact Entegris for best selection.*

***Flow ranges are scaled to zero flow, measurement is from 10 to 100% of full scale flow range.*

Product specified with a flared tube connection is packaged with two PVDF nuts. For alternative nut materials, or custom configurations and specifications, please contact Entegris.

(Note: Specifications are subject to change without notice. Please consult Entegris for the most current information.)

Certifications

CE COMPLIANCE

CE Entegris products are designed and tested to meet the most current CE requirements. Please visit www.entegris.com for the most current information.

REPAIR AND WARRANTY SERVICE

Repair and warranty service is available at the Entegris factory. To expedite the return and repair of the product, contact Entegris at +1 800 394 4084. A Return Materials Authorization (RMA) number, MSDS requirements and a product packaging and return procedure will be provided at that time.

If the product being returned was exposed to a hazardous substance, a copy of the Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned product.

⚠ **WARNING! Mishandling products exposed to a hazardous substance may result in death or serious injury.**

TECHNICAL SUPPORT

For technical support, contact Entegris at +1 800 394 4084. Please have the complete model number, chemical and application information ready when calling.

Notes

Notes

FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit entegris.com and select the Contact Us link to find the customer service center nearest you.

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