Operation Manual

Compressed Air Measurement System

SMC Part No: XAN7002

SMC Pneumatics

SMC Pneumatics (Australia) Pty. Ltd.
14-18 Hudson Avenue,
Castle Hill NSW 2154
Tel: 61-2-9354-8222
Fax: 61-2-9354-8253
ACN: 000 643 519
www.smcaus.com.au

26/5/09	A	DRAFT	B.BLYTH
16/11/09	B	CORRECTION ON P16	A.RAPSON
29/3/10	C	ADDED BATTERY MANEGMENT	A.RAPSON
DATE	**REVISION**	**DESCRIPTION**	**BY**

TABLE OF CONTENTS

Page

Safety precautions and warnings:

General Precautions

Safety instructions are intended to prevent hazardous situations and/or equipment damage. Safety instructions contained in this document apply to tasks that must be adhered to. It is important that these safety concerns are always followed. Failure to do so could result in personal injury and/or damage to the unit or other equipment.

With this in mind, here are some basic safety recommendations:

- Read and become familiar with this *Safety* section prior to installing, operating maintaining or repairing.
- Store this document within easy reach of operation and/or maintenance personnel.
- Wear personal protective equipment and clothing such as safety goggles and gloves.
- Familiarize yourself with and follow all safety guidelines prescribed by your company, and government safety regulations.

Warning Symbols

The following symbols are used to warn against dangers or possible sources of danger.

WARNING: Failure to observe may result in **personal injury**, **death** or equipment damage.

WARNING: Risk of electric shock. Failure to observe may result in **personal injury**, **death** or equipment damage.

CAUTION: Failure to observe may result in equipment damage.

Qualified Personnel

Only qualified personnel should operate this equipment.

“Qualified personnel” refers to individuals who understand the equipment and its safe operation, maintenance, and repair. Qualified personnel are physically capable of performing the required tasks, within the relevant safety rules and regulations and have been trained to safely install, operate, maintain, and repair the equipment. It is the responsibility of the company operating the equipment to see that its personnel meet these requirements.

Operation

The unit should be operated by qualified personnel in accordance with the instructions presented in this document.

WARNING: Failure to observe may result in **personal injury**, **death** or equipment damage.

- Prior to each start-up of the equipment, check protection devices and make sure they are functional. Do not operate the equipment if these devices are not functioning properly.
- When the removal of devices is required for installation, maintenance and repair; it must be re-connected immediately upon completion of work.
- Prior to start-up, ensure that all connections are correctly fitted.
- Use clean and dry air. Dirty, oily, and wet air will damage the internal components of the control valves and pneumatic actuators. Use air filters with air dryers and after coolers to provide good quality air to the control systems.
- Do not operate in areas with strong magnetic fields.
- The possibility that electrical and pneumatic potentials may remain in the unit after the unit was de-energized.
- If the unit malfunctions, switch it off immediately. Turn the circuit breaker or main switch OFF. Have the unit inspected by qualified personnel only.

Maintenance/Repair

Allow only qualified personnel to perform the procedures set out in this document. Wear appropriate protective clothing and equipment when carrying out maintenance or repairs.

WARNING: Ensure that electrical power is fully isolated from the unit. Even when only the circuit breaker is switched OFF the unit is still electrically energized. Failure to observe may result in **personal injury**, **death** or equipment damage.

WARNING: Air pressure has the potential to cause injury, do not perform maintenance duties until air supply is isolated, vented and is safe to carry out work. Failure to observe may result in **personal injury**, **death** or equipment damage.

- Disconnect, lock out and tag external power supply.
- Follow the specific instructions provided in this manual to relieve the system pressure in the entire unit.
- Only use genuine and authorized parts which do not compromise the safe operation of this unit.

Introduction

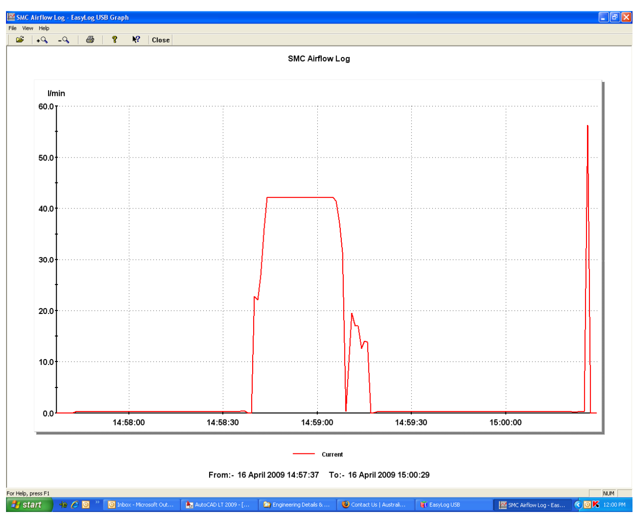
The XAN7002 Compressed Air Measurement System has been developed to provide a method of easily capturing compressed air flow and pressure data. As a portable datalogger the XAN7002 can be easily positioned close to the point of measurement; even in remote locations. Requiring no additional power source for the data logger or the Flowmeter/Pressure Switch, the XAN7002 provides a cost effective and efficient transportable compressed air measurement solution.

Utilizing a simple USB style data logger, the XAN7002 removes the need to have specialized customized software systems often configured to analyze the captured data.

While the standard XAN7002 is available as a single channel device and configured to a single input (pressure switch or flow meter), customized systems with multiple inputs can be provided on request.

USB Data Logger

The data logger used in the XAN7002 is a USB device, which can be easily configured to provide compressed air flow and pressure data in industry standard units. Graphs are time marked so that the pressure and flow can be referenced to a time period.



Compressed Air Flowrate Results

Raw data files can also be manipulated to develop further modes of analysis

- Columns 1 (Sample Number)
- Column 2 (Sample Time)
- Column 3 (Sample Value as % of maximum)
- Column 4 calculation has been added and references the flow meter used (in this case PF2A703H; range 150 -3000 lpm) :
  - Maximum Flowrate of meter = 3000 litres per minute
  - Column 4 = (Column3*0.01) * 3000 litres per minute.

Filling Line Flowrate			
EasyLog USB	***Time***	***Flowrate(%)***	***Flowrate LPM***
1	31/03/2005 16:35	22	660
2	31/03/2005 16:36	28.2	846
3	31/03/2005 16:37	34.4	1032
4	31/03/2005 16:38	39.2	1176
5	31/03/2005 16:39	42.8	1284
6	31/03/2005 16:40	46	1380
7	31/03/2005 16:41	48.6	1458
8	31/03/2005 16:42	50.6	1518
9	31/03/2005 16:43	53.6	1608
10	31/03/2005 16:44	55.6	1668
11	31/03/2005 16:45	56.6	1698

Compressed Air Flowrate Data

The data logger is powered from a single Li-ion battery. The batter life is approximately 12 months, but this is dependent upon shelf life and usage.

Replacement of the battery is simple, with replacement batteries available from specialty battery outlets (electronics suppliers etc).

EasyLog with Battery

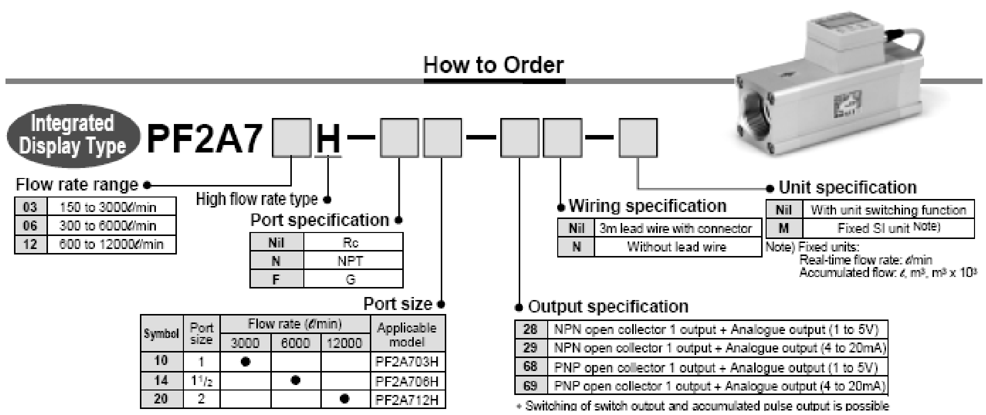
The battery must be installed prior to first using the datalogger.

Basic setup instructions are provided in this manual. However, for detailed information on Setup and Operation of the EasyLog refer to the supplied CD Disc which has instructions and information relating to:

1. Using the Software
2. The software interface
3. Set up the USB Data Logger and Start Logging
4. Set up the USB Data Logger and Start Logging
5. USB Data Logger name, sample rate & calibration
6. Custom calibration
7. Setting alarm levels
8. Setting start time and start date
9. Setup Summary
10. Stop Logging and Download Data
11. View and use EasyLog USB measurements
12. Graphing
13. Copying the graph to other applications
14. Importing the measurements into other applications
15. View the Data Logger Status
16. Using the EL-USB-4
17. Installing / Replacing the battery
18. LED Status Indication

PF2A Flow meter

The XAN7002 has been configured for use with the PF2A Series of Flow Meters. As the data logger receives the captured data in a 4 – 20mA analog format, check your model selection to ensure the flow meter is capable of providing a 4-20mA output.



How to Order

Integrated Display Type **PF2A7 □ H – □ □ – □ □ – □**

Flow rate range

03	150 to 3000ℓ/min
06	300 to 6000ℓ/min
12	600 to 12000ℓ/min

High flow rate type

Port specification

Nil	Rc
N	NPT
F	G

Port size

Symbol	Port size	Flow rate (ℓ/min)			Applicable model
		3000	6000	12000	
10	1	●			PF2A703H
14	$1^1/_2$		●		PF2A706H
20	2			●	PF2A712H

Wiring specification

Nil	3m lead wire with connector
N	Without lead wire

Unit specification

Nil	With unit switching function
M	Fixed SI unit Note)

Note) Fixed units:
Real-time flow rate: ℓ/min
Accumulated flow: ℓ, m^3, m^3 x 10^3

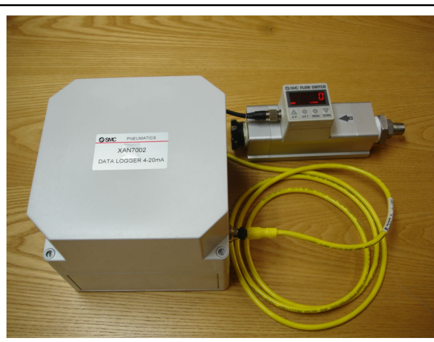
Output specification

28	NPN open collector 1 output + Analogue output (1 to 5V)
29	NPN open collector 1 output + Analogue output (4 to 20mA)
68	PNP open collector 1 output + Analogue output (1 to 5V)
69	PNP open collector 1 output + Analogue output (4 to 20mA)

∗ Switching of switch output and accumulated pulse output is possible

Selection of Analog Output Flowmeter

The flow meter is powered from a sealed battery contained in the Control Enclosure. The flow meter should display a **red LED** array (current flow conditions) when the cable is connected at both ends.



Flowmeter showing normal display

Possible causes for the flow meter display being blank (no LED display) could be:
Insufficient battery charge (less than 12vdc)
Charge battery; see *battery charging instructions*
Connecting cable is not correctly connected at both ends. Check cable connections at both ends.

Getting Started

Setup Power system

The unit is shipped with the battery as separate to the cabinet. Install the battery and attach the power leads

WARNING

When the lid is removed from the control box the terminals and electrical connections of the 12 volt dc sealed battery will be exposed. Take care not to contact battery terminals or live wiring or an electric shock may be experienced.

With the battery installed the battery manegent circuit will have to be enabled. To do this push the button on the circuit board to enable power to the system. (circuit board and RED button for enabling power shown below)

Note each time the battery is reconnected or battery voltage drops below a set point the system will have to be re-enabled.

Setup Data logger

More specific details for the EasyLog Data logger are available from the files on the supplied CD. The following provides a brief overview of the process to setup up the datalogger for use with the PF2A Flow meter.

Step 1

Remove USB EasyLog Device from the control box.

Step 2

Install Battery into USB Device

Step 3

Install EasyLog Software to a PC.

While the software has a self install program it is sometimes better to use the ***Add or Remove Programs*** function contained in Windows/Setup/Control Panel. If you experience problems with the self installation (or following installation the software fails to recognize the USB device then remove using the ***Remove Programs*** function and reinstall use the ***Add Programs*** function

Step 4

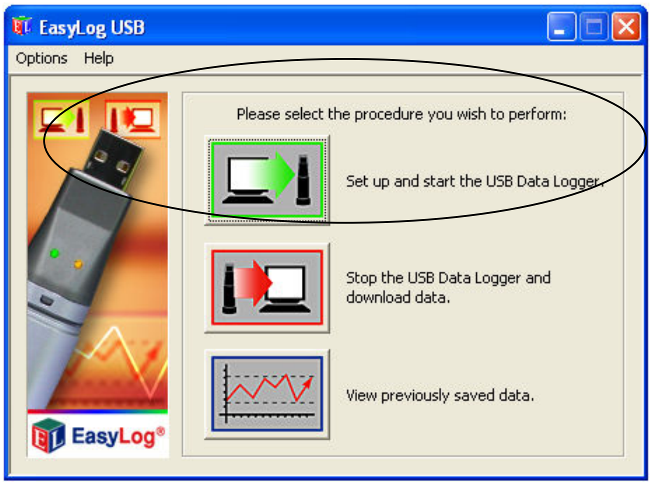
Insert USB device into PC

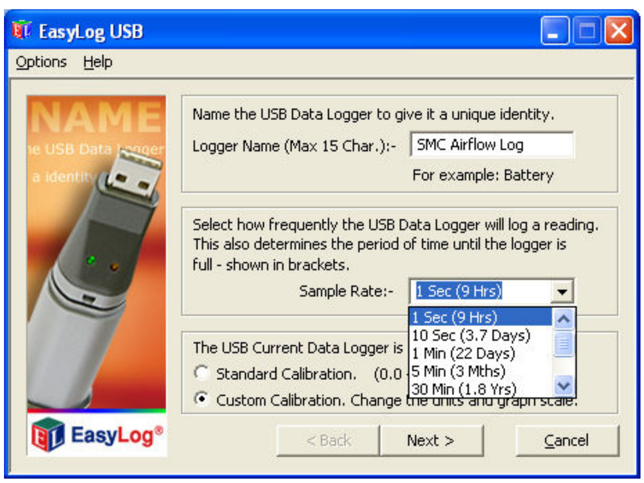
The PC should recognize the device and open the necessary file. The first step is to setup the necessary parameters for flow measurement. If the PC fails to recognize the device it may be necessary to reinstall the software; see step 3 note.

SMC

Step 5

Customizing the datalogger for your application





Insert the Name for the datalogger (can be changed with every application)

What sampling rate is required? For high speed processes or where changes to flow vary constantly then the sample rate should be higher to capture changes.

The Datalogger can be named to correspond with the project. This will apply an identity to the results, in all reports

When selecting the sampling period please ensure the battery life is considered

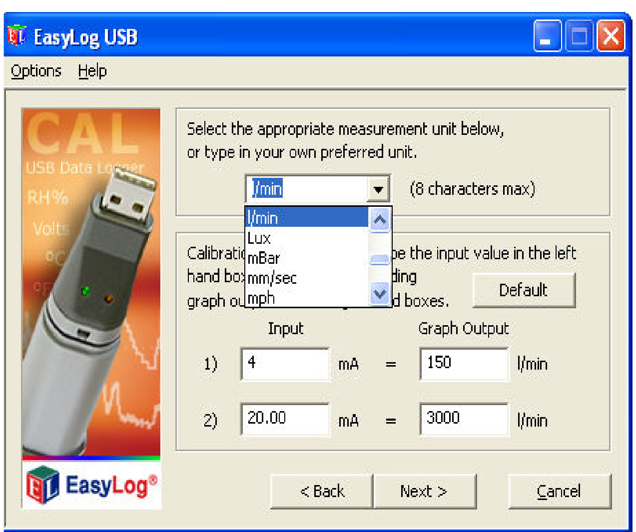
Sample Rate	Memory Capacity
1 second	9 hours
10 seconds	3 days
1 minute	22 days
5 minutes	3 months
30 minutes	1.8 years
1 hour	> 2 years*
6 hours	> 2 years*
12 hours	> 2 years*

It is likely the Data Logger battery life will not support continuous use over this period.

Step 6

Customizing the datalogger for your application

Setting units and scaling the reading to match the chosen PF2A Flowmeter.



In this selection box the data has been input to match a PF2A703H Flowmeter. This unit provides a range of 150 up to 3000 litres per minute for an output signal of 4-20mA
Please note that readings of less than 4mA (when airflow is less than 150 litres per minute will need to be ignored). If a flow range of less than 150 litres per minute is to be considered then a flow meter with a suitable range of measurement is required. (Discuss with your local SMC Representative)

Step 7

Customizing the datalogger for your application

Setting high and Low level alarms

It is possible to set alarms which will identify when a particular flow level has been exceeded (high) or not achieved (low).

If this is not required then pass through this step (press Next)

Step 8

Customizing the datalogger for your application

Setting the date and time to commence data logging

This will ensure that the flow measurement occurs over the required period.

The data logger is now setup for the required compressed air flow data logging project.

The USB Device can now be removed from the PC and installed into the data logger control box. **Please refer to the Warning in Step 1.**

Step 9

Charging the Flowmeter Battery

Ensure the Flowmeter battery is charged sufficiently for the required data logging.

These SLA (Sealed Lead Acid) chargers are fully automatic.
When the battery is charged, the charger automatically switches to trickle charge and a green LED will show this. A red LED is lit when there is normal charging.
Virtually any SLA battery can be charged but the higher the battery size, the longer the charge.
Features:
* Short circuit and wrong polarity prevention
* Constant charging current
* No charge with wrong polarity connection
* No voltage at alligator clips until battery is connected.
Will not charge a totally flat battery i.e. zero volts.

Details relating to the charging of Lead Acid Batteries are provided (courtesy: JAYCAR Electronics)

USING & CHARGING SLA BATTERIES

Sealed lead-acid or 'SLA' batteries are a development from the familiar 'flooded' lead-acid battery which has been used for many years in cars and trucks. This is the oldest type of secondary battery, developed nearly 150 years ago by the French physician Gaston Planté.

The flooded lead-acid battery has cells using positive plates of lead oxide, negative plates of porous 'spongy' metallic lead and sulphuric acid as the electrolyte. The SLA form is essentially very similar except that the electrolyte is in the form of a gel rather than a liquid, and largely absorbed in porous insulating separator sheets placed between the plates. The plates (electrodes) are also made from alloys of lead containing calcium and tin, designed to absorb the gasses produced when lead-acid cells are overcharged. This allows the cells to be sealed, apart from a safety valve.

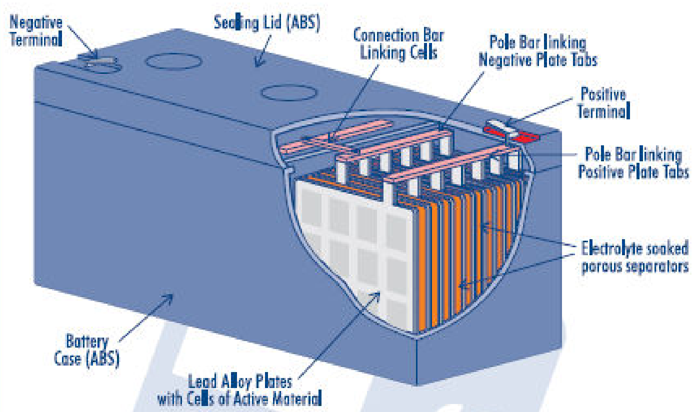


Fig.1: The construction of a typical 6V sealed lead-acid battery, with one cell broken open. The sealing valve and vent details have been omitted for clarity.

The basic construction of a typical multi-cell SLA battery is shown in Fig.1. Both positive and negative plates are in the form of rectangular grid frames, with multiple sequences of alternating plates and separators used to fill each cell. The terminal tabs of all the positive plates in each cell are connected together by 'pole bar' collector strips at the top, and the negative plates are connected together in the same way. Further strips used to interconnect the cells and connect to the main battery terminals. The entire battery is fitted into a multi-chamber case of ABS plastic, with each cell fitted with a safety valve to relieve pressure in the event of serious over-charging.

Because water is not lost during the discharging and recharging processes, SLA batteries require virtually no maintenance and can be used in almost any position.

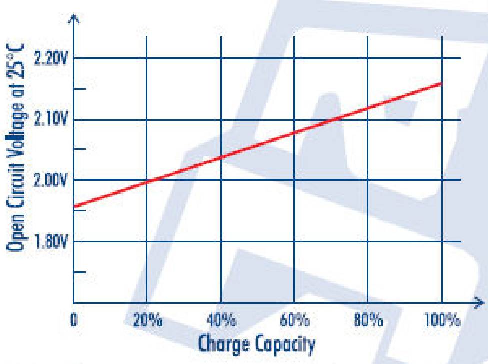


Fig.2: The open-circuit terminal voltage of an SLA cell is a fairly good guide to its state of charge. Multiply the typical voltage figures shown by three for a nominal '6V' battery, and by six for a '12V' battery.

However because they are never fully charged in the theoretical sense, SLAs tend to have the *lowest energy density* of any of the sealed rechargeables — typically only 30 watt-hours per kilogram.

As SLAs are also the cheapest of the rechargeables, this makes them best suited for applications where low-cost power storage is the main consideration, and bulk and weight are of lesser importance. Such applications include electric wheelchairs and golf buggies, etc.

SLAs have the *lowest self-discharge rate* of any of the rechargeables — only about 5% per month. They do not suffer from the memory effect displayed by NiCad and NiMH batteries, and are therefore quite suitable for shallow cycling applications where they spend most of their time connected to a trickle or float charger. In fact unlike NiCad batteries, they *prefer* shallow cycling. This makes them much more suitable for emergency-standby applications such as UPSs and emergency lighting systems.

Although SLAs do prefer shallow cycling to deep cycling, they are nevertheless capable of supplying occasional heavy discharges without adverse effect.

The nominal terminal voltage of each SLA battery cell is 2.0 volts. However the actual terminal voltage varies over a fairly wide range, both above and below the 2.0V level, depending on the cell's temperature and state of charge. This allows the open-circuit voltage to be used as a fairly reliable indicator of the battery's state of charge, as shown in Fig.2.

Incidentally the capacity of SLA batteries varies significantly depending on the actual rate of discharge, and is usually highest at the 20-hour rate — i.e., when supplying a current of 0.05C. The nominal capacity rating is therefore usually given on the basis of this discharge rate.

Generally speaking manufacturers recommend that SLA batteries are not stored in a discharged state, nor allowed to remain in such a state for very long. This results in a condition known as *sulphation*, which is effectively a permanent reduction in energy storage capacity. In fact to avoid sulphation and achieve the longest battery life, it's usually recommended that batteries be recharged when the open-circuit cell voltage falls to 2.10V — corresponding to about 70% of total capacity. This corresponds to a terminal voltage of 6.3V for a '6V' battery and 12.6V for a '12V' battery.

SLA batteries typically achieve a working lifetime of about 300 - 500 cycles, depending on the depth of cycling and the operating temperature. This is significantly shorter than the lifetime of NiCads, and is due to a chemical reaction at the positive plates which gradually causes them to expand and change in composition. So the charge capacity of an SLA slowly falls, as the battery is cycled.

SLA charging & chargers

Unlike NiCads, SLAs are not really suitable for very fast charging. Most manufacturers recommend that they should not be charged in less than 5 hours, or at a charging current level of higher than 0.4C — although some SLAs are able to accept charging currents of up to 0.8C for at least the initial phase of charging, without adverse effects.

The simplest type of SLA charger is the *float charger*, so called because an SLA can be connected across the output of such a charger almost indefinitely without damage.

Essentially an SLA float charger consists of a DC power supply with an output voltage which is reasonably well regulated, to a level corresponding to 2.25V per battery cell (i.e., 6.75V for a '6V' SLA and 13.5V for a '12V' SLA). When a discharged battery is connected to this type of charger, a moderately high charging current flows at first, but gradually reduces as the stored charge level rises. By the time full charge is reached the current has dropped to a low and steady level, just sufficient to maintain the battery at full charge.

This is the system generally used in most of the lower-cost SLA chargers, and it gives a typical charging time of around 16 hours. Most SLA batteries will give very close to their maximum working life when used with this type of charger, so they're fine if you can accept this charging time.

By the way, it is not advisable to attempt speeding up the charging process with this type of charger by increasing the charging voltage. This can easily result in overcharging and the conversion of electrolyte into hydrogen and oxygen gas, building up the internal pressure — which can cause venting via the safety valve, and permanent reduction in the battery's capacity.

Where faster charging of SLAs is desirable, the charging period can be reduced to about 5-6 hours by using a more complicated two-stage process which combines an initial constant-current (CC) bulk charging phase with a constant-voltage (CV) top-up phase. This is the type of system used in more sophisticated 'fast' SLA chargers.

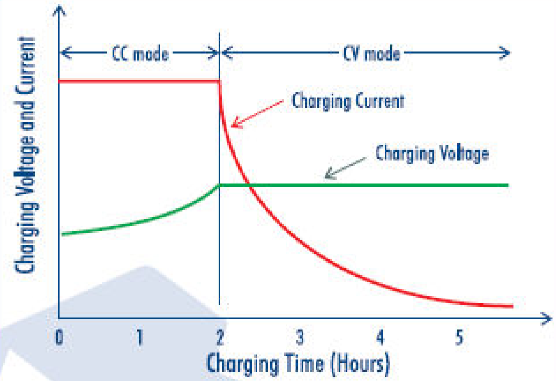


Fig.3: The voltage/current characteristics of a typical two-stage SLA charger, with automatic switching between the initial CC 'bulk' mode and the CV 'top-up' mode. Charging takes about 6 hours.

The voltage and current characteristics of a two-stage SLA charger are shown in Fig.3. As you can see, the discharged battery first receives a reasonably substantial CC charge, at a level of 0.4C or higher. This continues until the cell voltage reaches 2.45V per cell (i.e., 7.35V for a '6V' battery, 14.7V for a '12V' battery), whereupon the charger switches into CV mode and continues to apply this voltage while the remaining charge is stored. (The exact voltage level used for the CV stage should strictly be varied according to temperature, but this isn't often done. Note too that this voltage is an 'under charge' figure.)

During this second phase the charger monitors the current level, which gradually falls and finally stabilises when the battery is fully charged — typically after 5 or six hours. Then the charge is terminated.

Some high-end SLA chargers don't completely terminate the charging process when this fully charged state is reached, but instead switch the CV source voltage down to a lower 'float charge' level to maintain the battery in the fully charged state. This is generally the same level of 2.25V per cell used in low-cost SLA chargers. Chargers providing this additional feature are often called 'Three Mode' chargers.

Step 10

Correctly secure the cover on the Data logger control box.

Step 11

Installation of PF2A Flowmeter.

PF2A Flowmeters and Flow Indicators

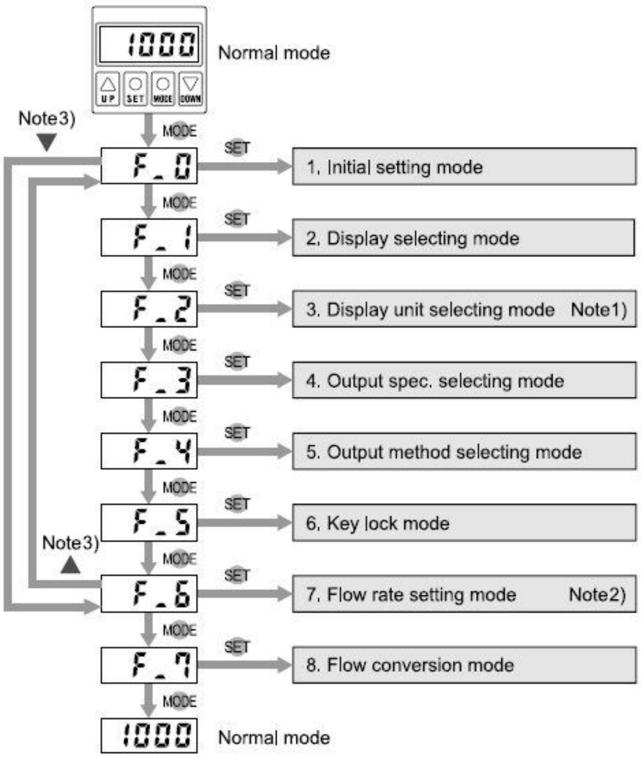
The PF2A Flowmeter is installed into an airline using screw thread connections. To ensure that the flowmeter operates correctly please ensure:

- Excessive thread tape/paste is not applied to the pipe, so as to cause any Teflon tape or paste to be introduced into the airline and/or flow meter.
- Do not use the flowmeter to support the weight of the pipework. Use suitable pipe clamps to secure the adjacent pipework.
- Do not overtighten the connections to the flowmeter
- Ensure the flowmeter is installed with the correct flow direction.
- Read instructions for the use of the flowmeter.

If more information is required please contact SMC or visit the website www.smcaus.com.au.

Quick Setup PF2A Flowmeter

Setting PF2A***H (High Flow Series)
– Quick Guide for use with XAN7002 Datalogger



The Functions that can be set from the keypad are as shown above. In the operation manual these functions are described in more detail.

NOTE 1 F2 is not available on models with –M suffix

NOTE 2 F6 is not available selecting oO1_2 during F3 (Pulse output mode selected)

NOTE 3 Pressing **UP** △ Arrow when in a **Function (F)** mode screen will move to previous Function (F) (i.e F3 to F2), pressing **DOWN** ▽ Arrow moves to next Function (i.e F4 to F5)

Initial setup requires several variables to be checked/setup.

Function (F0)

By pressing **MODE** ○ button the display moves to **F0**. Pressing **SET** ○ will start the setup process. Then as each variable is presented it can be adjusted. This will take the operator through the complete setup process. This method will take the operator through F0-F7 without actually identifying each Function, each time **SET** ○ is pressed it stores the value and moves to the next function; if no change is required then just press **SET** ○ and it will restore the current value and move to the next function.

Alternatively the operator can proceed direct to the ***specific* Function** by Pressing **MODE** button which will move screen to 'F0' then merely use the **UP** arrow or the **DOWN** arrow to move to the desired function between F0 - F7.

Function (F1)
This Function is not required if using the integration pulse output mode. Sets Integrated (accumulated) flow "d2" in Litres or Instantaneous Flowrate "d1" Flow Display in Litres/Minute by pressing **UP** arrow. Leave in desired reading and press **SET** . For data logging it is necessary to set **d1**

Function (F2)
U1 is now displayed (F1 Mode). This is the setting for 'metric units' of Flow. Pressing **UP** Arrow will change this to U_2 which will set 'Imperial measurements' flow measurement selection - Metric or Imperial.

Function (F3) (Not required for data logging)
The Display now shows o1_0. This indicates that the output method required will be provide a digital switch output (a digital switch will provide an output when a predetermined instantaneous flow rate is achieved). Using the **UP** Arrow will change to o1_1 which will provide a digital output when a predetermined air volume is achieved. Using **UP** Arrow changes the display to o1_2 which will provide a digital output when a predetermined pulse count has been reached. It is necessary to press the **SET** button for 5 seconds for the desired output required. Then the display shows the current setting for this output. To change the current setting press the **UP** or **DOWN** Arrow. When the required output is determined then press the **SET** button for 5 seconds to lock this value. NOTE: ***When using the integrate pulse output o1_2 it is not normally necessary to set a pulse output switch.***

Function (F4) (Not required for data logging)
The display now shows o1_P. This indicates the output is set for positive switching; in this mode the switch (digital) output will be ON when the preselected value is reached. Using the **UP** Arrow will change to o1_n which indicates reverse output mode. In this mode the output will be ON until the preselected value is reached at which time it will switch to OFF. Press the **SET** button at the desired mode.

Function (F5)
The display now reads 'unL'. This indicates the keypad is not locked. Values can be adjusted using the methods described above. If the **UP** Arrow is pressed the values changes to 'Loc'. This indicates the keypad is locked. To unlock the Keypad it is necessary to Press **MODE** Button and move to F5. Then use **UP** Arrow to change to unL. This lock function prevents inadvertent accidental value changes. Press **SET** to set as required.

Function (F6)

This will set the display flow value. It is possible to read instantaneous (d_1) and integrated pulse (d_2) during operation of the flow switch. Use the **UP** △ or **DOWN** ▽ arrow to move between d_1 and d_2, press **SET** ○ when at desired selection. (Pressing **UP** △ arrow will momentarily change between readings during normal operation but reading will read only default continuously, Select desired display mode the display that will act as the default (normally displayed). When the instantaneous display is set at default it normally displays an ever changing value depending on the instantaneous airflow passing through the flow switch. In this display mode it is difficult to ascertain the actual airflow at an instant because it will be changing as airflow changes through the flow meter (unless you fully understand the processes using the air at any point in time.) Using the integrated display is easier to interpret as it can be measured over a time period and an average Flowrate determined (integrated value in litres divided by the time you wish to measure).

When reading the display in ‘integrated flow (volume of air) the units continually increment. To reset to zero press both **UP** △ and **DOWN** ▽ buttons simultaneously for 5 seconds or more.

Normally for data logging purposes the display will be set to ‘Instantaneous flow’

Function (F7)

F7 sets the conversion factor. This is the reference against which all data measurements are compared. Normally this will be set to ‘ANR’ where the displayed values are referenced to a standard atmosphere (20° C, 65% Relative Humidity (RH), 101kPa atmospheric pressure). The other option is to select ‘NOR’ which references to alternative datum (not required here). Changing between datum is carried out by pressing the **UP** △ or **Down** ▽ Button

For more detailed instructions and information on the PF2A Flow switch please refer to the instruction booklet supplied or contact SMC or visit website www.smcaus.com.au.

For the complete range of Flow and Pressure measurement solutions from SMC please contact your local SMC office on 1800PNEUMATICS (freecall Australia) or visit www.smcaus.com.au