

InVue® Integrated Flow Controllers, Models NT6510, NT6520

User Guide




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Introduction

This manual is for use with a standard InVue® Integrated Flow Controller, Models NT6510 and NT6520. These instruments have been designed for use in high-purity fluid applications within industries that need tightly controlled chemical processes such as the semiconductor, biomedical, and solar cell industries. The wetted parts are constructed with Modified PTFE, PTFE, PFA, or other similar high-purity inert materials.

 **WARNING! Attempting to install or operate InVue Integrated Flow Controllers without reviewing the instructions contained in this manual could result in personal injury or equipment damage.**

IDENTIFYING NONSTANDARD PRODUCT CONFIGURATIONS

This User Guide applies to product manufactured as the standard InVue Integrated Flow Controller. Entegris also manufactures nonstandard product to meet the needs of specific applications. Nonstandard product may have different materials of construction, accuracy specifications, performance, and other specifications that differentiate the nonstandard product from the standard offering.

NOTE: Nonstandard InVue Integrated Flow Controllers may be identified by the model number found on the product label. Specifications for non-standard InVue Integrated Flow Controllers are available by contacting Entegris.

Nonstandard InVue Integrated Flow Controllers, Model NT6510, are identified with an "N" followed by a number code.

For example, in part number 6510-T2-F03-B06-A-P7-U3-N02, the "N02" designates the product as a nonstandard product manufactured to certain specifications designated under the "N02" code.

Nonstandard InVue Integrated Flow Controllers, Model NT6520, are identified with an "R" followed by a number code.

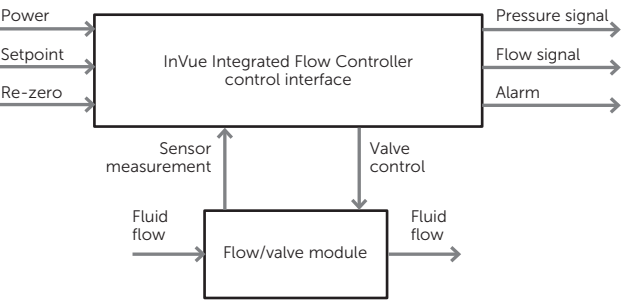
For example, in part number 6520-T6-F03-B06-A-P7-U3-R02, the "R02" designates the product as a nonstandard product manufactured to certain specifications designated under the "R02" code.

Contact Entegris for assistance with nonstandard product applications.

PRINCIPLE OF OPERATION

The user provides a setpoint signal that corresponds to the desired amount of flow. The InVue Integrated Flow Controller 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.

InVue Integrated Flow Controller System Diagram



FACTORY CONFIGURED

The InVue Integrated Flow Controller 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 InVue Integrated Flow Controller may be ordered as a continuous type controller or a batch type controller.

The continuous controller type is for applications requiring continuous flow (trickle flow), where the integral valve module is never required to fully close. Typically, another valve is used in conjunction with the flow controller to stop the liquid flow.

The batch controller type is for applications requiring flow rate control where the integral valve module will fully close between batch dispense

cycles. If total volume needs to be controlled, an additional separate totalizer device must be employed.

CALIBRATION REFERENCE CONDITIONS

Unless otherwise noted, the specifications listed for the InVue Integrated Flow Controller are referenced under the following operating conditions:

PARAMETER	REFERENCE CONDITION
Process fluid	Deionized water
Process temperature	23° ±3°C (73° ±5°F)
Ambient temperature	23° ±3°C (73° ±5°F)
Process pressure	207 kPa (30 psig)
Supply voltage	24 VDC ±10%
Operation	Re-zeroed

General Considerations

The following requirements and specifications are briefly provided here. Before installing and operating the InVue Integrated Flow Controller, see the *Installation and Unit Operation* sections of this user guide for more detailed information.

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.

POWER SUPPLY REQUIREMENTS

The power supply range for the flow controller is 24 VDC $\pm 10\%$. The power supply to the unit must provide **clean** power and must be used only to power similar measurement-type devices.

STORAGE TEMPERATURE RANGE

The flow controller can withstand storage temperatures between $-15^{\circ} - 40^{\circ}\text{C}$ ($5^{\circ} - 104^{\circ}\text{F}$) with no permanent effect on the performance of the device.

OPERATING AMBIENT TEMPERATURE RANGE

The flow controller is designed to operate in ambient temperature, cleanroom environments. It is specified to operate at temperatures of $10^{\circ} - 65^{\circ}\text{C}$ ($50^{\circ} - 149^{\circ}\text{F}$).

OPERATING PROCESS TEMPERATURE RANGE

The flow controller is designed to operate in process temperatures of $10^{\circ} - 65^{\circ}\text{C}$ ($50^{\circ} - 149^{\circ}\text{F}$).

LINE PRESSURE

The system line pressure (measured at the inlet of the unit) must be 69 – 414 kPa (10 – 60 psig).

PRESSURE DROP

The flow rate is calculated using Entegris' differential pressure flow technology. The minimum pressure drop (inlet to outlet port differential pressure) required for the unit is 69 kPa (10 psig).

DIMENSIONS

NT6510

The following fitting size and flow range combinations are available (Flaretek®, PrimeLock®, and Pillar® unless otherwise noted):

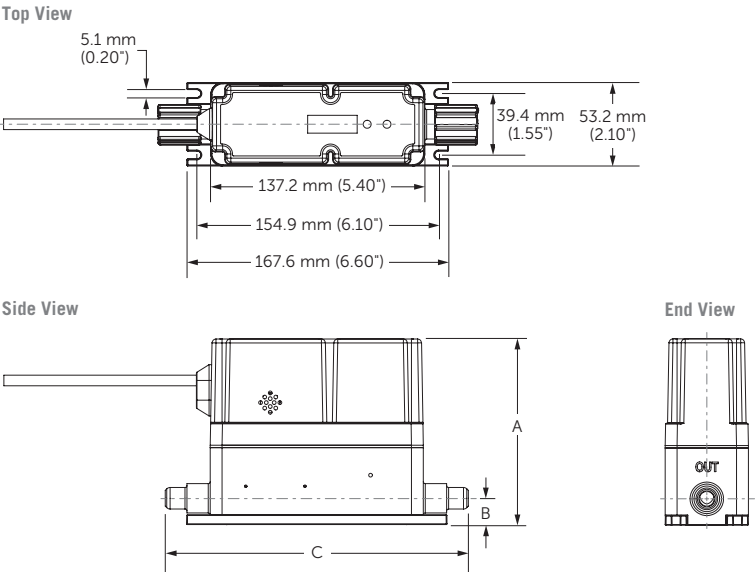
FITTING SIZE	FLOW RANGE (ML/MIN)						
	TL 0–15	TT 0–25	TO 0–50	T1 0–125	T2 0–250	T3 0–500	T4 0–1250
¼"	Yes	Yes	Yes	Yes	Yes*	Yes*	Yes*
⅜"	Yes**	Yes**	Yes**	Yes**	Yes	Yes	Yes

*Flaretek and Super 300 Type Pillar only.

**Flaretek only.

Please consult Entegris for custom flow range requirements.

INLET/OUTLET PORT CONNECTION	DIMENSIONS		
	A	B	C
¼" Flaretek tube fitting	118.1 mm (4.65")	17.0 mm (0.67")	187.5 mm (7.38")
⅜" Flaretek tube fitting	119.6 mm (4.71")	17.0 mm (0.67")	191.0 mm (7.52")
¼" PrimeLock tube fitting	118.1 mm (4.65")	17.0 mm (0.67")	177.8 mm (7.00")
⅜" PrimeLock tube fitting	119.6 mm (4.71")	17.0 mm (0.67")	177.8 mm (7.00")
¼" Super 300 Pillar tube fitting	118.1 mm (4.65")	17.0 mm (0.67")	159.3 mm (6.27")
⅜" Super 300 Pillar tube fitting	119.6 mm (4.71")	17.0 mm (0.67")	167.1 mm (6.58")



NT6520

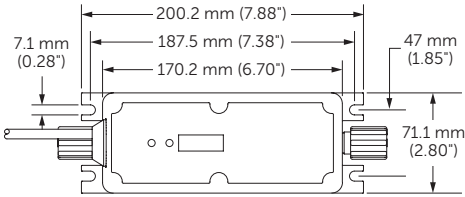
The following fitting size and flow range combinations are available (Flaretek, PrimeLock, and Pillar unless otherwise noted):

FITTING SIZE	FLOW RANGE (L/MIN)				
	T5 0–2.5	T6 0–5	T7 0–10	T8 0–20	T9 0–40
3/8"	Yes*	Yes*	—	—	—
1/2"	Yes**	Yes**	Yes*	—	—
3/4"	—	—	Yes**	Yes***	Yes

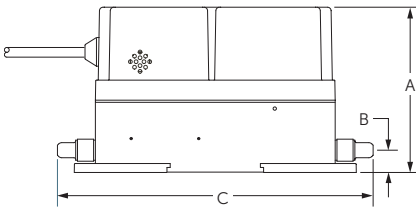
*Flaretek and Pillar only.
**PrimeLock only.
***Flaretek and PrimeLock only.
Please consult Entegris for custom flow range requirements.

INLET/OUTLET PORT CONNECTION	DIMENSIONS		
	A	B	C
3/8" Flaretek tube fitting	117.3 mm (4.62")	15.7 mm (0.62")	224.0 mm (8.82")
1/2" Flaretek tube fitting	120.9 mm (4.76")	18.3 mm (0.72")	228.0 mm (8.98")
3/4" Flaretek tube fitting	129.0 mm (5.08")	23.6 mm (0.93")	234.2 mm (9.22")
1/2" PrimeLock tube fitting	120.9 mm (4.76")	18.3 mm (0.72")	215.4 mm (8.48")
3/4" PrimeLock tube fitting	129.0 mm (5.08")	23.6 mm (0.93")	229.1 mm (9.02")
3/8" Super 300 Pillar tube fitting	117.3 mm (4.62")	15.7 mm (0.62")	200.2 mm (7.88")
1/2" Super 300 Pillar tube fitting	120.9 mm (4.76")	18.3 mm (0.72")	205.2 mm (8.08")
3/4" Super 300 Pillar tube fitting	129.0 mm (5.08")	23.6 mm (0.93")	214.1 mm (8.43")

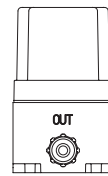
Top View



Side View



End View

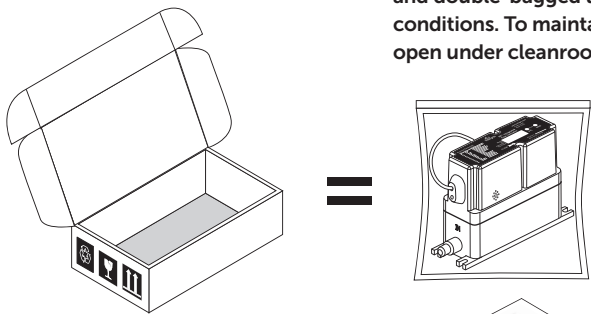


Installation

PROVIDED EQUIPMENT

Verify:

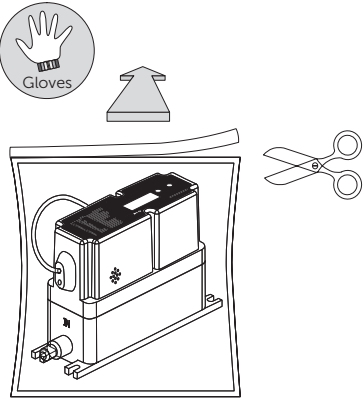
NOTE: This unit has been assembled and double-bagged under cleanroom conditions. To maintain purity, only open under cleanroom conditions.



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

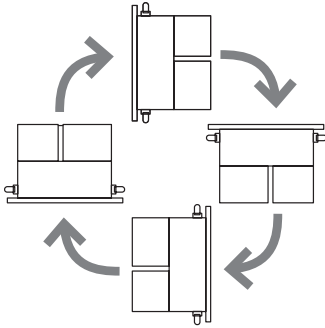


Remove Unit from the Bag



MOUNTING REQUIREMENTS

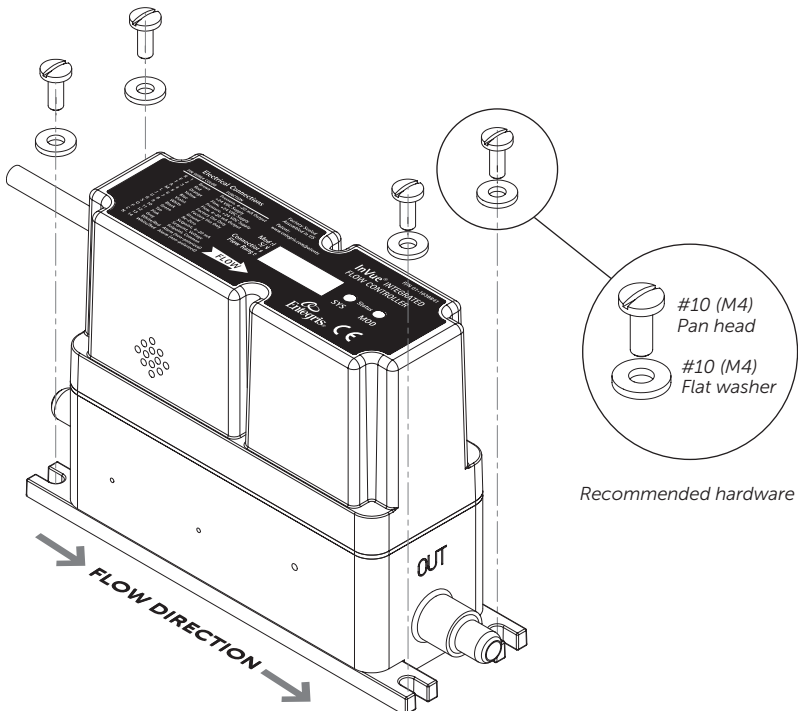
The flow controller may be mounted in any orientation. The unit does not require straight lengths of tubing at the inlet or the outlet connection.



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.



MECHANICAL INSTALLATION

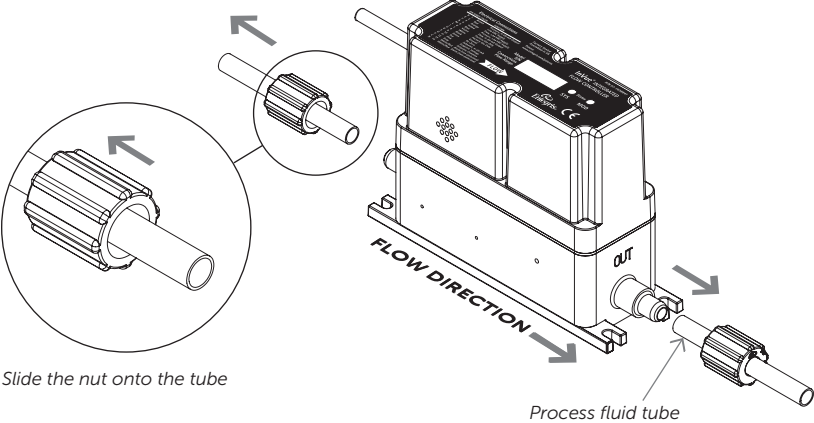
The InVue Integrated Flow Controller must be used with the proper tubing size and fittings.

NOTE: For detailed Flaretek and PrimeLock tube fitting assembly instructions, visit www.entegris.com.

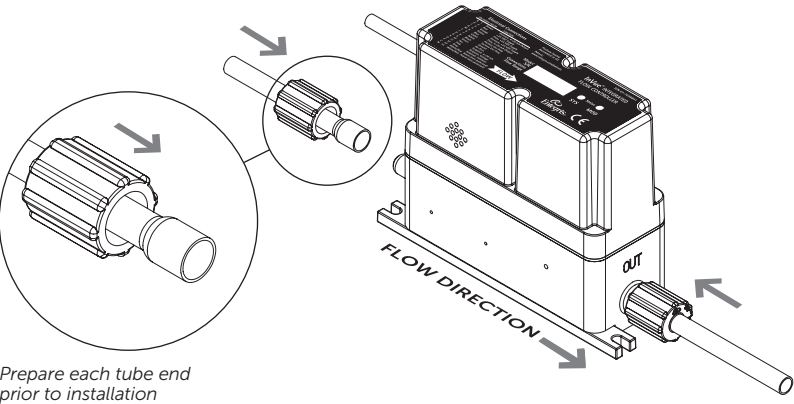
For detailed Super 300 Type Pillar tube fitting assembly instructions, contact Nippon Pillar Packaging Company, Ltd.

CAUTION! Over-tightening of the nuts will result in damage to the fitting.

Prepare Fluid Lines



Connect Fluid Lines



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.

POWER SUPPLY REQUIREMENTS

The power supply range for the flow controller is 24 VDC $\pm 10\%$ regulated. The power supply must provide continuous 1.0 ampere (nominal) service for each flow controller installed. The power supply requirements must be met at the wire connections or connector of the flow controller, not only at the power supply itself.

The power supply to the unit must provide clean power 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 milliseconds 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.

Input Impedance of the Voltage Setpoint

The input impedance of the voltage setpoint is 37 kOhm.

Voltage Drop at the 4 – 20 mA Setpoint Input

The 4 – 20 mA input will drop < 5 V at 20 mA. Input impedance is < 250 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 any wires will not harm the unit. To operate properly, the polarity must be correct.

Over-voltage on any Wire (DC)

In the event of accidental application of voltage greater than 24 VDC $\pm 10\%$, the flow controller will withstand continuous 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 of 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 InVue Integrated Flow Controller. 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.

ELECTRICAL CONNECTIONS

Pigtail Electrical Cable

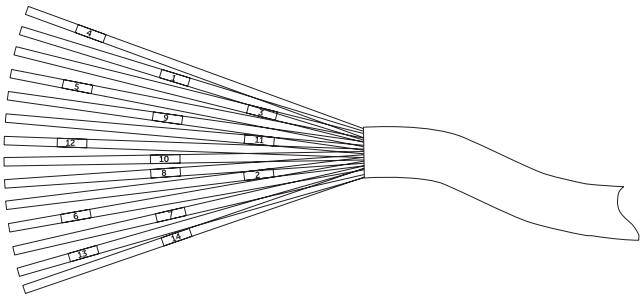
Units specified with a pigtail electrical connection are manufactured with a permanently attached cable.

Table 1 details the wire connections for the flow controller type with pigtail electrical cable.

Table 1: Wire connections – pigtail cable

WIRE COLOR	MARKER NUMBER	FUNCTION
Yellow	4	Pressure output, +24 VDC supply
Brown	1	Pressure output, 4 – 20 mA output
Orange	3	Flow output, +24 VDC supply
Blue	5	Flow output, 4 – 20 mA output
Green	9	Re-zero input
Pink	11	Setpoint, voltage, 0 – 10 or 0 – 5 VDC
Gray	12	Setpoint, common
Tan	10	Setpoint, current, 4 – 20 mA
Black	8	Ground (+24 VDC common)
Red	2	+24 VDC
Violet	6	Factory use only – do not connect
White	7	Factory use only – do not connect
White/red dot-dash	13	Alarm (non-polarized)
White/red dot-dash	14	Alarm (non-polarized)

Pigtail Cable



G-coded Electrical Connector

(Units where the electrical connector type has a code starting with "G", e.g., G01.)

Units specified with a G-coded connector use a Turck® brand, versafast style, BSMK type, constructed of polyurethane with a coupling nut. The connector is over-molded onto an electrically shielded, PVC-jacketed cable. The pin contacts for the electrical connection are gold-plated for performance and corrosion resistance. The connector is physically "keyed," making it easy to connect to a receptacle. Press it into a receptacle and turn the threaded coupling nut to draw the connector and receptacle together until finger tight. G-coded connectors to pigtail mating cables are available. See the *Ordering Information* section of this user guide.

The following pin diagram and Table 2 detail the wire connections for the flow controller type with G-coded electrical connector.

Mandatory Connections

2-Red/Pin R and 8-Black/Pin E wires must be connected according to Table 1, Table 2, and the Wiring Diagram on page 16. The setpoint must also be connected to 10-Tan/Pin U wire (4 – 20 mA setpoint) and 12-Gray/Pin S wire (common setpoint) or to 11-Pink/Pin G wire (voltage setpoint) and 12-Gray/Pin S wire (common setpoint). Connect 9-Green/Pin J (re-zero input) to switched, normally open 24 VDC $\pm 10\%$ main power supply in order to have the same ground as the 8-Black/Pine E (ground).

NOTE: The 24 VDC connected to re-zero must be the main power supply in order to have the same ground as 8-Black/Pin E. See the *Maintenance* section of this user guide for re-zero instructions.

Consult Entegris with any questions about electrical installation.

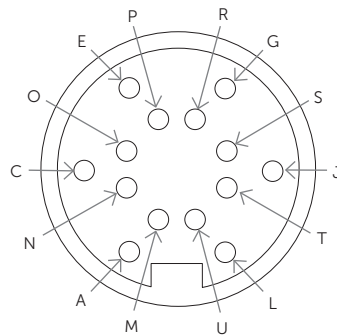
Table 2. Wire connections – G-coded connector

PIN	COLOR	FUNCTION
R	Red	+24 VDC
E	Black	Ground (+24 VDC common)
T	Yellow	Pressure output, +24 VDC supply
A	Brown	Pressure output, 4 – 20 mA output
M	Orange	Flow output, +24 VDC supply
L	Blue	Flow output, 4 – 20 mA output
J	Green	Re-zero input
U	Tan	Setpoint, current, 4 – 20 mA
G	Pink	Setpoint, voltage, 0 – 10 or 0 – 5 VDC
S	Gray	Setpoint, common
O	Violet	Factory use only – do not connect
P	White	Factory use only – do not connect
C	Red w/blue stripe	Alarm (non-polarized)
N	Gray w/brown stripe	Alarm (non-polarized)

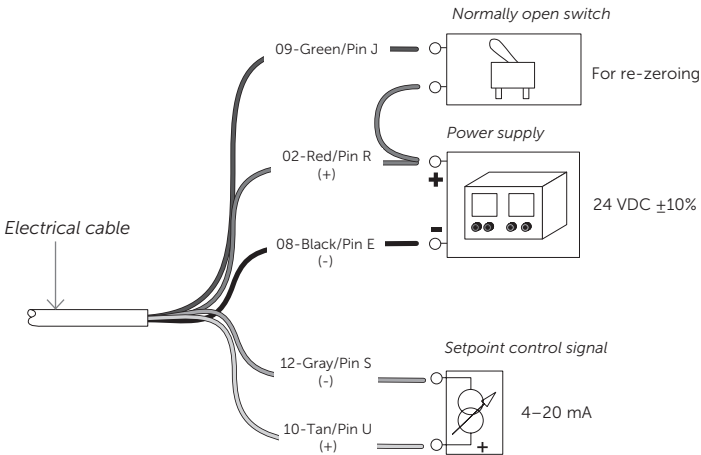
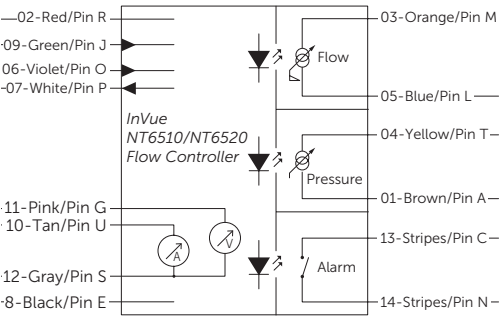
Unused Connections

The 6-Violet/Pin O and 7-White/Pin P wires are for factory use only. Do not connect to power supply or ground. These wires must remain disconnected.

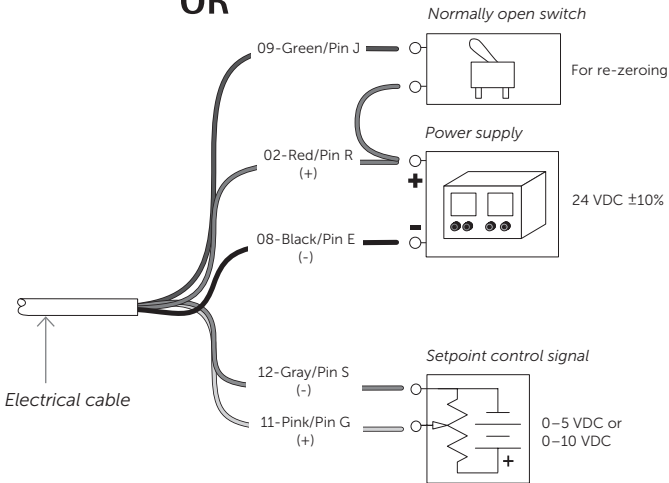
Plug Orientation, Face View



WIRING DIAGRAMS



OR

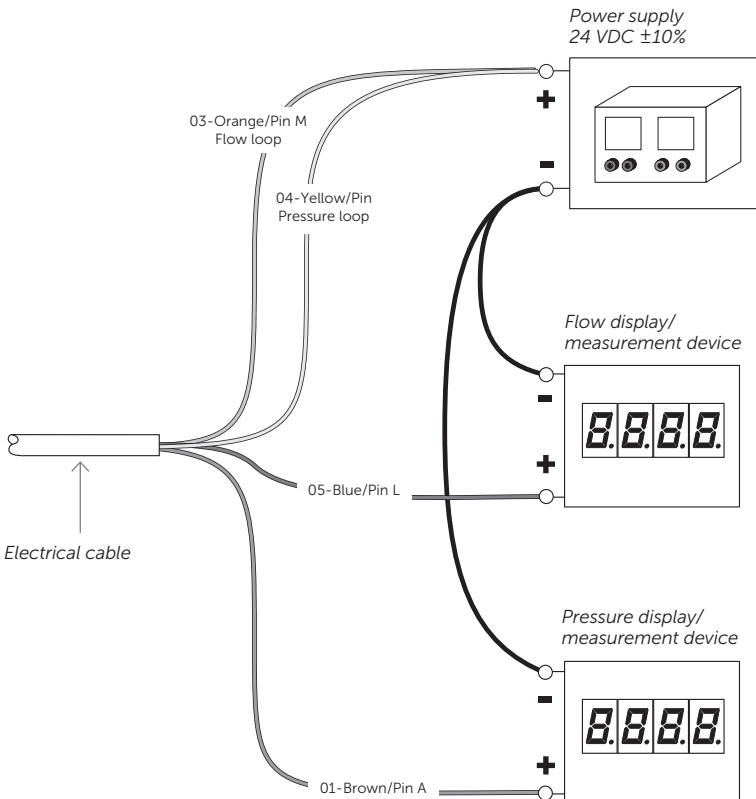


OPTIONAL CONNECTIONS

To monitor flow rate, apply 24 VDC to 3-Orange/Pin M wire and measure the 4 – 20 mA flow output signal from 5-Blue/Pin L wire.

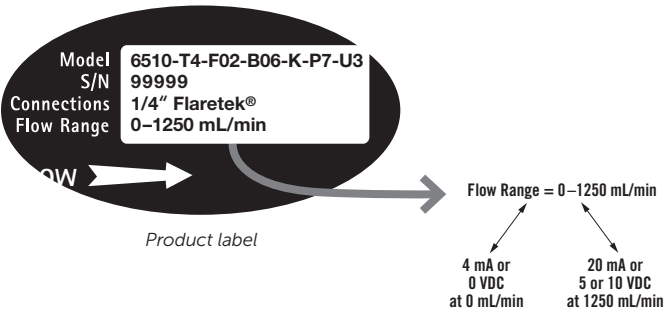
To monitor inlet pressure, apply 24 VDC to 4-Yellow/Pin T wire and measure the 4 – 20 mA pressure output signal from 1-Brown/Pin A wire.

These outputs are electronically isolated from all other circuit connections. 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

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

Range of product = 0–1250 mL/min
F = 125 mL/min
Span = 20 mA – 4 mA = 16 mA
FS = 1250 mL/min
$$\text{Setpoint}_{\text{mA}} = \frac{(125 \text{ mL/min}) \times (16 \text{ mA})}{(1250 \text{ mL/min})} + 4 \text{ mA}$$
$$\text{Setpoint}_{\text{mA}} = 5.6 \text{ mA}$$

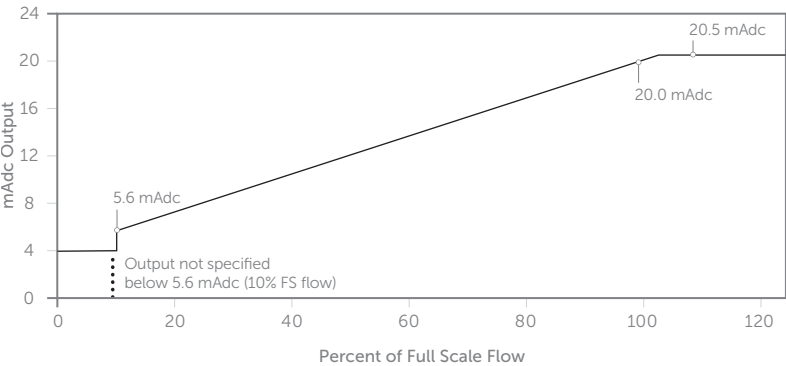
0–5 VDC or 0–10 VDC Setpoint Control Signal

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

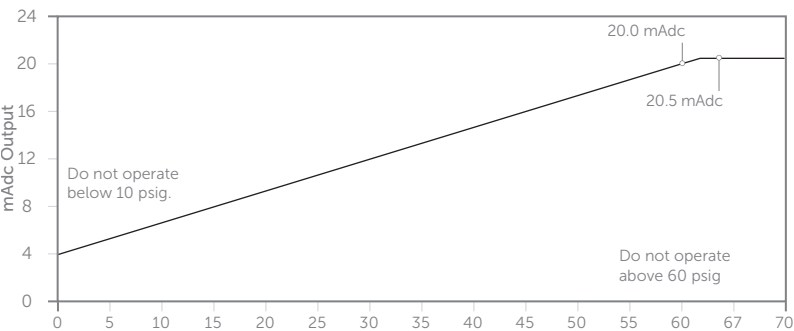
Range of product = 0–1250 mL/min
F = 500 mL/min
Span = 10 VDC – 0 VDC = 10 VDC
FS = 1250 mL/min
$$\text{Setpoint}_{\text{VDC}} = \frac{(500 \text{ mL/min}) (10 \text{ VDC})}{(1250 \text{ mL/min})}$$
$$\text{Setpoint}_{\text{VDC}} = 4.0 \text{ VDC}$$

CALIBRATION GRAPHS

mAdc Output vs. Full Scale Flow: 10 – 100% of 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

Storage Temperature Range

The flow controller can withstand storage temperatures between $-15^{\circ} - 40^{\circ}\text{C}$ ($5^{\circ} - 104^{\circ}\text{F}$) with no permanent effect on the performance of the device.

Operating Ambient Temperature Range

The flow controller is designed to operate in ambient temperature, cleanroom environments. It is specified to operate at temperatures of $10^{\circ} - 65^{\circ}\text{C}$ ($50^{\circ} - 149^{\circ}\text{F}$). For operation above 65°C (149°F), contact Entegris. The unit must be re-zeroed at operating ambient temperature conditions and after any temperature change for the accuracy specifications to apply. See the *Maintenance* section on page 27 for re-zeroing instructions.

Operating Process Temperature Range

The flow controller is designed to have a range of acceptable process temperatures of $10^{\circ} - 65^{\circ}\text{C}$ ($50^{\circ} - 149^{\circ}\text{F}$). When the process fluid is above ambient temperatures of 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 at operating process temperature conditions and after any temperature change for the accuracy specifications to apply. See the *Maintenance*

section on page 27 for re-zeroing instructions. The P8 (PFA) code sensor interface is recommended for process temperatures higher than 40°C (104°F). For operation above 65°C (149°F), contact Entegris. Positive system fluid pressure must be maintained at all times at elevated temperatures.

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 visiting our website at: www.entegris.com.

Unit Enclosure

The InVue Integrated Flow Controller cover is factory sealed and should not be tampered with or opened. Spray-down will not compromise the performance of the unit.

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

PERFORMANCE

Operating Line Pressure Requirements

The system line pressure (measured at the inlet of the unit) must be:

- 69 – 414 kPa (10 – 60 psig)



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

Operating Pressure Drop Requirements

The flow rate is calculated using Entegris' differential pressure flow technology. The minimum pressure drop (inlet to outlet port differential pressure) required for the unit is 69 kPa (10 psig).

For example, if a 0 – 125 mL/min (code T1) flow controller is operating at an inlet pressure of 103 kPa (15 psig) and outputs the flow to a pressurized canister at 69 kPa (10 psig), the differential pressure available to the unit will only be 34 kPa (5 psig) [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 psig) for this unit and it may not perform within the specification. For this example, either increase the inlet pressure or decrease the canister pressure to obtain a 69 kPa (10 psig) pressure drop.

Flow Accuracy

The accuracy of the analog flow measurement is $\pm 1\%$ of full scale flow for the operating range of the product. The accuracy specification includes the effects of linearity, hysteresis, and repeatability, using deionized water at 23°C (73°F).

To meet the accuracy specification, a re-zero is required for every 69 kPa (10 psig) change in line pressure.

Response Time

Response time is defined as the length of time required for the unit's input signal and the unit's calculated output to match within the full scale flow accuracy specification. The response time is <3 seconds.

When power is first applied to the unit, such as during a startup sequence, the calculated output will be controlled to within the full scale flow accuracy specifications within ten seconds.

Suspend Control Feature

Continuous controller type only:
The unit functions will be suspended when the setpoint is below 5% of the maximum setpoint controller signal (20 mA, 5 VDC, or 10 VDC).

In this condition, the unit valve position is locked and the control is suspended. Locking the valve position allows for uncontrolled flow. This can be useful if constant (trickle) flow for deionized water systems is required.

Pressure Accuracy

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

Temperature Increase at Unit Enclosure

You may notice a slight temperature increase of the unit cover while in an ambient environment after warm-up, when idling, or while controlling flow. This is normal.

OPERATIONAL RELIABILITY

Redundant Process Seals

All internal process wetted seals are redundant, i.e., there is a secondary seal that prevents process fluid from reaching the interior of the device in the case of a primary seal failure. Weep holes are provided from the secondary containment regions.

Drop and Topple

If the unit topples over from a 45-degree angle onto a bench top, the performance will not be compromised and the unit will not be externally damaged.

Cable Pull

The cable will withstand a static pull test of 9.1 kg (20 lbs) straight and 4.5 kg (10 lbs) at 90 degrees without being damaged.

STATUS AND ALARMING

Status

InVue Integrated Flow Controllers NT6510 and NT6520 provide local status LEDs. The LED status codes are listed in Table 3 on page 23.

Alarming

A discrete 2-wire alarm relay output is provided. The factory preset alarms are DEVICE CRITICAL FAULT and RE-ZERO FAULT (see Table 3). There are no delay options for these two faults.

There are three alarm delays. These are Flow delay, P delay, and SP delay. These are factory preset to 0 seconds. They can be programmed by the factory to the following ranges to meet the needs of the end user:

- Flow delay: 0 – 60 seconds
- P delay: 0 – 60 seconds
- SP delay: 0 – 60 seconds

Each individual alarm in Table 3 is tied to one of these three system level delay values and noted as such in the Trip Conditions column of Table 3. This value is applied commonly to all its associated alarms.

Before ordering, please consult Entegris for options on configuring alarm relay outputs and alarm delays differently than the factory presets.

LED STATUS GUIDE

Table 3. LED status codes

Led indication priority	State	Trip conditions (settable parameters)	Clear conditions (volatile with power cycle)	Alarm relay		Alarm condition and indication			
						Alarm condition		Color and pattern	
				Enable bit	Default	Enable bit	Default	Mod LED	Sys LED
—	Device OK	—	—	—	—	—	—	G	G
1	Device critical fault	Diagnostic fault	Power cycle with fault resolved	Fixed on	Factory enabled	Fixed on	Factory enabled	R	R
2	Re-zero fault	Pressure (P1 or P2) outside limits 7 – 414 kPa (1 – 60 psig) during zeroing	Successful re-zero cycle	Configurable	Factory enabled	Configurable	Factory enabled	G Off	Off Off
3	Over pressure (P1 >414 kPa [60 psig])	Trip point = P1 >100% (414 kPa [60 psig fixed]) Delay time = P delay P delay default = Ø Active w/both SP = 0 and SP ≠0 Will not trip on P2	Pressure P1 return to normal (after P delay)	Configurable	Disabled	Configurable	Factory enabled	G Off	G Off
4	Zero pressure (P1 <0 kPa [0 psig])	Trip point = P1 <0% (0 kPa [0 psig fixed]) Delay time = P delay P delay default = Ø Only active with setpoint ≠0 Will not trip on P2	Pressure P1 return to normal (after P delay)	Configurable	Disabled	Configurable	Factory enabled	G Off	Off G
5	Under pressure (P1 <62 kPa [9 psig])	Trip point = P1 <15% (62 kPa [9 psig fixed]) Delay time = P delay P delay default = Ø Only active with setpoint ≠0 Will not trip on P2	Pressure P1 return to normal (after P delay)	Configurable	Disabled	Configurable	Factory enabled	G Off G Off	Off Off G Off
6	Setpoint not equal to flow	Delta = SP - flow Delay time = SP delay SP delay default = Ø Only active with setpoint ≠0	Flow return to normal (after SP delay)	Configurable	Disabled	Configurable	Disabled	R G	G G
7	Flow high	Trip point = Flow high Delay time = Flow delay (default = Ø)	Flow return to normal (after Flow delay)	Configurable	Disabled	Configurable	Disabled	G Off	R Off
8	Flow low	Trip point = Flow high Delay time = Flow delay (default = Ø)	Flow return to normal (after Flow delay)	Configurable	Disabled	Configurable	Disabled	G Off	Off R
9	Pressure high (P1 > PressTrip-Point-High)	Trip point = P1 high Delay time = P delay P delay default = Ø Only P1 activates alarm	Pressure P1 return to normal (after P delay)	Configurable	Disabled	Configurable	Disabled	G Off	R G
10	Pressure Low (P1 < PressTrip-Point-Low)	Trip point = P1 low Delay time = P delay P delay default = Ø Only P1 activates alarm	Pressure P1 return to normal (after P delay)	Configurable	Disabled	Configurable	Disabled	G Off	R R

P=Pressure P1=Inlet pressure signal P2=Other pressure signal SP=Setpoint G=Green R=Red

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 <i>Operating Line Pressure Requirements</i> on page 21. Verify the pressure drop meets the requirements according to the <i>Operating Pressure Drop Requirements</i> on page 21.
	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.

Diagnostic Guide (continued)

SYMPTOM	POSSIBLE CAUSES	SUGGESTIONS
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 <i>Operating Line Pressure Requirements</i> on page 21. Verify the pressure drop meets the requirements according to the <i>Operating Pressure Drop Requirements</i> on page 21.
	Viscosity and specific gravity offsets.	Correct for viscosity and specific gravity.
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 <i>Operating Pressure Drop Requirements</i> on page 21. Verify the pressure drop meets the requirements according to the <i>Operating Pressure Drop Requirements</i> on page 21.

Diagnostic Guide (continued)

SYMPTOM	POSSIBLE CAUSES	SUGGESTIONS
8. Flow output is not responsive to changes in setpoint signal	Incorrect wiring of setpoint signal.	Review <i>Wiring Diagrams</i> on page 16. Ensure the ground connections are connected properly. 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/ Pin J 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 InVue Integrated Flow Controller requires no maintenance, other than a periodic re-zero of the unit.

RE-ZERO FUNCTION

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 between 7 – 414 kPa (1 – 60 psig) of static 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 $\pm 10\%$.
2. Using the pressure signal of the unit, verify stable static line pressure of between 7 – 414 kPa (1 – 60 psig). Optimum pressure for re-zero is the operation pressure, typically greater than 69 kPa (10 psig) or 83 kPa (12 psig). **There must be at least 7 kPa (1 psig) of stable static line pressure.**

3. Apply 24 VDC $\pm 10\%$ to the 9-Green/Pin J wire for the desired re-zero time. The suggested re-zero time is 20 seconds for NT6520 and 10 seconds for NT6510. The absolute minimum to guarantee accuracy specification is 11 seconds for NT6520 and 5 seconds for NT6510. The longer the re-zero process is active, the better the zero value will be for flow output. The 24 VDC for re-zero must have the same ground as the ground 8-Black/Pin E wire. Do not continuously apply 24 VDC to this 9-Green/Pin J wire.

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 re-zero function is completed when 24 VDC is disconnected from 9-Green/Pin J.

In order to obtain best performance, the re-zero function should be performed, at minimum if possible, once per day 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 startup and after fluid temperature changes of greater than 5°C (9°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 longer than two seconds after the valve closes and the line pressure is 7 – 414 kPa (1 – 60 psig). 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.

Reference

Physical specifications

Materials	Wetted parts	Body	PTFE
		Diaphragms	PTFE
		Sensor interface	CTFE or PFA
		O-rings	Perfrez® PXC Ultra
	Nonwetted parts	PTFE, polypropylene, Viton®, PVDF, polyurethane, nylon	
Connection type	Flaretek tube fitting, PrimeLock tube fitting, or Super 300 Type Pillar tube fitting		
Enclosure	IP64		

Electrical specifications

Input voltage	24 VDC $\pm 10\%$ regulated
Input current	1.0 A nominal, 1.2 A peak
Impedance of setpoint input (voltage)	37 kOhm
Voltage drop, current setpoint input	<5 Volts at 20 mA at 250 ohm
Lift-off voltage for current loops	12 VDC
Load effect on 4 – 20 mA outputs	R_{Load} 0 – 600 ohms, no effect
Electrical connection	FEP-jacketed or PVC-jacketed cable

Performance specifications

Operating range options	10 – 100% of full scale flow (Code "T" flow range – default)
Flow measurement	$\pm 1\%$ of full scale (calibrated using DI water @ 23°C [73°F])
Pressure accuracy	$\pm 1\%$ of full scale
Repeatability	$\pm 0.5\%$ of full scale
Response time	<3 seconds
Process temperature	10° – 65°C (50° – 149°F)
Storage temperature	-15° – 40°C (5° – 104°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 model number represents the configuration. For example, model number 6510-T2-F02-B06-K-P7-U3 represents the following configuration:

- InVue Integrated Flow Controller, Model NT6510
- Flow range of 0 – 250 mL/min
- ¼" Flaretek tube fitting
- 6' pigtail FEP-jacketed electrical cable

- 4 – 20 mA setpoint input, batch type
- CTFE sensor interface
- Perfrez® PXC Ultra/Viton for primary/secondary seal

The flow controllers are available in the following fitting sizes and flow range combinations (Flaretek and Pillar unless otherwise noted):

NT6510

FITTING SIZE	FLOW RANGE (ML/MIN)						
	TL 0–15	TT 0–25	T0 0–50	T1 0–125	T2 0–250	T3 0–500	T4 0–1250
¼"	Yes	Yes	Yes	Yes	Yes*	Yes*	Yes*
¾"	Yes**	Yes**	Yes**	Yes**	Yes	Yes	Yes

*Flaretek and Super 300 Type Pillar only.
**Flaretek only.
Please consult Entegris for custom flow range requirements.

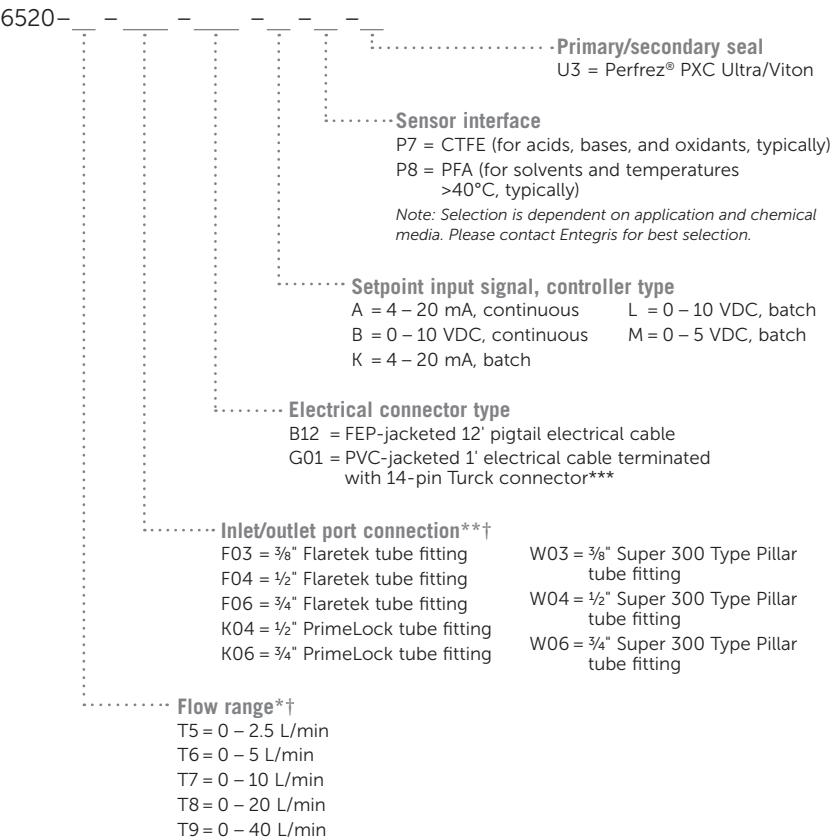
NT6520

FITTING SIZE	FLOW RANGE (L/MIN)				
	T5 0–2.5	T6 0–5	T7 0–10	T8 0–20	T9 0–40
⅜"	Yes*	Yes*	—	—	—
½"	Yes**	Yes**	Yes*	—	—
¾"	—	—	Yes**	Yes***	Yes

*Flaretek and Pillar only.
**PrimeLock only.
***Flaretek and PrimeLock only.
Please consult Entegris for custom flow range requirements.

Ordering Information (continued)

InVue Integrated Flow Controller, NT6520: part number



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

** For options not shown here, please contact Entegris.

*** For electrical connector type G01, a 14-pin mating cable is required for installation. See "Electrical Mating Cables for InVue Flow Controllers NT6510 and NT6520 – Accessory" (p. 33) for ordering information.

† Confirm flow range and inlet/outlet port connection compatibility in the table on page 30.

Product specified with a flared tube connection is packaged with two PVDF nuts.

For custom configurations and specifications, please contact Entegris.

Ordering Information (continued)

Electrical mating cables for InVue Flow Controllers NT6510 and NT6520 – accessory


PART NUMBER	DESCRIPTION	QUANTITY
14G05	14-pin mating Turck connector with 5-meter (16.4') PVC-jacketed cable	1
14G10	14-pin mating Turck connector with 10-meter (32.8') PVC-jacketed cable	1

Certifications

CE COMPLIANCE

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

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.**

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.

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.

FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit [entegris.com](https://www.entegris.com) and select the [Contact Us](#) link to find the customer service center nearest you.

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