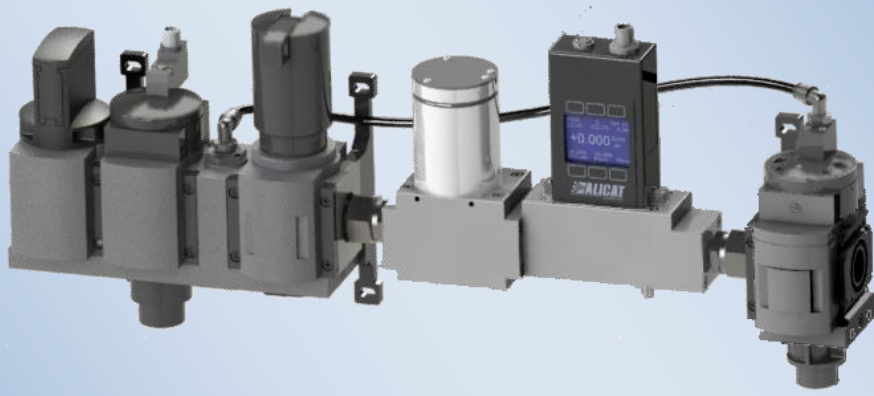
Pig Speed Control Module

RVO



Instruction manual

Reference: RVO1_NOT_EN

Version B (2021)

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1 GENERAL PRESENTATION

1.1. The manufacturer

SERVINOX is a specialist in processing equipment for the brewing, food-processing, cosmetics and chemical industries.

Expertise in process equipment:
In areas such as tank protection, sampling, injecting gas into liquids, pipe pigging and cleaning using patented products.

SERVINOX is ***ISO 9001***-certified and offers products that comply with the following applicable standards and directives:

- Pressure Equipment Directive ***(PED) 2014/68/EU***
- European Directive for Equipment in an Explosive Atmosphere **(ATEX)** ***2014/34/EU***
- US 3A manufacturers sanitary standard

We are an active member of the ***EHEDG France*** association (hygienic standard for European manufacturers).

1.2. Instruction manual

In order to guarantee the integrity of the equipment and the safety of personnel, you must read and understand the information contained in this manual before installing and using the equipment.

Depending on the installation and the fluid, specific guidelines and regulations apply. These must be respected.

In addition to the instructions stated in this instruction manual, general work and safety instructions must be applied. Regulations concerning the protection of the environment must also be respected.

1.3. Presentation of the equipment

The Pig Speed Control (RVO) module autonomously adjusts the pig's travel speed, irrespective of the particularities of the line to pig or the product to recover.

1.4. General Operation

This system is especially suited to very long lines, inside which products of varying quality, density and viscosity can be transferred.

This principle is effective in eliminating the so-called "Karcher" effect projections that can be seen on the PUSH, as well as the shocks at the end of pigging.

Without a RVO module, the push pressure is usually adjusted by a manually set regulator; thus it remains constant from the start to the end of the pigging.

At the start of the pigging phase, the pig must push the volume of product contained along the entire length of the line, possibly with riser pipes to pass through. Consequently the adjustment pressure must be sufficient to overcome these forces at the start of the pigging.

However, as the pig advances, it has less and less pressure drop to overcome, and therefore the required pushing pressure is less and the pig's travel speed will then increase significantly.

When the pig arrives at the end of the pigging, it is propelled by the same pressure as at the start and often arrives at its stop too fast, causing a severe impact, inducing the degradation of the pig, potential impacts on surrounding equipment and product projections.

When a pig travels too fast in a line, it also generates risks of jamming in the elbows, causing untimely stops and therefore more friction and ultimately premature wear of the pig. This jerky pigging operation can make the pig uncontrollable. The RVO manifold is strongly recommended from DN65, but it remains compatible with all diameters of pigged lines from DN25 to DN150.

The new generation 2020 RVOs provide identical performance irrespective of the DN of the pigged lines.

1.5. Applications

Consequently, it is **highly recommended to use** the RVO panel **in the following cases**:

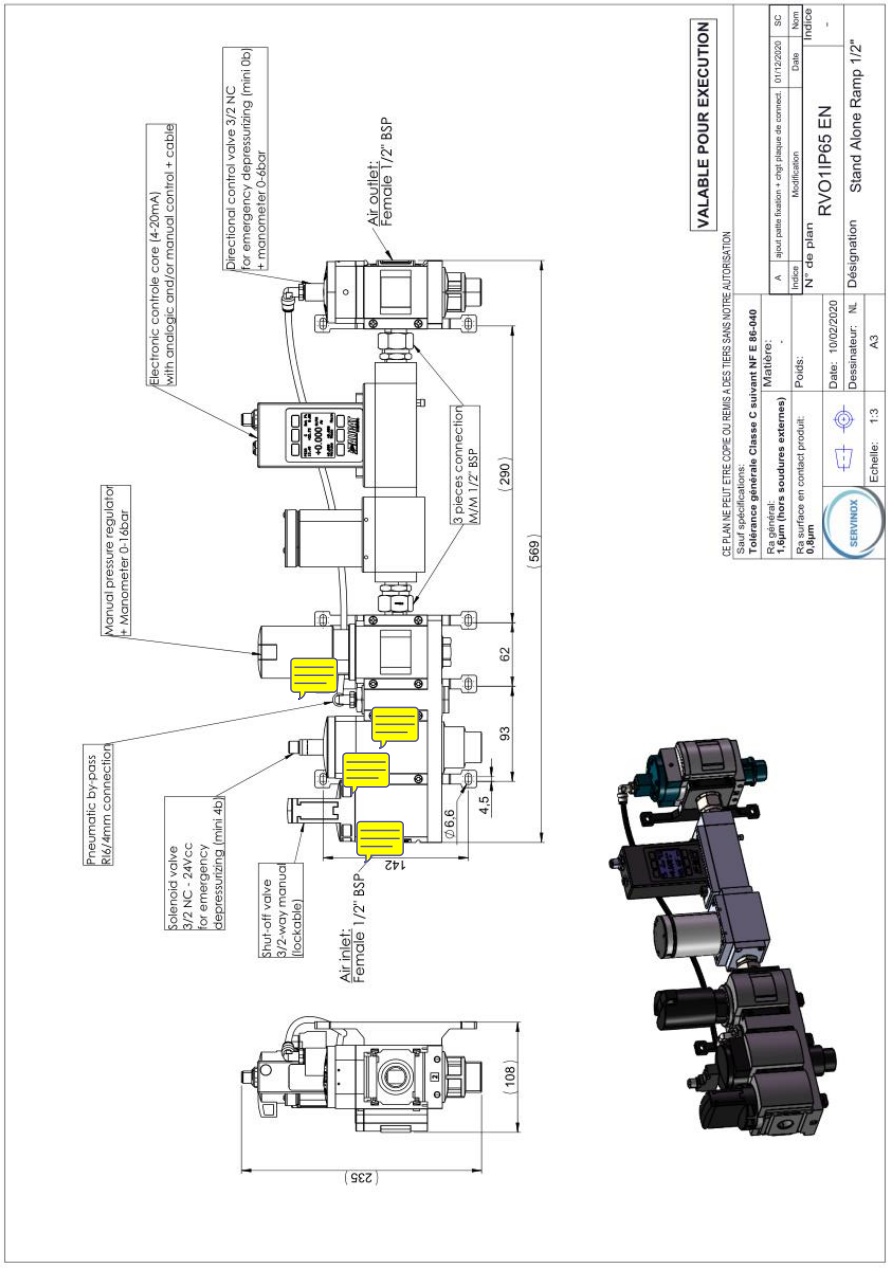
- When the **travel speed of the pig is too fast** when it arrives at the stop in its receiving station, generating "pressure surges" on the line.
- When the pig is stopped in an elbow and you have to manually increase the push pressure to release it.
- When a **flow rate is too irregular and/or pressure variations** (“Karcher” effects) are generated by the pig's behavior in the line, which can alter the quality of the product or even disrupt the process and more precisely the processing (essential on hoppers with high & low level management).
- When you want to **increase the pig's life** by adopting more linear travel, the result of constant speed during pigging without untimely stops, which generate gumming via abrupt restarts and therefore premature wear of the pig.
- When you want to pig a **multi-product line**, without having to worry about adjusting the push pressures for each product. This is especially the case when the products to be recovered have different viscosities, thixotropies and/or densities.

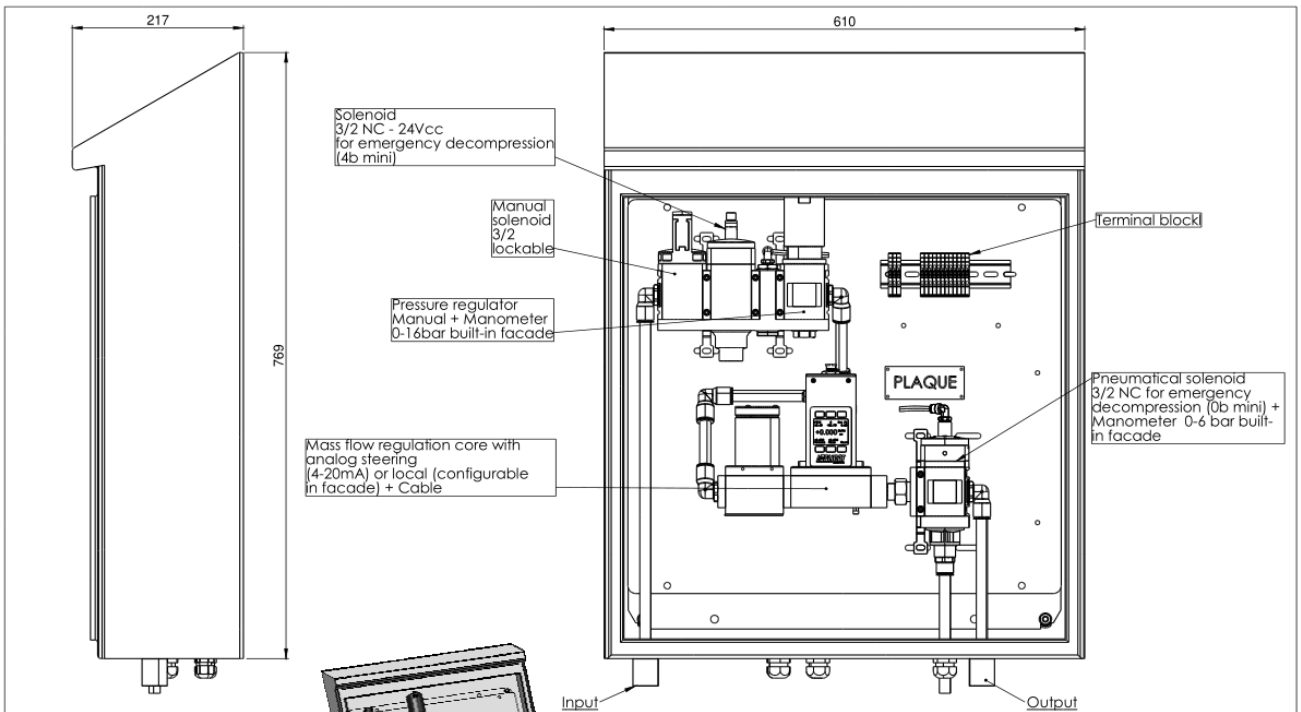
- When you want to **control the speed of the pig** without restricting the flow area at the end, a solution which has the main disadvantage of limiting the flow of the liquid, thus generating pressure drops along the line & increasing the risk of a "Karcher" effect, without being able to guarantee that this control principle responds instantly.

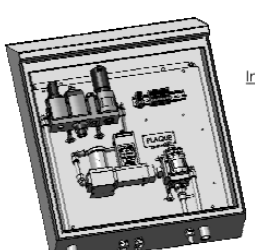
Consequently, this module is highly recommended as soon as:

- The pressure at the pump outlet is greater than or equal to 2 bars,
- The line is long and/or with a DN greater than or equal to 2½" (DN 65),
- There are big riser pipes of liquid to push,
- The product to be pushed is characterized by a significant density and/or viscosity,
- The line is "multi-product" with fluids of different types transferred,
- You want to increase the life of the pig & surrounding equipment.
- The safety of equipment and operators is a priority.

1.6. Plan


VALABLE POUR EXECUTION
Electronic controle core (4-20mA)
with analogic and/or manual control + cable
Directional control valve 3/2 NC
for emergency depressurizing (mini 0b)
+ manometer 0-6bar
Air outlet:
Female 1/2" BSP
Manual pressure regulator
+ Manometer 0-16bar
3 pieces connection
M/M 1/2" BSP
Pneumatic by-pass
Ri6/4mm connection
Solenoid valve
3/2 NC - 24Vcc
for emergency
depressurizing (mini 4b)
Shut-off valve
3/2-way manual
(lockable)
Air inlet:
Female 1/2" BSP
290
569
62
93
4.5
Ø6.6
142
108
235
Désignation Stand Alone Ramp 1/2"
RVO1IP65 EN
Date: 10/02/2020
Dessinateur: NL
Echelle: 1:3
A3





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Except specifications : **General tolerance class C according to NF EN 86-040**			
General Roughness: **1,6µm (out of outside welding)**	Material : -		
Roughness for surface in product contact : **0,8µm**	Weight : 40kg	Drawing number : RVO1IP69K EN	Index A
SERVINOX	Date: 16/06/2020		
	Drawer : NL	Designation	Stand alone ramp RVO1IP69K type
	Scale : 1:4	A3	

2 SAFETY INSTRUCTIONS

The operating instructions contain fundamental instructions that must be followed. Consequently, they must be read before the equipment is installed and commissioned.

2.1. Directions and symbols

The following symbols are intended to highlight important points concerning the safety of persons and the integrity of the equipment:

SYMBOL	DEFINITION
	Direct hazard for persons.
	Possible damage to the product or its environment
	Useful information or instructions for use
	Minimum number of people required for certain operations. (The number of people shown in the symbol indicates the minimum number required).
	Minimum level of technical ability. (the figure in red indicates the minimum level required).

Some work requires specific technical skills and qualifications, such as curative maintenance work or work on electrical equipment.

3 levels are used to indicate the technical ability required (knowledge of the equipment in question, experience, training, etc.).

	WORKER PROFILE	SPECIFIC POINTS
Level 1	**End user** with no technical knowledge.	**Default level** if the skill symbol is not present. Only **routine use and maintenance operations** are authorized.
Level 2	Experienced **professional.**	Trained and **experienced**. **Familiar with the equipment and technologies** used.
Level 3	**Manufacturer's personnel** / product expert	**Work reserved for the manufacturer of** the documented equipment.

2.2. Worker safety

Installation, inspection, adjustment, servicing and replacement operations must be performed:

- By qualified personnel,
- In accordance with the recommendations and instructions provided in this manual,
- Taking into account workplace safety provisions, the installer's procedures and means, and the legal requirements concerning accident prevention, especially with regard to electrical installations.

Failure to comply with the safety instructions may result in the loss of any right to compensation for damages.

2.3. Intended use

Compliant use

Check that the equipment has been selected for its intended use by consulting the accompanying documents.

Non-compliant use

The equipment must only be used for the intended use. The manufacturer cannot be held liable if the equipment is used for anything other than its intended use.

2.4. Generics

DANGER / RISK			
	Hot fluid	Very hot surface	Aggressive fluid
SPECIFIC POINTS	Burns	Burns	Burns
PREVENTION			
	Appropriate clothing, glasses and gloves	Appropriate gloves	Appropriate gloves, glasses and gloves

3 TECHNICAL CHARACTERISTICS

3.1. Standard version

REQUIREMENTS	SERVINOX PRODUCT
Minimum pressure	4 bar
Minimum pressure	10 bar
Operating temperature	1°C to 50°C
Standard overall dimensions	595 x 246 x 108 mm
Overall dimensions IP69K case	610 x 769 x 217 mm
Connections	Entry date: 1/2" female Pdg Exit date: 1/2" female Pdg

The RVO module is composed of:

① a 3/2-way manual shut-off valve,

② a 3/2-way NC 24Vdc solenoid valve,

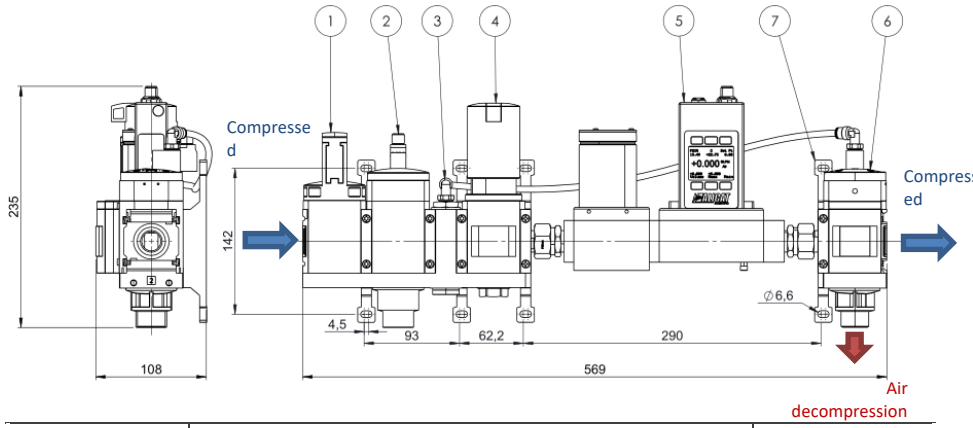
③ a pneumatic bypass,

④ a manual pressure regulator with built-in pressure gauge (displays the maximum allowable push pressure),

⑤ a 24Vdc electronic control core,

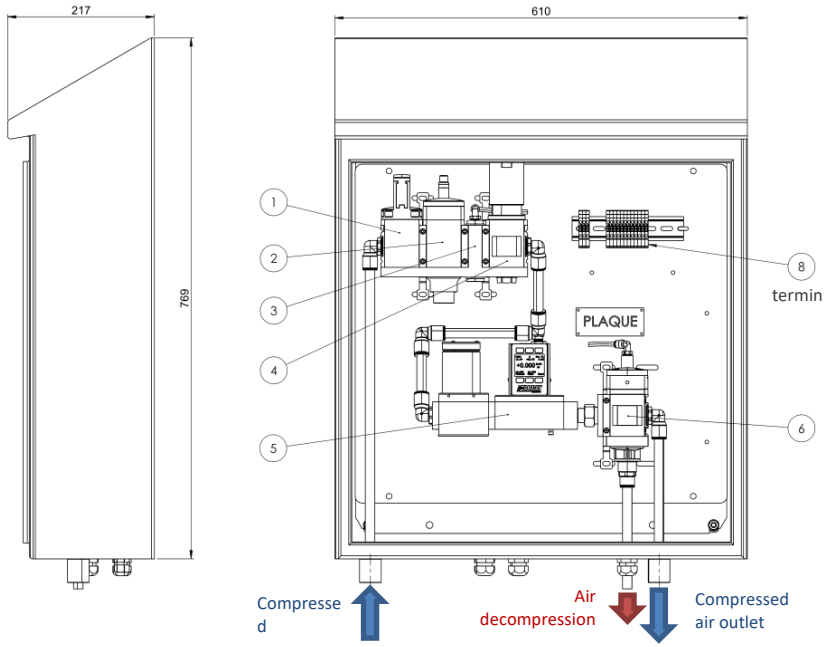
⑥ a pneumatically operated 3/2-way NC "special high flow" directional control valve with built-in pressure gauge (displays the instantaneous push pressure),

⑦ four wall mounting brackets.

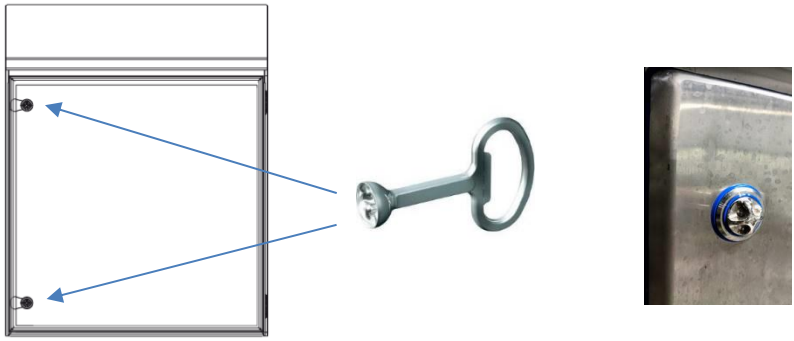


3.2. Option:

- IP69KStainless steel case



The case has a door with an integrated seal and its opening direction can be reversed. It is locked with a special key in a hygienic lock:



- Version ATEX 2014/34/EU , zones 2 & 22, gas and dust

4 DETAILED OPERATION

In general, the RVO module operates as follows:

Throughout the duration of a pigging, the RVO **measures 1000 times per second the instantaneous air flow** consumed by the pig, providing it with a value representative of its speed. The module then measures the difference between this speed and the set speed, then **corrects the push pressure 10 times/second** until the expected speed is obtained.

In the case of a pig traveling too fast:

When the pig exceeds its set speed, the RVO will detect this and instantly decrease the push pressure until the pig returns to the set speed.

In the event of a pig traveling too slowly or stopped:

If the pig stops in the line, the RVO will measure a drop in the pig's air consumption and gradually increase the pressure until the pig releases and/or its speed returns to the set speed.

The RVO must be inserted on the push gas supply line, **ideally as close as possible to the starting point**, upstream of the push fluid transmission valve(s).

The RVO module can be used to feed multiple lines, provided you complete one push before starting another, as it is sized to control the pig's travel speed in one line at a time.

4.1. *Description of the components*

① Cut-off valve:

It is a manually operated 3/2-way valve that can be locked in both positions (Servinox does not supply the lock). It is mainly used to manually isolate the inlet push fluid upstream and to decompress downstream as part of maintenance.

② Pneumatic assistance solenoid valve:

This 3/2-way NC solenoid valve is operated at 24Vdc and switches if the inlet pressure is >4b. See *4.2 Electrical connections* for details of the connector used.

It then sends via the pneumatic bypass③ a control >4b to the 3/2-way NC directional control valve located at the end of the manifold. The directional control valve manages emergency decompression and thanks to this assistance, it can work without constraints from 0b.

④ Pressure regulating valve:

It is used to adjust the downstream air pressure, so the user can set the maximum pressure available to the control core. The pressure gauge integrated on the front can read from 0 to 10b.

We recommend not to exceed a setting of 6 bar on the pressure reducer, which corresponds to the maximum pressure that the core will be able to use.

⑤ Control core:

This is a control loop with a **response time of <100 ms**, comprised of:

- A mass flowmeter that measures the instantaneous air flow consumed by the pig every 1 ms, in Nl/min.
- An electronic regulator that corrects every 100 ms the actual flow rate with the set speed (entered locally or controlled remotely).

It regulates a differential pressure until the target flow is obtained.

This core offers IP65 protection and incorporates as standard:

- A 24 Vdc power supply, the cable is provided.
  See *4.2 Electrical connections* for details of the connectors used.
- A man-machine interface with backlit display (the switch is the "ALICAT" button on the front) of the instantaneous air flow "Q" consumed in real time by the pig in Nl/min Other physical measurements can be selected: mass flow, volumetric flow, pressure & T°C (instantaneous or cumulative).
- Local (default) or remote settings that can be used to adjust a **set flow rate between and 1300 Nl/min** (at a relative inlet pressure of 3 bars).
- More than 30 types of gas are stored in memory and can be configured via the menu (factory setting = air)

- Remote control and/or instantaneous measurements can be done by analogue signal, RS-232/RS-485 or via PROFIBUS or DeviceNet type protocols.

It is connected at the inlet and outlet by 3-piece 1/2" Male to Male connections.

⑥ Pigging Emergency Stop Distributor (A.U.R.): user safety

This 3/2-way NC directional control valve can be used to quickly stop the current pigging in an emergency.

The solenoid valve, which is at the start of the manifold, is continuously controlled by a permanent 24 Vdc power supply. In the event there is no control voltage, it no longer sends pneumatic control signals (Ø6/4mm pipe) to the directional control valve, which then switches to the safety position.

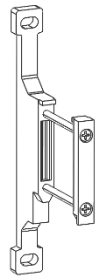
This state allows rapid decompression downstream, thanks to an identical flow area in both directions (intake and exhaust), thus enabling the **pig to be immobilized quickly**. The pressure gauge integrated on the front can instantaneously read the regulated pressure from 0 to 6b.

If you **forget to supply air** to the panel when starting a pigging, there is a **risk of liquid backflow.** In anticipation of this scenario, the 3/2-way NC distributor is no longer pneumatically assisted and will thus **protect the upstream control core**.

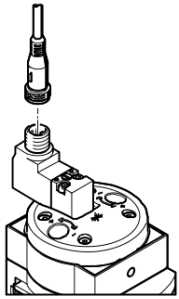
⑦ Wall mounting brackets:

These are support brackets sized to accommodate all of the equipment detailed above, which the integrator can use to easily install the assembly.

Fixing holes Ø6.6mm.



4.2. Electrical connections



② Pneumatic assistance solenoid valve:

This 3/2-way solenoid valve must be supplied with 24 Vdc by the user who only wants to decompress in the event of a power outage. If the user wants to **decompress quickly** in the event a **station opens manually during a pigging in progress** or there is a **B.A.U. breakdown**, this 3/2-way solenoid valve must be supplied directly by the PLC.

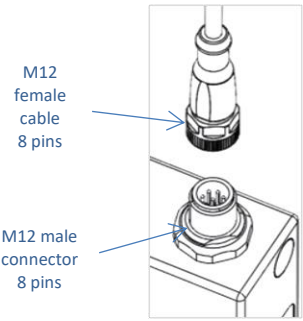
The electrical connection is made via a 4-pin M12 connector ISO 20401, EN 61076-2-101.

1 = Unused
2 = Unused
3 = com (–)
4 = Signal (+) solenoid 14

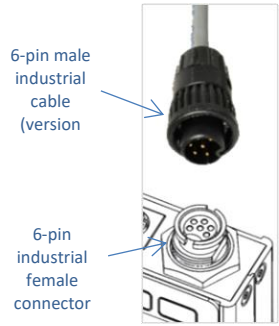
⑤ Control core:

In the standard version, the control core has an 8-pin M12 male connector (see Appendix page 80 for the pinout diagram).
In IP69K version, the core has a 6-pin female industrial connector (see Appendix page 79 for the pinout diagram).

The cable is included.

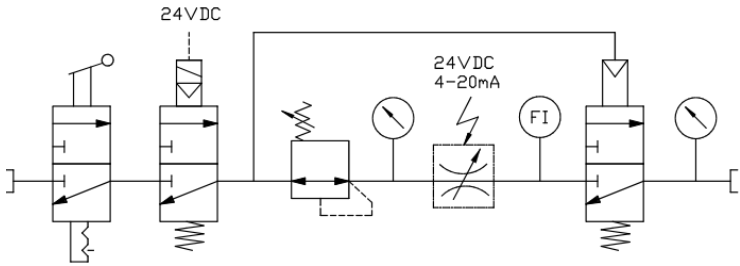


Standard



IP69K

4.3. Symbolic representation of the RVO module



6 OPERATING CONDITIONS

6.1. Air/gas quality:

The control module is not in itself a treatment and filtration unit. The end user is responsible for the quality of the fluid entering the manifold based on its own standards according to the current ISO 8573-1:2010 standard. Basic filtration of 40µ particles is required upstream.

6.2. The flow rate

The push fluid flow to be supplied to the manifold must be sufficient to ensure it operates correctly.

We recommend ensuring a **minimum flow rate of 54 Nm3/h with 6 bars** of pressure at the manifold inlet (values for air).

If the available flow on the main network is insufficient or fluctuating too much, it is recommended to set up a reserve (buffer tank) upstream of the module, whose size shall be validated with SERVINOX.

The network that brings the compressed gas from the compressor or the pressurized storage tank to the manifold and/or the push-air valve must be sized to always comply with a minimum internal DN, which is defined by:

- The length of the air network
- The size of the DN to pig.

The table below shows this minimum sizing value for an air network:

	DN mini du réseau d'air jusqu'aux gares							
DN de tuyauterie à racler*	DN25	DN40	DN50	DN65	DN80	DN100	DN125	DN150
Distance compresseur								
5 mètres	7,90 mm	11,10 mm	13,20 mm	15,60 mm	18,70 mm	22,30 mm	26,30 mm	28,70 mm
10 mètres	9,00 mm	12,70 mm	15,10 mm	17,80 mm	21,30 mm	25,40 mm	30,00 mm	32,70 mm
25 mètres	10,70 mm	15,10 mm	17,90 mm	21,20 mm	25,40 mm	30,20 mm	35,60 mm	38,90 mm
50 mètres	12,20 mm	17,20 mm	20,40 mm	24,10 mm	28,90 mm	34,40 mm	40,60 mm	44,30 mm
75 mètres	13,10 mm	18,50 mm	22,00 mm	26,00 mm	31,20 mm	37,10 mm	43,80 mm	47,80 mm
100 mètres	13,90 mm	19,50 mm	23,30 mm	27,50 mm	32,90 mm	39,20 mm	46,20 mm	50,50 mm
150 mètres	14,90 mm	21,10 mm	25,10 mm	29,60 mm	35,50 mm	42,30 mm	49,90 mm	54,50 mm
200 mètres	15,80 mm	22,30 mm	26,50 mm	31,30 mm	37,50 mm	44,60 mm	52,70 mm	57,50 mm

**: The DN of the pigged line is defined on a DIN basis. For any other standard (SMS, ISO, OD), the equivalent section must be taken into account*

It is recommended to increase this value in order to anticipate potential additional consumption that may subsequently be added to this network.

Make sure that the RVO module is at a maximum cumulative distance of 10 meters from the network (upstream) and from the air supply valve of the pigging station (downstream). Connected by a pipe with an internal diameter greater than or equal to the value defined in the table above (consider 1'' min. by default).

6.3. Pressure

Pay attention to Module IV of the European Directive 97/23/EC (subject to EC marking):

The user is responsible for deciding which components will or will not be subject to this regulation, depending on the chosen maximum operating pressures of group 2 liquids & gases in large pipes (for example the PED limit on a DN DIN125, P. max = 8 bars and on a DIN DN150, P. max = 6.6 bars).

6.4. Pig travel speed adjustment

The table on the next page shows the instantaneous air flow Q values in Nl/min consumed by the pig from 0 to 7m/s, depending on the nominal diameter of the line & the pig's travel speed.

By adjusting the set point, the flow rate (displayed on the front of the control core) is adjusted until the ideal setting is obtained. Be careful, however, if it is a question of scraping off a lubricating product or, on the contrary, one that adheres to the shell. For example in this second case, the ideal speed will be in the upper half of the RVO module's adjustment range.

These data remain indicative and experience or service conditions may lead to choosing different values.

PIG TRAVEL SPEED ADJUSTMENT

Vitesse trop basse : risque d'arrêt intempestif de l'obus

Plage de vitesse régulée par la RVO / liquides lubrifiants

Plage de vitesse régulée par la RVO / liquides adhérents

Vitesse dangereuse : risque d'accident

	Q = DEBIT D'AIR INSTANTANE (Nl/min) CONSOMME PAR L'OBUS							
DN	25	40	50	65	80	100	125	150
OD	1"	1" 1/2	2"	2" 1/2	3"	4"	5"	6"
DIN	28x1	40x1	54x2	70x2	85x2	104x2	129x2	154x2
SMS	25x1	38x1	51x1,2	63,5x1,5	76x1,6	104x2	N/A	N/A
ISO	26,9x1,6	42,4x1,6	48,3x1,6	60,3x2	76,1x2	88,9x2	114,3x2	139,7x2
VITESSE en m/s								
0,10 m/s.	3	8	12	21	31	48	75	110
0,25 m/s.	8	20	30	51	77	120	190	270
0,40 m/s.	12	31	48	81	130	200	300	430
0,55 m/s.	17	42	66	120	170	270	410	590
0,70 m/s.	21	54	84	150	220	340	530	750
0,85 m/s.	26	65	102	180	260	410	640	920
1,00 m/s.	30	77	120	210	310	480	750	1 100
1,15 m/s.	35	88	140	240	360	550	860	1 300
1,30 m/s.	39	99	160	270	400	620	970	1 400
1,45 m/s.	44	120	180	300	450	700	1 100	1 600
1,60 m/s.	48	130	200	330	490	770	1 200	1 800
1,75 m/s.	53	140	210	360	540	840	1 400	1 900
1,90 m/s.	57	150	230	390	580	910	1 500	2 100
2,05 m/s.	61	160	250	420	630	980	1 600	2 200
2,20 m/s.	66	170	270	450	680	1 100	1 700	2 400
2,35 m/s.	70	180	280	480	720	1 200	1 800	2 600
2,50 m/s.	75	200	300	510	770	1 200	1 900	2 700
2,65 m/s.	79	210	320	540	810	1 300	2 000	2 900
2,80 m/s.	84	220	340	570	860	1 400	2 100	3 000
2,95 m/s.	88	230	360	600	900	1 500	2 200	3 200
3,10 m/s.	93	240	370	630	950	1 500	2 400	3 400
3,25 m/s.	97	250	390	660	990	1 600	2 500	3 500
3,40 m/s.	110	260	410	690	1 100	1 700	2 600	3 700
3,55 m/s.	110	280	430	720	1 100	1 700	2 700	3 900
3,70 m/s.	120	290	450	750	1 200	1 800	2 800	4 000
3,85 m/s.	120	300	460	780	1 200	1 900	2 900	4 200
4,00 m/s.	120	310	480	810	1 300	2 000	3 000	4 300
4,15 m/s.	130	320	500	840	1 300	2 000	3 100	4 500
4,30 m/s.	130	330	520	870	1 400	2 100	3 200	4 700
4,45 m/s.	140	340	530	900	1 400	2 200	3 400	4 800
4,60 m/s.	140	360	550	930	1 500	2 200	3 500	5 000
4,75 m/s.	150	370	570	960	1 500	2 300	3 600	5 100
4,90 m/s.	150	380	590	990	1 500	2 400	3 700	5 300
5,05 m/s.	160	390	610	1 100	1 600	2 500	3 800	5 500
5,20 m/s.	160	400	620	1 100	1 600	2 500	3 900	5 600
5,35 m/s.	160	410	640	1 100	1 700	2 600	4 000	5 800
5,50 m/s.	170	420	660	1 200	1 700	2 700	4 100	5 900
5,65 m/s.	170	440	680	1 200	1 800	2 700	4 300	6 100
5,80 m/s.	180	450	700	1 200	1 800	2 800	4 400	6 300
5,95 m/s.	180	460	710	1 200	1 900	2 900	4 500	6 400
6,10 m/s.	190	470	730	1 300	1 900	3 000	4 600	6 600
6,25 m/s.	190	480	750	1 300	2 000	3 000	4 700	6 700
6,40 m/s.	200	490	770	1 300	2 000	3 100	4 800	6 900
6,55 m/s.	200	500	780	1 400	2 000	3 200	4 900	7 100
6,70 m/s.	200	520	800	1 400	2 100	3 200	5 000	7 200
6,85 m/s.	210	530	820	1 400	2 100	3 300	5 100	7 400
7,00 m/s.	210	540	840	1 500	2 200	3 400	5 300	7 500

6.5. Configuration

See the ALICAT MCR flow regulator user manual in the Appendix.

6.6. Recommendations

ALWAYS supply air or gas to the electronic core BEFORE supplying it with electricity.

DO NOT install limiting equipment and/or with risk of clogging (such as silencers or remote collection piping) which could throttle the outgoing flow at the emergency decompression level. This would eventually endanger users.

This manual describes the general operating diagram of the basic module developed by SERVINOX. As such, it cannot be considered as a standard solution applicable as is.

The SERVINOX team must conduct an audit of each production line on which one plans to install such a control system in collaboration with the users in order to define the most suitable solution for the proposed case.

7 COMMISSIONING

7.1. Transport/Reception/Handling

On reception, check that:

- ***the packaging is in good condition,***
- the delivered equipment ***conforms to the order,***
- the equipment ***has not been damaged.***

If the equipment is damaged, it must not be installed. Contact the manufacturer or, if necessary, the distributor.

7.2. Storage

If the equipment is not installed immediately upon delivery, it should be ***stored in accordance with best practices.***

It should be stored in its original packaging, in a covered place, protected from dirt, rain, snow, insects, and vibrations.

Safe storage temperature is between 5°C and 40°C, with relative air humidity < 50%.

7.3. Installation

General points

The customer is responsible for installing the module.

The customer should ensure the module is installed correctly as well as the connection to the main piping with standard fittings. It shall also check the tightness of the installation before commissioning.

The module must be installed right-side up (i.e., in the top/bottom direction as defined on the plan). In addition, the module is unidirectional. The direction of the compressed air flow in the module must not be reversed.

The module must not receive a shock, blow or fall that could damage it.

Before using the equipment, the user must visually inspect the equipment to ensure that it seems to be in good condition: no corrosion, damaged parts, etc.

Workers

The work must be performed by qualified and experienced personnel.

Precautions before commissioning

Before commissioning, the RVO module must be configured and tested (see the chapters on Operating conditions and Configuration) to ensure that it operates smoothly with the features of the production line it is installed on.

8 MAINTENANCE AND SERVICING

8.1. General points

The equipment must be maintained to operate properly.

It must be inspected at regular intervals. It must be inspected 6 months after commissioning.

SERVINOX supplies spare parts to ensure the equipment is maintained properly and to maintain the warranty. Specify the product SKU for any order.

Please contact SERVINOX for advice on equipment maintenance.

Maintenance precautions

Please comply with the following before any maintenance work:

- Lock out the equipment
- Depressurize the system

8.2. Inspections and servicing

At least the following aspects must be inspected:

- Absence of leaks.
- Traces of corrosion.

We recommend recording all maintenance and inspection operations performed on the system in a table of this type:

Date	Company	Worker name	Signature
PREVENTATIVE MAINTENANCE			
Operations		**Other, Remarks**	
CHECKS THAT THE MODULE OPERATES CORRECTLY AND IS IN GOOD CONDITION			
Operations		**Other, Remarks**	

9 WARRANTY

Unless stated otherwise in the proposal, ***the equipment is guaranteed for 12 months starting from the date of delivery.***

Parts acknowledged as defective by an expert analysis in our plant will be replaced at our expense.

All equipment components (wear parts, seals, etc.) must be replaced by original SERVINOX parts

The warranty does not cover damage resulting from:

Improper assembly, inappropriate use or abuse,

An accident or non-compliant installation,

A modification of the equipment,

Leakage due to the flow of impurities will not be taken into account,

Failure to perform mandatory servicing and/or maintenance.

The warranty provided for our products covers free repair of returned parts when it can be proven that they became prematurely unusable as a result of a manufacturing or material defect.

We cannot be held liable for any compensation or other obligation of this kind.

The equipment is inspected before leaving the plant.

It is hereby certified that this equipment has been inspected and is authorized for sale.

10 APPENDIX

The Fastest Flow Controller Company in the World!

OPERATING MANUAL

MC · MCW · MCR · MCV

Thank you for purchasing an Alicat flow controller.

If you have any questions about operating it, or if something is not working as expected, please let us know. We are eager to help you in any way possible.

Alicat Scientific, Inc.
info@alicat.com • alicat.com

7641 N Business Park Drive, Tucson, AZ 85743 USA

1-888-290-6060

Serial Number: _____

Next Calibration (Month/Day) : _____

Recalibrate your flow controller every year.

Alicat recommends that you have your flow meter calibrated every year in order to ensure the continued certainty of your readings and extend the Limited Lifetime Warranty. When it's time for your flow meter's annual recalibration, contact us by phone, email or live chat to set it up, or fill out the Service Request Form at **alicat.com/service**.

NIST

This Alicat device comes with a NIST traceable calibration certificate.

RoHS

This Alicat flow controller conforms to the European Union's Restriction of Use of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2011/65/EU.

CE

This Alicat flow controller complies with the requirements of the Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU and carries the CE Marking accordingly.

This Alicat flow controller complies with the requirements of the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC.

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Introduction

You're busy, and the last thing you want to do is waste time wrestling with your flow controller. We're here to make your life a little easier so you can do what you do best. It's our pleasure to introduce you to your new Alicat:

- **High-accuracy performance for all your gases.** Use your flow controller with any of the 98 or more gases that are part of Gas Select™, **page 34**.
- **Control pressure while monitoring flow rate.** Set the closed loop control algorithm for pressure control, **page 23**.
- **Backlit display with adjustable contrast** is easy to read in direct sunlight. In dimly lit areas, press the Alicat logo to turn on the backlight, **page 7**.
- **Change your STP** to match any standard temperature and pressure reference, **page 38**.
- **Log data to your PC.** Talk to the flow controller serially to capture all flow data for logging and analysis, **page 42**.

This manual covers the following Alicat Scientific instruments:

- **MC**, **MCP**, and **MCR**-Series Mass Gas Flow Controllers
- **MCD** and **MCRD**-Series Dual Valve Mass Gas Flow Controllers
- **MCE** and **MCES**-Series Mass Gas Flow Controllers
- **MCQ** and **MCRQ**-Series High Pressure Mass Gas Flow Controllers
- **MCS** and **MCRS**-Series Anti-Corrosive Mass Gas Flow Controllers
- **MCV** and **MCVS**-Series Vacuum Mass Gas Flow Controllers
- **MCW** and **MCRW (WHISPER)**
  Low Pressure Drop Mass Flow Controllers

This includes Alicat flow controllers labeled as approved for CSA Class 1 Div 2 and ATEX Class 1 Zone 2 hazardous environments. See **page 60** for Special Conditions regarding the use of CSA/ATEX labeled devices.

Please contact Alicat at 1-888-290-6060 or **info@alicat.com** if you have any questions regarding the use or operation of this device.

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Contents

Quick Start Guide

Setup

- **Connect your flow controller.** Ensure that flow through your device will be in the same direction as the arrow on the flow body (usually left to right).
- **Tare your flow controller.** Before you connect the flow meter, ensure that no air is flowing through the device and give it a zero setpoint for at least 2 seconds. **Note:** Whisper flow controllers are sensitive enough to measure the lightest of breezes, so ensure that one end is plugged before selecting tare.
- **Choose your engineering units.** Press the button above or below any parameter to enlarge it in the middle of the display. If you select that same item a second time, you can change the engineering unit for that parameter. You can choose units for all of the parameters at once by selecting `MENU` → `BASIC CONFIG` → `DEVICE UNITS` (see **page 18**).

Operation: Flow Verification

- **Monitor live flow readings.** You can monitor live readings of flow, pressure, and temperature by viewing the screen. Readings are updated in real time. See **page 17**.
- **Tare your flow controller** before you begin another round of measurements. Ensure that no flow is passing through your controller and wait for it to auto-tare. See **page 22**.
- (Optional) **Capture a totalized reading.** The totalizer option displays the total flow that has passed through the device since the last time the totalizer was reset. Press `TOTAL/MENU` to access the totalizer. See **page 19**.

Backlight

Your Alicat monochrome display comes equipped with a backlight. **To activate the backlight, press the center of the Alicat logo on the front of your device.** To turn the backlight off press the button again. For color displays, pressing this button will turn off the display to conserve power.

Maintenance and Care

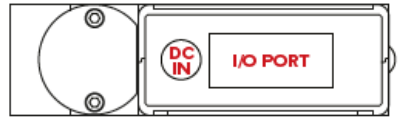
- If your gas is clean, your flow meter will require no periodic cleaning. Read more about maintenance on **page 51**.
- Calibrate your flow meter annually. Request an Alicat factory calibration at alicat.com/service or by calling **1-888-290-6060**.

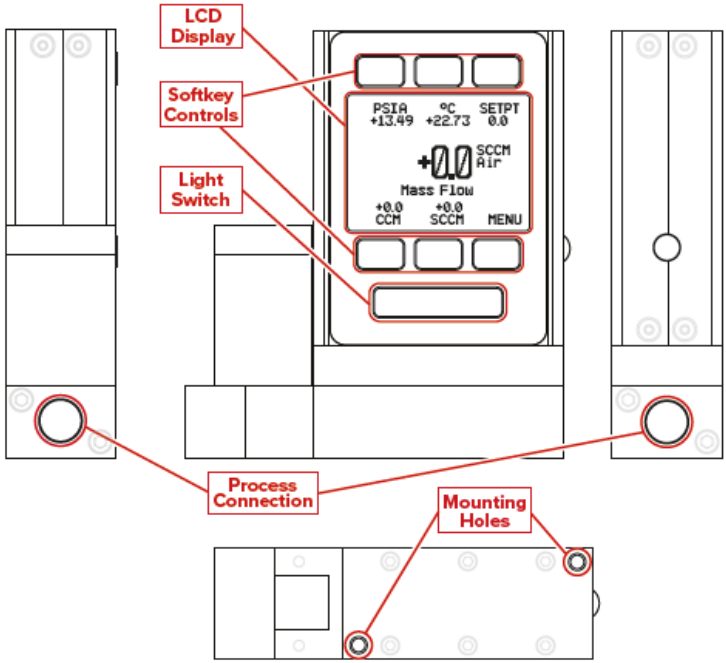
Getting Started

Getting to Know Your Alicat

Connectors and Buttons

The drawings below represent the default configuration of a standard Alicat mass flow controller (MC series) with an upstream valve. **Your flow controller's appearance and connections may differ**, especially if it has been ordered with a large Rolamite valve or a downstream valve.





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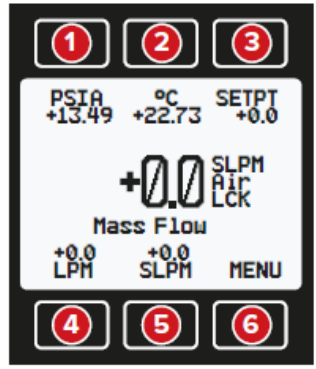
The Flow Controller Display

The figure below identifies the various features of the flow controller display. Press the large button with the Alicat logo to toggle the backlight on and off. For more details, see the Menu Map on **page 16** and the menu-by-menu descriptions that follow it.

Engineering units are used by the controller in its serial communications and calculations. These can be different from **button units**, which are the units being displayed. These are individually configurable. See **page 18**.



1. Highlights **pressure** in the center of the meter. Push a second time to choose the pressure parameter (if available), or to select pressure engineering units.
2. Highlights **temperature**. Push a second time to select temperature engineering units.
3. SETPT sets the **flow or pressure control setpoint** (see **page 24**).
4. Highlights **volumetric (actual) flow** rate. Push a second time to select volumetric flow rate engineering units.
5. Highlights **mass flow** rate. Push a second time to select mass flow (normal mass flow) or true mass flow engineering units.
6. TOTAL Accesses **flow totalizer** (optional) (**page 19**). MENU enters the Menu system (**page 22**)

Status Messages

ADC	Analog-digital converter error
EXH	Valve exhaust is active
HLD	Valve hold is active
LCK	Front display is locked (in the example above)
MOV	Mass flow over range of device
OPL	Overpressure limit exceeded (optional)
OVR	Totalizer rolled over to zero
POV	Pressure over range of device
TMF	Totalizer missed out of range flow
TOV	Temperature over range of device
VOV	Volumetric flow over range of device

Mounting

No straight runs of pipe are required upstream or downstream of the flow controller. Most Alicat flow controllers can be mounted in any position, including upside-down. MCS and MCRS series flow controllers use media-isolated sensors that must be tared after changing orientation.

Caution: *Flow controllers that use large Rolamite valves (MCR, MCRW, MCRQ, MCRS) should be mounted with their valve oriented vertically (right-side up). If another orientation is desired, please contact Alicat.*

Filters

When pressure drop is not an issue, use in-line sintered filters to prevent large particulates from entering the flow controller. Suggested maximum particulate sizes are as follows:

- **5 microns** for units with flow ranges of 1 SCCM or less.
- **20 microns** for units with flow ranges between 2 SCCM and 1 SLPM.
- **50 microns** for units with flow ranges of 1 SLPM or more.

Device Ports

Your controller has been shipped with plastic plugs fitted into its ports. To lessen the chance of contaminating the flow stream, do not remove these plugs until you are ready to install the device.

Standard Alicat Gas Flow controllers have female inlet and outlet ports. Welded VCR and other specialty fittings may have male connections.

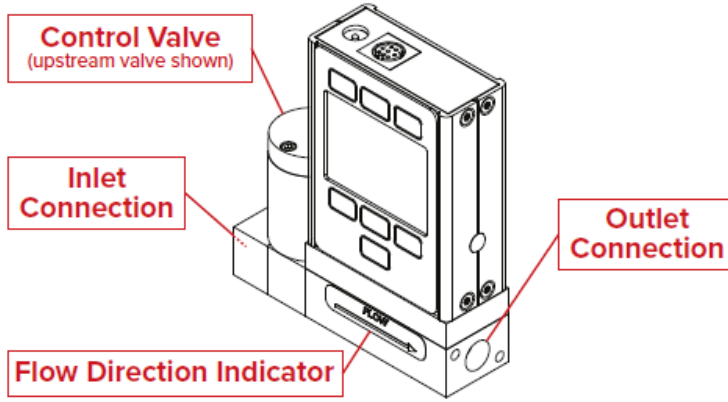
- If you are using a fitting that does not have a face seal, use thread-sealing Teflon tape to prevent leakage around the port threads, but do not wrap the first two threads. This will minimize the possibility of getting tape into the flow stream and clogging the laminar flow elements (LFEs).
- If you are using a fitting that has a face seal, there is no need to apply Teflon tape to the threads.

Warning: *It is not recommended to use pipe dopes or sealants on the process connections as these compounds can cause permanent damage to the controller should they get into the flow stream.*

Connecting Plumbing to Your Gas Flow Controller

Your Alicat flow controller can measure and control flow generated by positive pressure and/or suction. Connect the controller so that the flow travels in the same direction as the flow arrow, usually from left to right as you look at the front of the device.

Note: On instruments set up for vacuum or gas mixing, the control valve will be situated in the down-stream position.



Warning: *Using the flow controller above the maximum specified internal line pressure, or above the maximum recommended differential pressure between the inlet and outlet, will result in permanent damage to the internal pressure sensors.*

A common cause of this problem is the instantaneous application of high-pressure gas, as from a snap-acting solenoid valve either upstream or downstream of the flow controller. If you suspect that your pressure sensor is damaged, please discontinue use of the device and contact Alicat. See the chart below for pressure limits.

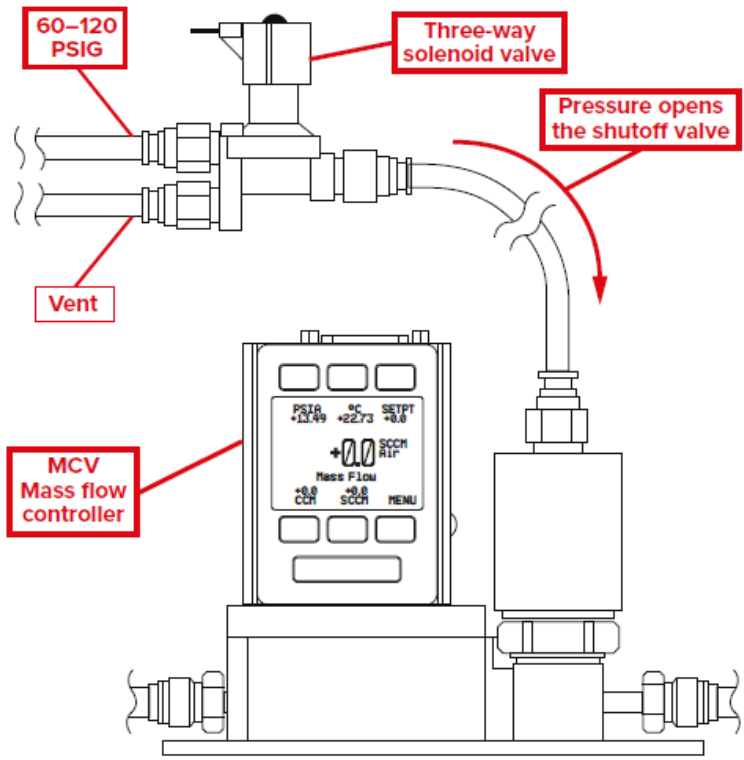
Model	Max Common Mode Pressure	Max Differential Pressure
MC, MCR, MCS, MCE, MCP, MCV	175 PSIA	75 PSID
MCW, MCRW	80 PSIA	15 PSID
MCQ, MCRQ	400 PSIA	75 PSID

MCV Controller Operating Notes

Alicat's MCV mass flow controller is equipped with an integrated Swagelok® positive shutoff valve. The normally closed valve is opened by supplying with 60–120 PSIG of air pressure. The shut-off valve closes again when this pressure is removed.

A common method for actuating the shutoff valve incorporates a three-way solenoid valve (below). Pressure is applied to one side of the solenoid valve while the other side of the solenoid is left open to atmosphere. When the solenoid is energized, pressure is delivered to the shutoff valve, causing it to open. When the solenoid is returned to a relaxed state, the gas vents to atmosphere, allowing the shut-off valve to close.

All standard MC-Series device features and functions are available on the MCV Series and operate in accordance with the standard MC Series operating instructions.



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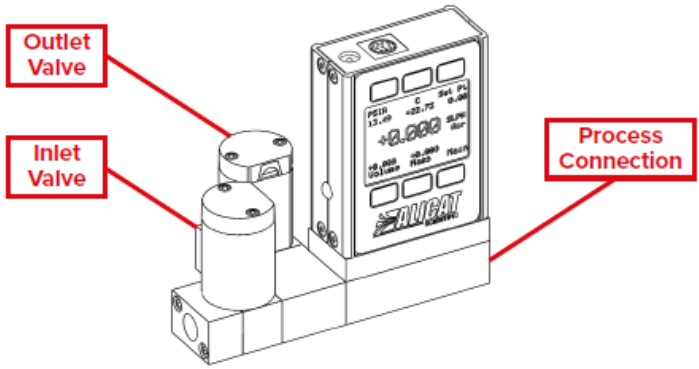
MCD Dual Valve Controller Operating Notes

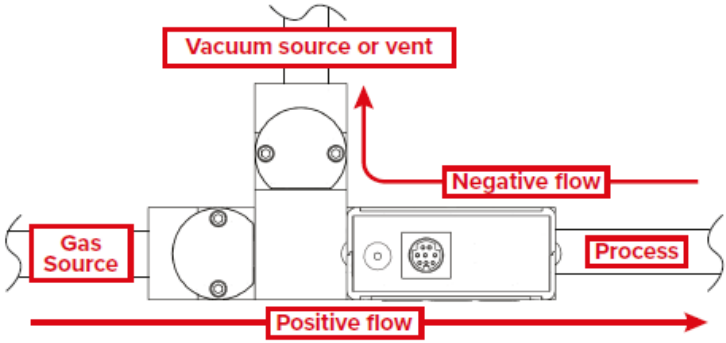
The MCD is a versatile Dual-Valve Mass Flow and Pressure Controller. It can be used to:

- Measure mass flow and volumetric flow in both directions, plus absolute pressure and temperature.
- Control mass or volumetric flow from a pressurized source or to vacuum.
- Control pressure in a flowing process.
- Control pressure in a closed volume with automatic venting.

Please contact Alicat if you have any questions regarding MCD use.



Bidirectional Mass or Volumetric Flow Control

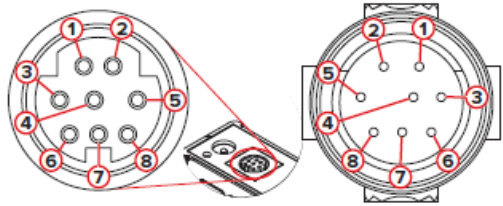


Power and Signal Connections

Power can be supplied to your controller through either the power jack or the multi-pin connector on top of your device.

Small valve controller power jacks require a 12–24 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 250 mA. 4–20 mA analog signal outputs require at least 15 Vdc, and 0–10 Vdc outputs require at least 10 Vdc.

Large valve controllers (MCR models) require a 24 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 1 A.



Female Connector: Device Male Connector: Cable

Standard 8-Pin Mini-DIN Pinout

Pin	Function	Cable color
1	Not Connected (or optional 4–20 mA Primary Output Signal)	Black
2	Static 5.12 Vdc by default. Optional: Secondary Analog Output (4–20 mA, 0–5 Vdc, 1–5V dc, 0–10 Vdc) or Basic Alarm	Brown
3	Serial RS-232 RX / RS-485(–) Input Signal (receive)	Red
4	Analog Setpoint Input	Orange
5	Serial RS-232 TX / RS-485(+) Output Signal (send)	Yellow
6	0–5 Vdc (or optional 1–5 Vdc or 0–10 Vdc) Output Signal	Green
7	Power In (as described above)	Blue
8	Ground (common for power, digital communications, analog signals and alarms)	Purple

Note: *The above pinout is applicable to all the flow controllers and controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.*

Caution: *Do not connect power to pins 1 through 6, as permanent damage can occur. It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0–5 Vdc analog output signal. Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage.*

For 6-pin locking industrial connector, M12, DB9, and DB15 pinouts, see ***page 56*** *to* ***page 59*** *or visit* **alicat.com/pinout**.

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Analog Signals

Primary Analog Output Signal

Most Alicat instruments include a primary analog output signal, which is linear over its entire range. For both standard 0–5 Vdc and optional 0–10 Vdc output signals, a zero flow condition is usually in the range of 0.010 Vdc. Zero flow for the optional 1–5 Vdc and 4–20 mA output signals is 1 Vdc and 4 mA, respectively. Full scale flow is 5 Vdc for 0–5 Vdc and 1–5 Vdc signals, 10 Vdc for 0–10 Vdc signals and 20 mA for 4–20 mA signals.

Alicat's default 8-pin mini-DIN connector places the primary analog output on Pin 6 for voltage signals and Pin 1 for 4–20 mA current signals. Ground for these signals is common on Pin 8.

Option: Second Analog Output Signal

Alicat's default 8-pin mini-DIN connector places the secondary analog output on Pin 2 for both voltage and current signals. Your device's secondary analog signal may differ from its primary output signal.

See the calibration sheet that shipped with your controller to determine which output signals were ordered.

Option: 4–20 mA Current Output Signal

If your controller has a 4–20 mA current primary or secondary output signal, your flow controller will require 15–30 Vdc power.

Caution: *Do not connect 4–20 mA devices to "loop powered" systems, as this will destroy portions of the circuitry and void the warranty. If you must interface with existing loop powered systems, always use a signal isolator and a separate power supply.*

Option: Color TFT Display

Instruments ordered with a color display function the same as standard backlit monochrome instruments, but color is used to provide additional on-screen information.

Multi-Color Display Indicators

- **GREEN**: Parameter labels and adjustments associated with the button directly above or below the label are presented in green.
- **WHITE**: A parameter is displayed in white while operating under normal conditions.
- **RED**: A parameter is displayed in red when its value exceeds 128% of the device's specifications.
- **YELLOW**: Menu items that are ready to be selected appear in yellow. This color replaces the symbol (>) in selections on monochrome display.

Press the Alicat logo button to turn off the color display backlight. The flow controller remains in operation while the backlight is off.

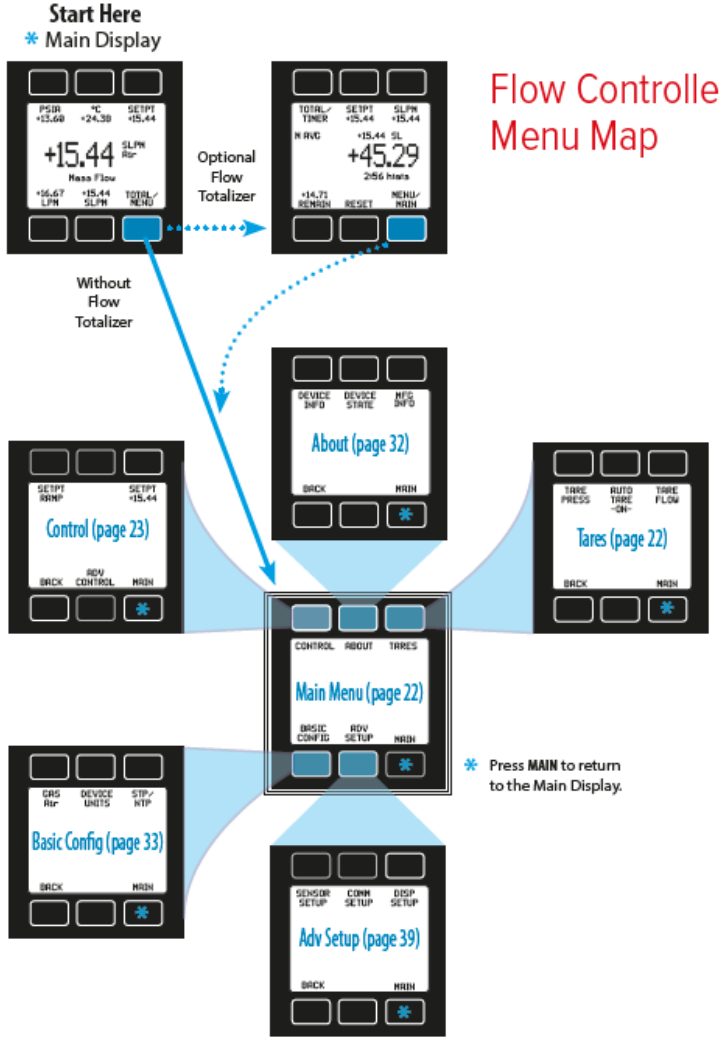
LCD Contrast

LCD contrast is ranged from 0 to 11 on color displays, with 11 indicating the greatest contrast. See "Display Setup" on **page 39.**

Specifications for Instruments with Color Displays

Color displays will require an additional 40 mA when using a 24 Vdc power supply. All other specifications from your device's specification sheet remain in effect.

Navigation and Customization



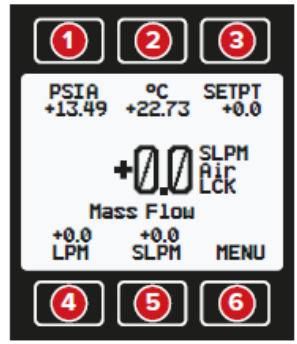
Displaying Live Flow Data

The Main Display has three primary functions:

- Displaying live temperature, pressure, and flow data (see below)
- Changing engineering units for temperature, pressure, and flow (**page 18**)
- Changing the flow or pressure control setpoint (**page 24**)

This screen displays live data for all flow parameters simultaneously. Live data is measured 1000 times per second and typically displayed 10 times per second on the device LCD screen. Press the button next to any of the four flow parameters once to highlight its value in the center of the screen. Press the same button again to enter the engineering unit selection menu for that parameter (**page 18**), which can optionally be different from units being displayed (see "Button engineering units" on **page 18**).

Main Display



1. Highlights **pressure** in the center of the meter. Push a second time to select pressure engineering units, or choose the pressure parameter:
   - Internal absolute pressure
   - Internal gauge pressure (optional)
   - Barometric pressure (optional)
2. Highlights **temperature**. Push a second time to select temperature engineering units.
3. SETPT sets the **flow or pressure control setpoint** (see **page 24**).
4. Highlights **volumetric (actual) flow** rate. Push a second time to select volumetric flow rate engineering units.
5. Highlights **mass flow** rate. Push a second time to select mass flow engineering units and switch between standardized, normalized, and true mass flow.
6. TOTAL Accesses **flow totalizer** (optional) (see **page 19**). MENU enters the Menu system (see **page 22**).

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Choosing Engineering Units

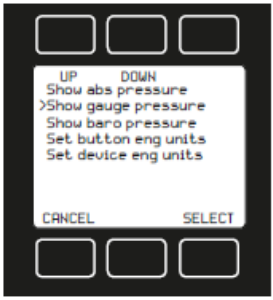
Press the button next to any of the four flow parameters twice to enter its unit selection menu. You can change units in two ways:

Button engineering units alter the display only, not the serial data:

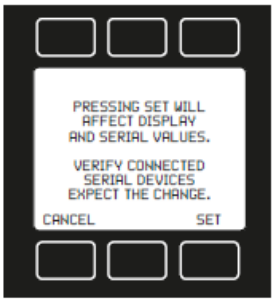
- Select **Set button eng units** and press **SELECT** to change the engineering unit on the display only. This does not alter the controller serial data.

Device engineering units alter both the display and the serial data frame:

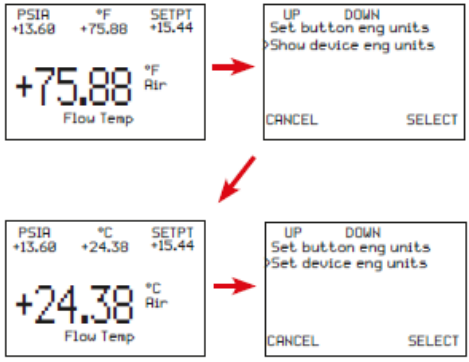
- Select **Set device eng units** and then choose the **engineering** unit as above. An additional confirmation screen asks you to confirm the serial change.
- If the button engineering unit is different than the device engineering unit, **Set device eng units** will not appear. First select **Show device eng units** to revert the button to the current device unit for that parameter. Enter the unit selection menu again to change the device engineering unit.



The example above shows the unit selection menu for a device that has the internal barometer option.



Examples of changing device engineering units:



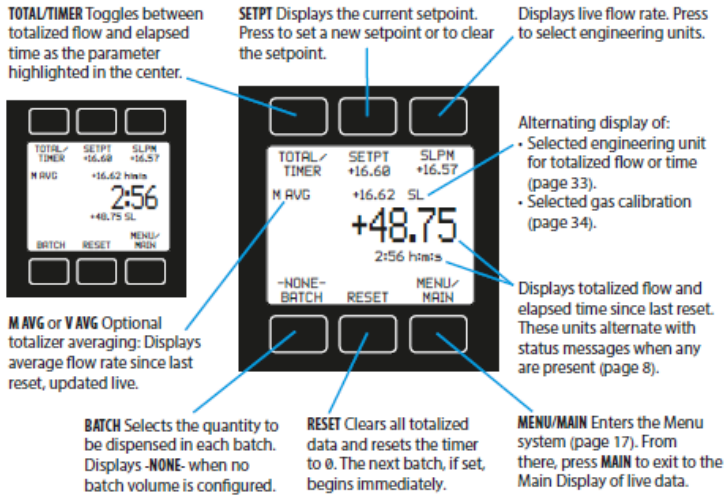
Changing device units:
In the example on the left, °F is not the existing device engineering unit, so the unit selection menu displays **Show device eng units**. Select this to revert the button unit to the device engineering unit for this parameter.

Changing device units:
After the change, °C is the existing device engineering unit, so the unit selection menu displays **Set device eng units**. Select this to choose a new unit.

Option: Totalized Flow Data and Batch Dispensing

Your flow controller may have an optional flow totalizer, which enables batch dispensing. The totalizer displays the total amount of mass or volume that has flowed through the instrument since its last reset, like a gasoline pump. Access the totalizer screen by pressing TOTAL/MENU on the Main Display.

Totalizer – Main Screen Totalizer Rollover Functions



Your flow totalizer has been configured to report a maximum of 7 digits. By default, the placement of the decimal is the same as the live flow rate. The totalizer can be configured at the time of order for the following behaviors. (By default, the totalizer rolls over and displays OVR.)

- **Rollover:** Totalizer resumes counting from 0 as soon as the maximum count has been reached.
- **Freeze:** Totalizer stops counting at max count, until it is reset manually.
- **Error:** Displays OVR status message when maximum count has been reached; compatible with Rollover and Freeze.

The elapsed time counter has a maximum value of 9999:59:59 (h:m:s) (416 days, 16 hours). If flow is still being totalized at that point, the timer freezes, regardless of the behavior chosen above for the totalized flow readings.

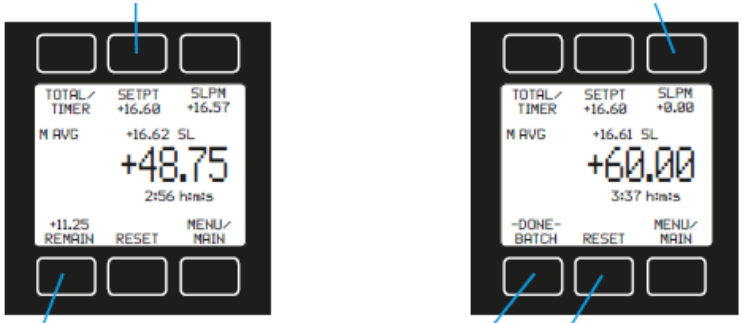
Dispensing Gas in Batches

Batch dispensing allows you to choose a desired total volume to flow, after which the valve closes. You can repeat batches with a single button press.

Totalizer – Batch Mode

SETPT Displays the current setpoint. Batch dispensing can begin only when there is a non-zero setpoint.

Flow stops as soon as the batch completes.



REMAIN Displays the remaining quantity yet to be dispensed. Press to select a new quantity.

DONE BATCH Appears when the batch is complete. Press to select a new quantity to be dispensed.

RESET Clears all totalized data and resets the timer to 0. The next batch begins immediately.

How to start batch dispensing

1. From the totalizer screen, press **BATCH**. Choose the total quantity to be dispensed in each batch. Press **SET** to accept the new batch size.
2. From the totalizer screen, press **SETPT** to choose a non-zero setpoint. Flow begins as soon as you press **SET**.

Note: *Batch dispensing requires an active batch size and a non-zero setpoint. If your controller already has a non-zero setpoint, flow begins as soon as you press SET from the batch size screen.*

3. While a new batch is being dispensed, the **BATCH** button changes to show the quantity that remains to be dispensed. When the batch size has been achieved, the **BATCH** button displays **–DONE–** and flow stops automatically.

The batch size can be changed while a batch is in progress. If the new batch size is larger than the current totalized flow, then flow continues until the new value is reached. If the new batch size is smaller than the current totalized flow, then the flow stops immediately. Press **RESET** to start the new batch.

How to repeat a batch

- For a new batch of identical size, simply press **RESET**. Flow begins immediately.
- For a new batch of a different size, press **BATCH**, and then select the new batch size. Flow begins as soon as you press **SET**.

How to cancel a batch

1. To pause a batch in progress, set the mass flow setpoint to 0 by pressing **SETPT** → **CLEAR** → **SET**. Resume with a non-zero set point.
2. To remove a batch setting, press **TOTAL/MENU** → **BATCH** → **CLEAR** → **SET** and then select a batch size of 0. Deleting the batch has no effect on the flow setpoint, so unless the controller's flow is interrupted (as in step 1 above) the controller will continue to allow flow at the setpoint's rate.

Caution: *If your controller has a non-zero setpoint when batch dispensing is turned off, flow will resume immediately at the current setpoint.*

Note: *The batch size is retained across power cycles of your flow controller. It must be manually cleared when no longer desired.*

When batch mode is off, –**NONE**– appears above the **BATCH** button.

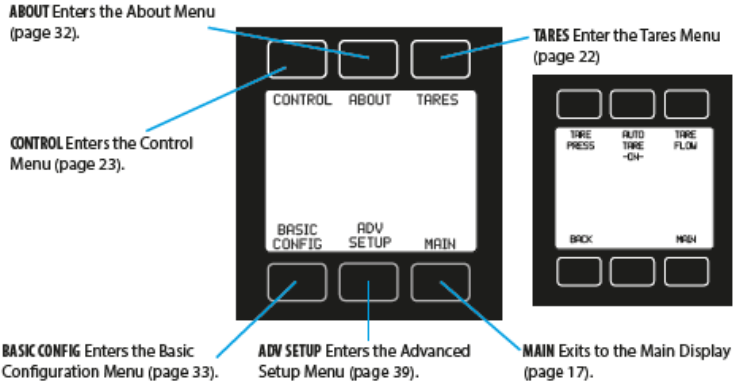
Using the Totalizer or Batch Dispensing while Controlling Pressure

While using a mass flow controller in pressure control mode, it is possible for the flow rate to exceed the maximum measurable flow (128% of full scale) when making an abrupt pressure change. In this case, the totalized flow value will flash, and the controller will report a **TMF** message to indicate that the totalizer missed flow data. Please reset the totalizer to clear the incomplete data.

In certain situations, it is possible to exceed the desired batch size. For example, if the feed pressure is too low to achieve the flow setpoint and then pressure is suddenly increased, the batch size may be exceeded before the valve reacts to the sudden burst of pressure.

Menu

Enter the menu system by pressing the **MENU** button from the Main Display.



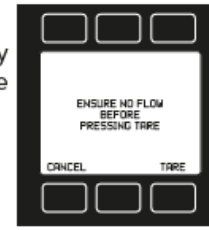
Taring Your Flow Controller

Taring is an important practice that ensures that your flow controller is providing the most accurate measurements possible. This function gives the flow controller a good zero reference for flow measurements. For controllers with a barometer, taring can also be used to align the internal absolute pressure sensor with the barometric pressure reading.

How to Tare

When auto tare is **–ON–** your flow controller automatically tares its flow rate whenever it has a zero setpoint for more than two seconds. For manual tares, follow these steps:

1. Ensure that nothing is flowing through the device, usually by giving the controller a zero setpoint.
2. **MENU** → **TARES** → **TARE FLOW**. Flow tares should occur at the expected process pressure, as long as there is no flow.
3. **MENU** → **TARES** → **TARE PRESS**. Absolute pressure tares must be done with the controller open to atmosphere. (Optional barometer required.)



TARE FLOW

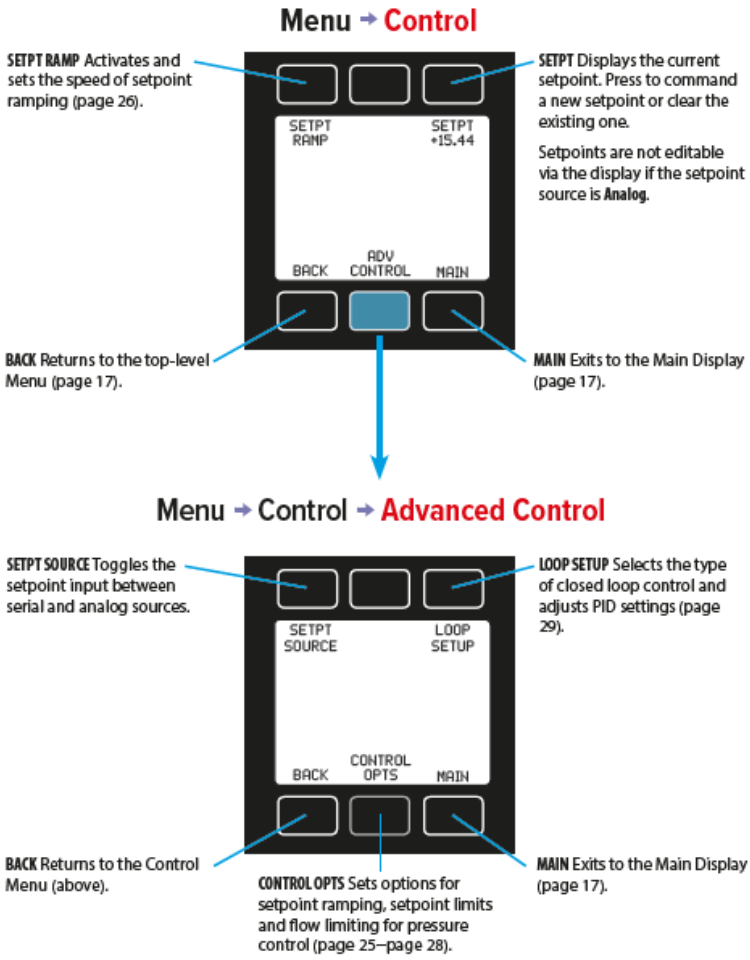
TARE PRESS

When to tare

- After significant changes in temperature or pressure.
- After installing the controller in a different orientation.
- After dropping or bumping the flow controller.

Control Menus

The **CONTROL** and **ADV CONTROL** menus allow you to command new setpoints, change the setpoint control loop, and adjust proportional integral and derivative (PID) control settings, among other options.



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Changing the Setpoint

Press the **SETPT** button from either the Main Display or the Control Menu (`MENU CONTROL`) to choose a new setpoint. The setpoint selection screen indicates the engineering units and maximum allowable setpoint (e.g., `SLPM 20.00 Max`). To cancel a setpoint, press `CLEAR`.

Changing Between Setpoint Sources

Mass flow controllers with RS-232/RS-485 and/or Modbus RTU communication will accept setpoints from the front panel, a serial connection, or an analog signal. Change the setpoint source by selecting `MENU` → `CONTROL` → `ADV CONTROL` → `SETPT SOURCE`.

- When the source is set to `Serial/Front Panel`, the controller will accept input from either the front panel, or an RS-232/RS-485 connection. Neither source is a slave of the other, so the controller will accept the most recent command from either source.
- When the source is set to `Analog`, the controller will ignore serial setpoint commands and will prevent input from the front panel.

Adjusting the setpoint with the optional IPC (Integrated Potentiometer Control)

If your controller has been ordered with a potentiometer control knob (IPC), the setpoint source must be set to Analog for the controller to accept setpoint commands from the IPC.

When using an analog setpoint signal with a controller that has an IPC, leave the IPC knob at the midpoint when it is not in use.

Changing the Control Loop Variable

Your mass flow controller can control the flow rate or the pressure in your process. Change the control loop variable by selecting `MENU` → `CONTROL` → `ADV CONTROL` → `LOOP SETUP` → `LOOP VAR`. Loop variables include mass flow, volumetric flow, and absolute pressure. Devices with internal barometers also allow control of gauge pressure.

Note: *When pressure is selected as the control loop variable, flow controllers with upstream valves will control the outlet pressure. Those with downstream valves can control upstream backpressure, but these must be configured for this type of control.*

When changing the control loop from mass or volumetric flow to absolute or gauge pressure, you may need to adjust the PID settings for optimal stability and speed of response. (See PID on ***page 29****.)*

Establishing Setpoint Limits

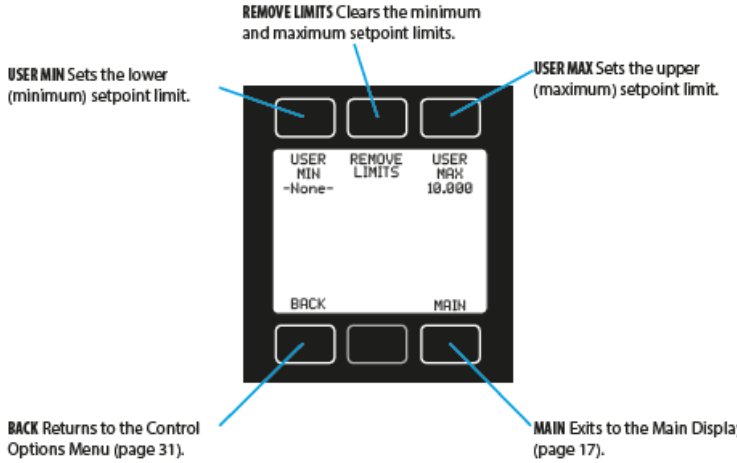
The Setpoint Limits Menu lets you set up upper and lower limits for selecting a flow or pressure control setpoint. To access this menu, select **MENU → CONTROL → ADV CONTROL → CONTROL OPTS → SETPT LIMITS.**

- When using the front panel, if you try to command a new setpoint that is outside of the upper and lower limits, the display notifies you that the requested setpoint is out of range.
- Over a serial connection, a setpoint outside the limit will be rejected with an error. When using an analog setpoint signal, setpoints that are outside of the setpoint limits are treated as if they were at the nearest limit. If you request a setpoint that is below the lower limit, the controller makes the setpoint to be at the lower limit. Likewise, if you request a setpoint that is above the upper limit, the controller sets the setpoint at the upper limit.

Flow controllers that have non-zero lower setpoint limits cannot be set to stop flow until the lower limit has been cleared.

Note: *When changing from one control loop variable to another, the flow controller remembers setpoint limits as percentages of full scale. For example, a 10-SLPM limit on a unidirectional 20-SLPM controller (50% full scale) will become a limit of 80 PSIA (50% of 160 PSIA) if the control loop is changed to absolute pressure.*

Menu → Control → Advanced Control → Control Options → Setpoint Limits



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Using Setpoint Ramping

Setpoint ramping regulates how quickly your mass flow controller will reach the requested flow or pressure setpoint. This feature is especially useful when you need to prevent sudden bursts of pressure or flow from hitting delicate instruments when you start up your process.

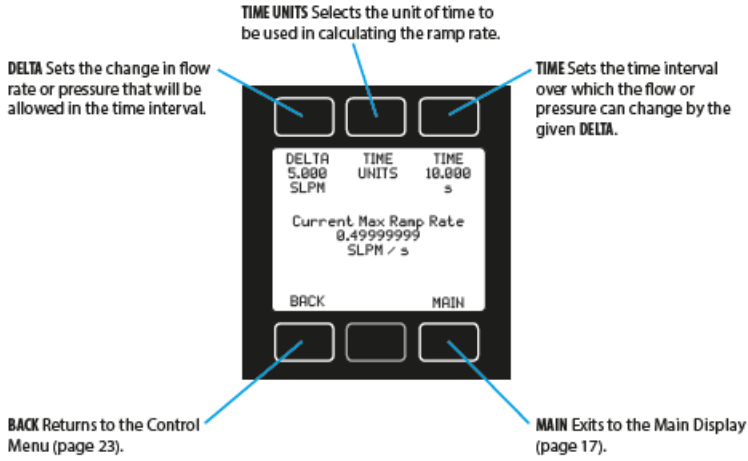
To activate setpoint ramping, you need to set a maximum ramp rate, and you need to configure when to enable the ramping function.

Setting a Maximum Setpoint Ramp Rate

With ramping enabled in at least one direction, set up the maximum ramp rate by selecting **MENU** → **CONTROL** → **SETPT RAMP**. Press **DELTA** to define the maximum allowable change in flow rate or pressure. Press **TIME** to define the amount of time within which that change occurs. The flow controller will display the resulting maximum ramp rate in the center of the display.

Note: *Setpoint ramping can be used with flow or pressure setpoints, depending on the control loop selected. Ramping for pressure control limits how quickly pressure changes before reaching the setpoint. To limit flow rates directly while controlling pressure, see "Limiting flow rate while controlling pressure" on* ***page 28****.*

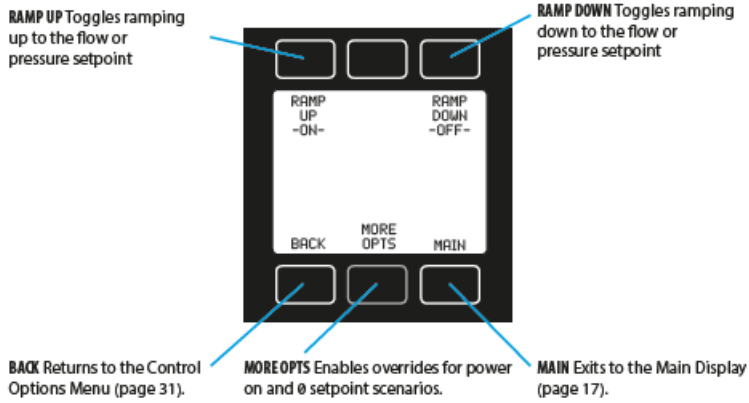
Menu → Control → Setpoint Ramp



Enabling the Setpoint Ramping Function

Your flow controller enables the ramping function independently for changes that require increases or decreases to achieve the new setpoint. For example, you can enable ramping up to a flow setpoint to prevent flow from building too quickly, but disable ramping down so that you can stop flow immediately. Enable these ramping directions by selecting **MENU** → **CONTROL** → **ADV CONTROL** → **CONTROL OPTS** → **RAMP ENABLE**. Each direction toggles on and off.

Menu → Control → Advanced Control → Control Options → Ramp Enable



Enabling setpoint ramping overrides

The **MORE OPTS** button in the Ramp Enable Menu lets you set up overrides for the ramping function for two independent scenarios:

- **POWER ON** applies an override where the controller ignores any enabled ramping whenever it is powered on. If it had a non-zero setpoint when it was turned off, it immediately reapplies this former setpoint. All setpoints after power up honor the enabled ramping options. This override is indicated by "Setpt at power on is instantly applied".
- **ZERO CMD** applies an override where controller ignores any enabled ramping whenever a 0 setpoint has been commanded. This override is indicated by "Zero setpt command instantly zeroes".

Note: *The two ramping options above either honor or override the ramp settings established in the Ramp Enable Menu. If ramping is not enabled for either direction, the override options have no effect.*

Limiting Flow Rate While Controlling Pressure

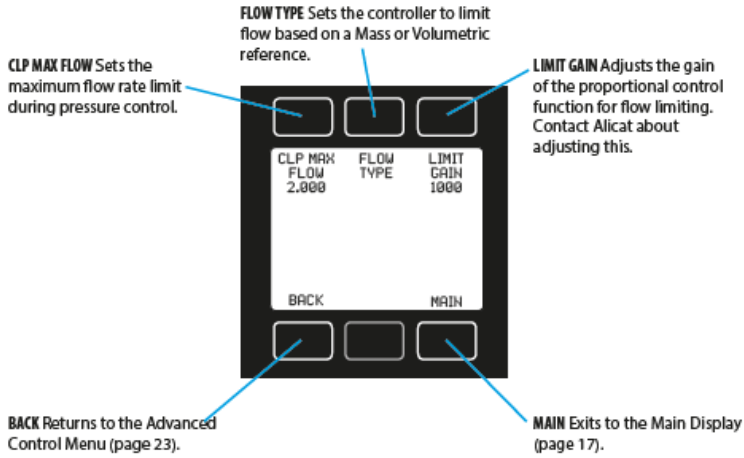
When the control loop variable is set to control pressure, setpoint ramping regulates how quickly it reaches the pressure setpoint by limiting how quickly the measured pressure can change. This provides direct control of pressure.

To limit flow rates directly while controlling pressure, set up flow limiting for pressure control by selecting **MENU** → **CONTROL** → **ADV CONTROL** → **CONTROL OPTS** → **CLP MAX FLOW**. Press **FLOW TYPE** to select a flow control loop based on mass flow or volumetric flow. Press **CLP MAX FLOW** to set the desired maximum flow rate.

The **LIMIT GAIN** option determines how aggressively the proportional control function will correct the error when the flow rate exceeds the defined maximum flow setting. Be sure to record the initial value before attempting any changes to this variable.

Note: *If both flow limiting and pressure setpoint ramping are active when controlling pressure, the more restrictive function will regulate the controller's operation as it attempts to attain the setpoint.*

Menu → Control → Advanced Control → Control Options → CLP Max Flow



Adjusting the Closed Loop Controller

Your mass flow controller uses an electronic closed loop controller to determine how to actuate its valve(s) in order to achieve the commanded setpoint. We have tuned these settings for your specific operating conditions, but changes to your process sometimes require on-site adjustments to maintain optimal control performance. If you encounter issues with control stability, oscillation or speed of response, fine-tuning your closed loop control may help.

The **LOOP SETUP** menu (**MENU** → **CONTROL** → **ADV CONTROL** → **LOOP SETUP**) lets you choose the closed loop control algorithm and adjust the gain settings for the proportional, integral, and derivative variables.

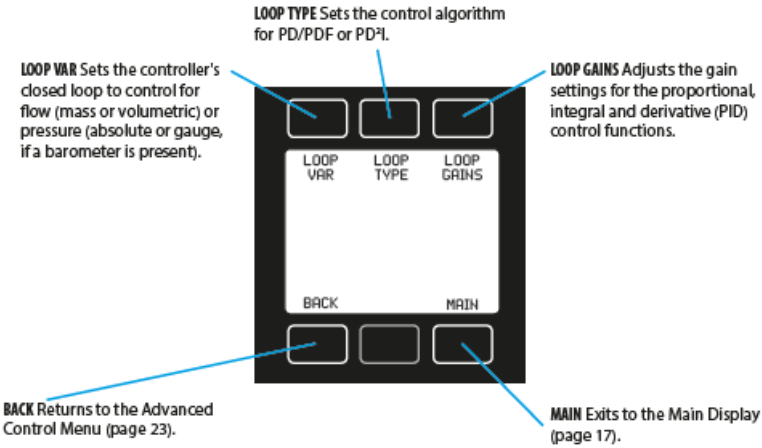
Tuning the PD/PDF control algorithm

Alicat's default control algorithm (PD) employs pseudo-derivative feedback (PDF) control, which uses two editable variables:

- The larger the **D** gain, the slower the controller will correct errors between the commanded setpoint and the measured process value. This is equivalent to the P variable in common PDF controllers.
- The larger the **P** gain, the faster the controller will correct for offsets based on the size of the errors and the amount of time they have occurred. This is equivalent to the I variable in common PDF controllers.

Note: *The D and P variables in Alicat's PD/PDF control algorithm are more typically referred to as P and I, respectively, in PDF controllers.*

Menu → Control → Advanced Control → Loop Setup



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Tuning the PD²I control algorithm

Alicat's PD²I control algorithm (also called PDDI) is used to provide faster response, most commonly in dual-valve flow and pressure controllers. This algorithm uses typical PI terms and adds a squared derivative term (D):

- The larger the **P** gain, the more aggressively the controller will correct errors between the commanded setpoint and the measured process value.
- The larger the **I** gain, the faster the controller will correct for offsets based on the size of the errors and the amount of time they have occurred.
- The larger the **D** gain, the faster the controller will predict needed future corrections based on the current rate of change in the system. This often results in slowing the system down to minimize overshoot and oscillations.

Troubleshooting valve performance with PID tuning

The following issues can often be resolved by adjusting the PID gain values for your mass flow controller.

Fast oscillation around the setpoint

- PD: Reduce the P gain in decrements of 10%
- PD²I: Increase the P gain in increments of 10%, and then adjust the I gain to fine-tune.

Overshot setpoint

- PD: Reduce the P gain in decrements of 10%.
- PD²I: If D is not 0, increase the P gain in increments of 10%.

Delayed or unattained setpoint

- PD: Increase the P gain in increments of 10%, and then decrease the D gain by small amounts to fine-tune.
- PD²I: Increase the P gain in increments of 10%, and then increase the I gain to fine-tune.

For help with configuring PD²I for the first time, visit **alicat.com/pd2i** *for tuning instructions.*

Valve tuning can be complex. Please give us a call, and we'll be happy to guide you through the process. Or, visit **alicat.com/pid** *for more detailed instructions.*

Using a Control Deadband for MCDs

The control deadband is designed for use with closed-volume pressure control applications to minimize the amount of gas exhausted. The deadband defines a region above and below the setpoint within which the process variable is permitted to deviate from the setpoint.

Example: When controlling pressure in a closed volume with a setpoint of 30 PSIA, a deadband of ±1 PSIA would allow the absolute pressure to vary between 29 and 31 PSIA before actively controlling the valves to the setpoint.

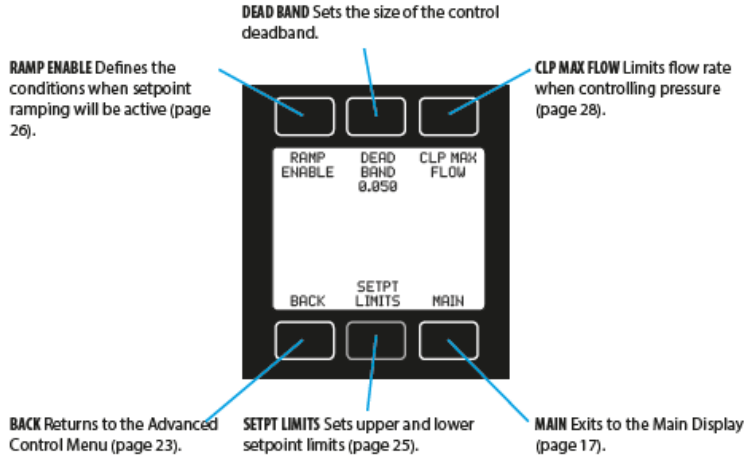
To turn on the control deadband, enter a non-zero value in **MENU** → **CONTROL** → **ADV CONTROL** → **CONTROL OPTS** → **DEAD BAND**. In order for the deadband to activate, the setpoint must first be achieved by the controller. If the process variable drifts to a deadband limit, active control resumes until the setpoint is achieved again.

Note: *Deadband settings for a **pressure control** loop **close** the valve(s) when activated.*

*Deadband settings for a **flow control** loop **freeze** the valve(s) in its current position.*

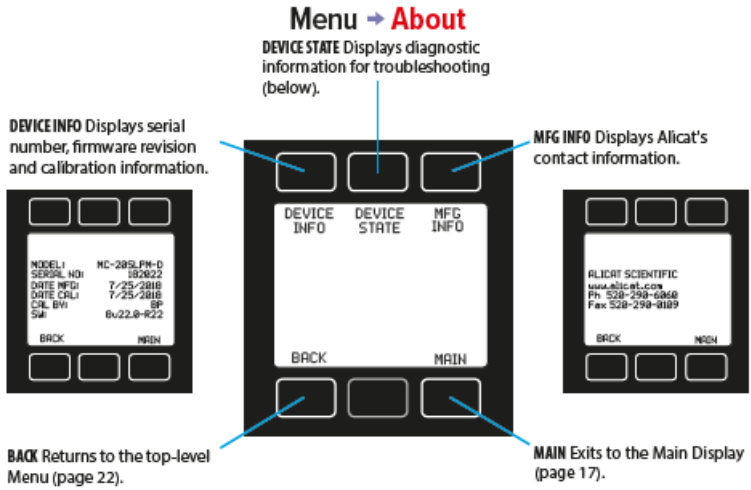
CAUTION: *Control deadband is also available on single valve mass flow controllers, however they do not have an exhaust valve to reduce pressure when pressure exceeds the deadband.*

Menu → Control → Advanced Control → Control Options



About

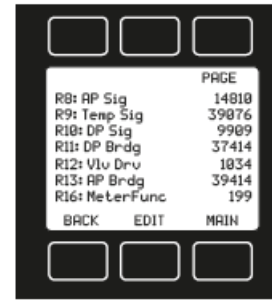
We hope you don't run into trouble using your flow controller, but if you do, the **ABOUT** menu contains information that can make the troubleshooting process easier. Select **MFG INFO** to look up Alicat's phone number and web address. **DEVICE INFO** shows you the serial number and firmware version (**SW:**) for your specific device. It also gives you the original manufacturing date and the last calibration date, as well as the initials of the Alicat calibration technician.



Diagnostic Information

The **DEVICE STATE** screen displays live values for the internal device registers.

Many of these values can help an Alicat applications engineer diagnose operational issues over the phone. Some register values clearly distinguish between hardware and operational problems, which speeds up the troubleshooting process.

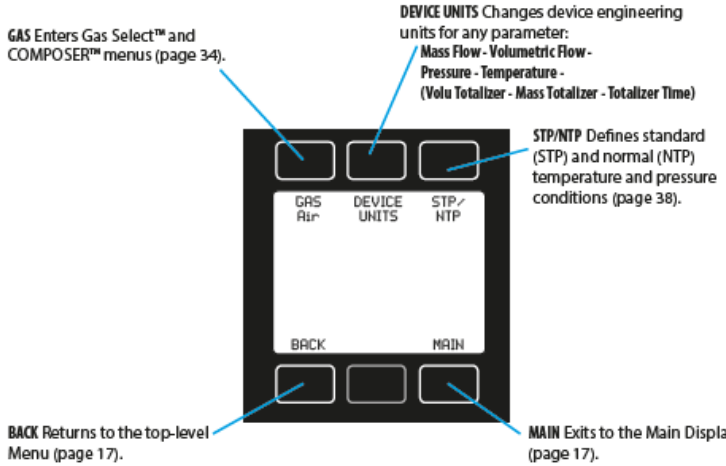


Within the **DEVICE STATE** screen (**MENU** → **ABOUT** → **DEVICE STATE**), press **PAGE** to advance to the next page of register values.

Basic Configuration Menu

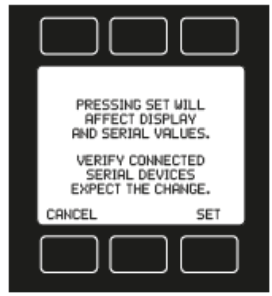
The Basic Configuration Menu contains options for choosing the gas calibration, device engineering units and STP/NTP mass flow references.

Menu → Basic Configuration



Choosing Engineering Units from the Basic Configuration

Your flow controller will come with preselected engineering units based on the full scale range of your device, usually SLPM or SCCM. Changing device engineering units alters both the display and the data frame. First choose the parameter whose unit you want to change, and then select your desired engineering unit, confirming the change on the last screen. If your controller has been configured with a flow totalizer, this screen will also include units for totalized volumetric and mass flow, plus elapsed time.



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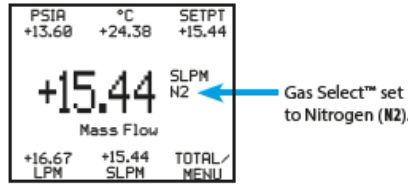
Gas Select™

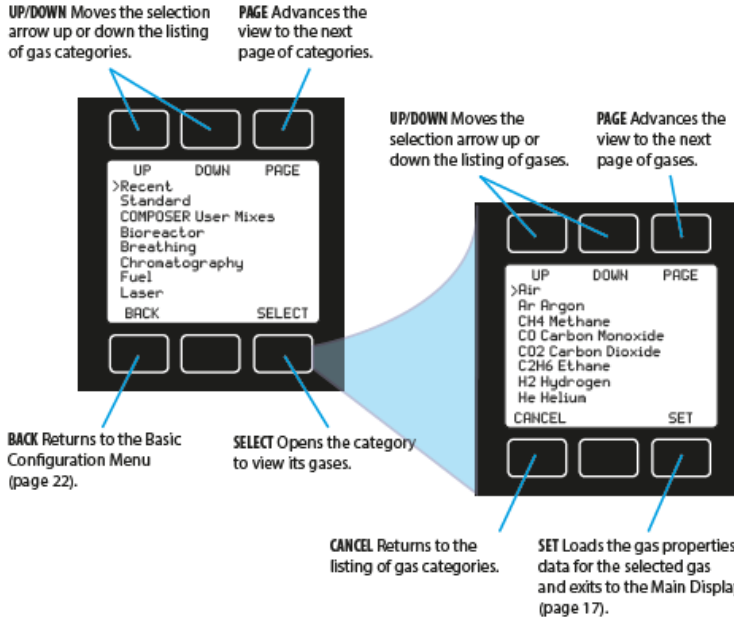
In most cases, your flow controller was physically calibrated on air at Alicat's factory. Gas Select™ allows you to reconfigure the flow controller to flow a different gas without sending it back to Alicat for a physical recalibration.

To use Gas Select™, simply choose a gas or gas mix from one of the listed categories. As soon as you press **SELECT** from the gas listing, your flow controller will reconfigure itself to accurately measure the flow of your chosen gas. There is no need to restart the flow controller.

Your current gas selection appears just below the unit's indicator on the right side of the Main Display:



Menu → Basic Config → Gas → Category Listing



Navigation and Customization

Gas List

Your Alicat is preloaded with gas properties data for the following gases:

Pure Non-Corrosive Gases

Acetylene (C_2H_2)
Air (Clean Dry)
Argon (Ar)
Isobutane (i-C_4H_{10})
Normal Butane (n-C_4H_{10})
Carbon dioxide (CO_2)
Carbon monoxide (CO)
Deuterium (D_2)
Ethane (C_2H_6)
Ethylene (Ethene) (C_2H_4)
Helium (He)
Hydrogen (H_2)
Krypton (Kr)
Methane (CH_4)
Neon (Ne)
Nitrogen (N_2)
Nitrous Oxide (N_2O)
Oxygen (O_2)
Propane (C_3H_8)
Sulfur Hexafluoride (SF_6)[1]
Xenon (Xe)

Breathing Gases

Metabolic Exhalant

EAN-32	EA-80	Heliox-50
EAN-36	Heliox-20	Heliox-60
EAN-40	Heliox-21	Heliox-80
EA-40	Heliox-30	
EA-60	Heliox-40	Heliox-99

Bioreactor Gas Mixes

5%–95% CH_4/CO_2 in 5% increments

Refrigerants[2]

R-11[3]	R-116	R-152a
R-14	R-124[3]	R-318
R-22[3]	R-125[3]	R-404A[3]
R-23[3]	R-134a[3]	R-407C[3]
R-32[3]	R-142b[3]	R-410A[3]
R-115[3]	R-143a[3]	R-507A[3]

Welding Gases

C-2	C-25	He-75
C-8	C-50	He-90
C-10	C-75	
C-15	He-25	A 1025
C-20	He-50	Stargon CS

Chromatography Gas Mixes

P-5 P-10

Oxygen Concentrator Gas Mixes

89% O_2, 7% N_2, 4% Ar
93% O_2, 3% N_2, 4% Ar
95% O_2, 1% N_2, 4% Ar

Stack/Flue Gas Mixes

2.5% O_2, 10.8% CO_2, 85.7% N_2, 1% Ar
2.9% O_2, 14% CO_2, 82.1% N_2, 1% Ar
3.7% O_2, 15% CO_2, 80.3% N_2, 1% Ar
7% O_2, 12% CO_2, 80% N_2, 1% Ar
10% O_2, 9.5% CO_2, 79.5% N_2, 1% Ar
13% O_2, 7% CO_2, 79% N_2, 1% Ar

Laser Gas Mixes

4.5% CO_2, 13.5% N_2, 82% He
6% CO_2, 14% N_2, 80% He
7% CO_2, 14% N_2, 79% He
9% CO_2, 15% N_2, 76% He
9.4% CO_2, 19.25% N_2, 71.35% He
9% Ne, 91% He

Fuel Gas Mixes

Coal Gas 50% H_2, 35% CH_4, 10% CO, 5% C_2H_4
Endothermic Gas 75% H_2, 25% N_2
HHO 66.67% H_2, 33.33% O_2
LPG HD-5 96.1% C_3H_8, 1.5% C_2H_6, 0.4% C_3H_6 , 1.9% n-C_4H_{10}
LPG HD-10 85% C_3H_8, 10% C_3H_6, 5% n-C_4H_{10}

Natural Gases

93% CH_4, 3% C_2H_6, 1% C_3H_8, 2% N_2, 1% CO_2
95% CH_4, 3% C_2H_6, 1% N_2, 1% CO_2
95.2% CH_4, 2.5% C_2H_6, 0.2% C_3H_8, 0.1% C_4H_{10}, 1.3% N_2, 0.7% CO_2

Synthesis Gases

40% H_2, 29% CO, 20% CO_2, 11% CH_4
64% H_2, 28% CO, 1% CO_2, 7% CH_4
70% H_2, 4% CO, 25% CO_2, 1% CH_4
83% H_2, 14% CO, 3% CH_4

Pure Corrosive Gases[2]

Ammonia (NH_3)	Dimethylether (DME)
Butylene (1-Buten)	Hydrogen Sulfide (H_2S)
Cis-Butene (c-Buten)	Nitrogen Trifluoride (NF_3)
Isobutane (i-Buten)	Nitric Oxide (NO)
Trans-Butene (t-Buten)	Propylene (C_3H_6)
Carbonyl Sulfide (COS)	Silane (SiH_4)
Chlorine (Cl_2)[4]	Sulfur Dioxide (SO_2)[4]

1 *Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.*

2 *S-series units only*

3 *Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.*

4 *S-series with PCA valves only*

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Using COMPOSER™ to Create Custom Gas Mix Compositions

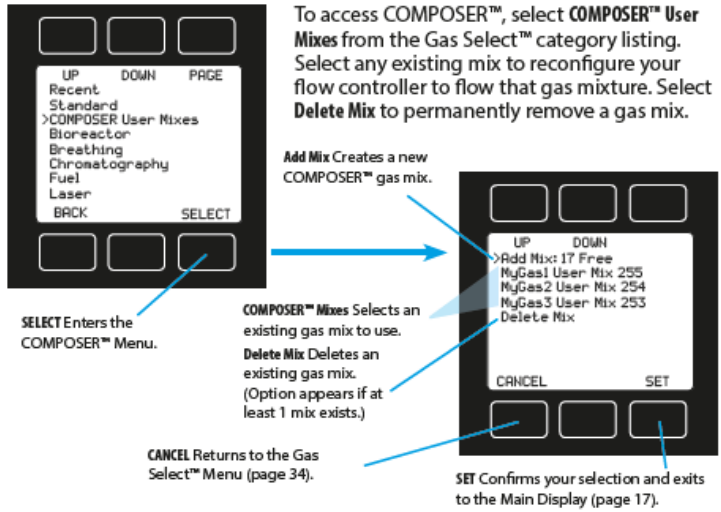
To remain accurate, your flow controller needs to know the viscosity of the gas you are flowing through it. The more closely you can define your actual gas composition, the more accurate your flow readings will be. Alicat's COMPOSER™ is an included feature of Gas Select™ that lets you define new mixed gas compositions to reconfigure your flow controller on the fly.

COMPOSER™ uses the Wilke method to define a new gas mixture based on the molar (volumetric) ratios of the gases in the mixture. You can define these gas compositions to 0.01% for each of up to five constituent gases in the mixture. Once you define and save a new COMPOSER™ gas mix, it becomes part of the Gas Select™ system and is accessible under the gas category COMPOSER™ User Mixes. You can store 20 COMPOSER™ gas mixes on your flow controller.

Note: *COMPOSER™ does not physically mix any gases, it configures your flow controller to report flow readings accurately based on the constituent gases of your mixture. If you require turnkey gas mixing, please contact Alicat.*

Menu → Basic Config → Gas → COMPOSER User Mixes

To access COMPOSER™, select **`COMPOSER User Mixes`** from the Gas Select™ category listing. Select any existing mix to reconfigure your flow controller to flow that gas mixture. Select **`Delete Mix`** to permanently remove a gas mix.

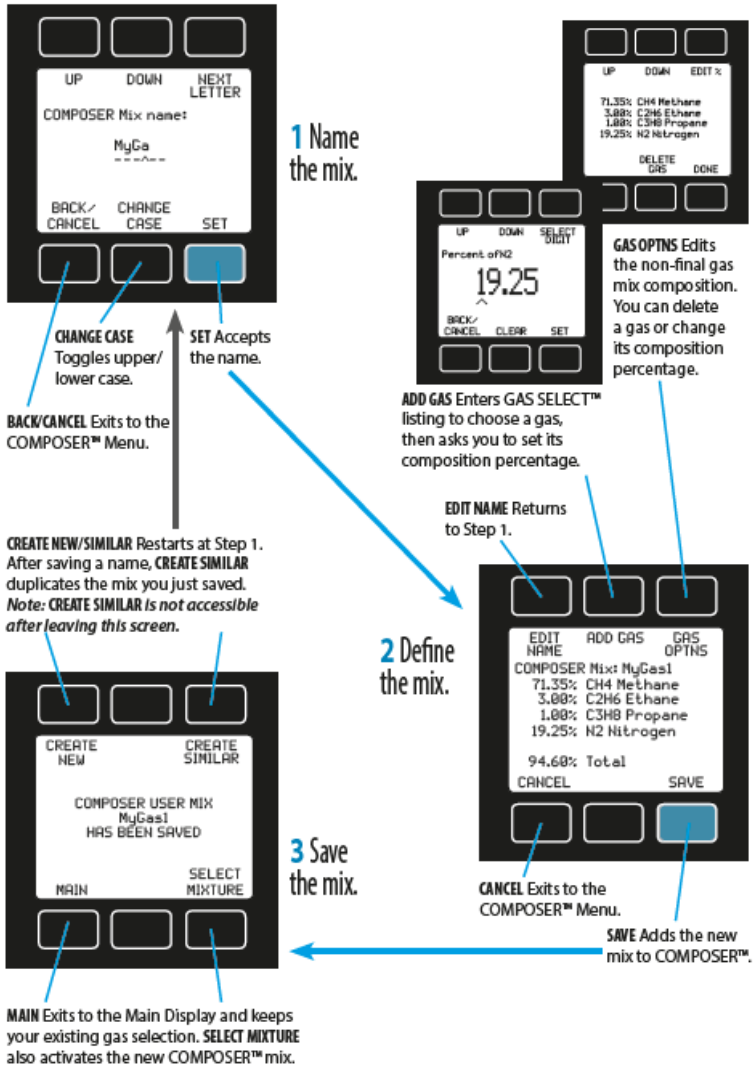


Note: *Your Alicat device does not store the composition of saved gas mixes, only the required viscosity and density as a function of temperature and pressure. It might be helpful to write it down.*

Adding a new COMPOSER™ mixed gas composition

Generate and store a new COMPOSER™ mix in 3 easy steps.

Note: *You cannot save your mix until the total is 100%.*
Saved gas compositions can be deleted, but not modified.



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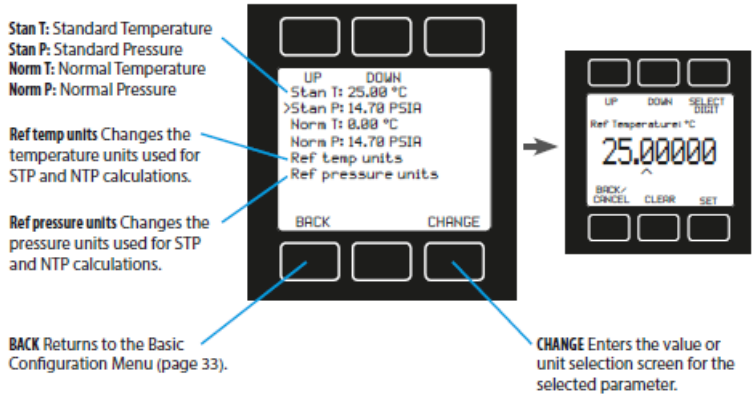
Defining STP/NTP Reference Values

Standardized flow rates are reported in "standard" or "normal" volumetric flow units that reference a given temperature and pressure combination. This reference is called an STP (standard temperature and pressure) or, typically in Europe, an NTP (normal temperature and pressure).

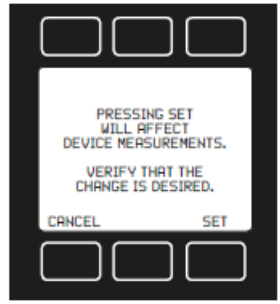
Menu → Basic Config → STP/NTP



Using the STP/NTP menu, you can independently change the temperature or pressure references for STP and NTP. Your flow controller ships with Alicat default STP of 25°C and 1 atm (for flow units beginning with "S"), and an NTP of 0°C and 1 atm (for flow units beginning with "N").

To make changes, follow these steps:

1. Select the desired pressure or temperature reference engineering unit by selecting `Ref temp units` or `Ref pressure units` and pressing `CHANGE`. Both normal and standard references use the same engineering units.
2. Select the temperature or pressure value you wish to modify, and press `CHANGE`.
3. At the confirmation screen, press `SET` to confirm your desired change.

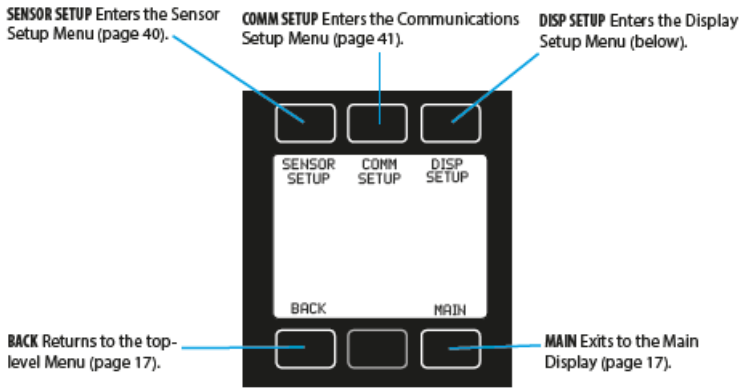


Caution: *Changes to STP/NTP references will alter your mass flow readings.*

Advanced Setup

The Advanced Setup Menu lets you configure the display, zero band, averaging (for flow and pressure), and serial communications.

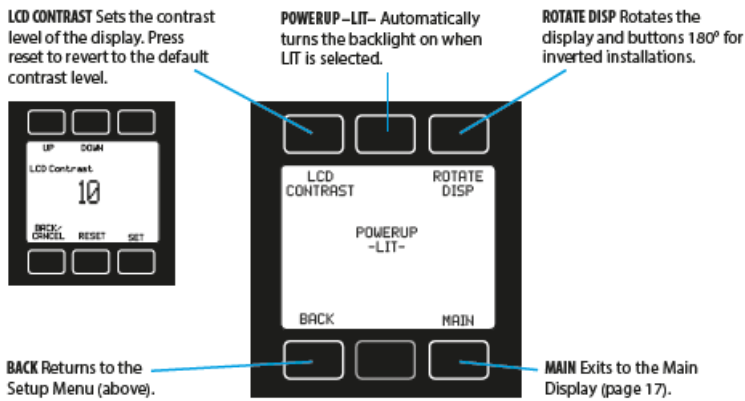
Menu → Advanced Setup



Display Setup

The options in the Display Setup Menu adjust the contrast of the display and enable screen rotation.

Menu → Advanced Setup → Display Setup



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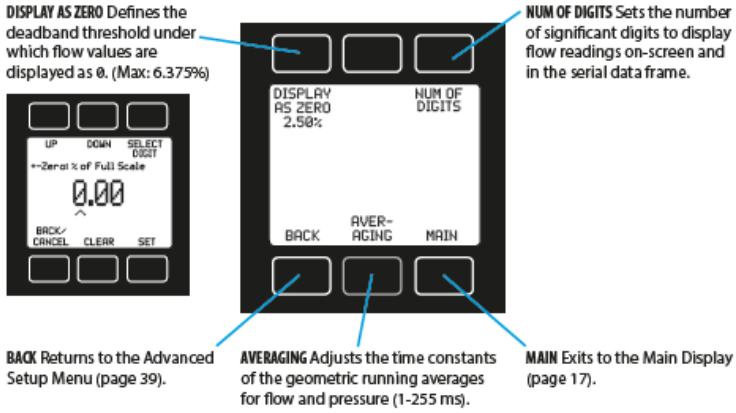
Sensor Setup

The **Sensor Setup** Menu contains advanced settings that govern how the flow and pressure sensors report their data.

Menu → Advanced Setup → Sensor Setup



The zero band threshold (**DISPLAY AS ZERO**) is the value below which the flow controller displays all flow readings as "0" (no flow). This function also applies to gauge pressure readings when using the optional barometer. The default deadband is optimized for the model and range of the mass flow controller to ignore common noise sources. This can be changed to accommodate a zero dead band up to 6.375% of full scale and is rounded on the display. For example, if you set a deadband value of 0.25%, so on a 20-SLPM instrument, all readings below 0.05 SLPM would display as 0 SLPM.

Note: *Deadband settings do not affect the values reported in serial data.*

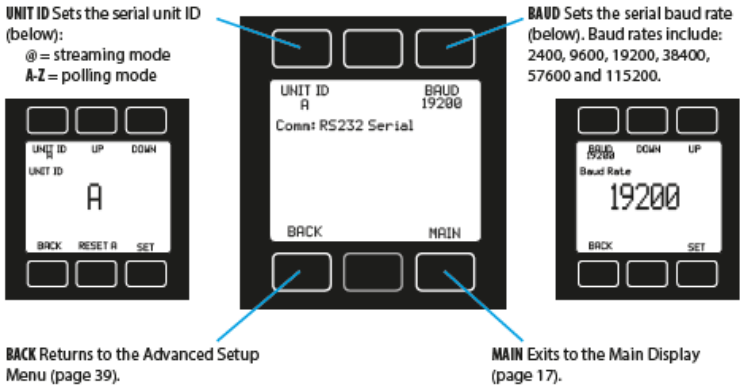
The **AVERAGING** button opens a submenu for adjusting the flow and pressure averaging, which are changed independently. Values roughly correspond to the time constant (in milliseconds) of the averaged values. Higher numbers generate a greater smoothing effect on rapidly fluctuating readings.

The maximum averaging time is 255 ms.

Configuring Serial Communications

You can operate the flow controller remotely via serial communication for easy streaming and logging of all data. Before connecting the flow controller to a computer, ensure that it is ready to communicate with your computer by checking the options in the **COMM SETUP** menu.

Menu ▶ Advanced Setup ▶ Comm Setup



Unit ID

The unit ID is the identifier that a computer uses to distinguish your flow controller from other Alicat devices when it is connected to a network. Using the unit ID letters A–Z, you can connect up to 26 devices to a computer at the same time via a single COM port. This is called polling mode (**page 43**). Unit ID changes take effect when you select SET.

If you select @ as the Unit ID, the flow controller enters streaming mode when you exit the menu (see **page 43**).

NOTE: *Devices equipped with Modbus RTU will also have a Modbus ID that can be set separately from the unit ID.*

Baud Rate

Baud rate is the speed at which digital devices transfer information. The flow controller defaults to a baud rate of 19200 baud (bits per second). If your computer or software uses a different baud rate, you must change the flow controller baud rate in the **BAUD** menu to match. Alternatively, you can change your computer's baud rate in Device Manager. Baud rate changes take effect once you press SET, but you may need to restart your computer software.

Serial Communication

Connecting your flow controller to a computer allows you to log the data that it generates. The flow controller communicates digitally through its communications connector and cable using a real or virtual COM port on your computer. This section of the manual shows you how to operate the flow controller using ASCII commands.

Establishing Communications

After connecting your flow controller using a communications cable, you will need to establish serial communications through a real or virtual COM port on your computer or programmable logic controller (PLC).

- If you have connected your device to a serial port, note its COM port number. This can be found in Windows Device Manager.
- If you have used a USB cable to connect your device to a Windows computer, in most cases it will recognize your USB as a virtual COM port. If it does not, download the appropriate USB device driver at **alicat.com/drivers** and note the COM port number as found in Windows Device Manager.
- The controller unit will be configured with the following settings:
  - **Baud:** 19200 (default; others can be used if the computer, its software and the Alicat device are set for the same rate)
  - **Data bits:** 8
  - **Stop bits:** 1
  - **Parity:** none
  - **Flow control:** none

Serial Terminal Application

Alicat's Serial Terminal is a preconfigured program for serial communications that functions much like the older Windows' HyperTerminal program.

Download Serial Terminal for free at **alicat.com/drivers**. Once downloaded, simply run SerialTerminal.exe. Enter the COM port number to which your device is connected and the baud rate of the flow controller. The default baud rate is 19200, but this is adjustable by entering the `SERIAL COMM` menu on your flow controller: `MENU` → `ADV SETUP` → `COMM SETUP` → `BAUD` (**page 41**).

Serial Streaming vs Polling

Note: *In what follows, ↵ indicates an ASCII carriage return (decimal 13, hexadecimal D). For many devices, this is the same as hitting the Enter key. Serial commands are not case-sensitive.*

Polling Mode

Your flow controller was shipped to you in polling mode with a unit ID of A, unless requested otherwise. Polling the flow controller returns a single line of data each time you request it. To poll your flow controller, simply enter its unit ID.

Poll the device: [unit ID]↵
Example: a↵ (polls unit A)

You can change the unit ID of a polling device by typing:

Change the unit ID: [current unit ID]@=[desired unit ID]↵
Example: a@=b↵ (changes unit A to unit B)

You can also do this via the flow controller menu: **MENU** → **ADV SETUP** → **COMM SETUP** → **UNIT ID** (**page 41**). Valid unit IDs are letters A–Z, and up to 26 devices may be connected at any one time, as long as each unit ID is unique.

Streaming Mode

In streaming mode, your flow controller continuously sends a line of live data at regular intervals without you having to request the data each time. Only one unit on a given COM port may be in streaming mode at a time. To put your flow controller into streaming mode, type:

Begin streaming: [unit ID]@=@↵

This is equivalent to changing the unit ID to "@". To take the flow controller out of streaming mode, assign it a unit ID by typing:

Stop streaming: @@=[desired unit ID]↵
Example: @@=a↵ (stops and assigns unit ID of A)

When sending a command to a flow controller in streaming mode, the flow of data will not stop while the user is typing. This may make the commands you type unreadable. If the device does not receive a valid command, it will ignore it. If in doubt, simply hit ↵ and start again.

Note: The default streaming interval is 50 ms, but this can be increased by changing Register 91 while the device is in polling mode:

Set streaming interval: [unit ID] w91=[number of ms]↵
Example: aw91=500↵
(streams new data every 500 ms)

Taring

Before collecting flow data, be sure to tare your flow controller. If auto-tare is enabled, this can be accomplished by provided a setpoint of 0 for at least 2 seconds.

Manual taring can be accomplished serially through two separate commands. Taring flow sets the zero flow reading and must be done when no flow is passing through the flow controller:

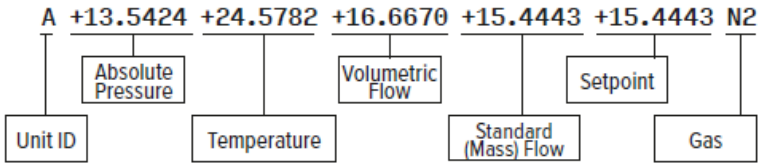
Tare flow: [unit ID]v↵
Example: av↵ (sets flow reading to zero)

For devices equipped with a barometer, the second tare aligns the internal absolute pressure sensor with the current barometer reading and must be done with the flow controller open to atmosphere:

Tare absolute pressure: [unit ID]pc↵
Example: apc↵
(aligns internal pressure to barometer)

Collecting Flow Data

Collect live flow data by typing the [unit ID] ↵ command or by setting your flow controller to streaming. Each line of data for live flow measurements appears in the format below, but unit ID is not present in streaming mode.



Single spaces separate each parameter, and each value is displayed in the chosen device engineering units, which may differ from the engineering units visible on the flow controller display (see "Choosing Engineering Units" on **page 18**). You can query the engineering units of the instant data frame by typing:

Query live data info: [unit ID]??d*↵
Example: a??d*↵
(returns the data frame descriptions)

Additional columns, including status codes (see "Status Messages" on **page 8**), may be present to the right of the gas label column. The unit ID appears in the data frame only when the flow controller is in polling mode.

Commanding a New Setpoint

Before attempting to send setpoints to your mass flow controller serially, confirm that its setpoint source is set to `Serial/Front Panel` by selecting `MENU` → `CONTROL` → `ADV CONTROL` → `SETPT SOURCE`.

There are two ways to command a new setpoint over a serial connection, as described below. In either of these methods, the data frame returns the new setpoint value when it has been accepted as a valid setpoint.

Sending Setpoints as Floating Point Numbers

This is how to send the desired setpoint value as a floating point number in the engineering units selected:

New setpoint: **as**[setpoint as floating point number]↵
Example: **as15.44**↵ (setpoint of +15.44 SLPM)

When using a bidirectional mass flow controller, negative setpoints are sent by adding the minus sign (−):

Example: **as-15.44**↵ (setpoint of −15.44 SLPM)

Sending Setpoints as Integers

In this method, your controller's **full scale range (FS)** is represented by a value of 64000, and a zero setpoint is represented by 0. To calculate your intended setpoint, use the following formula:

Integer value = 64000 × [desired setpoint]/[device FS]

Example 1: A desired setpoint of +15.44 SLPM on a 20-SLPM mass flow controller is calculated as 64000 × 15.44/20.00 = **49408**. The command to assign the setpoint based on this integer value is:

New setpoint: **a**[setpoint as integer where 64000 is FS]↵
Example 1: **a49408**↵ (setpoint of 15.44 SLPM)

Example 2: When using a bidirectional mass flow controller, 0 represents −100% of full scale, 32000 represents 0, and 64000 represents +100% of full scale. Use the following formula to calculate the integer value:

Integer value = 64000 × [desired setpoint + FS]/[device FS x 2]

A desired setpoint of +15.44 SLPM on a 20-SLPM bidirectional mass flow controller is calculated as 64000 × (15.44 + 20.00)/40.00 = **56704**.

Example 3: A desired setpoint of −15.44 SLPM on the same bidirectional mass flow controller is calculated as:

Integer value = 64000 × (−15.44 + 20.00)/40.00 = **7296**

Using Gas Select™ and COMPOSER™

To reconfigure your flow controller to flow a different gas, look up its Gas Number (see "Gas List" on **page 52**). Then type:

Choose a gas: [unit ID]g[Gas Number]↵
Example 1: ag8↵ (reconfigures to flow nitrogen)
Example 2: ag206↵ (reconfigures to flow P-10)

COMPOSER™ user mixes are selected in the same way. All COMPOSER™ gas mixes have a Mix Number between 236 and 255.

Choose a user mix: [unit ID]g[Gas Number]↵
Example: ag255↵ (reconfigures for user mix 255)

Defining a new COMPOSER™ gas mix is faster using serial commands than using the front panel. The basic formula for this is:

[unit ID]gm [Mix Name] [Mix Number] [Gas1 %] [Gas1 Number] [Gas2 %] [Gas2 Number]...↵

[Mix Name] Use a maximum of 6 letters (upper and/or lower case), numbers and symbols (space, period or hyphen only).

[Mix Number] Choose a number from 236 to 255. If a user mix with that number already exists, it will be overwritten. Use the number 0 to assign the next available number to your new gas. Gas numbers are assigned in descending order from 255.

[Gas1 %] [Gas1 Number]... For each gas, enter its molar percentage up to 2 decimal places, then its Gas Number (**page 52**). COMPOSER™ requires 2–5 gases, and the sum of all gas constituent percentages must equal 100.00%. After creating a mix, the controller will confirm the new gas:

Example 1: Create a mix of 71.35% helium, 19.25% nitrogen, and 9.4% carbon dioxide as Gas 252, called "MyGas1".

Command:

```
agm MyGas1 252 71.35 7 19.25 8 9.4 4↵
```

Response: `A 252 71.35% He 19.25% N2 9.40% CO2`

Example 2: Create a mix of 93% methane, 3% ethane, 1% propane, 2% nitrogen, and 1% CO_2, using the next available gas number, called "MyGas2".

Command:

```
agm MyGas2 0 93 2 3 5 1 12 2 8 1 4↵
```

Response: `A 253 93.00% CH4 3.00% C2H6 1.00% C3H8 2.00% N2 1.00% CO2`

Quick Command Guide

Note: *Serial commands are not case-sensitive. For simplicity, we assume that the unit ID of the flow controller when not streaming is* a *in the listing that follows.*

Change the unit ID:	a@=[desired unit ID]↵
Tare flow:	av↵
Tare absolute pressure with barometer:	apc↵ (barometers are optional to controllers)
Poll the live data frame:	a↵
Begin streaming data:	a@=@↵
Stop streaming data:	@@=[desired unit ID]↵
Set streaming interval:	aw91=[number of milliseconds]↵
New setpoint:	as[setpoint as floating point num.]↵
New setpoint:	a[setpoint as integer where 64000 is full scale]↵
Hold valve(s) at current position:	ahp↵
Hold valve(s) closed:	ahc↵
Cancel valve hold:	ac↵
Query gas list info:	a??g*↵
Choose a different gas:	ag[Gas Number]↵
New COMPOSER™ mix:	agm [Mix Name] [Mix Number] [Gas1 %] [Gas1 #] [Gas2 %] [Gas2 #]...↵
Delete COMPOSER™ mix:	agd [Mix #]↵
Query live data info:	a??d*↵
Manufacturer info:	a??m*↵
Firmware version:	a??m9↵ or ave↵
Lock the front display:	al↵
Unlock the display:	au↵

If you have need of more advanced serial communication commands, please contact us or refer to the Serial Communications Primer: documents.alicat.com/alicat-serial-primer.pdf.

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Troubleshooting

If you run into any trouble with your Alicat's installation or operation, please get in touch with us by phone, chat, or email. You'll also find help on our website alicat.com and in the pages that follow.

General Use

Issue: My Alicat does not turn on, or has trouble staying on.
Action: Check power and ground connections. Please reference the technical specifications to ensure you have the proper power for your model.

Issue: The buttons do not work, and the screen shows LCK.
Action: The flow controller buttons were locked out via a serial command. Press and hold all four outer buttons to unlock the interface.

Issue: I can't read the display easily.
Action: During the day, you can increase the visibility of the display by increasing the contrast (MENU → ADV SETUP → DISP SETUP → LCD CONTRAST). If you are working under low-light conditions, push the large Alicat button (located below the display) to turn on the backlight.

Issue: The analog output signal indicates values lower than what appears on my instrument's display .
Action: Analog signal voltage degrades over long distances. You can minimize this effect by using wires with a heavier gauge, especially in the ground wire.

Issue: How often do I need to calibrate my Alicat?
Action: Alicat recommends annual recalibrations. Check your flow controller's last calibration date by selecting MENU → ABOUT → DEVICE INFO. If it is time to recalibrate, request a recalibration at alicat.com/service.

Issue: I dropped my Alicat. Is it OK? Do I need to recalibrate?
Action: If it turns on and appears to respond normally, then it is probably OK. It may or may not need a recalibration. Give it a tare, and compare it against a known-good flow standard. If it checks out, keep using it, but tell us about the drop at your next annual recalibration so we can check it out for you.

Issue: How can I see temperature, pressure, or flow in different units?
Action: From the main menu, select BASIC CONFIG → DEVICE UNITS. From this menu, you can adjust temperature, pressure, or flow units. For more information, see **page 33**.

Flow Readings

Issue: The live flow readings won't settle down.
Action: The flow controller is very fast, so it can detect subtle variations in flow that may go unnoticed by your other flow devices. This sensitivity can help detect problems with pumps or flow controllers. You can lessen this sensitivity by increasing the flow averaging (press **MENU** → **ADV SETUP** → **SENSOR SETUP** → **FLOW AVG**). Alicat mass flow controllers use PD or PD²I control loop algorithms to reach the setpoint given. These parameters are adjustable in the field. See **page 29** for a quick guide on tuning.

Issue: My controller won't reach its setpoint.
Action: The flow rate is related linearly to the pressure drop across the device. If there isn't enough of a pressure difference between the inlet and outlet, the controller may not be able to reach setpoint. Often, increasing the inlet pressure will fix this issue.

If increasing the pressure doesn't help, check to see if there is a clog. Teflon tape can often get stuck in the flow channel and block flow. Make sure to clean out any loose Teflon tape and never tape the last two threads to help avoid this issue.

Issue: My flow readings are negative.
Action: Request a zero setpoint to see if the flow returns to 0 after 2 seconds. Under conditions of no flow, a negative flow reading can indicate a poor tare. Ensure that auto tare is enabled and give the controller a zero setpoint for at least 2 seconds.

Issue: Does the Alicat work if it is laying down? Will it be accurate?
Action: Yes to both for small valve controllers! The flow controller is internally compensated for any changes in orientation, so you can use it sideways, on its back, or upside-down. S-series devices should be tared again after changing their orientation. Large valve controllers (MCR and MCRH-series) should be operated with the valve cylinder vertical and upright.

Issue: Can I put the Alicat on top of a vibrating device? Will it be accurate?
Action: Yes for small valve controllers. The flow controller is internally compensated for any changes in orientation. Noise will increase if the flow controller is vibrating. Large valve controllers (MCR and MCRH-series) are not recommended for use on vibrating surfaces.

Issue: My controller does not agree with another mass flow meter I have in line.
Action: Check the STP or NTP settings (MENU → BASIC CONFIG → STP/NTP) to ensure that your standardized temperature and pressure references match those of your other flow calibrator. Also check that your device's Gas Select™ is set to the right gas or mixture.

Issue: My flow readings won't change when flow changes.
Action: If your flow readings won't change regardless of actual flow, your flow sensor may be damaged. Please contact Alicat to troubleshoot.

Issue: Can I use the Alicat with other gases?
Action: Yes! Your flow controller is designed specifically to work with many different gases. Gas Select™ (MENU → BASIC CONFIG → GAS) includes up to 130 preloaded gases and gas mixes, or you can define your own using COMPOSER™. If your desired gas is not listed, please contact Alicat to ensure compatibility.

Serial Communications

Issue: I can't communicate to the Alicat when it is connected to my PC.
Action: **1.** Make sure the baud rate your software and COM Port require is the one your flow controller is using (MENU → ADV SETUP → COMM SETUP → BAUD).
2. Check the flow controller unit ID (MENU → ADV SETUP → COMM SETUP → UNIT ID) to make sure you are addressing it properly with your serial commands.
3. Check the pinout (see **page 56** or **alicat.com/pinouts**)
4. Make sure the COM number matches the one your software is using to connect to the flow controller.
5. On the external serial communications device (PC, PLC, etc.), be sure that the flow control (hand-shaking) settings are set as on **page 42**.

Still experiencing issues?

Issue: None of the above helped.
Action: We're here to help! Give us a call (**1-888-290-6060**) during our normal business hours (7am–5pm Mountain Standard Time) to get help from a friendly and capable applications engineer. Or, go to **alicat.com** and start a live chat. Is it after hours? Send an email to **info@alicat.com**, and we'll get in touch with you as soon as we can.
Additionally, our troubleshooting resources online are more detailed than the manual. Please visit alicat.com/support.

Maintenance

Cleaning

Your flow controller requires no periodic cleaning, provided that it has been flowing clean, dry gas. If necessary, the outside of the device can be cleaned with a soft dry cloth. Alicat also offers remote panels and ingress protection for some models used in hazardous or remote applications.

If you suspect that debris or other foreign material has entered your device, do not take apart the flow body to clean it, as this will negate its NIST-traceable calibration. Please contact Alicat for cleaning.

Recalibration

The recommended period for recalibration is once every year. A label located on the back of the device lists the most recent calibration date. This date is also stored inside your flow controller and is visible by selecting `MENU` → `ABOUT` → `DEVICE INFO`.

When it is time for your flow controller's annual recalibration, contact us by phone or live chat to set it up. Or, send an email to **service@alicat.com**, or fill out the form at **alicat.com/service**. We'll ask for your device's serial number and your contact information and send you an email with instructions for returning the flow controller to us.

Replacement Accessories

Please contact Alicat to order replacements for any accessories.

For repair, recalibration, or recycling of this product contact:

Alicat Scientific, Inc.

service@alicat.com • alicat.com

7641 N Business Park Drive Tucson, AZ 85743 USA

1-888-290-6060

Technical Specifications and Dimensional Drawings

Please visit **alicat.com/specs** to find the complete operating specifications and dimensional drawings for your Alicat mass flow meter.

Gas List

#	Short Name	Long Name
0	Air	Air (Clean Dry)
1	Ar	Argon
2	CH4	Methane
3	CO	Carbon Monoxide
4	CO2	Carbon Dioxide
5	C2H6	Ethane
6	H2	Hydrogen
7	He	Helium
8	N2	Nitrogen
9	N2O	Nitrous Oxide
10	Ne	Neon
11	O2	Oxygen
12	C3H8	Propane
13	nC4H10	Normal Butane
14	C2H2	Acetylene
15	C2H4	Ethylene (Ethene)
16	iC4H10	Isobutane[2]
17	Kr	Krypton
18	Xe	Xenon
19	SF6	Sulfur Hexafluoride[1]
20	C-25	25% CO_2, 75% Ar
21	C-10	10% CO_2, 90% Ar
22	C-8	8% CO_2, 92% Ar
23	C-2	2% CO_2, 98% Ar
24	C-75	75% CO_2, 25% Ar
25	He-25	25% He, 75% Ar
26	He-75	75% He, 25% Ar
27	A1025	90% He, 7.5% Ar, 2.5% CO_2
28	Star29	Stargon CS (90% Ar, 8% CO_2, 2% O_2)
29	P-5	5% CH_4, 95% Ar
30	NO	Nitric Oxide[2]
31	NF3	Nitrogen Trifluoride[2]
32	NH3	Ammonia[2]
33	Cl2	Chlorine[2,4]
34	H2S	Hydrogen Sulfide[2]
35	SO2	Sulfur Dioxide[2,4]
36	C3H6	Propylene[2]
80	1Buten	1-Butylene[2]
81	cButen	Cis-Butene (cis-2-Butene)[2]
82	iButen	Isobutylene
83	tButen	Trans-2-Butene[2]
84	COS	Carbonyl Sulfide[2]
85	DME	Dimethylether (C_2H_6O)[2]
86	SiH4	Silane[2]
100	R-11	Trichlorofluoromethane (CCl_3F)[2,3]
101	R-115	Chloropentafluoroethane (C_2ClF_5)[2,3]
102	R-116	Hexafluoroethane (C_2F_6)[2]
103	R-124	Chlorotetrafluoroethane (C_2HClF_4)[2,3]
104	R-125	Pentafluoroethane (CF_3CHF_2)[2,3]
105	R-134A	Tetrafluoroethane (CH_2FCF_3)[2,3]
106	R-14	Tetrafluoromethane (CF_4)[2]
107	R-142b	Chlorodifluoroethane (CH_3CClF_2)[2,3]
108	R-143a	Trifluoroethane ($C_2H_3F_3$)[2,3]
109	R-152a	Difluoroethane ($C_2H_4F_2$)[2]
110	R-22	Difluoromonochloromethane ($CHClF_2$)[2,3]
111	R-23	Trifluoromethane (CHF_3)[2,3]
112	R-32	Difluoromethane (CH_2F_2)[2,3]
113	R-318	Octafluorocyclobutane (C_4F_8)[2]
114	R-404A	44% R-125, 4% R-134A, 52% R-143A[2,3]
115	R-407C	23% R-32, 25% R-125, 52% R-143A[2,3]
116	R-410A	50% R-32, 50% R-125[2,3]
117	R-507A	50% R-125, 50% R-143A[2,3]
140	C-15	15% CO_2, 85% Ar
141	C-20	20% CO_2, 80% Ar
142	C-50	50% CO_2, 50% Ar
143	He-50	50% He, 50% Ar
144	He-90	90% He, 10% Ar
145	Bio5M	5% CH_4, 95% CO_2
146	Bio10M	10% CH_4, 90% CO_2
147	Bio15M	15% CH_4, 85% CO_2

#	Short Name	Long Name
148	Bio20M	20% CH_4, 80% CO_2
149	Bio25M	25% CH_4, 75% CO_2
150	Bio30M	30% CH_4, 70% CO_2
151	Bio35M	35% CH_4, 65% CO_2
152	Bio40M	40% CH_4, 60% CO_2
153	Bio45M	45% CH_4, 55% CO_2
154	Bio50M	50% CH_4, 50% CO_2
155	Bio55M	55% CH_4, 45% CO_2
156	Bio60M	60% CH_4, 40% CO_2
157	Bio65M	65% CH_4, 35% CO_2
158	Bio70M	70% CH_4, 30% CO_2
159	Bio75M	75% CH_4, 25% CO_2
160	Bio80M	80% CH_4, 20% CO_2
161	Bio85M	85% CH_4, 15% CO_2
162	Bio90M	90% CH_4, 10% CO_2
163	Bio95M	95% CH_4, 5% CO_2
164	EAN-32	32% O_2, 68% N_2
165	EAN	36% O_2, 64% N_2
166	EAN-40	40% O_2, 60% N_2
167	HeOx20	20% O_2, 80% He
168	HeOx21	21% O_2, 79% He
169	HeOx30	30% O_2, 70% He
170	HeOx40	40% O_2, 60% He
171	HeOx50	50% O_2, 50% He
172	HeOx60	60% O_2, 40% He
173	HeOx80	80% O_2, 20% He
174	HeOx99	99% O_2, 1% He
175	EA-40	Enriched Air-40% O_2
176	EA-60	Enriched Air-60% O_2
177	EA-80	Enriched Air-80% O_2
178	Metab	Metabolic Exhalant (16% O_2, 78.04% N_2, 5% CO_2, 0.96% Ar)
179	LG-4.5	4.5% CO_2, 13.5% N_2, 82% He
180	LG-6	6% CO_2, 14% N_2, 80% He
181	LG-7	7% CO_2, 14% N_2, 79% He
182	LG-9	9% CO_2, 15% N_2, 76% He
183	HeNe-9	9% Ne, 91% He
184	LG-9.4	9.4% CO_2, 19.25% N_2, 71.35% He
185	SynG-1	40% H_2, 29% CO, 20% CO_2, 11% CH_4
186	SynG-2	64% H_2, 28% CO, 1% CO_2, 7% CH_4
187	SynG-3	70% H_2, 4% CO, 25% CO_2, 1% CH_4
188	SynG-4	83% H_2, 14% CO, 3% CH_4
189	NatG-1	93% CH_4, 3% C_2H_6, 1% C_3H_8, 2% N_2, 1% CO_2
190	NatG-2	95% CH_4, 3% C_2H_6, 1% N_2, 1% CO_2
191	NatG-3	95.2% CH_4, 2.5% C_2H_6, 0.2% C_3H_8, 0.1% C_4H_{10}, 1.3% N_2, 0.7% CO_2
192	CoalG	50% H_2, 35% CH_4, 10% CO, 5% C_2H_4
193	Endo	75% H_2, 25% N_2
194	HHO	66.67% H_2, 33.33% O_2
195	HD-5	LPG: 96.1% C_3H_8, 1.5% C_2H_6, 0.4% C_3H_6, 1.9% n-C_4H_{10}
196	HD-10	LPG: 85% C_3H_8, 10% C_3H_6, 5% n-C_4H_{10}
197	OCG-89	89% O_2, 7% N_2, 4% Ar
198	OCG-93	93% O_2, 3% N_2, 4% Ar
199	OCG-95	95% O_2, 1% N_2, 4% Ar
200	FG-1	2.5% O_2, 10.8% CO_2, 85.7% N_2, 1% Ar
201	FG-2	2.9% O_2, 14% CO_2, 82.1% N_2, 1% Ar
202	FG-3	3.7% O_2, 15% CO_2, 80.3% N_2, 1% Ar
203	FG-4	7% O_2, 12% CO_2, 80% N_2, 1% Ar
204	FG-5	10% O_2, 9.5% CO_2, 79.5% N_2, 1% Ar
205	FG-6	13% O_2, 7% CO_2, 79% N_2, 1% Ar
206	P-10	10% CH_4 90% Ar
210	D-2	Deuterium

1 *Sulfur hexafluoride is a highly potent greenhouse gas monitored under the Kyoto Protocol.*

2 *S-series units only*

3 *Under the Montreal Protocol and Kigali Amendment, the production and consumption of these ozone-depleting substances (ODS) is being or has been phased out. It is recommended you ensure compliance with this universally ratified treaty before attempting to use these gases, in addition to R113, R-123, and R-141b.*

4 *S-series with PCA valves only*

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Engineering Units

True Mass Flow Units

Label	Notes
mg/s	milligram per second
mg/m	milligram per minute
g/s	gram per second
g/m	gram per minute
g/h	gram per hour
kg/m	kilogram per minute
kg/h	kilogram per hour
oz/s	ounce per second
oz/m	ounce per minute
lb/m	pound per minute
lb/h	pound per hour

Temperature Units

Label	Notes
°C	degrees Celsius
°F	degrees Farenheit
K	Kelvin
°R	degrees Rankine

Time Units

Label	Notes
h:m:s	hours:minutes:seconds
ms	milliseconds
s	seconds
m	minutes
hour	hours
day	days

Flow Units

Volumetric	Std.	Normal	Notes
uL/m	SuL/m	NuL/m	microliter per minute
mL/s	SmL/s	NmL/s	milliliter per second
mL/m	SmL/m	NmL/m	milliliter per minute
mL/h	SmL/h	NmL/h	milliliter per hour
L/s	SL/s	NL/s	liter per second
LPM	SLPM	NLPM	liter per minute
L/h	SL/h	NL/h	liter per hour
US GPM			US gallon per minute
US GPH			US gallon per hour
CCS	SCCS	NCCS	cubic centimeter per second
CCM	SCCM	NCCM	cubic centimeter per minute
cm^3/h	Scm^3/h	Ncm^3/h	cubic centimeter per hour
m^3/m	Sm^3/m	Nm^3/m	cubic meter per minute
m^3/h	Sm^3/h	Nm^3/h	cubic meter per hour
m^3/d	Sm^3/d	Nm^3/d	cubic meter per day
in^3/m	Sin^3/m		cubic inch per minute
CFM	SCFM		cubic foot per minute
CFH	SCFH		cubic foot per hour
CFD	SCFD		cubic foot per day
	kSCFM		1000 cubic feet per minute
count	count	count	setpoint count, 0–64000
%	%	%	percent of full scale

Pressure Units

Absolute or Barometric	Gauge	Notes
PaA	PaG	pascal
hPaA	hPaG	hectopascal
kPaA	kPaG	kilopascal
MPaA	MPaG	megapascal
mbarA	mbarG	millibar
barA	barG	bar
g/cm2A	g/cm2G	gram force per square centimeter
kg/cmA	kg/cmG	kilogram force per square centimeter
PSIA	PSIG	pound force per square inch
PSFA	PSFG	pound force per square foot
mTorrA	mTorrG	millitorr
torrA	torrG	torr
mmHgA	mmHgG	millimeter of mercury at 0°C
inHgA	inHgG	inch of mercury at 0°C
mmH_2OA	mmH_2OG	millimeter of water at 4°C (NIST conventional)
mmH_2OA	mmH_2OG	millimeter of water at 60°C
cmH_2OA	cmH_2OG	centimeter of water at 4°C (NIST conventional)
cmH_2OA	cmH_2OG	centimeter of water at 60°C
inH_2OA	inH_2OG	inch of water at 4°C (NIST conventional)
inH_2OA	inH_2OG	inch of water at 60°C
atm		atmosphere
m asl		meter above sea level
ft asl		foot above sea level
V		volt
count	count	setpoint count, 0–64000
%	%	percent of full scale

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Optional Pinouts

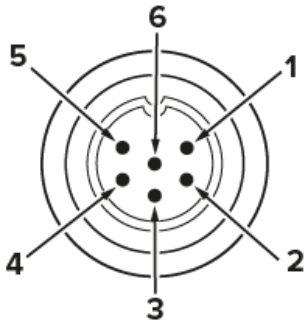
Additional Pinouts

Individual pinouts available at www.alicat.com/pinout

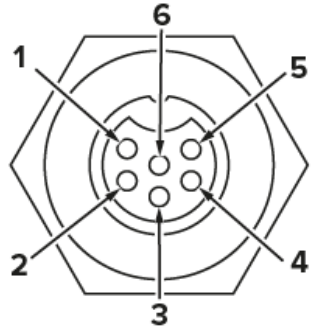
Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

Locking Industrial Connector Pinouts

If your Alicat Instrument was ordered with a Six Pin Locking Industrial connection, please be sure to reference the following pinout diagram.



Male Connector: Cable



Female Connector: Device

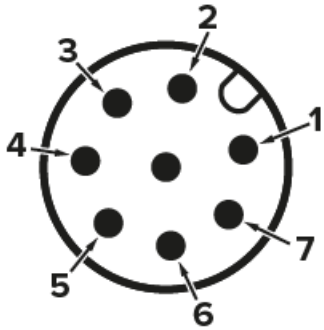
Pin	Function
1	Power In (+)
2	RS-232 TX / RS-485(+)
3	RS-232 RX / RS-485(–)
4	Meters / Gauges: Remote Tare (Ground to Tare) Controllers: Analog Setpoint Input
5	Ground (common for power, communications and signals)
6	Signal Out (Voltage or Current as ordered)

The above pinout is applicable to all the flow meters and controllers ordered with the industrial connector. The availability of different output signals depends on the flow controller options ordered.

M12 Connector Pinouts

If your Alicat Instrument was ordered with the M12 connection, please be sure to reference the following pin-out diagram.

M12 Connector Male



Pin	Function
1	0–5 Vdc (or optional 0–10 Vdc) Output Signal
2	Power In +24 VDC, 1 A recommended for most models
3	Serial RS-232 RX / RS-485(–) Input Signal (receive)
4	Meters / Gauges = Remote Tare (Ground to Tare) Controllers = Analog Set-Point Input
5	Serial RS-232 TX / RS-485(+) Output Signal (send)
6	Static 5.12 Vdc [or optional Secondary Analog Output (4–20 mA, 5 Vdc, 10 Vdc) or Basic Alarm]
7	Ground (common for power, digital communications, analog signals and alarms)
8	Inactive (or optional 4–20 mA Primary Output Signal)

Note: *The above pin-out is applicable to all the flow meters and controllers with the M12 connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.*

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

Individual pinouts available at www.alicat.com/pinout

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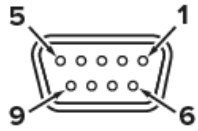
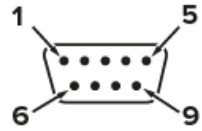
9 pin D-Sub Common Pinouts

If your instrument was ordered with a DB9 connection, be sure to check the calibration label on the device or the calibration data sheet and reference the appropriate pinout diagram.



Male Connector: Cable



Female Connector: Device

Common 9-pin D-Sub Pinouts

Pin	DB9 (Female) DB9M (Male)	DB9A / DB9K	DB9R	DB9T	DB9U
1	Current Out	NC	TX (+)	TX (+)	RX (–)
2	Analog Out 2	Analog Out	Analog Out	Analog Out	Analog Out
3	RX (–)	Power In	Analog In	Power In	Power In
4	Analog In	Ground	Ground	Ground	Ground
5	TX (+)	TX (+)	NC	NC	NC
6	Analog Out	Analog In	RX (–)	Analog In	Analog In
7	Power In	Ground	Power In	Ground	Ground
8	Ground	Ground	Ground	Ground	Ground
9	Ground	RX (–)	Ground	RX (–)	TX (+)

Additional 9-pin D-Sub Pinouts

Pin	DB9B	DB9G	DB9H	DB9I	DB9N
1	Analog Out 2	RX (–)	TX (+)	NC	Power In
2	Analog Out	Analog Out	Analog Out	Analog Out	Analog In
3	Power In	Ground	Analog In	Power In	Analog Out
4	Ground	Power In	RX (–)	Ground	NC
5	Ground	Ground	Analog Out 2	NC	Ground
6	Analog In	TX (+)	NC	Analog In	Ground
7	Ground	Analog In	Power In	Ground	RX (–)
8	TX (+)	Current Out	Ground	RX (–)	TX (+)
9	RX (–)	Ground	Ground	TX (+)	NC5

Key of Terms:

Current Out
Not Connected or optional 4–20 mA analog output signal

Analog In
Setpoint for controllers or remote tare function for meters

Analog Out
0–5 Vdc Output Signal (or 0–10 Vdc optional)

Analog Out 2
5.12 Vdc or Optional Secondary Analog Output

TX (+)
Serial RS-232 TX or RS-485(+)

RX (–)
Serial RS-232 RX or RS-485(–)

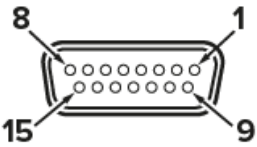
NC Not Connected

Power In (+Vdc)

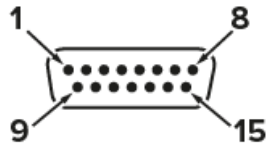
Ground
Common for power, digital and analog signals, and alarms

15 pin D-Sub Common Pinouts

If your instrument was ordered with a DB15 connection, be sure to check the calibration label on the device or the calibration data sheet and reference the appropriate pinout diagram.



Male Connector: Cable



Female Connector: Device

Pin	DB15	DB15A	DB15B	DB15H	DB15K	DB15O	DB15S
1	Ground	Ground	Ground	NC	NC	Ground	Ground
2	Analog Out	Analog Out	Analog Out	RX (–)	Analog Out	NC	Analog Out
3	Ground	Analog In	NC	NC	NC	NC	NC
4	NC	Ground	NC	NC	NC	Analog Out	NC
5	Power In	Ground	Power In	Ground	Ground	Power In	Ground
6	NC	Ground	NC	Analog Out	NC	NC	NC
7	NC	Power In	NC	Ground	Power In	Analog In	NC
8	Analog In	TX (+)	Analog In	NC	Analog In	NC5	Analog In
9	Ground	Ground	Ground	NC	Analog Out 2	Ground	Ground
10	Ground	NC	Ground	Analog Out 2	NC	Ground	Ground
11	Analog Out 2	NC	Analog Out 2	Power In	Ground	Analog Out 2	Analog Out 2
12	NC	Analog Out 2	NC	Ground	Ground	NC	RX (–)
13	RX (–)	NC	NC	NC	RX (–)	NC	Power In
14	Ground	NC	RX (–)	Analog In	TX (+)	RX (–)	TX (+)
15	TX (+)	RX (–)	TX (+)	TX (+)	Ground	TX (+)	Ground

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

Individual pinouts available at www.alicat.com/pinout

Key of Terms:

Current Out
Not Connected

Analog In
Setpoint for controllers or remote tare function for meters

Analog Out
0–5 Vdc Output Signal (or 0–10 Vdc optional)

Analog Out 2
5.12 Vdc or Optional Secondary Analog Output

TX (+)
Serial RS-232 TX or RS-485(+)

RX (–)
Serial RS-232 RX or RS-485(–)

NC Not Connected

Power In (+Vdc)

Ground
Common for power, digital communications, analog signals and alarms

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Additional Information for Alicat CSA and ATEX Approved Devices

EEx nA IIC T4

Class I, Div. 2 Group A, B, C and D T4

24 Vdc, 0.800A max

Class I, Zone 2 AEx nA IIC T4

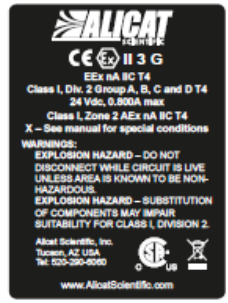
WARNINGS:

EXPLOSION HAZARD – *DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.*

EXPLOSION HAZARD – *SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.*

Alicat CSA / ATEX approved devices are equipped with a locking connector. Please see page 56 to page 59 for the correct power and signal connections for each type of connector.

See the following page for special conditions regarding the use of these units!



USE of Alicat instruments (L, LC, LCR, M, MW, MS, MC, MCW, MCS, MCR, MCRW, MCRS, MCD, P, PS, PC, PCD, PCS, PCR and PCRS product families) in Class 1 Division 2 applications.

CSA certifies the use of this product for general use as well as use in hazardous locations as defined by Class 1 Division 2 Group A, B, C and D T4.

CSA certification is indicated by the product label as shown below and not by the statements in this, or any accompanying documentation.

Special Conditions:
To comply with CSA certification the following information is included in the product literature:

- When equipment is properly labeled, it is suitable in Class I, Division 2, Group A, B, C and D, T4
  - Tamb. −40°C to +50°C
- Electrical Rating 24Vdc, 0.800A max
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection
- Instrument's final approval shall be provided by the local authority having jurisdiction

USE of Alicat instruments (L, LC, LCR, M, MW, MS, MC, MCD, MCW, MCS, MCR, MCRW, MCRS, P, PS, PC, PCD, PCS, PCR and PCRS product families) in applications requiring ATEX Class 1 Zone 2 Certification.

Properly labeled Alicat instruments comply to the following ATEX standard:

Ex II 3 G EEx nA IIC T4
(−40°C ≤ Ta ≤ +50°C)

The examination certificate was issued by the CSA in accordance with accepted practices and procedures. This confirms compliance with the European ATEX Directive or Group II Category 3G equipment.

ATEX certification is indicated by the product label as shown above and not by the statements in this, or any accompanying documentation.

Special Conditions:

- Properly labeled equipment is only certified for use in ambient temperatures in the range of −40°C to +50°C only
- Electrical Rating 24Vdc, 0.800A max
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection
- Instrument's final approval shall be provided by the local authority having jurisdiction

Limited Lifetime Warranty

Alicat Scientific, Inc. warrants to the original purchaser (hereinafter referred to as "Buyer") that instruments manufactured by Alicat Scientific (hereinafter referred to as "Product") shall be free from defects in materials and workmanship for the life of the Products.

Under this warranty, the Products will be repaired or replaced at manufacturer's option, without charge for parts or labor when the Product is carried or shipped prepaid to the factory together with proof of purchase.

The foregoing shall constitute the exclusive and sole remedy in lieu of other remedies of the Buyer for any breach by Alicat Scientific of this warranty to the maximum extent permitted by law.

This warranty does not apply to any Product which has not been installed or used in accordance with the Product operation and installation specifications provided to Buyer verbally or in writing by Alicat Scientific for the proper and normal use of the Product.

Buyer agrees hereunder that Alicat reserves the right to void any warranty, written or implied, if upon Alicat's examination of Product shall disclose to Alicat's satisfaction that the Product failure was due solely, or in part, to accident, misuse, neglect, abuse, alteration, improper installation, unauthorized repair or improper testing by Buyer or agent of Buyer.

Alicat Scientific shall not be liable under any circumstances for indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the Products covered by this warranty.

Alicat Scientific does not recommend, warrant or assume responsibility for the use of the Products in life support applications or systems.

Alicat's warranties as herein above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of Alicat's rendering of technical advice in connection with Buyer's order of the Products furnished hereunder.

If Product becomes obsolete, Alicat Scientific, at its own discretion, reserves the right to repair the Product with available replacement parts or upgrade the Product to a current, commercially available version of the original Product. Should upgrading the Product be deemed necessary by Alicat, Buyer hereby agrees to pay an upgrade fee equal to seventy percent of the retail value of the replacement Product. Alicat Scientific hereunder makes no claim that replacement Products will look, function or operate in the same or similar manner as the original product.

When a Product is returned to Alicat Scientific for recalibration this service is considered normal preventative maintenance. Recalibration of Product shall not be treated as a warranty service unless recalibration of Product is required as the result of repairs to Product pursuant to this Warranty. Failure of Buyer to send Product to Alicat Scientific for recalibration on a yearly basis after a period of 36 months from date of manufacture will remove any and all obligations regarding repair or replacement of Product as outlined by this Warranty to Buyer from Alicat Scientific.

This Warranty is in lieu of all other relevant warranties, expressed or implied, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose, and any warranty against infringement of any patent.

Continued use or possession of Products after expiration of the applicable warranty period stated above shall be conclusive evidence that the warranty is fulfilled to the full satisfaction of Buyer.

Alicat makes no warranty as to experimental, non-standard or developmental Products.

Accessories purchased from Alicat are not covered by this warranty.

The product complies with the requirements of the Low Voltage Directive 2014/35/EU, the EMC Directive 2014/30/EU and the RoHS Directive 2011/65/EU and carries the CE Marking accordingly. Contact the manufacturer for more information.

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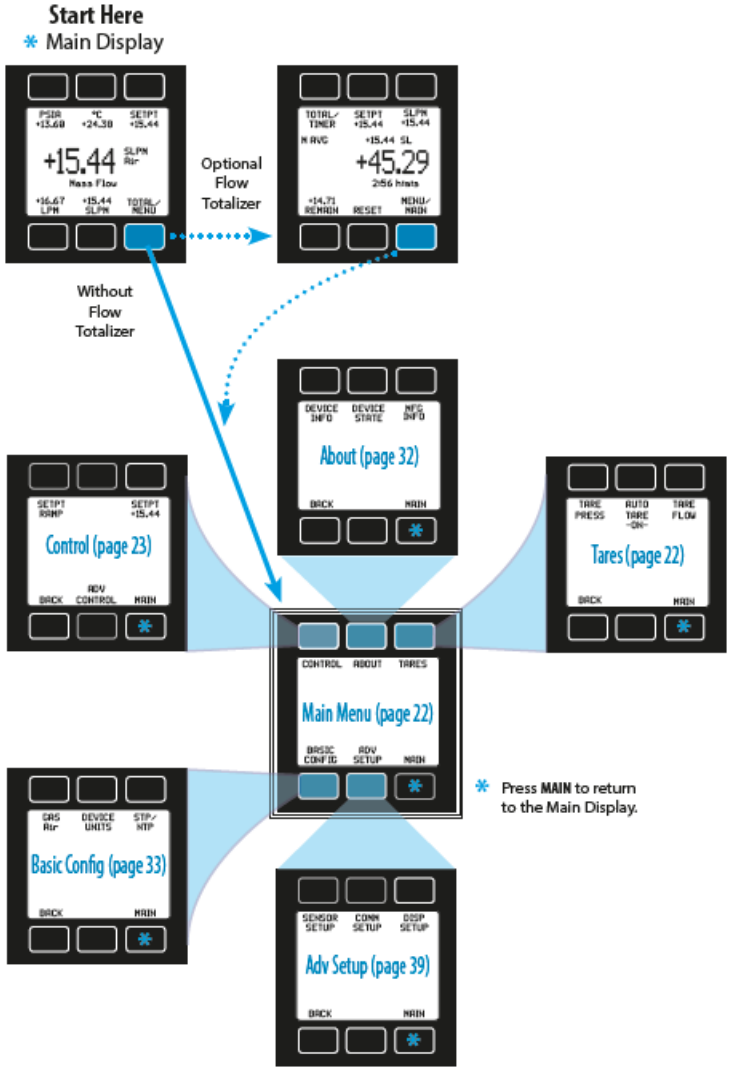
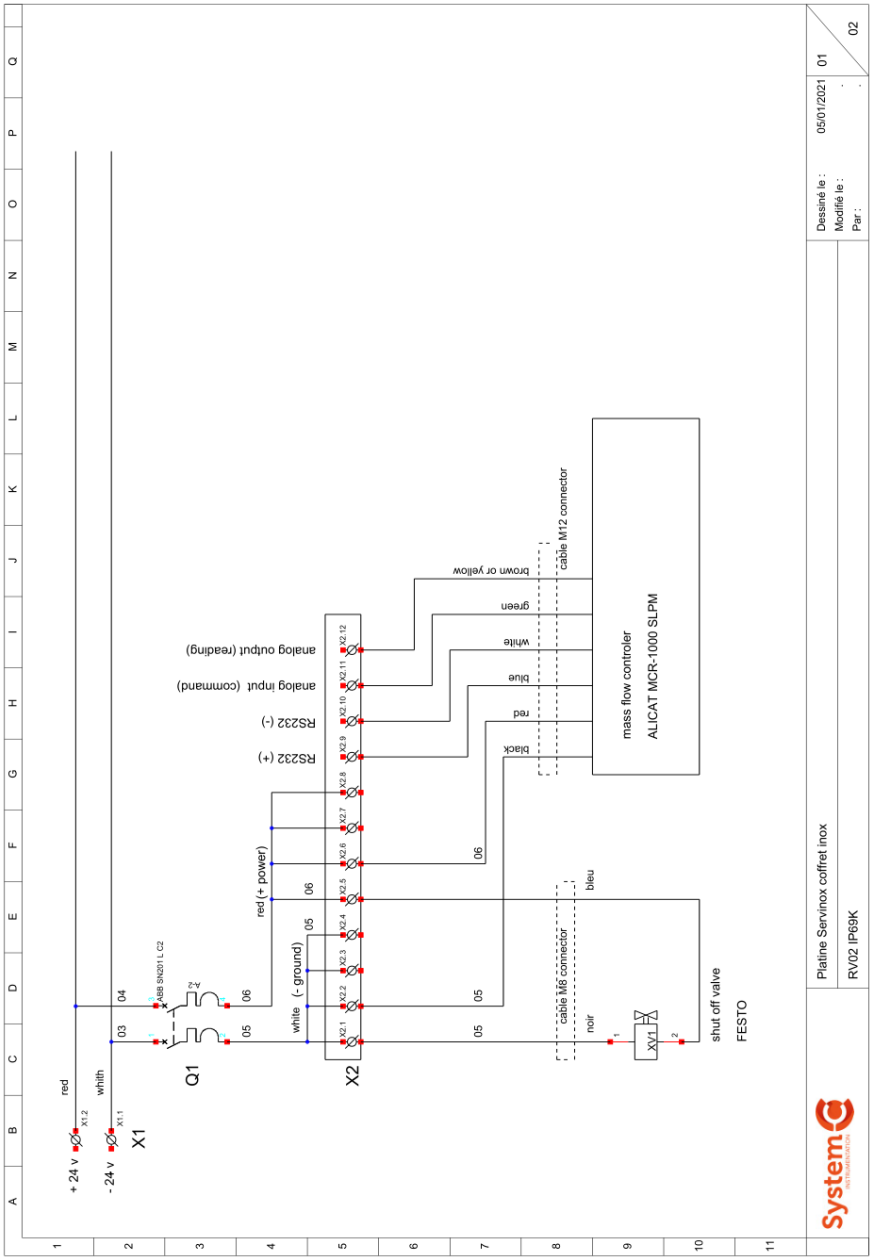
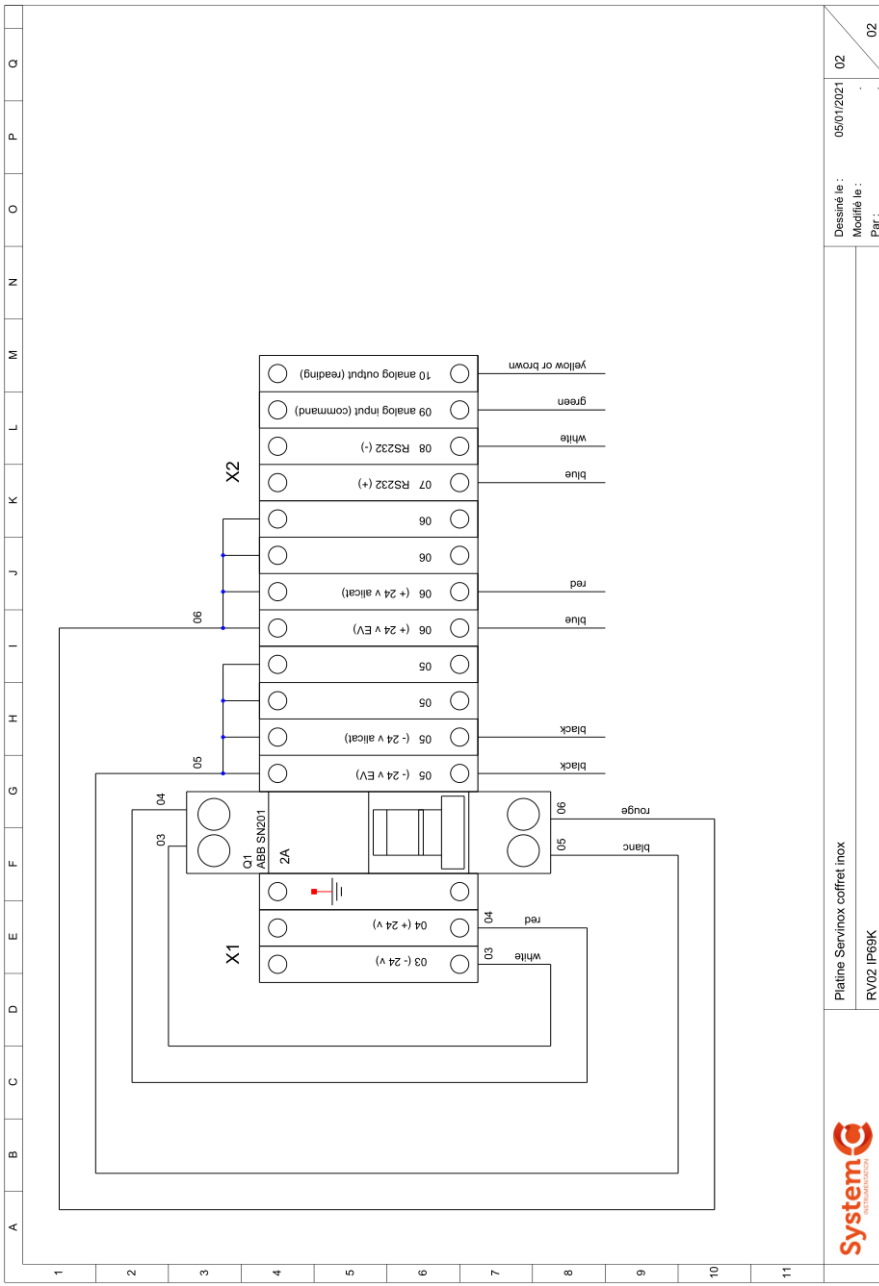
Flow Controller Menu Map



IP69K wiring diagram




X2
10 analog output (reading)
09 analog input (command)
08 RS232 (-)
07 RS232 (+)
06
06
06 (+ 24 v allcat)
06 (+ 24 v EV)
05
05
05 (- 24 v allcat)
05 (- 24 v EV)
yellow or brown
green
white
blue
red
blue
black
black
X1
03 (- 24 v)
04 (+ 24 v)
Q1
ABB SN201
2A
03
04
05
06
white
red
blanc
rouge
Platine Servinox coffret inox
RV02 IP69K
Dessiné le : 05/01/2021 02
Modifié le : . .
Par : . .
02

Notes