# LUDLUM MODEL 336 TRITIUM-IN-AIR COLLECTOR September 2025

# LUDLUM MODEL 336 TRITIUM-IN-AIR COLLECTOR

## September 2025





#### STATEMENT OF WARRANTY

Ludlum Measurements, Inc. warrants the products covered in this manual to be free of defects due to workmanship, material, and design for a period of twelve months from the date of delivery. The calibration of a product is warranted to be within its specified accuracy limits at the time of shipment. In the event of instrument failure, notify Ludlum Measurements to determine if repair, recalibration, or replacement is required.

This warranty excludes the replacement of photomultiplier tubes, G-M and proportional tubes, and scintillation crystals which are broken due to excessive physical abuse or used for purposes other than intended.

There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face there of. If the product does not perform as warranted herein, purchaser's sole remedy shall be repair or replacement, at the option of Ludlum Measurements. In no event will Ludlum Measurements be liable for damages, lost revenue, lost wages, or any other incidental or consequential damages, arising from the purchase, use, or inability to use product.

#### RETURN OF GOODS TO MANUFACTURER

If equipment needs to be returned to Ludlum Measurements, Inc. for repair or calibration, please send to the address below. All shipments should include documentation containing return shipping address, customer name, telephone number, description of service requested, and all other necessary information. Your cooperation will expedite the return of your equipment.

LUDLUM MEASUREMENTS, INC. ATTN: SERVICE DEPARTMENT 501 OAK STREET SWEETWATER, TX 79556

800-622-0828 325-235-5494 FAX 325-235-4672

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# Introduction

he Model 336 Tritium-In-Air Collector is a desktop or rack-mounted Tritium sample collecting instrument. It features a maintenance-free diaphragm air pump to pull air through six cascaded 60 mL vials. The first three vials collect HTO from the air being monitored. The first vial catches the bulk of the HTO, while the second and third vials ensure that most all the HTO is collected. The air is then oxidized by an internal catalyst, converting all the HT still in the air to HTO to get collected by the last three vials.

While running, two important measured values are the catalyst temperature (which must be maintained to catalyze the HT), and the airflow, which must be maintained to take in tritium and provide sensitivity. Audible and visual alarms are triggered if either of these values drop below acceptable levels. A third alarm is triggered if, through some failure, the internal instrument temperature exceeds 60 °C (140 °F).

Backflow prevention ensures the catalyst is protected from the sampling fluid. Airflow is measured with a mass-flow sensor, with the value displayed on the front LCD. Catalyst temperature setpoint and real-time reading are conveniently displayed on the front panel.

The instrument is easy to use, only having a few simple controls. It comes in a housing, which can be installed in a standard 19-inch rack or set on a desktop. It is powered by 120 Vac and has a standard North American IEC 320 inlet receptacle and three-wire UL-certified power cord. If mains power is uncertain, an Uninterruptible Power Supply (UPS) is recommended for uninterrupted performance.



# **Getting Started**

## **Unpacking and Repacking**

Remove the Instrument Setup and Verification Checklist and place it in a secure location. Remove the instrument and ensure that all the items listed on the packing list are in the carton. Check individual item serial numbers and ensure verification checklists match. The Model 336 serial number is located on the back of the unit.

To return an instrument for repair, provide sufficient packing material to prevent damage during shipment.

Every returned instrument must be accompanied by an **Instrument Return Form**, which can be downloaded from the Ludlum website at <a href="https://www.ludlums.com">www.ludlums.com</a>. Find the for by clicking the "Support" tab and selecting "Service Center" from the drop-down menu. Then choose the appropriate Service Center division where you will find a link to the form.



# **Specifications**

**Sensitivity:** 1 x 10<sup>-9</sup> μCi/cc for 7-day collection time at 100 cc/min

**Airflow:** 0 to 600 cc/min, real-time LCD readout with current and totalized readings, and low airflow alarm

**Temperature Display:** real-time readings, a temperature setpoint, and a low temperature alarm

**Sample Tubing Connections:** 1/8 inch MNPT connections on back of instrument; one inlet, one exhaust

**Ambient Temperature Range:** 0 to 50 °C (32 to 122 °F)

**Warm-up Time:** <25 minutes for catalyst to reach oxidizing temperature, 45 minutes to reach operating temperature

**Unit Cooling:** 2 ea. 27 CFM (cubic feet per minute) parallel continuous duty fans

**Pump:** maintenance-free diaphragm pump, typically 100-600 cc/min airflow

**Power:** 120 Vac input with two 5A fuses

**Construction**: powder-coated aluminum, stainless steel tubing throughout tritium path

**Size (W x H x D)**: 48.3 x 26.4 x 59.2 cm (19 x 10.4 x 23.3 in.)

**Weight**: 14 kg (30 lb)

#### Connectors:

- 9-pin D connector provides data out for streaming measurements or calibration use.
- 4-pin connector provides potential free relay contacts for failure conditions.



# **Operation**

#### Start-up:

Plug in the power cord and turn the instrument on with the on/off switch located next to the power cord on the back. The mass-flow sensor and temperature controller will power on and begin displaying readings. The LOW CATALYST TEMP light should turn on and the LOW AIRFLOW light will turn on if the PUMP ON/OFF switch is off.

#### Flowmeter:

If the Flowmeter still has its factory settings, it will be displaying both current airflow in cc/min (which may be zero if the pump switch is off) and the totalized airflow (the volume of air that has passed through) in cc. The totalizer will continue to add to its value until it is purposefully reset, not just turned off. There is a dial on the totalizer to physically restrict the airflow. The dial is factory set for an airflow of 100 cc/min but can be changed by the operator. The LOW AIRFLOW light is factory set (but can be changed by the user) to activate when the airflow is less than 70 cc/min. The settings menu can be password protected if desired but comes from the factory without a password. Refer to the Redy Compact Series manual in the appendix for more information on changing settings.

#### **Temperature Controller:**

The temperature controller controls the catalyst chamber temperature and has two displayed temperatures (both in Fahrenheit per factory settings). The top is the setpoint that the instrument is trying to reach, and the bottom is the current measured value. The setpoint will display the last value entered before the machine had been shut off. Typically, this value will be 937 °F because this is the standard operating temperature and under normal operation this will not need to change. To change the setpoint, simply hold either the up or down button according to which way you want the temperature to change. The upper and lower setpoint limits are 937 °F and 0 °F respectively. There is no way to cool the catalyst, so if the measured value should never go below room temperature. Refer to the ProHeat Controls manual in the appendix for more information on changing settings.

#### **Pump Runtime:**

The PUMP RUNTIME display will always be on, whether the instrument is on or not because it has an internal battery meant to last 10 years. This counter is tied to when the pump is running and is intended to be an indicator of pump life. It can be reset at any time but is intended to be reset when the pump is replaced, or maintenance is done. Refer to the LE8N datasheet in the appendix for more information. Refer to the Micro Diaphragm Gas Sampling Pumps manual in the appendix for more information on servicing the pump.

#### Alarm:

The INTERNAL TEMP ALARM should only go off if something is wrong with the instrument. It is set by an internal reed switch to alarm if the internal temperature goes above 140 °F. This cannot be changed by the end user. Refer to the TRS Thermal Reed Switch datasheet and the Floyd Bell Inc alarm datasheet in the appendix for more information.

#### Catalyst Temperature Explanation:

To minimize the places for air leaks to occur, the thermocouple measuring the catalyst chamber temperature is located on the outside wall of the catalyst chamber. With the instrument running at the desired 100 cc/min airflow, temperatures were measured on both the inside and outside, and it was found that when the inside was at the desired 842 °F (450 °C), the outside wall was reading 937 °F steadily.

Based on these readings, the temperature controller on the front panel should be set at 937 °F to reach the desired internal catalyst temperature of 450 °C.

Tests performed at Ludlum Measurements show that the outside wall of the chamber heats up faster than the inside chamber. It was found that when the LOW CATALYST TEMP light goes off at 933 °F on warm-up, the internal temp is approximately 750 °F (400 °C), when the catalyst just starts oxidizing. It takes about 45 minutes for the internal temperature to reach 450 °C.

Therefore, it is recommended to wait about 45 minutes after starting the instrument before running tritium through it (even though the "Low Catalyst Temp" light will go off before that then), to ensure that the catalyst is fully up to temperature. Once up to temperature, the "Low Catalyst Temp" light can then be treated as the failure indicator it was designed to be, showing if something is wrong with the catalyst.

#### Maintenance:

The air inlet filter located on the back of the instrument should be changed periodically, depending on the environment in which the instrument is located.

The pump has a rated life of approximately 10,000 hours. After this time either the pump can get rebuilt using the rebuild kit referenced in Section 6, or the whole pump can be replaced, which should come from Ludlum Measurements due to the connectors installed on the pump.



# Recycling

Ludlum Measurements, Inc. supports the recycling of the electronics products it produces for the purpose of protecting the environment and to comply with all regional, national, and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies — public and private — involved in this pursuit, it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

- Batteries
- Glass
- Aluminum and Stainless Steel
- Circuit Boards
- Plastics
- Liquid Crystal Display (LCD)



# **Parts List**

#### Wiring Diagram, Drawing 520 x 453

Reference	Description	Part number
J1	VAC inlet/fuse/switch module DD14-52020-12111-1100	2309988
J2	AC/DC 12V 7A power supply EPS-12-12	2309990
J3-J4	12V fan CFM-7015V-133-315	2314249
J5	Mass flow sensor GCR-K5WPWER4	2309994
J6	Int temp thermostat TRS3-60MLR00	2309995
J7	12V pump PMM4990-NMP830KPDC-BI4	2314240
J8	Timer LE8N-BF	2309999
J9	Temperature controller 6000-101-00	2309996
J10	Heater 120VAC 156W AWH-051-020D	2314248
J11	Type K Thermocouple 3856K912	2314251
DS1	Airflow alarm red LED WL-19081250	07-6563
DS2	Internal hi-temp alarm LED TUHB-V88R-930-Q(F)	22-8281
DS3	Low-temp alarm LED WL-19081250	07-6563
F1-F2	5A 5x20 fuse 217005XP	21-9078
no ref	Barrier strip 4-141	18-8758
SW2	Pump On/Off switch DM62J12S205PQ	08-6715

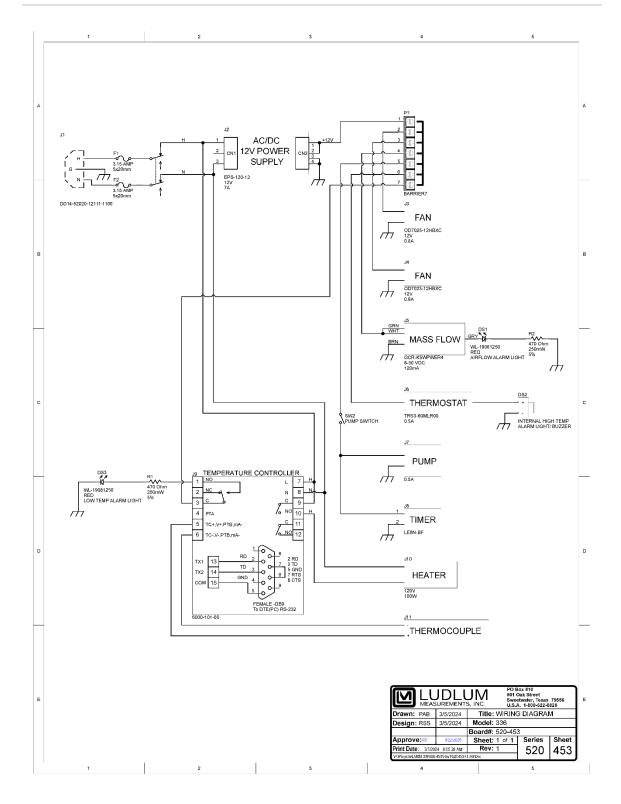
#### Accessories

Description	Part number
Glass Vials – Wheaton, 60mL, 42mm dia, W216996	2309986
Pump Rebuild Kit (not supplied)	2314252

# Section

# **Drawings and Diagrams**

Wiring Diagram, Drawing 520 x 453





# **Component Information**

Following this page are the data sheets and manuals for the components used with the Model 336. Those components include:

Component and description	Title of Manual/Data Sheet	Document Page #
Flow Meter – thermal mass flow meter and manual regulator for gases	RedyCompact Series Thermal Mass Flow Meters and Manual Regulators for Gases	16
Internal Temperature Buzzer	Floyd Bell Inc. Sound Solutions - Twin Turbo Series	89
Thermal Sensor – TRS Thermal Reed Switch	Kemet - Thermal Sensors  - TRS Thermal Reed Switch	92
Power Supply – 120W Single Output Switching Power Supply	MW Mean Well – 120W Single Output Switching Power Supply – EPS-120 Series	113
Pump Timer – DIN W48 x H24mm, Indication Only, LCD Timer (Hour Meter)	LE8N Series	118
Pump – Micro Diaphragm Gas Sampling Pump	Operating and Installation Instructions	124
Temperature Controller – PID microprocessor-based controller	User's Manual – PROHEAT Controls	143

# RedyCompact® Series

# Thermal Mass Flow Meters and Manual Regulators for Gases

RedyCompact® Meter (GCM)
RedyCompact® Regulator (GCR)
RedyCompact® Meter with Alarm Module (GSC)
RedyCompact® Regulator with Alarm Module (GCA)

# **Instruction Manual**



Part Number: IM-RedyCompact V1.Compact.EN A2-2



#### Global Support Locations: We are here to help!

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For Global Service Centers, go to http://www.sierrainstruments.com/facilities.html

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#### **TRADEMARKS**

RedyCompact® and Redy® are registered trademark of Sierra Instruments. Other product and company names listed in this manual are trademarks or trade names of their respective manufacturers.

# **Warnings and Cautions**

"Warning," "Caution," and "Note" statements are used throughout this manual to draw your attention to important information.

	Symbol Key		
Symbol	Symbol Meaning	Descripition	
	Warning	"Warning" statements appear with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application. Failure to comply with these instructions may damage the meter and cause personal injury.	
!	Caution	"Caution" indicates that failure to comply with stated instructions may result in damage or faulty operation of the meter.	
(!)	Note	"Note" indicates that ignoring the relevant requirements or precautions may result in flow meter damage or malfunction.	



Warning! Do not remove the electronics housing. A damaged hologram seal will void the warranty.

Warning! There are no serviceable parts inside the unit.

Warning! Repairs must only be performed by qualified personnel.

**Warning!** This unit has several power supply possibilities. If you use the external 24 VDC power supply, it is strongly recommended to have this device grounded.

**Warning! Toxic, Flammable, Gases and ATEX:** In the case of toxic and flammable gases, the respective safety guidelines in each country must be followed. This Redy device is **not** Ex certified. In the case of flammable and toxic gases, fittings, cable glands and pipes intended for that purpose must be used. The responsibility for safe operation lies with the user and designer of the facilities.

#### **Important Customer Notice-Oxygen Service**

Sierra Instruments, Inc. is not liable for any damage or personal injury, whatsoever, resulting from the use of Sierra Instruments standard mass flow meters or controllers for oxygen gas. You are responsible for determining if this mass flow meter or controller is appropriate for your oxygen application. You are responsible for cleaning the mass flow meter or controller to the degree required for your oxygen flow application.

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**Warning! Power.** If it becomes necessary to remove the instrument from the system or change a battery, the power to the device must be disconnected. Always switch off the power before you disconnect terminal connections in potentially dangerous surroundings to avoid sparks.



**Note! Subject to Change:** Due to our policy of ongoing product development, we reserve the right to change the information in this manual without notice.

# RedyCompact® Series Instruction Manual

This manual is for RedyCompact Series models:

- RedyCompact<sup>®</sup> Meter (GCM)
- RedCompact® Regulator (GCR)
- RedyCompact® Meter with Alarm Module (GSC)
- RedyCompact<sup>®</sup> Regulator with Alarm Module (GCA)

This manual is valid for instruments with a serial number greater than (>300000).

This manual is updated for the latest firmware version of the red-y compact 2. Please verify that your unit is updated with firmware version 3.0.6 available from our website (see chapter 5.12 Firmware upgrade).

#### **Receipt of System Components**

When receiving a Sierra mass instrument, carefully check the outside packing carton for damage incurred in shipment. If the carton is damaged, notify the local carrier and submit a report to the factory or distributor. Remove the packing slip and check that all ordered components are present. Make sure any spare parts or accessories are not discarded with the packing material. Do not return any equipment to the factory without first contacting Sierra Customer Service.

#### **Technical Assistance**

If you encounter a problem with your flow meter, review the configuration information for each step of the installation, operation, and setup procedures. Verify that your settings and adjustments are consistent with factory recommendations. Installation and troubleshooting information can be found in this manual. See Chapter 3 for installation and Chapter 6 for troubleshooting.

If the problem persists after following the troubleshooting procedures outlined in the RedySmart product manual, contact Sierra Instruments by fax or by E-mail (see inside front cover). For urgent phone support you may call (800) 866-0200 or (831) 373-0200 between 8:00 a.m. and 5:00 p.m. PST. In Europe, contact Sierra Instruments Europe at +31 20 6145810. In the Asia-Pacific region, contact Sierra Instruments Asia at +86-21-58798521. When contacting Technical Support, make sure to include this information:

- The flow range, serial number, and Sierra order number (all marked on the meter nameplate)
- The software version (visible at start up)
- The problem you are encountering, and any corrective action taken
- Application information (gas, pressure, temperature and piping configuration)

#### Recycling



Note the existing regulations of your country.

## **Register Your Product Today**

# Three (3) Year Warranty (Sierra MEMS Therma Mass Flow Sensor: RedySmart and RedyCompact Brands)

All Sierra products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to Buyer, provided return or rejection of product is made within a reasonable period but no longer than three (3) years for calibration and non-calibration defects, from date of delivery.

To assure warranty service, customers must register their products online on Sierra's website. Online registration of all of your Sierra products is required for our warranty process. Read complete warranty policy at <a href="https://www.sierrainstruments.com/warranty">www.sierrainstruments.com/warranty</a>.

# Lifetime No-Drift Sensor Warranty Sierra Mems Thermal Mass Flow Products

In addition to Sierra's standard three (3) year manufacturing warranty on all MEMS mass flow instruments produced, Sierra also offers a Lifetime No-Drift Sensor Warranty. Sierra defines nodrift as less than 1% of full scale over the life of the instrument. Therefore, if drift of greater than 1% of full scale occurs over the sensor's lifetime, the sensor and/or entire instrument will be repaired or replaced and recalibrated free of charge.

This warranty applies to all MEMS/CMOS thermal mass flow sensors standard on every Sierra RedySmart® and RedyCompact® models sold after January 15, 2020. This warranty is only valid if the unit is exclusively used with the gas or gases specified during the initial calibration or recalibration, without any additives in any form and under the operating conditions (temperature, inlet and outlet pressure, full scale flow rate) the unit was originally specified for.

Sierra's Lifetime No-Drift Sensor Warranty is made possible due to high-precision MEMS (Micro-Electro Mechanical Systems) technology utilizing an advanced ultra-stable CMOS (Complementary Metal Oxide Semiconductor) sensor. The use of MEMS techniques allows both electronic circuits and mechanical devices to be manufactured on a silicon chip, similar to the process used for integrated circuits.

Learn more about Sierra's Lifetime No-Drift Sensor Warranty at <a href="https://www.sierrainstruments.com/warranty">www.sierrainstruments.com/warranty</a> or see detailed lifetime no-drift sensor warranty in Appendix 8.

## **Register Warranty Online**

Register now at <a href="https://www.sierrainstruments.com/register">www.sierrainstruments.com/register</a>. Learn more about Sierra's warranty policy at <a href="https://www.sierrainstruments.com/warranty">www.sierrainstruments.com/warranty</a>.

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# 1. Introduction

Thank you for choosing devices from the RedyCompact® Series. These operating instructions will help you to install and operate these gas flow measuring devices. Please read through these instructions carefully before installing the unit. Our aim has been to write a full and practical guide. We would be grateful if you would notify us of any shortcomings or mistakes.

Please contact <u>Sierra Instruments</u>" <u>Customer Service</u> if you have questions about any aspect of the product (s), you may call (800) 866-0200 or (831) 373-0200 between 8:00 a.m. and 5:00 p.m. PST. In Europe, contact Sierra Instruments Europe at +31 20 6145810. In the Asia-Pacific region, contact Sierra Instruments Asia at +86-21-58798521.

The RedyCompact is a thermal based mass flow meter that can measure the mass flow of gases. The core element of the red-y thermal mass flow meter is a CMOS sensor chip. The sensor and parts of the electronics are on one board and offer a number of advantages for the user.

# 1.10. Features of RedyCompact Thermal Mass Flow Meters

In developing and manufacturing the devices, we have focused primarily on customers and their applications. Our aim is to implement customers' requirements in the form of new developments or enhancements on an ongoing basis. The essential features are:

- Compact design
- Battery operated optional (Portable)
- Dot-matrix LCD touch screen
- Multiple gases possible (3 gases)
- Flexible due to the many different settings accessible through the touch screen
- Back-light screen in USB and 8...30 VDC power mode
- Power also possible with USB micro-B connector or external 8...30 VDC (Separate module)
- Optional alarm module with power, 3 contacts and 2 inputs
- Display can be rotated 180 degrees
- Fast and accurate measurement and control
- Integrated temperature compensation and flow totalizer (standard)
- Easy to maintain and service
- Firmware upgradable through USB connection
- 3-year warranty

# 1.11. Scope of Warranty

Warranty for the RedyCompact product line extends to material and manufacturing defects only. Maximum warranty covers product replacement free of charge. The following causes of faults/damage are not covered under warranty:

- Use outside the operating limits
- Damage due to corrosion
- Damage due to leaking batteries
- Mechanical damage in general

- Contamination due to improper sealing
- Contamination due to impure gases or penetration of liquids
- Damage to electronic components due by over-voltage or electrostatic discharges, and corrosion damage due to aggressive environments
- Functional failure due to incorrect operation or faulty parameterization
- If the unit has been opened or otherwise tempered with
- Drift in the calibration
- EEPROM damage

# 1.12. Instructions and Warnings

Read all of the operating instructions thoroughly before installing and commissioning equipment. Misconceptions and incorrect use can lead to breakage of the measuring device or risk of personal injury. Should one of these cases occur, the responsibility lies solely with the operator of the device. The installation, commissioning and operation and maintenance must be done by appropriately qualified personnel.

#### 1.12.1 Installation

#### **Important Note**



Please note before the start-up:

- Do not use sealing tape or liquid sealant
- Piping must be cleaned before installation of instrument

#### Warning!



Products in this manual may contain metal or elastomer seals, gaskets, orings or valve seats. It is the "user's" responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process limitations of the device, may result in equipment damage and/or personnel injury or death.

It is recommended that the user check the devices on a regular schedule to ensure that it is leak free as both metal and elastomer seals, gaskets, o-rings and valve seats may change with age and exposure to process gas.

#### 1.12.2 Power

If it becomes necessary to remove the instrument from the system or change a battery, the power to the device must be disconnected. Always switch off the power before you disconnect terminal connections in potentially dangerous surroundings to avoid sparks.

# 1.13. Documentation and Cables Supplied

A printed quickstart quide is shipped together with each device. However, we recommend to visit our website to obtain the latest version of the manual and the latest firmware version for the *RedyCompact*.

Every device comes with a USB A to USB Micro-B cable. This cable can be used to power the unit and to upgrade the firmware.

We ship the device with the following accompanying documentation:

- 1 factory calibration certificate per ordered calibration
- Final inspection report
- USB cable + 1 x AA battery (if battery powered)
- Quick Install Guide
- Product Information Card with links to current instruction manual

# 1.14. The Measurement Principle

The thermal mass flow measurement principle is particularly suitable for the measurement and control of clean and dry gaseous media. The most significant advantage is that the measurement process measures the real mass flow and is largely independent of temperature and pressure.

Stated simply, the thermal measurement principle measures the heat transport by gas flowing past.

In the case of *red-y* mass flow measuring instruments, a constant heat input gives a flow-dependent temperature difference ( $\Delta T$ ). Two temperature sensors are positioned in the measuring channel (T1, T2), one before the heating system (H) and one after it (see Figure 1).

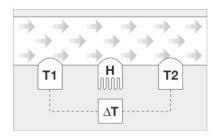


Figure 2: Measurement Principle

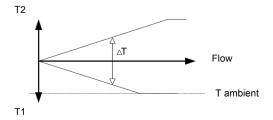


Figure 1: Sensor Operation

If there is no flow, the heat spreads symmetrically in directions T1 and T2. The temperature difference T1-T2 is therefore zero.

Flow rates > 0 create a temperature difference. The sensor T1 at the inlet is cooled by the gas flowing past it, and the temperature of the second sensor T2 rises due to the heat drawn from the heating system.

The temperature difference is related non-lineary to the mass flow, with very high repeatability. The electronics will, based on the calibration, convert this temperature difference in a linear and proportional indication of the mass flow of the gas.

## 1.15. Real, Standardized and Normalized flow

The user-selectable engineering units of the *RedyCompact* has been divided in two groups: "Real and Normal" units and "Other units."

This separation is not only there to find the unit you want to select quicker, it also separated the "Normalized flow" from the "Standardized flow."

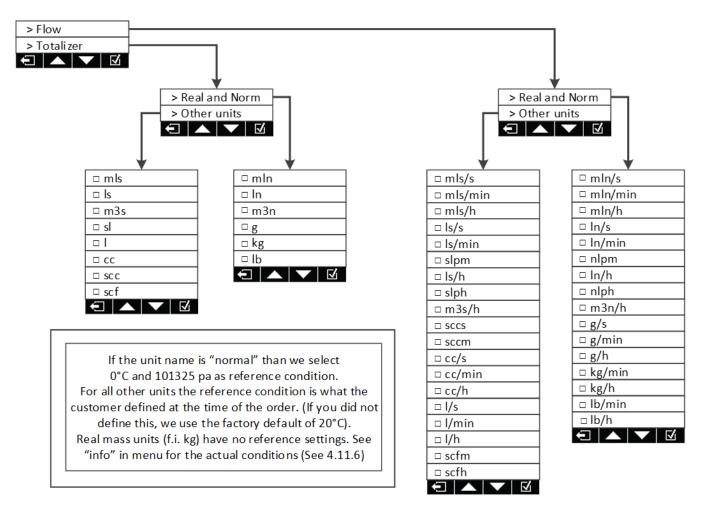


Figure 3: Units Menu

The RedyCompact has basically two reference conditions: One for "Real and Normal" units and one for "Other units."

The factory setting is as follows:

- 1) For all units that are used in "normal" (like ln/min), the reference conditions are always 0°C and 1013.25 mbara. This cannot be adapted.
- 2) For all the other units that are "standard" (like ls/min and sccm) and the l/min the reference conditions has to be be defined when the unit is ordered.

The reference value for all units that are not "Normal" or "Real" it has to be defined with the purchase order. It cannot be changed after the units has been delivered.

On the label of the RedyCompact we will mention a reference condition. This reference condition is for the "Standard" units only. The "normal" units will always be 0°C and 1013.25 mbara.

In future version of the firmware the reference conditions will be adjustable in the menu.

Gas flow in general can be expressed in one of the following:

- **Volumetric Flow:** (f.i. I/min). This theoretically cannot be measured by the RedyCompact because it is volume. The RedyCompact measures **mass flow**. However, due to regional requirements we still have it as a flow unit that is selectable. Units shown as volume (I/min) refer to the customer defined reference conditions (Same as "standard").
- **Real Mass Flow**: (f.i. kg/h). This refers to true mass units per time unit. The RedyCompact can measure this and you can select this type of unit from the menu.
- Normalized Volumetric Flow: Normalized means that the units are "translated" to
  predefined pressure and temperature conditions. Normalized or Normal Conditions refers to
  0°C and 1013.25 mbar absolute. You can select this type of unit from the menu of the
  RedyCompact. These units are mostly used in Europe and China.
- Standardized Volumetric Flow: Standardized means that the units are "translated" to predefined pressure and temperature conditions. Standardized or Standard conditions refers to 20°C (68°F) and 1013.25 mbar (=760 mmHg) absolute. You can select these type of units from the menu of the RedyCompact. These units are mostly used in the USA. Standardized can also refer to other reference conditions (f.i. Natural Gas industry often uses 15°C and 1013.25 mbar absolute. In the semicon world they often use 25°C and 1013.25 mbara. Please define and mention these reference condition at the time of your order.

#### **Important Note**



Please note that reference condition relating to Normalized or Standardized volumetric flow are **not** the operating conditions. According to the ideal gas law, the gas volume will change by 0.35% per K.

#### **Important Note**



Please note that Sierra standard uses the following densities for their main 3 gasses: Air: 1.293 gr/m3, N2: 1.2504 gr/m3, O2: 1.429 gr/m3 (All at 0°C and 1013.25 mbar absolute). If you use other densities or need additional information for other gasses, please contact the factory. Densities need to be defined before manufacturing and cannot be adjusted once the unit has been delivered.

# 1.16. CMOS technology

The Redy measuring and control devices are equipped with an innovative CMOS semiconductor sensor that sets new standards for accuracy, speed and measurement dynamics.

With our CMOS technology the sensor element, amplifier and A/D converter form a single silicon chip.

# 1.17. Block Diagram

The following GCM block diagram shows the structure of the device. The block diagram does not show the optional manual control/needle valve (model GCR) that would normally be placed on the outlet of the unit.

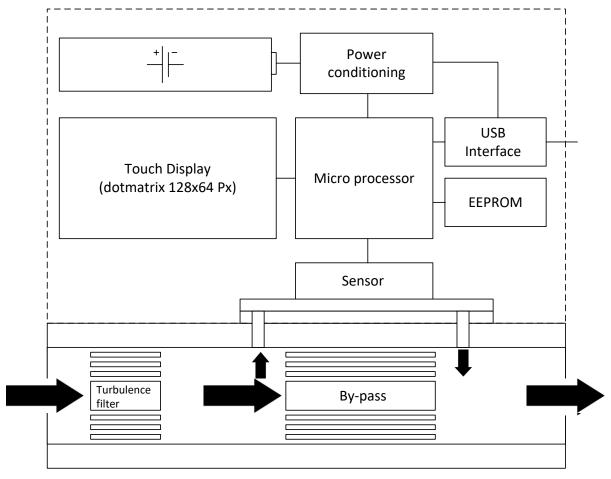


Figure 4: Block Diagram

# 2. General device specifications

Media (real gas calibration):	Air, O2*, N2*, He, Ar, CO2, H2, CH4, C3H8 (other gases and gas mixtures on request)
*O <sub>2</sub> & N <sub>2</sub> are calibrated with air.	
Accuracy:	
Eco	±2.0% of full scale; Ranges > 200 ln/min ±3.0% of full scale
Special	±1.0% of full scale (only G¼" instruments and real gas calibrations)
Dynamics:	
Eco	1:50 (Meter reads zero if flow is less than 1.7% of full scale)
Special	1:100 (Meter reads zero if flow is less than 0.83% of full scale)
Response Time	Maximum 300 msec (filter setting dependend)
Flow Update By Sensor	40 ms (Battery mode 500 ms)
Display Update	240 ms (Battery mode 500 ms)
Repeatability	±0.5% of full scale
Long-Term Stability	< 1% of reading / year
Temperature Coefficient	< 0.025% FS measuring range type per °C
	< 0.012% FS measuring range type per 1°F
Pressure Coefficient	< 0.2% / bar of reading (typical N2)
	< 0.014% / psi of reading (typical N2)
Working Pressure Range	0.2 - 11 bara (3-160 psia)
Test Pressure	16 bara (232 psia)
Storage Conditions	-20 to 80°C (-4 to 176°F), 0-95% RH, non-condensing
Temperature Range	0 – 50°C (32 bis 122°F), 0-95%, RH, non-condensing
	Warning: Do not expose device to direct sun light.
Warm-Up Time	< 5 sec. for full accuracy

Materials	
Electronics Housing	ABS (Acrylnitril-Butadien-Styrol)
Body Material	Anodized aluminium or stainless steel 1.4404 (316L)
Sensor Area	Silicon, glass, epoxy
Seal Material	FKM, optional EPDM (FDA compatable)
Wetted Parts	See appendix (see chapter 6.17 Wetted Parts List)

Integration	
Display	Touch display 128x64 px
	Backlighted only with external power supply (Micro-USB or 24 VDC )
Process Connection	G¼" (BSPP* female) up to 60 ln/min,
	G½" (BSPP* female) up to 450 ln/min *British Standard Pipe Parallel
Inlet Section	None required
Mounting Orientation	Any position (consult manufacturer above 5 bara (72 psia) if the
Wounting Onentation	RedyCompact will be mounted vertical)
Connection Cable	For external power supply: 2 m with loose ends (fly leads)

# **2.10.** Safety

Test Pressure:	16 Bara (232 psia)
Leak rate to external:	1 x 10 <sup>-6</sup> mbar*l/s He
Protection class:	IP-50
EMC	EN 61326-1

# 2.11. Electrical Data for Meter GCM and Regulator GCR

Supply Voltage	Power supply RedyCompact meter & regulator Standard AA battery or USB micro-B power supply (DIN 62684)
	Option: External power 830 VDC , 120 mA. We recommend a power supply with a minimum current of 150 mA. (Power supply hereafter refered to as the 24 VDC power supply)

# 2.12. Measurement Ranges (air)

The RedyCompact has four different flow elements available. Each element has a defined maximum operating flow range that will be defined during calibration. The flow ranges selectable below are the maximum flow ranges for  $air/O_2$  and  $N_2$  only. For other gasses consult the factory. These ranges are adjustable electronically during factory configuration to your desired full scale range.

	Type	Measurement full scale (air), scale freely selectable	
<b>RedyCompact Meter GCx:</b>	GCx-A	from 50 mln/min	to 600 mln/min
	GCx-B	from 600 mln/min	to 6000 mln/min
	GCx-C	from 6 In/min	to 60 ln/min
	GCx-D	from 60 In/min	to 450 ln/min

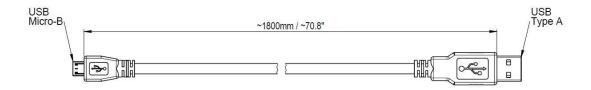
### 2.13. USB Interface

The unit has a female USB micro-B connection (DIN 62684) that can be used as an external power supply and to upgrade the firmware. USB micro-B is the same connector you find on older Android and Windows portable phones, you can use the charger of your telephone to power the RedyCompact.



#### Note

It is not possible to read data from the flow meter through the USB connection.



# 2.14. Battery

The battery operated RedyCompact can operate on any common AA battery. The lifetime is strongly dependent on the usage and the quality of the battery. In general we can state that the battery lasts for about 3-6 months under non-continuous use (see Notes below).

We recommend to use external power (USB micro-B or 24 VDC ) if you application needs continuous measurement like measuring totalized flow. To extend the lifetime of the battery, the back-light is disabled during battery operation, you cannot activate it. We strongly recommend to use the "auto power off" in the menu for battery driven devices (see chapter 4.12.7 Battery auto off) More information on the battery in chapter 3.15 Electrical power supply and 3.16 How to replace the battery?.



#### **Note**

When we supply the unit, the "auto power off" will be set to 15 minutes.



#### **Note**

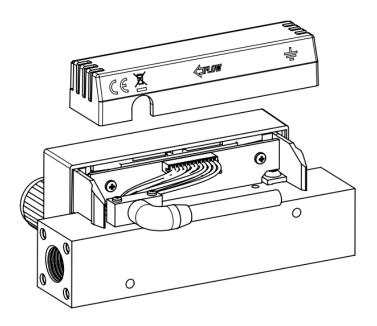
The unit can be set to performance mode when powered from the battery, this will strongly increase the battery usage. See chapter <u>4.12.1</u> <u>Measurement</u> for more information.

# 2.15. Optional Modules

As an additional option you can purchase a power supply or an alarm module.

#### 2.15.1 Power Supply Module

The **power supply module**, is provided with a voltage from 8-30 VDC , will power the unit. The unit comes with a 2-meter cable.



#### 2.15.2 Alarm Module

The **alarm module** provides three individually settable alarms and two inputs. Each alarm can be set by the customer. The module is supplied with a 2-meter fly-lead cable and needs to be powered by 8-30 VDC which also powers the RedyCompact flow meter.

Each of the 3-alarm contacts can be configured as high, low, window and totalizer alarm. Once the alarm becomes active, the three potential free alarm contacts can be reset in many different ways. Automatic, through the touch screen or with one of the two input signals. Other options like hysteresis settings and delays (timers) are also available.

The two input contacts or customer set alarm conditions can also be used to reset the totalizer.

Colour Pin Assignment 1 PWR+ red Power in 2 black PWR-3 white IN2 4 brown IN1 5 IN GND green 6 yellow OUT3.NO 7 OUT3.NC grey 8 pink OUT3.COM 9 blue OUT2.A 10 violet OUT2.B OUT1.A 11 grey-pink 12 red-blue OUT1.B

For detailed information see 4.11.2 Alarm Menu in this manual.



#### Note

Both the power and the alarm module are mounted similar to the battery module (see <u>3.16 How to replace the battery</u>). They replace the battery module, so you cannot use these modules in combination with battery power.



#### Warning

An external magnet can unintentionally influence the alarm contacts.

## **Generic Specifications Optional Alarm Module GCA**

Power Input				
Voltage Supply Range : 8-30 VDC supply)	(Power supply hereafter refered to as the 24 VDC power			
Maximum Current : 300 mA				
Protection input: Polyfuse (trip current > 500mA) and reverse polarity protected				
Switch Ratings Switch 1 + 2 (SPST hard contact)				
Maximum Current	0.5 A			
Maximum Voltage	30 VDC			
Relais Lifetime	> 5 million			
Switch ratings switch 3 (DPST contact)				
Maximum Current	1 A			
Maximum Voltage	30 VDC			
Relais Lifetime	> 5 million			
Inputs 1 + 2 (Opto-couplers)				
Voltage Range (polarity sensitive): 5 – 30 VDC (@ 5mA max)				
Min. Recommended Pulse Width	100 msec (Sample interval: 20 msec)			

# 2.16. Calibration

Each measuring device is supplied with a factory calibration report. The calibration is traceable to American and/or European standards. On request we can also provide DAkkS calibration (German Accreditation Body).

# 2.17. Operation with Other Gases

Each measuring device can store data for up to 3 types of gas or operational states that need to be defined at the time of purchase.

CMOS gas flow sensors are not linear (The output is linearized) and respond different to each gas. If the gas or gas composition is different than the gas that the unit was calibrated for, the unit will not measure accurately. It is possible to program up to three different gases and gas mixtures, but this needs to be done at the factory or at a Sierra Instruments' certified calibration center. Please

note that the K-factors as used in the traditional capillairy MFM/MFC cannot be used for CMOS mass flow meters. Please contact the factory for additional information.



#### Note

Please note that, among other effects, the zero-point error (offset display) will be higher if the device is not operated with the type of gas, for which it had been calibrated. A difference in zero indication is also possible if the used pressure is different than specified.

## 2.18. Pressure Loss

Our thermal mass flow meters have a low pressure drop. The pressure drop depends mainly on the medium, the pressure conditions and the flow rate. In chapter <u>6.11 Pressure Loss</u> you find the pressure drop for the most common gases. Your sales partner has a calculation program for the other gases. Please note that the size of the pipes has a large effect on the pressure loss. For example from around 60 ln/min, we recommend a pipe inside diameter of at least 10 mm.



#### Caution

Please also note that some fittings have a reduced diameter and can cause considerable pressure drop in your system. Be especially careful with vacuum applications, please select a relative big pipe diameter).

# 2.19. Temperature Compensation

The *RedyCompact* thermal mass flow meters measure the mass flow of gases, the result being largely independent of pressure and temperature. In addition to the fundamental principle an internal sensor measures the gas temperature and, with the help of a 3-dimensional table of interpolation values, a correction factor is calculated automatically. The flow indication is thus temperature-compensated.

# 2.20. Pressure Compensation

During calibration, the specified operating pressure is taken into account. Changes to the pressure conditions may introduce an additional error. This is around ±0.2% per bar.

Please note that the control behavior is influenced by substantially different pressure conditions. This is relevant for units with an intergrated needle valve only.

# 2.21. Response Time

The response time is time required to display 98% of its final value after a sudden change in flow. This response time for the RedyCompact is around 300 ms but is dependent on your filter settings. On battery operation you might experience a slower response time than on external power. (See chapter <u>4.12.1 Measurement</u> for more information.

# 2.22. Filter settings

The filter settings smoothens the reading of pulsating or noisy flows. It can be set through the setup menu. Higher filter settings will slow down the response time of the unit.

Please always first try to find and remove the cause of your noisy or pulsating flow e.g. add volume to your system. More information on the filter settings in chapter 4.12.4 Filter

# 3. Installation and Commissioning

## 3.10. Mounting Position and Mounting Location

Although the recommend mounting position is horizontal, the unit can used be upright, vertical or upside down. With a vertical mounting position, dependent on the type of gas and at pressures above 5 bara (72 psia, 500 kPa(abs)), a zero-point offset can be possible. This effect is caused by convection in stationary media.

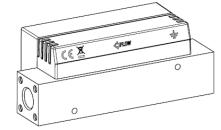
With regard to mounting location, the following situations can cause problems:

- Strong heat sources, or ambient temperatures outside the specification
- Strong sources of electromagnetic radiation such as spark discharges
- Humid environments and the associated condensation lead to damage of the electronic components
- In general, aggressive environments reduce the service life.
- Liquid running backwards can penetrate into the measuring instrument. An elevated mounting location generally helps, or using check valves.
- If your ambient air contains high humidity and at night the temperature goes down, it is possible that you will get some condensation inside the unit. Please take precautions to avoid this.



#### Warning

At installation make sure to respect the flow direction of the gas. It is indicated by an arrow on the back side of the instrument's housing.



## 3.11. Requirements for Pipework

The most common causes of faults concern the way that devices are connected to the gas supply.

### Please note the following points:

- The pipes must be absolutely clean. Please flush them <u>before</u> installing the measuring instruments!
- Please ensure there are no pieces of thread sealant (f.i. Teflon tape) in the piping!
- Use appropriate pipe materials (pressure rating, durability)
- Even when connected to fixed pipework, we recommend that the devices are mounted using the appropriate mounting holes
- From 50 ln/min, we recommend the following flow-calming sections of straight and unobstructed straight tubing: Inlet: 10 x diameter; outlet: 5 x diameter
- Use appropriate fittings (see chapter 3.13 Fittings and filters).
- Malfunctions can be caused by unstable pressure controllers, pumps that oscillate, and
  volumes before and/or after the measuring device that are generally too small. Install an
  air reservoir with 2 liter volume in the feed pipe (2 liter is an example, the volume
  depends on the application).

- The size of the pipe must be matched to the measuring/control device. A diameter that is too small results in an increased pressure drop.
- Check for any leaks before commissioning the devices.
- For maintenance work, we recommend that a bypass system is used. This is particularly important where the gas supply must not be interrupted.

## 3.12. Fittings and Filters

You can order a wide range of process fittings and adapters for the RedyCompact. Some compression fittings are available with an internal 50µ filter. Please refer to our website contact you local distributor for more details. Please also consider that fittings and filters can create additional pressure drops over the flow meter.



Figure 5: 316SS Compression fittings



#### Warning

Please note that the length of the tread on you fitting that is screwed inside the body is for the  $G\frac{1}{4}$ " no longer than 10mm ( $\frac{3}{8}$ ") and for the  $G\frac{1}{2}$ " no longer than 13mm ( $\frac{1}{2}$ ") to **avoid internal damage.** 



#### Warning

The design of the devices enables sealing at the ends with O-rings or flat seals. It is **essential** that you **avoid**:

- ⇒ the use of <u>sealing tape</u> to seal threads. Small pieces can cause incorrect measurements and control-valve malfunctions. As well as that, if the device has to be checked or recalibrated, there will be an extra charge for the additional cleaning work.
- ⇒ sealing with <u>liquid sealants</u> will incur a higher cleaning charge for cleaning the device in an ultrasonic tank.

### 3.12.1 Installation

The fittings are supplied in pairs. They preferably should be installed with filter at the inlet and without filter at the outlet. The fitting with a filter must be installed at the inlet (as determined by the flow direction). The sealing rings (O-rings) must not be damaged during assembly.

For more information, see the <u>data sheet for the fittings</u>.

## 3.13. Filters / Gas Cleanliness

We always recommend that a filter, or at least a fine-mesh sieve (50 microns), is installed before the measuring devices. It often happens that solid matter such as welding residues, metal or plastic chips, rust, sealing tape, etc. affect the function.

In pressurized-air applications using compressors, the air must be dry and free of oil. Please ensure that a suitable processing unit is located before the devices. In the case of gases from cylinders, in general no filter is needed. For more information, see chapter <u>5</u>. <u>Maintenance</u>.

## 3.14. Electrical Power Supply

The RedyCompact can be provided with power from a standard AA battery or from a common USB micro-B charger that you typically use for the charging of your android phone. There are optional modules by which you can apply a 8-30 VDC external power.

The lifetime of the battery strongly depends on the type and quality of the AA battery you use. We recommend (and determine the specifications with) an Alkaline-Manganese Dioxide Battery with a capacity of 3000 mAh (ANSI: 15A IEC: LR6)

Other types of batteries (for instance Zinc Carbon, Zinc Chlorine, NiCd, NiMH or Li-ion) can be used, as long as the voltage is 1.2 to 1.8 VDC. Using other batteries will influence the life of the battery when used in the RedyCompact flow meter.

It is also possible to use rechargeable batteries, but the unit will however not charge the battery if powered by the USB micro-B.

We strongly recommend to remove the battery from the case if you do not use the meter for longer periods of time to avoid damage to the flow meter in case the battery starts to leak. The unit will retain its settings so when you re-insert the battery the settings will be the same as when you took it out. (The totalizer will be stored to the non-volatile memory in an interval that you can set. See chapter 4.11.3 Totalizer)

There is no need to remove the battery if you connect the USB power supply. When you run the unit on power from the USB micro-B and have a battery inserted, you can remove the USB connector and the battery automatically takes over.

When the unit is powered by the battery you will not see the backlight to conserve energy. The backlight is only operational when there is a power supply other than a battery and the unit is not in ECO mode. (See chapter 4.12.1 Measurement for more information)



#### **Note**

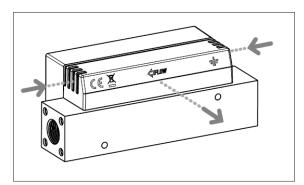
When you replace or install a battery, all power to the unit should be disconnected.

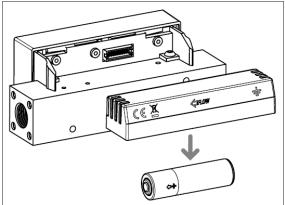
## 3.15. How to replace the battery?



## Warning

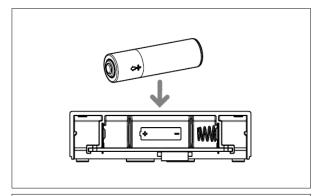
Before replacing or installing the battery, disconnect any external power supply.





The battery is placed in a compartment mounted above the body and connected to the housing that contains display and electronics.

The battery compartment has three notches on each side. To remove the battery compartment, hold the housing on both sides of the display. Using your other hand grab the notches and pull the battery compartment out of the housing.



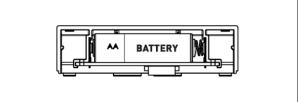


Figure 6: Battery replacement

Replace the battery and push the battery compartment back into place.

Note that this will not automatically power up the device. You have to press the screen for about 3 seconds in order to power up the device.



Please dispose of the battery on an environmental friendly way (Recycle)

# 3.16. Warm-up time

All instruments of red-y line are ready for use within seconds of connecting the power. There is no significant warm-up time (<5 sec).

# 4. Operation



## Warning

In case of incorrect handling of the flow meter the measurement function can be impaired.

Figure 7:



Horizontal Mode



Figure 8 Vertical Mode

## 4.10. Introduction

### 4.10.1 Power Up



### Warning

Before using the device verify that it is suitable for your application and check gas, range, pressure and temperature. You find these parameters on the calibration sheet. If any of these parameters deviate from your application please contact the manufacturer. The flow direction indicated by an arrow on the back side of the housing has to be respected.

The RedyCompact has a pressure sensitive touch screen. The device can be operated with your fingers or a suitable touch pen that does not damage the display.

To power up the device insert a battery or connect an external power supply (USB or 24 VDC). The device switches on automatically when connected to an external power supply. To power up the device using a battery press the screen for about 3 seconds until the start-up screen appears.

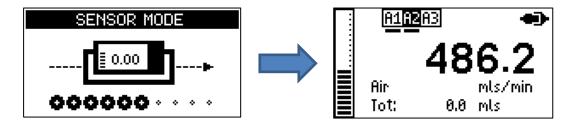


### **Important Note**

Note that the backlight is operational only if the device is powered by an external power supply.

## 4.10.2 Start-up Screen

During startup the device shows a startup screen ("SENSOR MODE"). After about four seconds, the device shows home screens displaying most relevant measurement values.





#### **Important Note**

If keeping the screen pressed for too long during startup "Service mode" is entered. Service mode is required for firmware upgrades only. To leave Service mode keep the screen pressed for about 6 seconds (see <u>5.12 Firmware upgrade</u>).

## 4.10.3 Touch Screen Operation

The device is operated using a pressure sensitive touch screen. You can either press the screen or swipe the screen ("swipe control").

A "short press" means touching the screen for about 0.5 seconds while a "long press" means touching the screen for at least one (1) second or more.

To use swipe control, press the screen while moving your finger in one direction. You can move your finger to the top ("swipe up"), to the bottom ("swipe down") to the left ("swipe left") or to the right ("swipe right"). The minimum distance to move is about one centimetre. Since it's a pressure sensitive touch screen swiping requires slight pressure.



### **Important Note**

Note that swipe control can be disabled (see 4.12.2.6. Touch input).

#### 4.10.4 Home Screen Modes

There is a vertical and a horizontal home screen mode (see Figures 8 and 9). The device switches between these modes automatically depending on the orientation of the flow meter. This behavior can be changed and the orientation can be set manually (see <u>4.12.2.3 Orientation</u>).

## 4.10.5 Home Screen Navigation

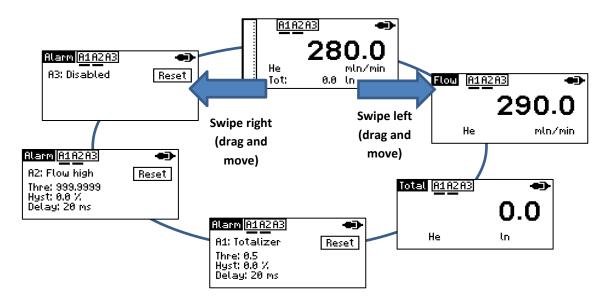
There are different home screens. A short press or swipe control (swipe left or swipe right) is used to switch between these home screens.

A short press switches to the next home screen available. Repeatedly doing this cycles through all available home screens:



\*\* only functional with optional alarm module

This can also be done via swipe control. Swipe left or swipe right to switch between home screens:



It is possible to hide individual home screens (see <u>4.12.2.1 Home screen</u>). Alarm home screens are only functional when the optional alarm module is installed.

#### 4.10.6 **Home Screens**

In horizontal home screen mode, the following home screens are available:

(no icon) Overview

Flow

Total

Alarm (A1, A2, A3)

In vertical home screen mode a single home screen is available only.

### Every home screen displays the following information:

## **Power Supply**



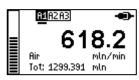
An external power supply icon (if powered by an external power supply) or a battery icon (if powered by battery) indicating the power source. The battery icon also indicates the remaining energy within the battery by the number of bars.

#### (no icon)

#### **Alarm and Notification Area**

This area displays warnings (e.g. overflow) and errors (e.g. sensor error). If the optional alarm module is installed the alarm status and enable state of the individual alarms (A1, A2, A3) is displayed.

#### The individual home screens display the following information:



#### Overview

Flow value, flow unit, totalizer value, unit of totalizer value and selected gas. The bar graph visualizes the flow value within 0-100% of the maximum flow range.



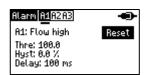
#### **Flow**

Flow value (big digits), flow unit and selected gas.



#### **Total**

Totalizer value (big digits), unit of totalizer value and selected gas.



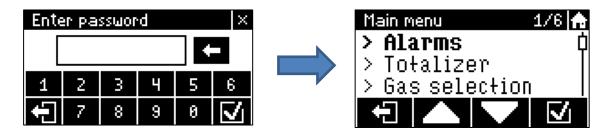
#### Alarm (if the optional alarm module is installed)

Alarm configuration and alarm reset button. Each alarm (A1, A2, A3) has its own home screen. To reset an alarm using the reset button the alarm must be configured for manual reset.

### 4.10.7 Menu Navigation

The device can be configured for specific applications and preferences by using a graphical menu. This menu is entered from any home screen by a long press or by using swipe control (swipe up or swipe down). The menu is always displayed in horizontal orientation.

To access the menu, the password must be entered if that feature is enabled (see 4.12.6 Security):



The menu is organized in a hierarchical way containing submenus. Each menu is a list of menu items. Within each list one menu item is selected (printed in a bold font):



The menu headline contains the name of the menu and the index of the selected menu item (position of the selected menu item within the list / number of menu items in the list).

The type of menu item is indicated by its icon:

>	Submenu
	Selection: Not selected (not activated)
	Selection: Selected (activated)
:==	Input dialog (f.i. alarm threshold value input)
C	Message dialog (f.i. shutdown confirmation dialog)
-:-	Direct action (f.i. alarm reset)

The menu is operated by using the following buttons:



The selection is moved up and down using the arrow buttons.

A short press on an arrow button moves the selection by one position. A long press on an arrow button selects the first menu item in list or the last menu item in list.

Swipe control is used to scroll through the list *without moving the selection*. Swipe up to move towards *last item* in list and swipe down to move towards *first item* in list. The selection can be set to a particular menu item by a short press on its menu item text.



To activate or execute a menu item press the check mark button. If the menu item is a submenu the submenu is entered.

The *selected menu item* can also be activated by a short press on its menu item text. Note that this function can be disabled (see <u>4.12.2.6</u>. Touch input).



A menu is left by a short press on the back button. The menu can also be left using swipe control (swipe right).

Leaving a menu causes its parent menu to be activated again (one level up in hierarchy). Otherwise if there is no parent menu the entire menu is left jumping back to home screens.

A long press on the back button always leaves the entire menu.



It is possible to hide the menu by a short press on the home button.

Hiding the menu jumps back to home screens but keeps the current menu location in background. Reentering the menu then resumes at that location.

#### 4.10.8 Alarms and Notifications

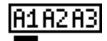
In horizontal home screen mode, the top of the screen contains the alarm and notification area. In vertical home screen mode, the alarm and notification area are on the left-hand side of the screen.

The alarm and notification area displays:



#### Overflow

If the flow is higher than 108% of the calibrated full range an overflow condition is signaled. The flow value shown is limited and does never exceed that limit.



#### **Alarm Indicator**

If the optional alarm module is installed the alarm status and enable state of the alarms A1, A2 and A3 is displayed (see <u>4.11.2 Alarm Menu</u>).



**Economy and Performance Measurement Mode** 



The device selects between economy and performance measurement mode automatically depending on the power supply. This behavior can be changed and the measurement mode can be set manually. In that case an indicator shows whenever the measurement mode deviates from the default behavior:

- ECO: External power supply but operating in economy mode
- PERF: Battery power supply but operating in performance mode



#### Sensor error

Other conditions displayed outside of the alarm and notification area:



#### Flow value too big

If the flow value is too large "Out of range" is displayed. In that case flow measurement is still operational but the flow value is not displayed anymore.

Select a flow unit (see <u>4.12.3 Units</u>) that causes the flow value to fit the number of available digits again.



#### Totalizer value too big

If the totalizer value exceeds the value of 9999999 it is too large to be displayed. In that case the totalizer continues to operate but the totalizer value is limited to 9999999 on display.

Select a totalizer unit (see <u>4.12.3 Units</u>) that causes the totalizer value to fit the number of available digits again (for instance m3n or kg).

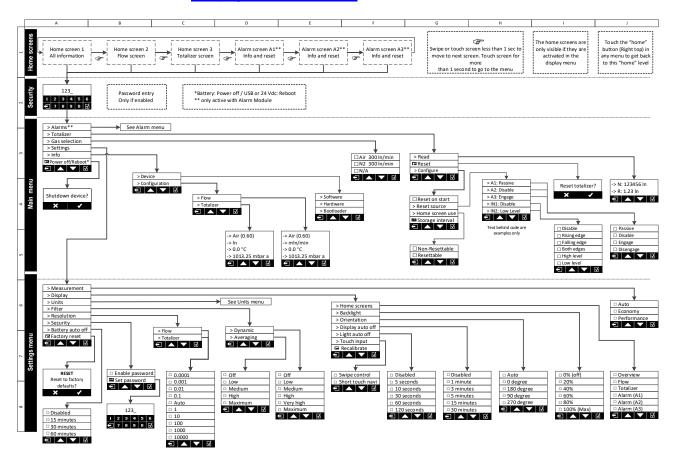
## 4.11. Main Menu



### **Important Note**

The menu is only available in horizontal mode.

Below is an overview of the main menu structure. A complete overview of the entire RedyCompact menu can be found on the <u>last pages of this manual.</u>



#### 4.11.1 Main Menu

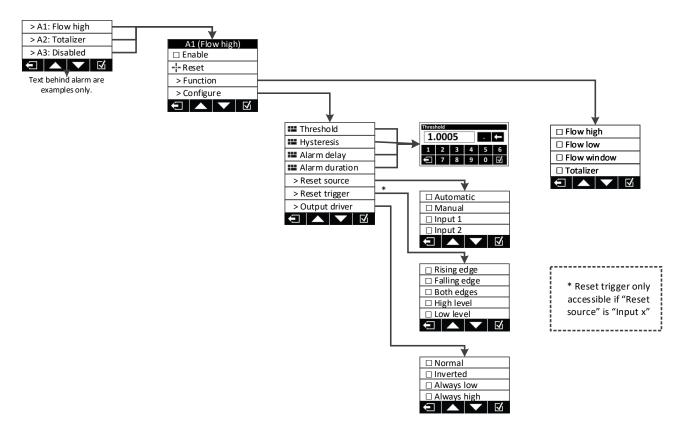


In the main menu you have access to the "Alarms," "Totalizer," "Gas Selection," "Settings", and information (under "Info") about the status and settings of your unit. If your unit is battery powered, it will give the option "Power off" on the bottom line. If the unit is externally powered it will give you the option to "Reboot" the unit.

<sup>\*\*</sup>Alarms will be visible but if the Alarm module is not installed this menu option cannot be used.

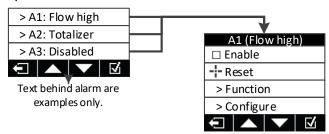
#### 4.11.2 Alarm Menu

If you have installed the optional alarm module and once the alarm function is selected from the main menu, you can select which of the 3 alarms (A1, A2 or A3) you want to configure. Please note that alarm 3 has a different contact type and capacity than alarms 1 and 2 (see diagram in 2.15 Optional Modules). If an alarm has already been configured the primary function is mention behind the Alarm (Example A1: flow high).



#### 4.11.2.1 Select Alarm Menu

Once you selected A1, A2 or A3, you go into the specific alarm menu. You have the following options:



#### **Enable (Default: disabled)**

If you activate this, the alarm becomes operational. You can see that an alarm is enabled on any home screen. If an alarm has been enabled the corresponding alarm name is shown underlined (see picture on the right).



#### Reset

If applicable you can manually reset an alarm here (The other reset location is on the alarm home screen). If the alarm is active you will see a star (\*) behind the word "Reset".

#### **Function**

With this submenu you can set the function of the alarm (Options: Flow high, low or window and totalizer). For more details see next page.

### Configure

In this menu item you can set the details of the alarm like it alarm value(s), how the alarm is reset, Alarms delays, hysteresis and more. For more details see next page.

#### 4.11.2.2 Function Alarm Menu

Under the "Function Alarm" menu, you can you define the functionality of the alarm.

☐ Flow high			
☐ Flow low			
☐ Flow window			
□ Totalizer			
Ū		$\Box$	Q

#### Flow high (Default)

With this function, the alarm gets activated if the flow goes over a predefined value set in the threshold by the customer.

#### Flow low

With this function the alarm gets activated if the flow is under a predefined value set in the threshold by the customer.

#### Flow window

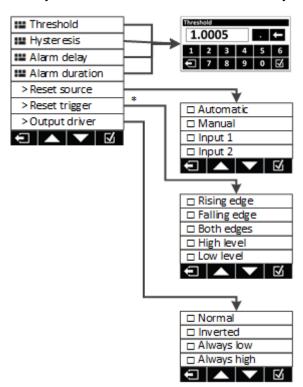
With this function, the alarm gets activated if the flow is outside a "Window" that is predefined by the customer. For example, if upper threshold is set to 5 and lower threshold to 4 the alarm will get active if flow is lower than 4 or higher than 5.

#### **Totalizer**

The RedyCompact has two built in totalizers. One is permanent and is non-resettable. The second one is a resettable totalizer. You can bring it back to zero (see <u>4.11.3 Totalizer</u>). The totalizer alarm works with the resettable totalizer. You enter a value in the threshold and once that value is reached the alarm is activated.

### 4.11.2.3 Configure Alarm Menu

Once you defined the function of an alarm you can define the details of the operation in this menu



#### **Numerical entry screen**

If you have to enter numeric values (Like an alarm value (Threshold)) you will see a little keyboard on the screen where you can enter a numerical value. The decimal point is located behind the number display field. Once you entered a decimal point followed by another number, the dot changes into an "E". If you press this you can enter the scientific notation, for instance 1.0E-3 = 0.001 or 2.2E2=220.

#### **Threshold**

Threshold is the activation value. If you for instance selected a high alarm, the alarm will be active when the flow value comes over the Threshold value. The value is entered in flow engineering values that the unit is set for at that moment (for instance in mln/min). If you change the engineering units of the unit in a later stage, the Threshold value will automatically adjust itself to the new flow unit.



#### Important Note

Please note that there is no limit to the value you can enter as a threshold. Please double check your entered value.

#### **Hysteresis (Default: 0=OFF)**

The hysteresis is the difference between the value where the alarm turns **on** from turning **off** and the value where it turns **off** from turning **on**.

This difference is defined in % of full scale. In figure 10 an example of a 50% threshold value high alarm with a 10% hysteresis. The blue line in the top graph reflects the gas flow, the vertical dotted lines the switching points.

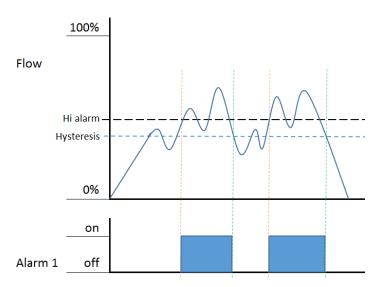


Figure 9: Explanation hysteresis

The blue area's in the graph below is where the alarm is activated. The reset is set to automatic.



#### Warning

Please note that you can enter a value of 100% as hysteresis value. If you do that the alarm will no longer switch off.

#### Alarm delay (Default: 20ms)

The alarm delay is a delay in milliseconds between the moment the alarm situation occurs to the moment that the alarm is activated. It can be set from 20 to 9999999 msec (=2.777 hr).

#### Alarm duration (Default: 500ms)

The alarm duration is minimum time that the alarm is active after it is activated. It can be set from 100 to 9999999 msec (=2.777 hr)



#### **Important Note**

This function is only active if the reset is set to automatic.

#### **Reset source (Default: Manual)**

The alarm can be reset in different ways. Below a list of the 4 possible settings:

#### **Automatic**

The alarm is reset the moment the alarm situation is no longer valid. This unless you programmed an alarm duration. For a totalizer alarm this setting will reset the totalizer as soon as the threshold has been exceeded.

#### Manual

The alarm stays active until you manually reset the alarm through the touch screen of the flow meter.

#### Input 1

The alarm stays active until you activate input 1

#### Input 2

The alarm stays active until you activate input 2

#### Reset Trigger (Default: Falling edge):

When you use input 1 or 2 as an alarm reset, you can set exactly on which action the alarm is reset. If for example the input is a manual push button, the rising edge is the moment that you push the button and the falling edge the moment when you let go of the push button.

□ Low level					
☐ High level					
☐ Both edges					
☐ Falling edge					
☐ Rising edge					



#### **Important Note**

The "Reset trigger" function only relates to alarm reset by input 1 or 2.



#### **Important Note**

Please note that the reset overrides the alarm. Even if the alarm is still valid, if you set this reset trigger to high level, the alarm is ignored until the level becomes low again.

If the blue represents the input being active you can see the different trigger points below (See Figure 11).

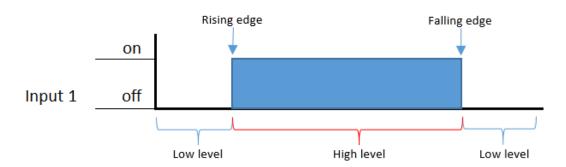
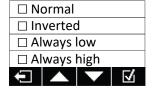


Figure 10: Explanation trigger points

#### **Output driver (Default: Normal)**

The output driver setting offers the possibility to invert the action from the alarm switch and set the alarm to a predefined state which is convenient for testing systems.



The "Always low" and "Always high" override all alarm settings and flow signals. Please make sure that you take precautions before you use these options in a "life" system.

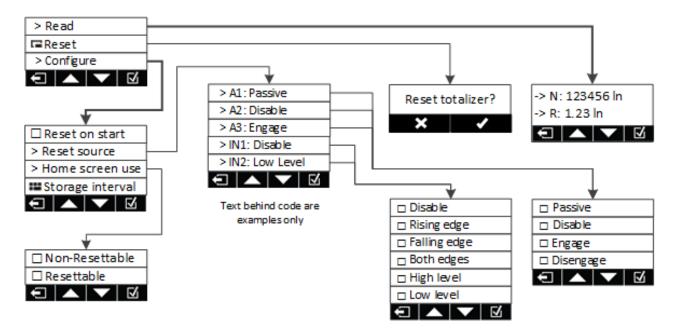
#### 4.11.3 Totalizer

The totalizer calculates how much gas has totally passed through the flow meter based on the measured flow and the factor time. The instrument has 2 totalizers. Each can display a maximum of 8 digits. The totalizer value will be stored internally as an IEEE 754 floating point number. The internal totalizer will never roll-over, the maximum value far exceeds the lifetime of the instrument. One of the two totalizers is resettable, the other can never be reset and always continues to count for the lifetime of the instrument. Both the totalizer values are stored every 10 minutes in a permanent memory so even if there is no power supply the last stored value will still be kept. If you

apply power again the saved value will be restored (Unless you activated the "reset on start" feature).

Please note that if the flow rate exceeds the full scale of the unit (overflow), the totalized value will not be correct. Even if there is an overflow the totalizer operation will continue normally. However, since the flow value is limited the totalizer is totalizing the limited flow value only.

If the totalizer value exceeds the possible 8 digit display, you can set the totalizer engineering units to a suitable unit that can display the value within the 8 digits, for instance m³n or kg. See section 4.12.3 Units.



#### Read

Read the totalizers (for instance in-case you only activated the flow screen). N: is the non-resettable totalizer, R: is the current value of the resettable totalizer.

#### Reset

Reset the resettable totalizer to zero

## Configure

#### **Reset on Start**

Activate this option if you want that the resettable totalizer is set to zero every time you switch the unit on. Please note: Upon start-up the totalizer will be silently reset without asking for confirmation. It simply resets the resettable totalizer to zero every time you switch the unit on.



#### **Important Note**

With the alarm module it is possible to reset the totalizer with an external remote switch or signal.



#### **Important Note**

The following settings are **only** possible if you have the optional alarm module. If you do not have the alarm module installed, the display will show N/A behind the alarms.

#### **Reset Source**

In this menu you can set what event triggers the totalizer to reset

#### **Totalizer Reset Via Alarm Handling**

Reset trigger via alarm state (A1, A2, A3):

Passive: An enabled alarm configured as totalizer alarm can reset the

totalizer [Standard]

Disabled: Totalizer reset via alarm handling is disabled

Engage: Totalizer is reset if selected alarm (A1, A2, A3) gets active\*

Disengage: Totalizer is reset if selected alarm (A1, A2, A3) gets inactive\*

#### **Totalizer Reset Via Alarm Input Contact**

Reset trigger via alarm inputs (IN1, IN2):

- Disable: Totalizer is *not reset* via selected alarm input [Standard]

Rising edge: Rising edge on selected alarm input
 Falling edge: Falling edge on selected alarm input
 Both edge: Any edge on selected alarm input

High level: High level on selected alarm input (kept in reset)
 Low level: Low level on selected alarm input (kept in reset)

More information on how to work with the Alarm module inputs can be found in Chapter <u>2.15</u> Optional modules

#### **Home Screen Use**

Here you can select if you want to read the Non-resettable or Resettable totalizer on the main screen.

#### Storage Interval

The values of the totalizer is saved in an EEPROM so if the battery is empty or the power fails the value is still retained. The frequency in which this happens is standard 600 seconds (=10 minutes).

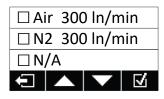
If required this frequency can be increased or reduced in this setting (Minimum value is 10 seconds).



#### Warning

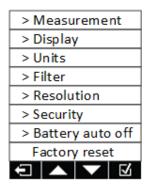
Be aware that the lowering this value will decrease the EEPROM life expectancy. Sierra Instruments does not provide any warranty on the lifetime of the EEPROM.

#### 4.11.4 Gas Selection



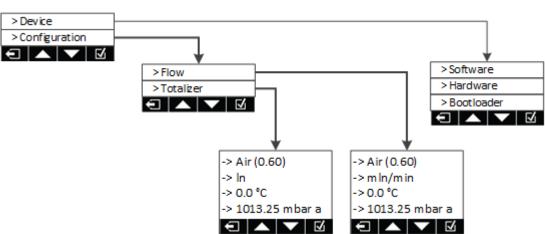
The *RedyCompact* can store up to 3 different curves for different gases or gas mixtures in its memory. If you have ordered more than one gas when you purchased this unit, you can select the required gas here. The locations that do not have a gas programmed are marked with "N/A". Behind the gas name you see the maximum flow you can measure in your selected units.

### 4.11.5 Settings



In this menu you can adjust your preferences. See section 4.12 Settings for details.

## 4.11.6 Info



Info brings you to menu that informs you about the current configuration of the unit. When you for instance select "Software" under the Info menu you can see the current firmware version and the date that this version was released. Other fields provide similar information.

Under "Configuration" you see the active settings for the flow and the totalizer. The temperature and pressure refer to the reference conditions for the selected flow units. (See <u>1.15 Real</u>, <u>Standardized and Normalized flow</u>)

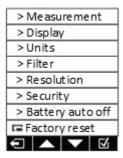
### 4.11.7 Reboot or Power Off

Shutdown device?

If your unit is battery powered, it will give the option "Power off" in the main menu. You can switch the unit on again by touching the display for 3 seconds.

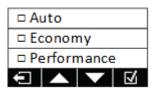
If the unit is externally powered it will give you the option to "Reboot" the unit. "Reboot" restarts the unit. If you select one of these options the unit will ask you to confirm your selection.

## 4.12 Settings



In the settings menu you can adjust the user variables. See the chapters below for more details.

### 4.12.1 Measurement



The RedyCompact has 2 measurement modes. When you set the measurement to "Auto":

- 1) When on battery it takes a flow sample every 300 milliseconds and due to that extends the battery life
- 2) When on external power (24 VDC or USB) it takes a flow sample every 40 millisecond and due to that will have a faster response and a more accurate totalizer when you have fluctuating flows. With this menu you can force either measurement mode independent of the power source.

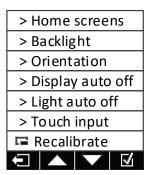


#### Caution

Please note that when you set the measurement mode to "Performance" and you use the unit on battery the battery life is limited.

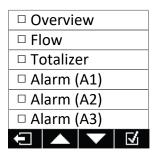
If the measurement setting is forced to "performance" and the unit is operating on the battery, the display shows "PERF". If the measurement setting is forced to "Economy" and you use an external power supply the display shows "ECO". Please note that in "ECO" mode the backlight is always off.

## 4.12.2 Display



In the display menu you can configure the settings for the display. Below you find more details on the individual settings of the display.

#### 4.12.2.1 Home Screen



There are 6 different home screens in horizontal mode and one in vertical mode (see <u>4.10.6 Home screens</u>). In this menu you can deactivate up to 5 home screens (one home screen must stay activated).

#### 4.12.2.2 Backlight

□ 0% (off)				
□ 20%				
□ 40%				
□ 60%				
□ 80%				
□ 100% (Max)				

In this menu you can select the brightness of the backlight. The backlight is only available if you use an external power (USB or 24 VDC).

#### 4.12.2.3 Orientation

□ Auto				
□ 0 degree				
□ 180 degree				
□ 90 degree				
□ 270 degree				

The screen can be orientated (turned) in the most convenient position for reading (upside down or vertical). If this menu is set to Auto, the unit will do this automatically. A sensor determines it's orientation. The sensor can be overridden with the 0, 90, 180 or 270 degrees settings. This is very convenient if you want the gas inlet to be on the right side of the flow meter or place the meter vertical. Note: The menu can only be displayed in horizontal mode and the vertical screen mode has only one "Home screen".

**Remark**: at installation make sure you respect the flow direction of the gas indicated by an arrow on the rear of the instrument.

### 4.12.2.4 Display Auto Off



The display can be set to switch off after a defined time following your last touch event. If you set the "Display auto off" to "Disabled", the display stays on till the power is switched off. When the display is switched off, the backlight will also switch off. The totalizer is still working. You can activate the display again by touching it.

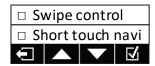
### 4.12.2.5 Light Auto Off



In this menu you can define a time before the backlight automatically switches off (after the last touch event). The backlight goes on again when you touch the display. When the setting is "Disabled" the light is continuously on.

When the backlight is switched off you can still read the display. The backlight only works if there is an external power connected. On battery power supply or in ECO mode the backlight is not operational.

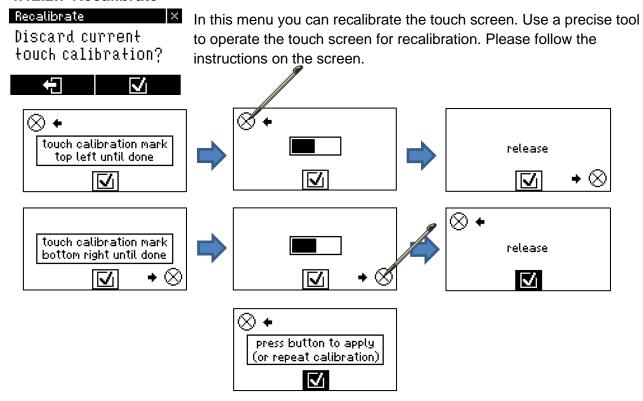
### 4.12.2.6 Touch Input



In this menu you can activate or deactivate swipe control and short touch navigation:

- Swipe control: Ability to operate the device by swipe movements
- Short touch navigation: Ability to activate a selected menu item by touching the menu item text.

#### 4.12.2.7 Recalibrate

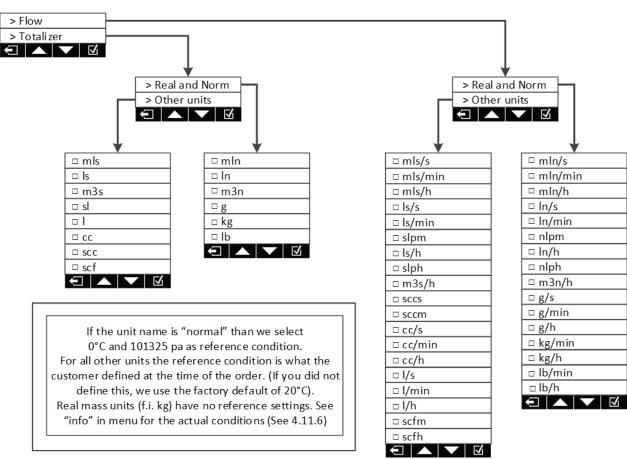


To calibrate the unit use a precise tool and touch the upper left crosshair. Keep the Touch-Display touched until the progress bar has run to completion. Repeat the step touching the lower right crosshair. When progress bar has run to completion the new calibration is applied.

Test the calibration in the area in the middle of the touch screen. The touch position is highlighted by a dot. To repeat the calibration redo the previous steps. This can be done as often as possible.

When the calibration is satisfying touch the apply button in the bottom row.

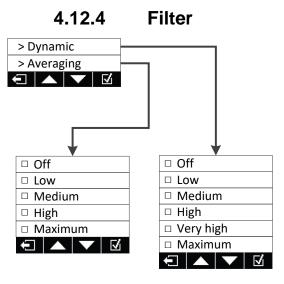
## 4.12.3 Units



In the "Units" menu you can set the required engineering units for the totalizer and the flow indication. If there is a unit selected with too many digits, the device will show: "Out of range" on the display.

If you select a totalizer unit that would create too many digits the totalizer will show 9999999. More information in section <u>4.10.8 Alarms and notifications</u>.

For more information on "normal" and "standard" flow units see chapter <u>1.15 Real, Standardized</u> and Normal<u>ized flow</u> of this manual.



With the filter settings you adjust the reading of quickly changing flows. The filter basically averages the readings from the sensor. More information can be found in chapter 2.22 Filter Settings.

There are two separate filters that are adjustable and independent of each other.

Dynamic and Averaging filter:

#### **Dynamic Filter:**

The dynamic filter will increase the number of readings that are averaged when the flow is less dynamic and decrease the number of readings that are averaged when the flow shows quick changes. So when the flow is quickly rising or falling it will take less averages in it calculations. On this way the unit will react faster to changes in the flow.

#### **Averaging filter**

The averaging filter is a "moving average filter". It calculates the average value of a number of measurements and shows the average on the display. As you increase the filter setting from off to maximum, you increase the number of measurements the average is calculated from.

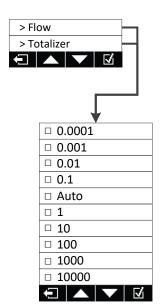


#### Warning

Before you apply higher filter values, please try to identify the cause of the flow pulsations. This could be a compressor, pressure amplifiers, incorrectly sized fittings, non-return valves or pressure regulators. Sometimes creating more "dead volume" before of behind your flow meter could solve the problem.

### 4.12.5 Resolution

The RedyCompact has the ability to show the actual flow in many different engineering units. This means that the number of digits in the readout can change a lot. In automatic resolution mode the required number of digits is automatically calculated depending on the range and selected units. This resolution is however adjustable by the user.



In this menu you can adjust the resolution of your flow and totalizer values shown on the display.

The RedyCompact has the ability to show the actual flow and the totalizer in many different engineering units. This means that the number of digits in the readout can change a lot. In automatic resolution mode (menu option "Auto") the number of digits are computed depending on range and current selected unit.

The minimum number of digits is 4, the maximum 6 (Excluding the decimal point). Below you find the table on how many digits will be visible in this auto mode.

	Range	Example	es display value	s Display resolution
from	until	from	until	
0.01	0.09	0.01	0.09999	0.00001
0.1	0.9	0.1	0.9999	0.0001
1	9	1	9.999	0.001
10	99	10	99.99	0.01
100	999	100	999.9	0.1
1000	9999	1000	9999	1
10'000	99'999	10'000	99'990	10
100'000	999'999	100'000	999'900	100

#### Notes:

- 1. Because the value is right-aligned, it is possible that depending on the actual flow you can see a change in the number of digits behind the decimal point. For example if the flow is changing from 2 to 2.01 and then 2.1 you can see: 2.0, 2.01 and 2.1 on the display.
- 2. If the maximum number of digits is exceeded you see out of range on the display. In that case select another unit (see chapter 4.12.3 Units).
- 3. The step size in auto mode between each reading is depending on the range but it is always well within the accuracy of the flow meter. For other setting mentioned below, this does not have to be the case.

The other settings are the minimum step that the value will take between values.

Example: If you have a flow of 189.673 mln/min than the unit will show 189.6 in auto mode. When selecting the other settings you would see:

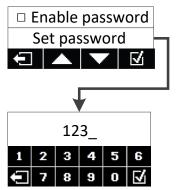
Resolution setting	Flow	Displayed	Remarks
0.0001		189.673	The display cannot show more than 6 digits
0.001		189.673	
0.01		189.67	
0.1		189.6	
auto	100 672	189.6	
1	189.673	189	
10		180	
100		100	
1000		0.0	
10000		0.0	



#### **Note**

The numbers are not rounded off, but they are made invisible (also called a floor function). The totalizer and the bar graph will not be effected by this setting and will also work based on the real high resolution flow.

## 4.12.6 Security



To avoid the unauthorized changing of settings in the menu, it is possible to protect the menu with a self-defined password. If you enable this option you first have to enter a 4-digit numeric password to gain access to the menus. In this setting you can also define that password. You can only activate the password after you have defined your own personal password under "Set password" If you forget or lose your password, please contact the factory at: service@voegtlin.com

### 4.12.7 Battery Auto Off



To extend the battery life to the maximum we recommend that you set this menu so that, when powered with a battery, the *RedyCompact* will switch off automatically after the indicated number of minutes. Please note that this menu has no effect if the unit is powered by USB or the external 24 VDC . **Once the unit is switched off it no longer totalizes the flow.** 

Note: When we supply the unit, the "auto power off" will be set to 15 minutes

## 4.12.8 Factory Reset



If you activate the factory reset, all variables will be reset to the factory default (for instance the password protection will be disabled). The continuous totalizer, however, keeps its value. Only the resettable totalizer gets reset to zero. The reset takes about 30 seconds.

## 5 Maintenance

When operated properly and with the use of clean and dry gas, *RedyCompact* devices do not require any routine maintenance. There are no internal moving parts in the measurement part of the device. However, we recommend that the calibration is checked after 12 months. If your *RedyCompact* is still within tolerance, this time interval can be extended. The timing of the periodic check is the customer's responsibility.

## 5.10. Cleaning to Remove Contamination

Depending on the type of contamination, on-site cleaning of the measuring or control device may be possible. As a first step, we recommend flushing with  $N_2$  or dry air. If it is contaminated with liquids (ex. oil), pure methanol alcohol (100%) can be used. After cleaning, rinse the *RedyCompact* with the optional needle valve position fully open with dry air or nitrogen for approximately 15 minutes to dry out all liquids.



#### Warning

- The warranty is null and void if the housing was removed.
- Only use the proper tools.
- Be careful when handling the device and the individual components.
- Make sure that the disassembly environment is clean.
- Do not touch the circuit board or electronic components without first grounding yourself and the surroundings. Electrostatic discharges can destroy components.
- After cleaning, you should have the device checked or, if necessary, recalibrated by your sales partner at the next opportunity.

#### Flow Splitter Disassembly



#### Warning

Before you carry out any mechanical work on the unit the gas supply must be disconnected, any pressure relieved and the all power disconnected/removed

If the basic body has become contaminated, the flow splitter can be removed. The removal should only be done by trained service personnel. Removal and Assembly can potentially shift the calibration of a unit. Disassembly is different for the different device types:

Note: The fourth letter of the article code defines the type of the flow splitter. For example: GCM-**B**9EA-BB20 contains a flow splitter of the type **B**.

#### Type A

- First release the slotted screw in the center of the flow splitter (Left tread, approx. 5 turns)
- Unscrew the whole flow splitter with a hex key

#### Type B, C

Unscrew the whole flow splitter with a hex key

#### Type D (G 1/2")

- First unscrew the locking pin (underside of the body) with a hex key
- Unscrew the flow straightener with a suitable tool
- Pull the flow splitter out of the body

#### Flow Splitter Assembly

- Carry out the steps described above in reverse order
- After correct assembly flush *red-y* with dry inert gas.
- Check that the cleaned measuring device is functioning correctly by checking the zero point and some defined measurement values.

#### Recalibration

It is mandatory to recalibrate the flow measurement of the instrument after replacing the flow splitter for optimal accuracy.

### **5.11.** Returns

When returning a *RedyCompact* please insure suitable packaging. Please contact us before you return the unit to us. To repair the unit we require a detailed and accurate description of the problem, the required service and the possible causes of the faults.



#### Warning!

If the device has come into contact with aggressive or toxic gases, please ensure that it is properly cleaned/flushed before returning the device to us. Please always complete the contamination declaration form when submitting your RMA.

## **Instructions for Returning Your Instrument for Service**

The following information will help you return your instrument to Sierra Instruments' Factory Service Center and will ensure that your order is processed promptly. Prices may vary depending on the flow range, type of gas and operating pressure of your unit. To request detailed pricing, contact your local Sierra Instruments distributor or contact one of our offices directly.

# Please follow these easy steps to return your instrument for factory service:

- 1. To obtain a Return Materials Authorization (RMA) number from the Sierra Instruments to <a href="http://www.sierrainstruments.com/rma/new.php">http://www.sierrainstruments.com/rma/new.php</a> to create a Sierra Account.
- 2. Once you have created an account, click on the Submit New RMA tab and fill in the RMA form and follow the instructions. You will receive an email confirmation once you have submitted your RMA.
- 3. Print a copy of the RMA (that now includes RMA #) and send a copy of the RMA form along with your meter back to the factory.

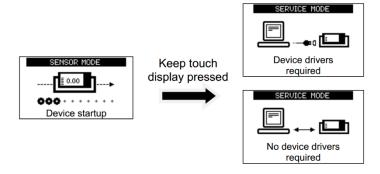
If you require service beyond calibration, but do not know which service(s) will be required, describe the symptoms as accurately as possible on the RMA form.

Pack your instrument carefully. Use the original packaging and foam or bubble wrap (packing peanuts NOT recommended) and include a copy of the RMA form (complete with Sierra supplied RMA number) with the unit(s).

## 5.12. Firmware Upgrade

Sierra Instruments continues to improve and add features to the firmware. Firmware updates are available free of charge on our website <a href="www.sierrainstruments.com">www.sierrainstruments.com</a>. Register as user on our website to get notified on any future firmware updates.

- 1) Download and install the Service Tool software
- 2) Remove the battery and any module from your RedyCompact.
- 3) Start RedyCompact in service mode while connected to your computer via USB cable. To enter service mode restart (or power up) the instrument and keep the touch display pressed for about 4 seconds during startup (see picture below).
- 4) If after the 4 seconds you see the screen with the plug between the icons, refer to the Service tool manual how to install the required driver. If you see arrows, continue with 5)



5) Start the Service Tool software and follow the instructions

Do not disconnect USB cable during the firmware update. Once the firmware update is finished, the instrument automatically restarts using the updated firmware.

To leave service mode without performing a firmware update, keep the touch display pressed for about 6 seconds. This will power-off (on battery supply) or restart (on cable power supply) the instrument without replacing its current firmware. The update will not influence your settings



#### **Note**

Please read the manual supplied in the upgrade package service tool. You will find the link to the extended version of the upgrade manual in the menu bar once you installed and started the software.



#### Note

Valid for upgrade 3.0.6 only: After an update it is possible that the unit will ask you to calibrate the touch screen. Please follow the instructions on the screen (See <u>4.12.2.7</u> Recalibrate).

If you upgrade from 3.0.5 the swipe and direct select fuctions will be disabled. If you want to make use of these you have to enable them. (See <u>4.12.2.6 Touch input</u>).



## Note

Alarm configurations set in a previous firmware version will not be affected by a firmware update.

# 6. Troubleshooting

In the following table we have compiled fault symptoms, their possible causes and suitable measures you can take. If you do not recognize your fault symptom, or the proposed measures were not successful, please consult your sales partner.

If you are planning to return a product, please refer to the chapter <u>5.11 Returns</u>.

If you have to remove the measuring or control device from the pipeline, please observe any flushing procedures and the relevant safety guidelines. You will find a guide on how to remove and clean the devices in the chapter "Operation and Maintenance."

Error	Possible causes	Measures	
Output indicates high flow continuously	Flow is too high (Overflow)	Reduce the flow rate. If necessary, the full scale can be extended. Please consult your sales partner	
	Device is heavily contaminated	Please consult your sales partner	
	Sensor faulty	Please consult your sales partner	
Flow is shown despite zero flow.	Sensor contaminated	Please consult your sales partner	
	The device is being operated with a different gas from its calibration.	For multi-gas instruments, you can set the appropriate gas type	
	Offset due to mounting position	Particularly with small measurement ranges, heavy gases and gauge pressures > 5 bar, a zero-point offset can occur where the mounting position is vertical >> chimney effect. Where possible, mount the device horizontally	
The manual valve is leaking	Contaminated valve	Flush the valve repeatedly with clean dry nitrogen	
Meter does not indicate the expected value.	Leakage	Flow rate > than reference:  Leakage between measuring device and your reference  Flow rate < than reference:  Leakage upstream of the measuring instrument	
	Contamination	With contamination by sealing tape, for example, it is possible that the flow divider is partially blocked. In this case the device displays more than the reference. Please consult your sales partner	
	The device is being operated with a different gas than calibrated.	Connect the intended gas, or change the type of gas in the 'Calibration' menu	
	Different reference conditions	Verify "Normal" or "Standard" conditions	
	Inlet pressure is too low	Check your inlet and outlet pressures	
	Pressure drop too high	Check for blockage or polution. Check fittings ID	

Error	Possible causes	Measures
Unit, backlight or display	Battery empty	Replace battery
unexpectedly switched off	Menu settings incorrect	Adjust the auto off menu's
Unit always enters service mode when switched on	Firmware damaged	Perform a firmware upgrade as described in this manual. If the problem remains please consult your sales partner.
Out of Range	Wrong unit selection	Select a unit that fits better to the current flow.
Forgot Password	Contact the factory or distributor	Please consult your sales partner
Totalizer shows 9999999	Overflow totalizer units	Select a different unit (try m3n or kg)
Disfunction alarm contacts	An external magnet can unintentionally influence the alarm contacts	Please remove the interfering magnet
Touch display does not work properly	Calibration issue with touch screen	Apply calibration procedure for touch screen. See 4.12.2.7 Recalibrate

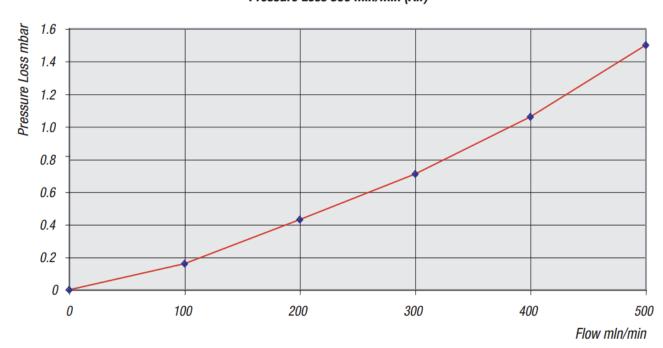
If you need any support please contact Sierra' Customer Service team at <a href="https://www.sierrainstruments.com/techsupport/techsupport.html">https://www.sierrainstruments.com/techsupport/techsupport.html</a>.

## 6.10. Pressure Loss

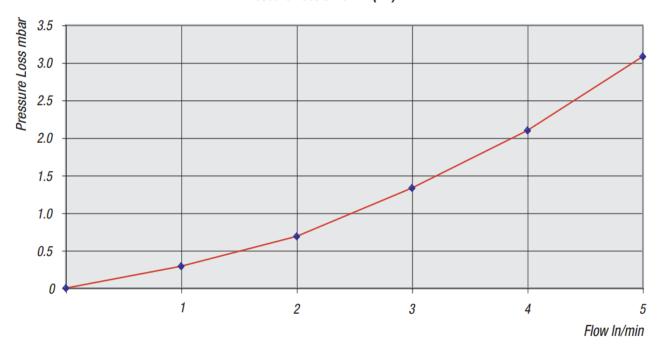
The following figures show examples of the pressure drop of a *RedyCompact* (measuring instrument only, not the valve)

Please note that the curves below are as an indicator only and based on atmopheric outlet pressure. Especially when the outlet is under vacuum, the pressure drop can be higher. Heavier gasses like Argon will greate more pressure drop, lighter gasses like helium will create less pressure drop.

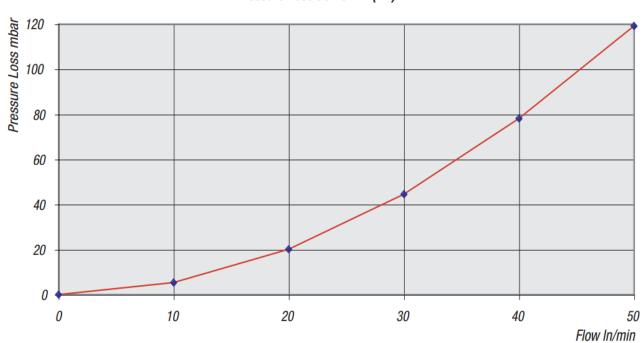
#### Pressure Loss 500 mln/min (Air)



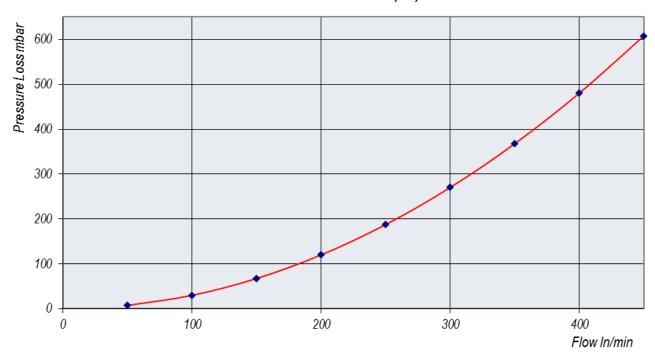
## Pressure Loss 5 In/min (Air)



## Pressure Loss 50 In/min (Air)

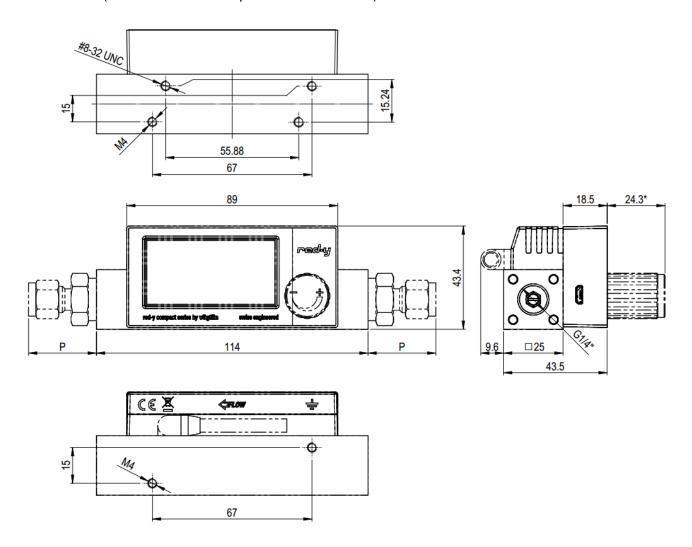


## Pressure loss 450 In/min (Air)



## 6.11. Dimensional Drawings 1/4" In mm

GCx-A/B/C: (Units with 1/4" BSPP process connections)



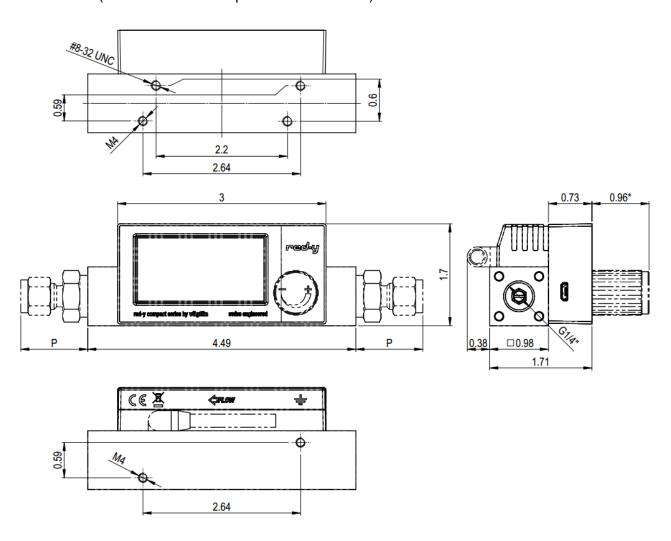
"P" referes to the optional fittings length. Fittings are options only. Standard process connection is female  $\frac{1}{4}$ " BSPP tread.

You can find detailed information for the individual products on our homepage <a href="https://www.sierrainstruments.com">www.sierrainstruments.com</a>.

If additional information is needed, please consult your <u>Sierra Sales Representative</u>.

## 6.12. Dimensional Drawings 1/4" In Inches

GCx-A/B/C: (Units with 1/4" BSPP process connections)



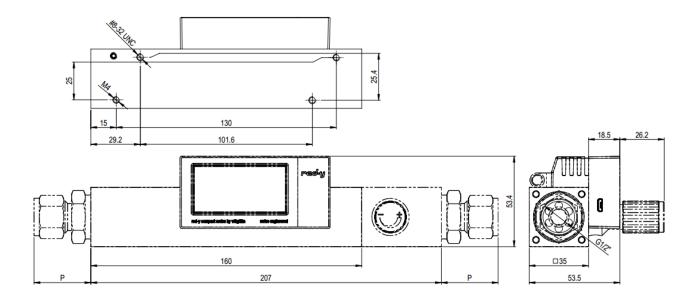
"P" referes to the optional fittings length. Fittings are options only. Standard process connection is female  $\frac{1}{4}$ " BSPP tread.

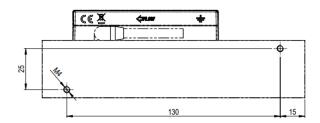
You can find detailed information for the individual products on our homepage <a href="https://www.sierrainstruments.com">www.sierrainstruments.com</a>.

If additional information is needed, please consult your Sierra Sales Representative

## 6.13. Dimensional Drawings ½" In mm

GCx-D: (Units with 1/2" BSPP process connections)





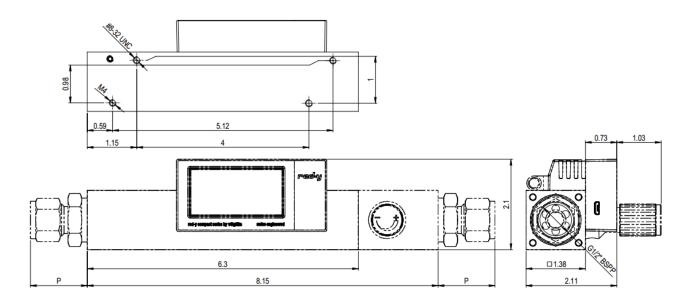
"P" referes to the optional fittings length. Fittings are options only. Standard process connection is female  $\frac{1}{2}$ " BSPP tread.

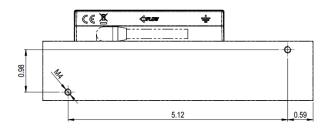
You can find detailed information for the individual products on our homepage <a href="https://www.sierrainstruments.com">www.sierrainstruments.com</a>.

If additional information is needed, please consult your <u>Sierra Sales Representative</u>

## 6.14. Dimensional Drawings ½" In Inches

GCx-D: (Units with 1/2" BSPP process connections)





"P" referes to the optional fittings length. Fittings are options only. Standard process connection is female  $\frac{1}{2}$ " BSPP tread.

You can find detailed information for the individual products on our homepage <a href="https://www.sierrainstruments.com">www.sierrainstruments.com</a>.

If additional information is needed, please consult your Sierra Sales Representative

# 6.15. Type Code Overview

Instrument type	red-y compact series (Gas)	G	С						
Function	Meter			М					
	Regulator - With manual valve			R					
	Switch* - With alarm		S						
	All-In* - With manual valve & alarm		- 1	A					
Full scale of measuring range (Air)	Customer-specific (Divider A, up to 600 mln/min)			A	Х	(			
	Customer-specific (Divider B, up to 6000 mln/min)			E	3 X	(			
	Customer-specific (Divider C, up to 60 ln/min)			C	; x	(			
	Customer-specific (Divider D, up to 450 ln/min)				) X	(			
nstruments version	Eco (±2.0% of FS / > 200 In/min ±3.0% of FS, 1 : 60)	Г				E			
	Special (±1.0% of FS, 1 : 100)	Г	S						
	Customer-specific / OEM	П	K						
Materials (Body, seals)	Aluminium, FKM	Г	Г			Т	A		
	Aluminium, EPDM	Г	В						
	Stainless steel, FKM	Г	S						
	Stainless steel, EPDM	Г	Т						
	Customer-specific / OEM			K					
Supply (Micro-USB always available)	Battery Supply	Г				П	Т	В	
	External supply 24 Vdc					F			
	Customer-specific / OEM	Г	Г					K	
Material valve (regulator, all-in)	Nickel-plated brass						Т		A
	Stainless steel								S
	Customer-specific / OEM	П	Г				Т		K
	No valve	T					T		N
Manual valve	NS 1.0	Т	Г				T		1
lefined by manufacturer	NS 1.5	T					T		1
	NS 2.0	T					T		2
	NS 2.5	T					T		2
	NS 3.0	T					T		3
	NS 3.6	T					T		3
	NS 4.0	T					T		4
	NS 6.0						Ť		6
	Valve not defined	T					Ť		8
	Valve mounted	T					Ť		9
	Customer-specific / OEM						Ť		9
	No valve		T				1		0

# 6.16. Wetted Parts RedyCompact Series

Instrument Gerät	RedyCompact series
Body Grundkörper	1.4404 (316L) or aluminium
Body: O-Rings Grundkörper: O-Ringe	FKM (Standard), EPDM (option)
Flow divider Strömungsteiler	1.4305
Control valve Regelventil	1.4305/1.4105/1.6908
Control valve: O-Rings Regelventil: O-Ringe	FKM (Standard), EPDM (option)
Sensor material Sensormaterialien	Silicon, silicon oxide, silicon nitride Silizium, Siliziumoxid, Siliziumnitrit Epoxy
Sensor packaging	1.4305

		Remarks Bemerkungen
EPDM	-	Ethylene-propylene-diene-monomer rubber Ethylen-Propylen-Dien-Kautschuk
Ероху	-	Adhesive for sensor fixation, protection for wire bonding Klebstoff für Sensorfixierung, Schutz für Bonddrähte
FKM	-	Fluor rubber Fluor-Kautschuk

For units with EPDM O-rings it is possible to get a FDA compatible materials statement. Please contact the factory or your local distributor for additional information.

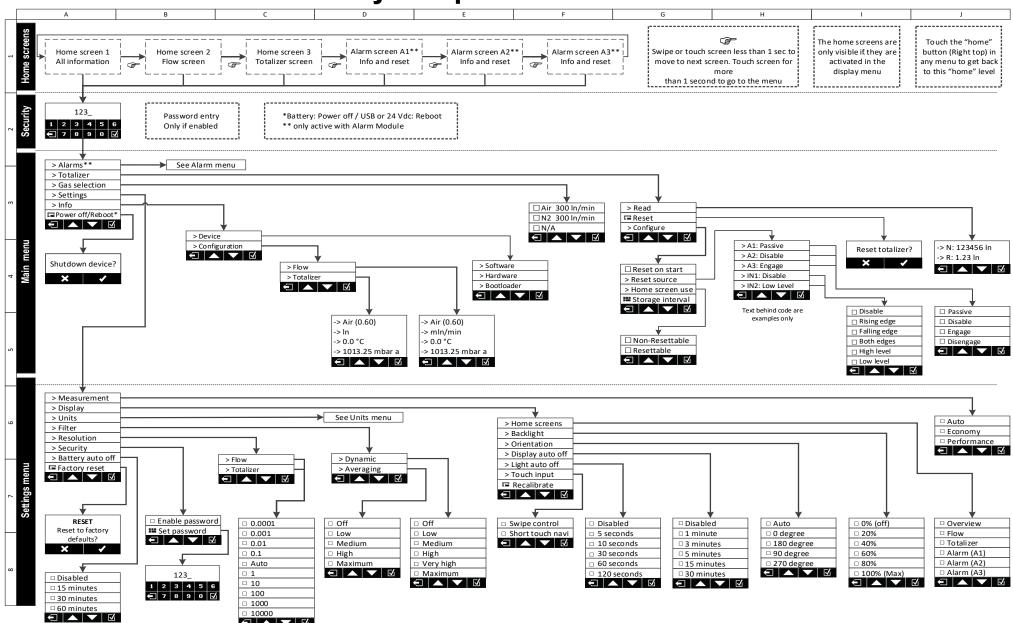
# 6.17. Overview Default Settings

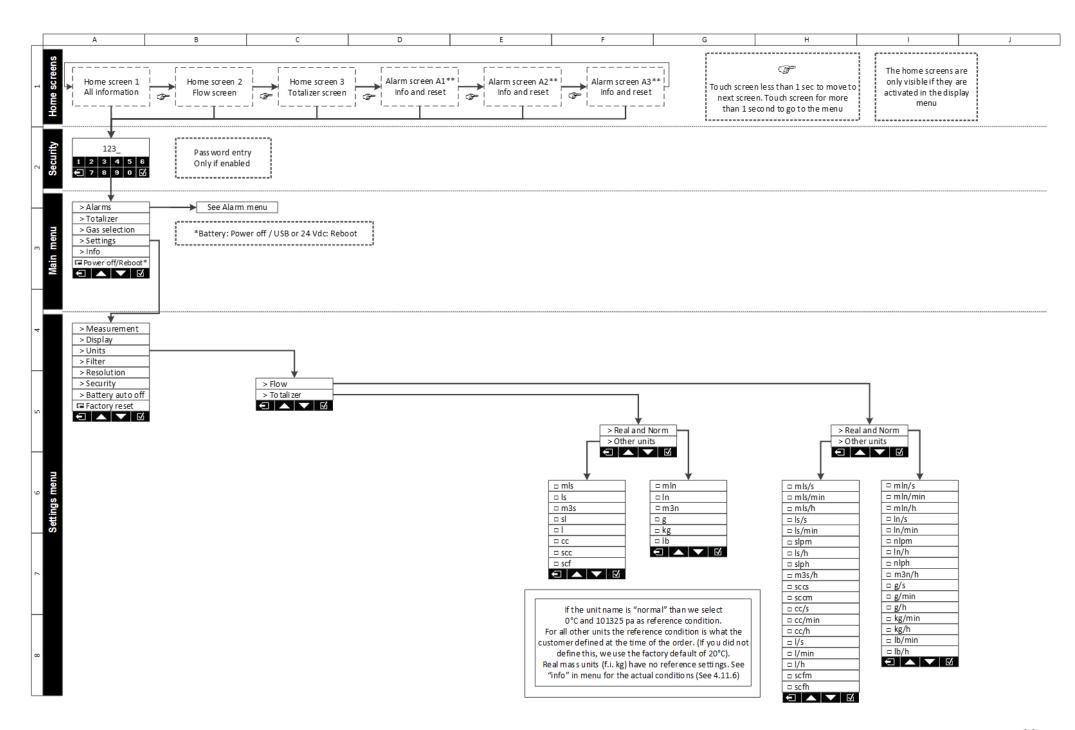
Totalizer   Configure   Home screen use   Non-Resettable	No.	Group	Subgroup	Name	Options	Default	Remarks
2   Gas selection	1	Totalizer	Configure	Home screen use			
Settings							4)
Settings	2	Gas selection				l —	1)
Auto							
Economy Performance	2	Sottings	Moasuromont				
Settings	3	Settings	weasurement				
Home screens (multiple choice)   Home screens (multiple choice)   Flow   Totalizer   Alarm (A1)   Alarm (A2)   Alarm (A3)   Alarm (A3							
Alarm (A2)	4	Settings	Display	Home screens		_	
Alarm (A2)		J commige					
Alarm (A2)					Totalizer	$\boxtimes$	
Settings					Alarm (A1)		
Settings					Alarm (A2)		
20%					Alarm (A3)		
A0%	5	Settings	Display	Backlight			
60%							
Settings							
Settings							
Settings							
Settings		0 "	B: :	10: ( "			
Settings	6	Settings	Display	Orientation			
180 degree					_		
Settings   Display   Display auto off   Disabled   1 minute   3 minutes   5 minutes   15 minutes   30 minutes   15 minutes   30 minutes   15 minutes   10 minut						_	
7   Settings   Display   Display auto off   Disabled   1 minute   3 minutes   5 minutes   15 minutes   30 seconds   30 seconds   30 seconds   30 seconds   10 seconds   120 seconds   30							
1 minute   3 minutes   5 minutes   5 minutes   15 minutes   30 minut	7	Settings	Dienlay	Display auto off			
Settings   Display   Light auto off   Disabled   Seconds   Display   Seconds   Display   Display   Seconds   Display   Displ	'	Settings	Display	Display auto oii			
Settings						_	
Settings							
Settings						ΙĒ	
Settings   Display   Touch input   Swipe control   Short touch navi   Settings   Units   Flow   Custom   2)   Totalizer   Custom   2), 3)					30 minutes		
Settings   Display   Touch input   Swipe control   Short touch navi   Settings   Units   Flow   Custom   2)   Totalizer   Custom   2), 3)	8	Settings	Display	Light auto off	Disabled		
30 seconds					5 seconds		
Settings   Display   Touch input   Swipe control   Short touch navi					10 seconds		
9 Settings Display Touch input Swipe control Short touch navi Short touch							
9 Settings Display Touch input Swipe control Short touch navi   10 Settings Units Flow Custom 2)  11 Settings Units Totalizer Custom 2), 3)  12 Settings Filter Dynamic filter Off Low Medium High Very high Maximum  13 Settings Filter Averaging filter Off Low Medium High High High High High High High High							
Settings   Units   Flow   Custom   2)							
10 Settings Units Flow Custom 2)  11 Settings Units Totalizer Custom 2), 3)  12 Settings Filter Dynamic filter Off Low Medium High Very high Maximum   13 Settings Filter Averaging filter Off Low Medium High Unit Medium High Uni	9	Settings	Display	Touch input			
11 Settings Units Totalizer Custom 2), 3)   12 Settings Filter Dynamic filter Off Low Medium High Very high Maximum Image: Custom of the company of the					Short touch navi		
12 Settings Filter Dynamic filter Off Low Medium High Very high Maximum   13 Settings Filter Averaging filter Off Low Medium High   13 Medium High Image: Control of the control o		_					
Low Medium High Very high Maximum  13 Settings Filter Averaging filter Off Low Medium High							2), 3)
Medium High Very high Maximum  13 Settings  Filter  Averaging filter  Off Low Medium High  High  □  □  □  □  □  □  □  □  □  □  □  □  □	12	Settings	Filter	Dynamic filter			
13 Settings Filter Averaging filter Off Low Medium High							
13 Settings Filter Averaging filter Off Low Medium High							
13 Settings Filter Averaging filter Off Low Medium High							
13 Settings Filter Averaging filter Off Low Medium High							
Averaging filter    Low   Medium   High   Maximum	10	Settings	Filtor	Averaging filter			
Medium High Maximum	13	Semilys	FIICEI	Averaging inter			
High Maximum							
Maximum							

14	Settings	Resolution	Flow	0.0001 0.001 0.01 0.1 Auto 1 10 100 1000 10000	
15	Settings	Resolution	Totalizer	0.0001 0.001 0.01 0.1 Auto 1 10 100 1000 10000	
16	Settings		Security	Enable password	
17	Settings		Battery auto off	Disabled 15 minutes 30 minutes 60 minutes	

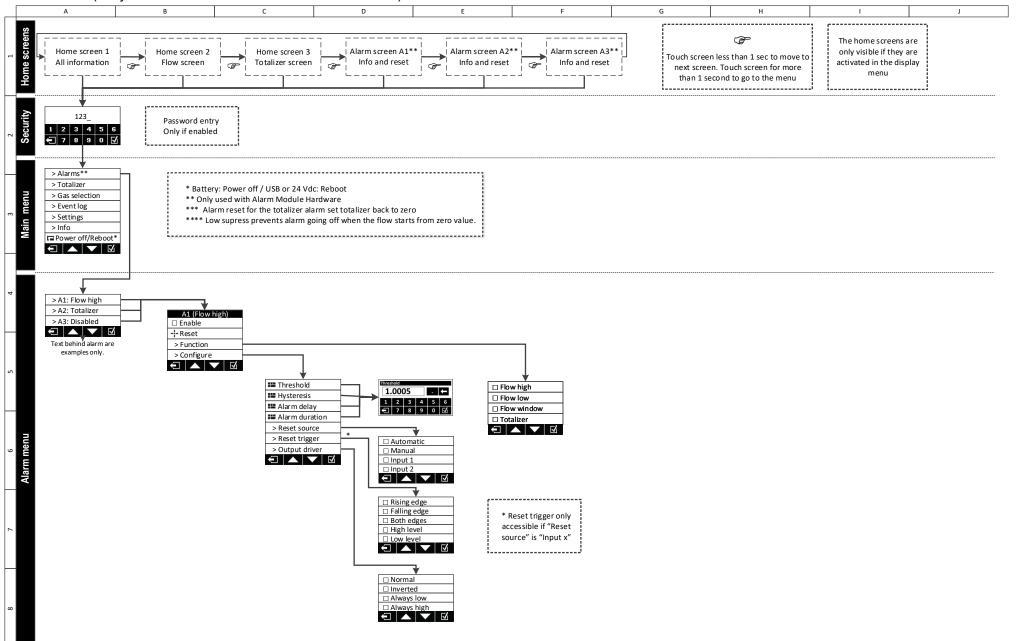
- 1) If ordered for air **or** N<sub>2</sub> **or** O<sub>2</sub> and the unit is calibrated with air and all have the same operating conditions, range and dynamics, all these 3 gasses will be programmed. The gas is set default on the customer ordered gas.
- 2) The reference condition of all units under "Real and Norm" are always 0°C and 1013.25 mbara. (Both for the totalizer and flow units). The reference conditions of all "Other Units" are always defined at the time of ordering.
- 3) If no units are specified for the totalizer, it is set it the same as the main unit without the time factor. For example: In/min becomes In, kg/h becomes kg, etc. The totalizer unit can be changed by the user anytime. See 4.11.3 Totalizer and 4.12.3 Units.

## 7. Overview Menu RedyCompact





#### Alarm menu (Only valid if the Alarm Module has been install)



# Detailed Warranty Statement for RedySmart & RedyCompact Brands

In addition to Sierra's standard three (3) year manufacturing warranty on all MEMS mass flow instruments produced, Sierra also offers a Lifetime No-Drift Sensor Warranty. Sierra defines no-drift as less than 1% of full scale over the life of the instrument. Therefore, if drift of greater than 1% of full scale occurs over the sensor's lifetime, the sensor and/or entire instrument will be repaired or replaced and recalibrated free of charge.

This warranty applies to all MEMS/CMOS thermal mass flow sensors standard on every Sierra RedySmart™ and RedyCompact™ models sold after January 15, 2020. This warranty is only valid if the unit is exclusively used with the gas or gases specified during the initial calibration or recalibration, without any additives in any form and under the operating conditions (temperature, inlet and outlet pressure, full scale flow rate) the unit was originally specified for.

Sierra's Lifetime No-Drift Sensor Warranty is made possible due to high-precision MEMS (Micro-Electro Mechanical Systems) technology utilizing an advanced ultra-stable CMOS (Complementary Metal Oxide Semiconductor) sensor. The use of MEMS techniques allows both electronic circuits and mechanical devices to be manufactured on a silicon chip, similar to the process used for integrated circuits.

To assure warranty service, customers must register their products online on Sierra's website. Online registration of all of your Sierra products is required for our warranty process.

#### **Warranty Limitations:**

Warranty does not cover any damage or discoloration caused by particulates deposited by dirty gases, liquids, residue or any other source. Warranty does not cover usage of any corrosive gas not compatible with the wetted materials listed:

#### Wetted Material Sensor Compartment

- Aluminum
- Stainless Steel

#### **Sensor Element CMOS**

- Silicon (Si)
- Silicon oxide (SiOx)
- Silicon nitride (Si3N4)
- Stainless steel
- Hysol FP4450/4451TD
- Gold connectors

#### **Sensor Compartment O-ring Sealing**

- FKM
- EPDM / FFKM on request

Warranty does not cover electronics drift or recalibration expenses for any reason other than the failure described above. Such returns are contingent on Sierra's examination and reasonable satisfaction that any defects are covered by this warranty and that the customer has not returned the equipment in a damaged condition, due to any negligence, tampering, misapplication or product modification on the part of the customer or customer agents. Third party reports will not be accepted for warranty claims.

Sierra shall not be liable for installation charges, for expenses of customer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. Sierra extends this warranty only to Sierra products properly used and properly installed for the particular application for which intended and quoted, and this warranty does not cover products which have been modified without Sierra's approval or which have been subjected to unusual physical or electrical stress, alteration, or tampering, or upon which the original identification marks have been removed or altered. Whenever the design of the equipment to be furnished or the system in which it is to be incorporated originates with the customer, Sierra's Lifetime No-Drift Sensor Warranty is limited specifically to matters relating to furnishing Sierra equipment free of defects in materials and workmanship and Sierra assumes no responsibility for implied warranties of fitness for purpose or use. Any replacement or repair shall be done by Sierra's factory by qualified technicians.

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## Twin Turbo Series TUHB-V88R-930-Q(F)



More Information



#### **Specifications**

**Mounting** Panel Mount with Volume Control

Color Red

**Operating Mode** Extra Loud Fast Beep Tone

Operating Voltage 9-30 Vdc
Operating Frequency 3000±250 Hz

Typical Operating Current 65 mA at 9 Vdc
125 mA at 30 Vdc

Typical Sound Pressure  $85 \pm 5 \text{ dB(A)}$  at 9 Vdc at 24 inches (61 cm), at 25°C  $103 \pm 5 \text{ dB(A)}$  at 30 Vdc at 24 inches (61 cm), at 25°C

**Termination** Quick Connect Blades

**Termination Strength** Pull test with a maximum of 22 pounds (10 kg) load

**Operating Temperature** -20\_C to +65\_C **Storage Temperature** -40\_C to +85\_C

**Surge Voltage** 20% over maximum rated voltage for less than 5 minutes

**Reverse Voltage Protection** To the maximum operating voltage

Construction Materials Lens/Case- Red Translucent Polycarbonate 94 VO

Potting- 2 parts epoxy resin or silicone, black

**Gasket** Gasket (Included) 0.125" thick, 60 Durometer Neoprene

ASTM B117 Certified - Withstands exposure to salt spray for 300 hours IP 68 Certified - Withstands water submergence and dust exposure

Construction Materials

Humidity- 95% relative humidity at +40 C continuously for 100 hours.

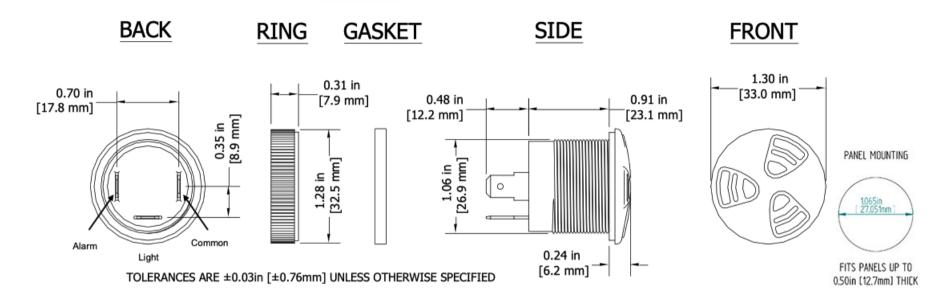
Vibration- Withstands vibration between 0 and 55 Hz. on all axes.

**Life Expectancy** 91 years under normal operating conditions.

**Warranty** For a period of two years from the date of manufacture under normal operating conditions.

**Notes** This product is not intended as a life safety device.

Terms and Conditions of Sale Link here



## **TRS Thermal Reed Switch**



#### **Overview**

The TRS Thermal Reed Switch is a highly reliable, precise temperature-sensitive switch ideal for energy conservation.

Its unique proprietary design features a magnet and a temperature-sensing soft ferromagnetic substance called Thermorite®. The material's magnetic flux density decreases as the temperature increases turning it into a paramagnetic substance at the Curie temperature.

These products have also been attested by the International Relay Association.

### **Applications**

Typical applications include temperature detection and overheat monitoring of electric appliances, heat-retention heater control for rice cookers, defrost for air conditioners and vending machines, roll heater temperature control for copying machines, radiator water temperature detection for automotive electric fan control.

#### **Benefits**

- · High reliability for on/off operations
- · High-speed response
- · Long operational life
- Excellent environmental durability
- · Extremely simple circuit design
- Compact, light and easy to handle
- · Dust, explosion and corrosion-proof

- Wide range of operating temperatures available from -10°C to +130°C
- Excellent temperature accuracy of ±2.5°C
- UL and CSA approved for TRS5\*\*\*BLRU 100V
- UL approved for TRS5\*\*\*BLRVU 200V
- · RoHS/REACH compliant

**Axial Type** 



Case Type



#### Wire Harness Type



Molded Type





### **Ordering Information**

M-	TRS	3-		50		M	CR	00	V	U
Shape	Series	Maximum Opening/Closing Power (W)	Operating Temperature (°C)		Contact Type	Shape Classification	Lead Type	Rated Voltage (VDC)	Approvals	
Blank M = Mold	TRS	1 = 10.0 W 3 = 35.0 W 5 = 60.5 W	M10 = -10°C 0 = 0°C 5 = 5°C 10 = 10°C 15 = 15°C 20 = 20°C 25 = 25°C 30 = 30°C 35 = 35°C 40 = 40°C	45 = 45°C 50 = 50°C 55 = 55°C 60 = 60°C 65 = 65°C 70 = 70°C 75 = 75°C 80 = 80°C 85 = 85°C 90 = 90°C	95 = 95°C 100 = 100°C 105 = 105°C 110 = 110°C 115 = 115°C 120 = 120°C 125 = 125°C 130 = 130°C	B = Break M = Make	Blank = Molded axial CR = C shape fixing bar LR = L shape fixing bar SR = S shape	Blank 00 = Wire harness 01 = Lead terminal 01E = Lead terminal (S shape only)	Blank = 100 V V = 200 V	Blank = No approvals U = UL and CSA approved for 100 V and UL approved for 200 V

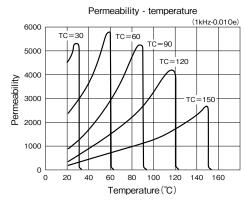
### **Structures and Principles of Operation**

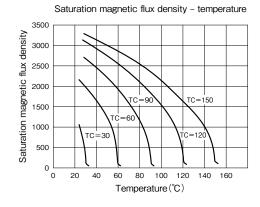
Thermal Reed Switches (TRS) are temperature-sensing switches composed of a magnet and a temperature-sensing soft ferromagnetic substance called Thermorite. This material's saturation magnetic flux density decreases as the temperature increases, and it turns into a paramagnetic substance at its Curie temperature.

#### Thermorite properties

- Thermorite changes its magnetic property rapidly at its Curie temperature, providing quick response times.
- The Curie temperature of Thermorite does not vary with time, as it is based on a compounding ratio.
- · Thermorite is stable against moisture and hazardous gas.

#### Thermal property of Thermorite





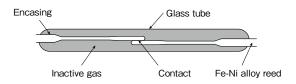
TC=Curie temperature

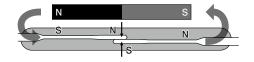


### **Structures and Principles of Operation cont.**

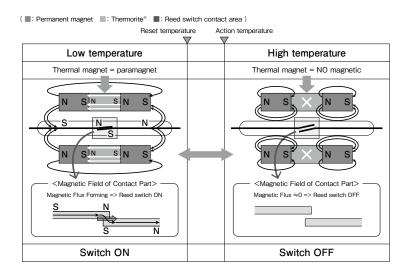
#### Reed switch structure

- The reed switch is a contact switch comprised of a pair of Fe-Ni alloy reeds encased in a glass tube with inactive gas. The reeds are switched on or off by the magnetic field of a permanent magnet or magnet coil.
- The reeds in the glass tube become magnetized from the magnetic field, allowing the two reeds to make contact and connect (switch on).
   When the magnetic field disappears, the reeds separate and disconnect (switch off).
- The glass encasement of the reeds ensures high environmental resistance and a long operational life.

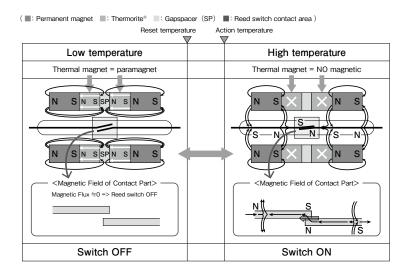




#### TRS principle: Break (B) type



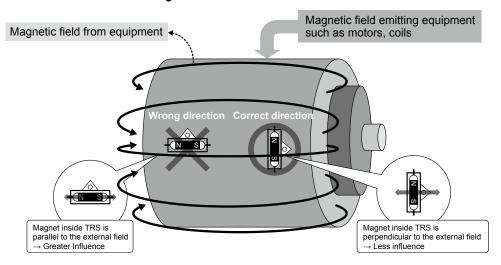
#### TRS principle: Make (M) type



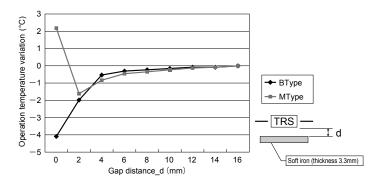


### **External Magnetic Field**

#### TRS installation in external magnetic field

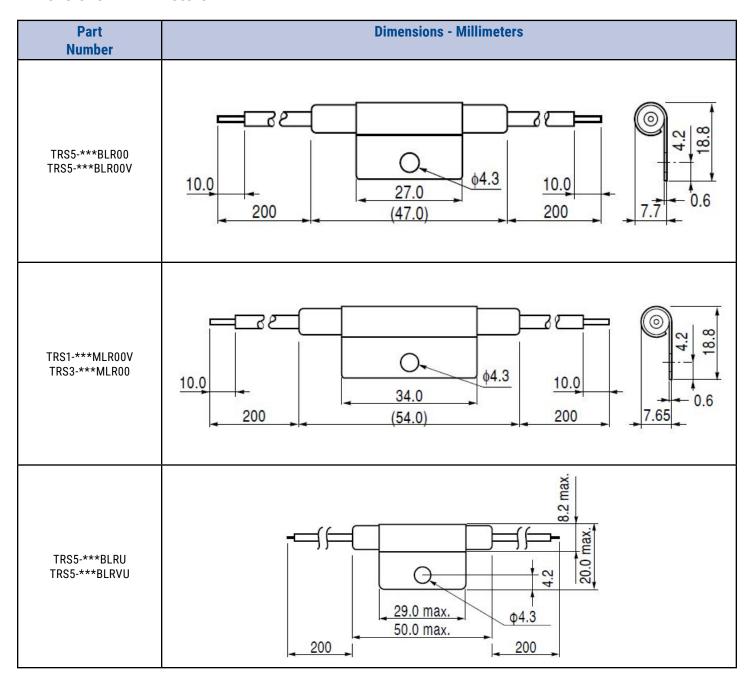


#### Ferromagnetic material influence



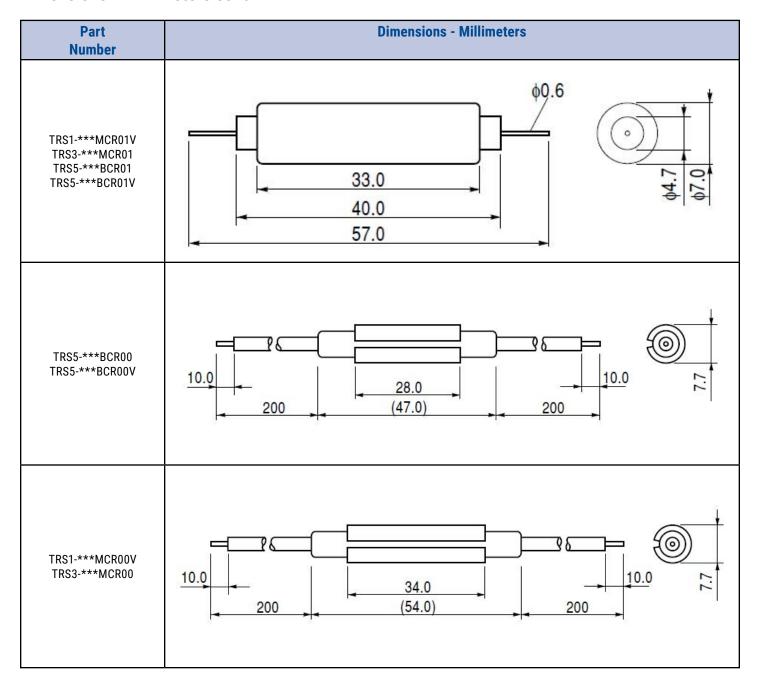


### **Dimensions - Millimeters**



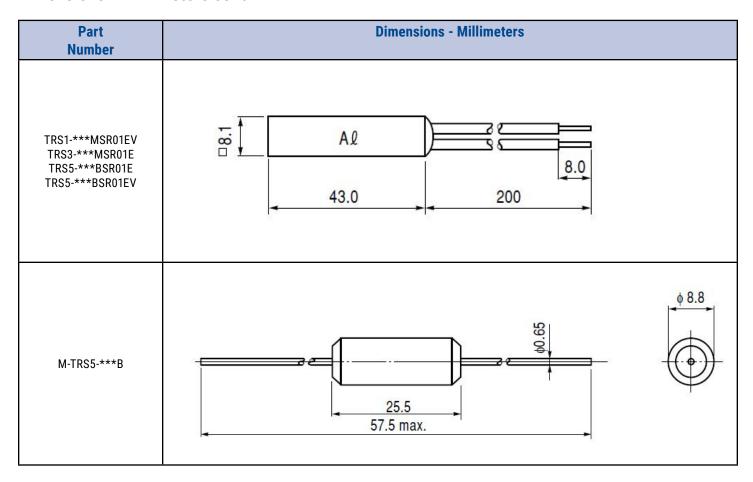


### **Dimensions - Millimeters cont.**





### **Dimensions - Millimeters cont.**



## **Environmental Compliance**

All KEMET Thermal Sensors are RoHS compliant.





## **Approvals**

Certification Body	File Number	Part Type		
UL	E67648	TRS5-***BLRU TRS5-***BLRVU		
CSA	LR50414	TRS5-***BLRU		

### **Performance Characteristics**

Item	Performance Characteristics						
Operations	All types	100,000 times					
	TRS5-***BCR00, TRS5-***BLR00, TRS5-***BSR01E, TRS5-***BLRU and TRS5-***BCR01	110 VAC – 200 Ω (purely resistive load)					
	TRS3-***MCR00, TRS3-***MLR00, TRS3-***MSR01E and TRS3-***MCR01	110 VAC - 346 $\Omega$ (purely resistive load)					
Condition	TRS5-***BCR00V, TRS5-***BLR00V, TRS5-***BSR01EV and TRS5-***BCR01V	240 VAC – 1,143 $\Omega$ (purely resistive load)					
	TRS3-***MCR00V, TRS3-***MLR00V, TRS3-***MSR01EV and TRS1-***MCR01V	200 VAC – 4,445 Ω (purely resistive load)					
	TRS5-***BLRVU	240 VAC – 952 $\Omega$ (purely resistive load)					
	M-TRS5-***B	100 VAC – 200 $\Omega$ (purely resistive load)					
Judgement	All types	1) No stick 2) Contact resistance be within 500 m $\Omega$					
Dip Washing	TRS5-***BCR01, TRS3-***MCR01, TRS5-***BCR01V, TRS1-***MCR01V and M-TRS5-***B	Using isopropyl alcohol at normal temperature for 90 seconds					
Lead Wire Material	TRS5-***BCR00, TRS5-***BLR00, TRS3-***MCR00, TRS3-***MLR00, TRS5-***BCR00V, TRS5-***BLR00V, TRS3-***MCR00V, TRS3-***MLR00V, TRS5-***BLRU and TRS5-***BLRVU	Silicone rubber glass braided wire					
	TRS5-***BSR01E, TRS3-***MSR01E, TRS5-***BSR01EV and TRS3-***MSR01EV	Vinyl chloride wire					
Lead Wire Size	TRS5-***BCR00, TRS5-***BLR00, TRS3-***MCR00, TRS3-***MLR00, TRS5-***BCR00V, TRS5-***BLR00V, TRS3-***MCR00V, TRS3-***MLR00V, TRS5-***BLRU and TRS5-***BLRVU	0.5 mm <sup>2</sup>					
	TRS5-***BSR01E, TRS3-***MSR01E, TRS5-***BSR01EV and TRS3-***MSR01EV	0.3 mm <sup>2</sup>					
	TRS5-***BCR00, TRS5-***BLR00, TRS3-***MCR00, TRS3-***MLR00, TRS5-***BCR00V, TRS5-***BLR00V, TRS3-***MCR00V and TRS3-***MLR00V	Red and white					
Lead Wire Color	TRS5-***BSR01E, TRS3-***MSR01E, TRS5-***BSR01EV and TRS3-***MSR01EV	Black					
	TRS5-***BLRU and TRS5-***BLRVU	White					



### **Insulation & Temperature Characteristics**

Shape Type	Insulation Withstand Voltage <sup>1</sup>	Minimum Insulation Resistance <sup>1</sup>	Operating Temperature Range	Switching Temperature Range	Switching Temperature Precision <sup>2</sup>	Differential Temperature <sup>3</sup>
CR00	1,500 VAC/1 minute or 1,800 VAC/1 second					10°C Maximum"
CR01			-20°C to +130°C	0°C to +130°C		
LR00			-20 C t0 +130 C	0 C t0 +130 C	±2.5°C	
LRU		VAC/1 second 500 VDC to 100 MΩ				
SR01E			-20°C to +100°C	-10°C to +100°C		
M-TRS	1,000 VAC/1 minute or 1,200 VAC/1 second		-20°C to +150°C	-10°C to +130°C		

<sup>&</sup>lt;sup>1</sup>Between wire harness and mounting resin surface.

### **Table 1 - Ratings & Part Number Reference**

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS1-0MCR00V	0°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-10MCR00V	10°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-20MCR00V	20°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-30MCR00V	30°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-40MCR00V	40°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-50MCR00V	50°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-60MCR00V	60°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-70MCR00V	70°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-80MCR00V	80°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-90MCR00V	90°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-100MCR00V	100°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-110MCR00V	110°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-120MCR00V	120°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.1	-
TRS1-0MCR01V	0°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-10MCR01V	10°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-20MCR01V	20°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-30MCR01V	30°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-40MCR01V	40°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-50MCR01V	50°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-60MCR01V	60°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-70MCR01V	70°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-

<sup>&</sup>lt;sup>2</sup> Switching temperature precision does not include measurement error.

<sup>&</sup>lt;sup>3</sup> The differential temperature is also referred to as the hysteresis temperature on thermal sensors.



## Table 1 - Ratings & Part Number Reference cont.

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS1-80MCR01V	80°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-90MCR01V	90°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-100MCR01V	100°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-110MCR01V	110°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-120MCR01V	120°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	3.4	-
TRS1-0MLR00V	0°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-10MLR00V	10°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-20MLR00V	20°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-30MLR00V	30°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-40MLR00V	40°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-50MLR00V	50°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-60MLR00V	60°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-70MLR00V	70°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-80MLR00V	80°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-90MLR00V	90°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-100MLR00V	100°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-110MLR00V	110°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-120MLR00V	120°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-130MLR00V	130°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	150	8.5	-
TRS1-M10MSR01EV	-10°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-0MSR01EV	0°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-10MSR01EV	10°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-20MSR01EV	20°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-30MSR01EV	30°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-40MSR01EV	40°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-50MSR01EV	50°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-60MSR01EV	60°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-70MSR01EV	70°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-80MSR01EV	80°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-90MSR01EV	90°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS1-100MSR01EV	100°C ±2.5°C	10°C	Make	220 AC	0.045 AC	10.0 AC	1 mA/5 VDC	300	7.2	-
TRS3-0MCR00	0°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-10MCR00	10°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-20MCR00	20°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-30MCR00	30°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-40MCR00	40°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-50MCR00	50°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-60MCR00	60°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-70MCR00	70°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-80MCR00	80°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-90MCR00	90°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-



Table 1 - Ratings & Part Number Reference cont.

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS3-100MCR00	100°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-110MCR00	110°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-120MCR00	120°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.1	-
TRS3-0MCR01	0°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-10MCR01	10°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-20MCR01	20°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-30MCR01	30°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-40MCR01	40°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-50MCR01	50°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-60MCR01	60°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-70MCR01	70°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-80MCR01	80°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-90MCR01	90°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-100MCR01	100°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-110MCR01	110°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-120MCR01	120°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	3.4	-
TRS3-0MLR00	0°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-10MLR00	10°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-20MLR00	20°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-30MLR00	30°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-40MLR00	40°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-50MLR00	50°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-60MLR00	60°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-70MLR00	70°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-80MLR00	80°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-90MLR00	90°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-100MLR00	100°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-110MLR00	110°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-120MLR00	120°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-130MLR00	130°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	150	8.5	-
TRS3-M10MSR01E	-10°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-0MSR01E	0°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-10MSR01E	10°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-20MSR01E	20°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-30MSR01E	30°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-40MSR01E	40°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-50MSR01E	50°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-60MSR01E	60°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-70MSR01E	70°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-80MSR01E	80°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-
TRS3-90MSR01E	90°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	-



## Table 1 - Ratings & Part Number Reference cont.

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS3-100MSR01E	100°C ±2.5°C	10°C	Make	140 AC/200 DC	0.500 AC/DC	35.0 AC/10.0 DC	1 mA/5 VDC	300	7.2	
TRS5-0BCR00	0°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-10BCR00	10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-20BCR00	20°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-30BCR00	30°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-40BCR00	40°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-50BCR00	50°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-60BCR00	60°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-70BCR00	70°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-80BCR00	80°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-90BCR00	90°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-100BCR00	100°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-110BCR00	110°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-120BCR00	120°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	6.8	-
TRS5-0BCR00V	0°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-10BCR00V	10°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-20BCR00V	20°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-30BCR00V	30°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-40BCR00V	40°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-50BCR00V	50°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-60BCR00V	60°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-70BCR00V	70°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-80BCR00V	80°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-90BCR00V	90°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-100BCR00V	100°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-110BCR00V	110°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-120BCR00V	120°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	6.8	-
TRS5-0BCR01	0°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-10BCR01	10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-20BCR01	20°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-30BCR01	30°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-40BCR01	40°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-50BCR01	50°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-60BCR01	60°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-70BCR01	70°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-80BCR01	80°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-90BCR01	90°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-100BCR01	100°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-110BCR01	110°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-120BCR01	120°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	3.1	-
TRS5-0BCR01V	0°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-



Table 1 - Ratings & Part Number Reference cont.

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS5-10BCR01V	10°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-20BCR01V	20°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-30BCR01V	30°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-40BCR01V	40°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-50BCR01V	50°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-60BCR01V	60°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-70BCR01V	70°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-80BCR01V	80°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-90BCR01V	90°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-100BCR01V	100°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-110BCR01V	110°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-120BCR01V	120°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	3.1	-
TRS5-0BLR00	0°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	-
TRS5-10BLR00	10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	-
TRS5-20BLR00	20°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	-
TRS5-30BLR00	30°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	-
TRS5-40BLR00	40°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	-
TRS5-50BLR00	50°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	-
TRS5-60BLR00	60°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	_
TRS5-70BLR00	70°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	_
TRS5-80BLR00	80°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	_
TRS5-90BLR00	90°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	<u> </u>
TRS5-100BLR00	100°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	<u> </u>
TRS5-110BLR00	110°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	_
TRS5-120BLR00	120°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	<u>-</u>
TRS5-130BLR00	130°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	7.3	_
TRS5-0BLR00V	0°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	
TRS5-10BLR00V	10°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-10BLR00V		10°C								<u> </u>
TRS5-20BLR00V	20°C ±2.5°C 30°C ±2.5°C	10°C	Break Break	264 AC 264 AC	0.275 AC 0.275 AC	60.5 AC 60.5 AC	1 mA/5 VDC 1 mA/5 VDC	150	7.3	<u> </u>
										<u> </u>
TRS5-40BLR00V	40°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	
TRS5-50BLR00V	50°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-60BLR00V	60°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-70BLR00V	70°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-80BLR00V	80°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-90BLR00V	90°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-100BLR00V	100°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-110BLR00V	110°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-120BLR00V	120°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-130BLR00V	130°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	7.3	-
TRS5-0BLRU	0°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA



Table 1 - Ratings & Part Number Reference cont.

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS5-5BLRU	5°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-10BLRU	10°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-15BLRU	15°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-20BLRU	20°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-25BLRU	25°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-30BLRU	30°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-35BLRU	35°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-40BLRU	40°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-45BLRU	45°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-50BLRU	50°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-55BLRU	55°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-60BLRU	60°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-65BLRU	65°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-70BLRU	70°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-75BLRU	75°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-80BLRU	80°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-85BLRU	85°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-90BLRU	90°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-95BLRU	95°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-100BLRU	100°C ±2.5°C	10°C	Break	140 AC	0.500 AC	50.0 AC	1 mA/5 VDC	150	8.5	UL & CSA
TRS5-0BLRVU	0°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-5BLRVU	5°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-10BLRVU	10°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-15BLRVU	15°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-20BLRVU	20°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-25BLRVU	25°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-30BLRVU	30°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-35BLRVU	35°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-40BLRVU	40°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-45BLRVU	45°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-50BLRVU	50°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-55BLRVU	55°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-60BLRVU	60°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-65BLRVU	65°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-70BLRVU	70°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-75BLRVU	75°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-80BLRVU	80°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-85BLRVU	85°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-90BLRVU	90°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-95BLRVU	95°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL
TRS5-100BLRVU	100°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	150	8.5	UL



## Table 1 - Ratings & Part Number Reference cont.

Part Number	Switching Temperature (°C)	Maximum Differential Temperature (°C)	Contact Type	Maximum Opening/ Closing Voltage (V)	Maximum Opening/ Closing Current (A)	Maximum Opening/ Closing Power (W)	Minimum Opening/ Closing Current	Maximum Contact Resistance (mΩ)	Weight (g)	Approval
TRS5-M10BSR01E	-10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-0BSR01E	0°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-10BSR01E	10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-20BSR01E	20°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-30BSR01E	30°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-40BSR01E	40°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-50BSR01E	50°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-60BSR01E	60°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-70BSR01E	70°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-80BSR01E	80°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-90BSR01E	90°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-100BSR01E	100°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	300	6.6	-
TRS5-M10BSR01EV	-10°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-0BSR01EV	0°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-10BSR01EV	10°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-20BSR01EV	20°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-30BSR01EV	30°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-40BSR01EV	40°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-50BSR01EV	50°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-60BSR01EV	60°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-70BSR01EV	70°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-80BSR01EV	80°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-90BSR01EV	90°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
TRS5-100BSR01EV	100°C ±2.5°C	10°C	Break	264 AC	0.275 AC	60.5 AC	1 mA/5 VDC	300	6.6	-
M-TRS5-M10B	-10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-0B	0°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-10B	10°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-20B	20°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-30B	30°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-40B	40°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-50B	50°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-60B	60°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-70B	70°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-80B	80°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-90B	90°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-100B	100°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-110B	110°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-120B	120°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-
M-TRS5-130B	130°C ±2.5°C	10°C	Break	140 AC/200 DC	0.550 AC/DC	60.5 AC/10.0 DC	1 mA/5 VDC	150	4.1	-



### **Table 2 – Ratings & Part Number Reference**

Part Type	Packaging Type	Pieces per Tray	Pieces per Box
LR00			500
CR00		50	
LRU	Rubber Band	30	600
LRVU			
SR01E		25	500
CR01	Trov	30	600
M-TRS	Tray	50	1,000

## **Soldering**

#### TRS1-\*\*\*MCR01V, TRS3-\*\*\*MCR01, TRS5-\*\*\*BCR01 and TRS5-\*\*\*BCR01V

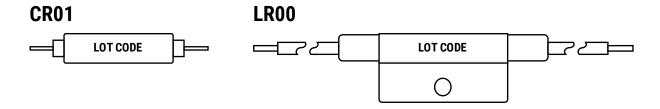
	Preheating Temperature	100 - 150°C	
Flour Coldonina	Preheating Time	Within 60 seconds	
Flow Soldering	Heating Temperature	260°C	
	Heating Time	10 ±1 seconds	
Ivon Coldovina	Temperature of Tip	350°C or lower	
Iron Soldering	Worktime	Within 5 seconds	

#### M-TRS5-\*\*\*B

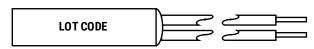
	Preheating Temperature	100 - 150°C	
Flow Coldoring	Preheating Time	Within 60 seconds	
Flow Soldering	Heating Temperature	260°C	
	Heating Time	10 ±1 seconds	
Iron Soldering	Temperature of Tip	320°C or lower	
	Worktime	Within 4 seconds	



## Marking



### SR01E

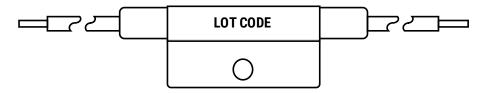


	Lot Code 12345	
Operating Temperature	(1) 1-3 digits	M10 = -10°C 65 = 65°C 100 = 100°C
Contact Type	(2) 1 digit	B = Break M = Make
Month of the Year	(3) 1 digit	1 = January 9 = September X = October Y = November Z = December
Last Digit of the Year	(4) 1 digit	0 = xxx0 1 = xxx1 9 = xxx9
Voltage	(5) 0-1 digit	Blank = 100 V V = 200 V



# Marking cont.

# **LRU & LRVU**



Lot Code 1234556						
Operating Temperature	(1) 1-3 digits	0 = 0°C 65 = 65°C 100 = 100°C				
Contact Type	(2) 1 digit	B = Break				
Contact Power	(3) 0-1 digit	Blank = 100 V (LRU) G = 200 V (LRVU)				
Month of the Year	(4) 1 digit	1 = January 9 = September X = October Y = November Z = December				
2 Last Digits of the Year	(5) 2 digits	10 = xx10 11 = xx11 19 = xx19				
Factory ID	(6) 1 digit	5 = Japan				



## Marking cont.

# M-TRS



Lot Code 1-2345						
Model	(1) 1 digit	Last Digit of Part Number				
Operating Temperature	(2) 1-3 digits	M10 = -10°C 60 = 60°C 100 = 100°C				
Contact Type	(3) 1 digit	B = Break				
Month of the Year	(4) 1 digit	1 = January 9 = September X = October Y = November Z = December				
Last Digit of the Year	(5) 1 digit	0 = xxx0 1 = xxx1 9 = xxx9				

## **Handling Precautions**

# Precautions to be taken when using Thermal Reed Switches (Please read these precautions before using our products)

- Do NOT use in close proximity to strong magnetic parts.
- Do NOT use product under mechanical weight load.
- Do NOT use if dropped or severely shocked.
- · Do NOT use with a greater load than specified.
- · Avoid stress (especially torsion) in case of additional processing.
- Thermal Reed Switches have a specific resonance frequency. Please contact a KEMET representative if an oscillation is added.



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Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.

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#### Features

- 4"x2" miniature size
- · Universal AC input / Full range
- EMI Class B for both Class I (with FG) and Class II (without FG) configuration
- No load power consumption<0.3W</li>
- High efficiency up to 91%
- · Protections: Short circuit / Overload / Over voltage / Over temperature
- · Cooling by free air convection for 84W and 120W with 10CFM forced air
- Built-in 12V/0.5A fan supply
- LED indicator for power on
- · Operating altitude up to 5000 meters
- 3 years warranty









# Applications

- · Industrial automation machinery
- Industrial control system
- · Mechanical and electrical equipment
- Electronic instruments, equipments or apparatus

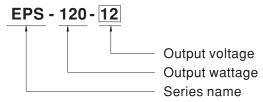
#### GTIN CODE

MW Search: https://www.meanwell.com/serviceGTIN.aspx

## Description

EPS-120 is a 120W highly reliable green PCB type power supply with a high power density on the 4" by 2" footprint. It accepts 80~264VAC input and offers various output voltages between 12V and 48V. The working efficiency is up to 91% and the extremely low no load power consumption is down below 0.3W. EPS-120 is able to be used for both Class I (with FG) and Class II (no FG) system design. EPS-120 has the complete protection functions; it is complied with the international safety regulations such as TUV BS EN/EN62368-1, UL62368-1 and IEC62368-1. EPS-120 series serves as a high price-to-performance power supply solution for various industrial applications.

## Model Encoding



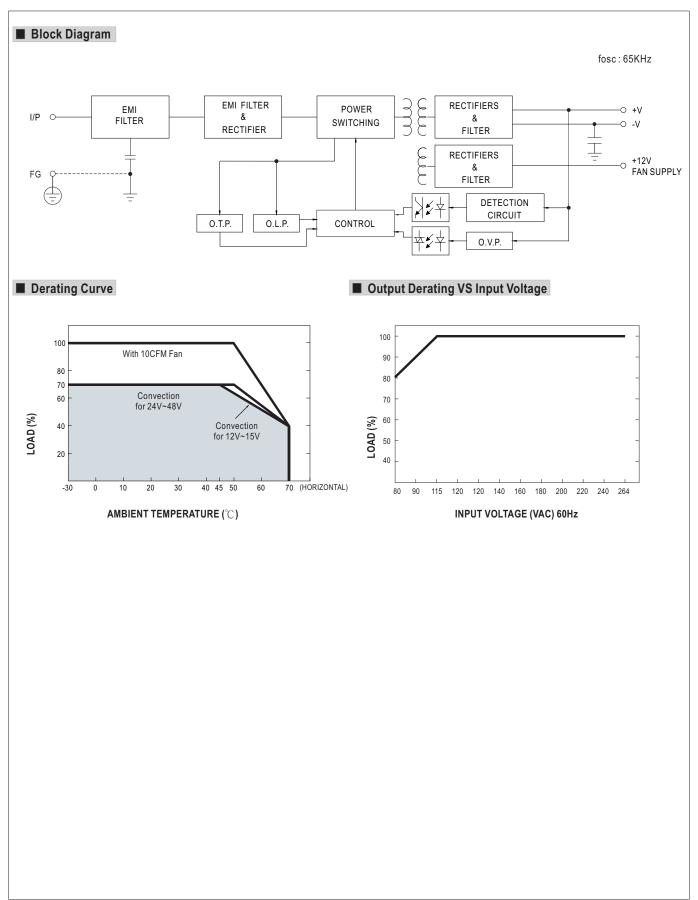


#### **SPECIFICATION**

DC VOLTAGE		12V	15V	24V	27V	48V
auppent.	10CFM	10A	8A	5A	4.5A	2.5A
CURRENT	Convection	7.0A	5.6A	3.5A	3.15A	1.75A
RATED	10CFM	120W	120W	120W	121.5W	120W
POWER	Convection	84W	84W	84W	85W	84W
RIPPLE & NOISE (max.) Note.2		120mVp-p	120mVp-p	150mVp-p	150mVp-p	200mVp-p
VOLTAGE A	J. RANGE	11.4~12.6V	14.3~15.8V	22.8~25.2V	25.6 ~ 28.4V	45.6 ~50.4V
VOLTAGE TOLI	ERANCE Note.3	±2.0%	±2.5%	±1.0%	±1.0%	±1.0%
LINE REGUL	ATION	±0.5%	±0.5%	±0.5%	±0.5%	±0.5%
LOAD REGUI	ATION	±1.0%	±1.0%	±1.0%	±1.0%	±1.0%
SETUP, RISE	TIME	500ms, 30ms/230VA	500ms, 30ms	/115VAC at full load		
HOLD UP TIM	IE (Тур.)	50ms/230VAC	0ms/115VAC at full le	oad		
VOLTAGE RA	NGE Note.4	80 ~ 264VAC 11	3 ~ 370VDC			
FREQUENCY	RANGE	47 ~ 63Hz				
EFFICIENCY	(Тур.)	88%	88.5%	90%	90%	91%
AC CURRENT	Г (Тур.)	2.1A/115VAC 1	2A/230VAC			
INRUSH CUR	RENT (Typ.)	COLD START 30A/1	15VAC 60A/230	VAC		
LEAKAGE CI	JRRENT	<0.75mA/240VAC				
OVERLOAD		115~150% rated output power				
		Protection type : Hiccup mode, recovers automatically after fault condition is removed				
OVER VOLTAGE		13.2 ~ 15.6V	16.5 ~ 19.5V	26.4 ~ 31.2V	29.7 ~ 35V	52.8 ~ 62.4V
		Protection type : Shu	t down o/p voltage, re	e-power on to recover		
OVER TEMP	ERATURE	Protection type : Shut down o/p voltage, re-power on to recover				
FAN SUPPLY		12V@0.5A for drivin	g a fan ; tolerance -1	5% ~ +10% at main outp	ut 40% rated current (	10CFM)
WORKING TE	MP.	-30 ~ +70°C (Refer to	"Derating Curve")			
WORKING HI	JMIDITY	20 ~ 90% RH non-co	ndensing			
STORAGE TEI	MP., HUMIDITY	-40 ~ +85°C, 10 ~ 95	% RH			
TEMP. COEFF	ICIENT	±0.03%/°C (0~50°	C)			
OPERATING A	LTITUDE Note.6	5000 meters	•			
VIBRATION		10 ~ 500Hz, 2G 10m	n./1cycle, 60min. ead	ch along X, Y, Z axes		
SAFETY STA	NDARDS				EAC TP TC 004 app	roved
WITHSTAND	VOLTAGE	I/P-O/P:3KVAC I/P	-FG:2KVAC O/P-F	G:0.5KVAC		
ISOLATION F	RESISTANCE	I/P-O/P, I/P-FG:100M	Ohms / 500VDC / 2	5°C/70% RH		
EMC EMISSIO	ON	Compliance to BS EN EAC TP TC 020	I/EN55032 (CISPR32	2) Class B, BS EN/EN610	00-3-2,-3, GB9254.1	Class B,GB17625 Class
EMC IMMUNI	ТҮ	Compliance to BS EN/EN61000-4-2,3,4,5,6,8,11, BS EN/EN55035, BS EN/EN61000-6-2, heavy industry level, criteria A, EAC TP TC 020				2, heavy industry level,
MTBF		3746.9K hrs min.	Telcordia SR-332 (Be	ellcore); 491.2K hrs min.	MIL-HDBK-217F (	25°C)
DIMENSION		101.6*50.8*29mm (I	_*W*H)			
		0.15Kg; 72pcs/11.8Kg/0.82CUFT				
	POWER RIPPLE & NOIS VOLTAGE AD VOLTAGE TOLE LINE REGUL/ LOAD REGUL SETUP, RISE HOLD UP TIM VOLTAGE RA FREQUENCY EFFICIENCY AC CURRENT INRUSH CUR LEAKAGE CU OVERLOAD  OVER VOLTA OVER TEMPI FAN SUPPLY WORKING TE WORKING TE WORKING HU STORAGE TEM TEMP. COEFF OPERATING AI VIBRATION SAFETY STAI WITHSTAND ISOLATION F EMC EMISSIC	CURRENT  RATED POWER  RATED POWER  RIPPLE & NOISE (max.) Note.2  VOLTAGE ADJ. RANGE  VOLTAGE TOLERANCE Note.3  LINE REGULATION  LOAD REGULATION  SETUP, RISE TIME  HOLD UP TIME (Typ.)  VOLTAGE RANGE Note.4  FREQUENCY RANGE  EFFICIENCY (Typ.)  AC CURRENT (Typ.)  INRUSH CURRENT (Typ.)  LEAKAGE CURRENT  OVERLOAD  OVER VOLTAGE  OVER TEMPERATURE FAN SUPPLY  WORKING TEMP.  WORKING HUMIDITY  STORAGE TEMP., HUMIDITY  TEMP. COEFFICIENT  OPERATING ALTITUDE Note.6  VIBRATION  SAFETY STANDARDS  WITHSTAND VOLTAGE  ISOLATION RESISTANCE  EMC EMISSION  EMC IMMUNITY  MTBF	CONVECTION   TOWN	Convection   7.0A   5.6A	CONVECTION   T.O.A   S.6A   S.5A   S.5A	Convection   T.OA   5.6A   3.5A   3.15A   3.15A

- 2. Ripple & noise are measured at 20MHz of bandwidth by using a 12" twisted pair-wire terminated with a 0.1  $\mu$  F & 47  $\mu$  F parallel capacitor.
- Tolerance: includes set up tolerance, line regulation and load regulation.
   Derating may be needed under low input voltages. Please check the derating curve for more details.
- 5. The power supply is considered a component which will be installed into a final equipment. All the EMC tests are been executed by mounting the unit on a 360mm\*360mm metal plate with 1mm of thickness. The final equipment must be re-confirmed that it still meets EMC directives. For guidance on how to perform these EMC tests, please refer to "EMI testing of component power supplies." (as available on https://www.meanwell.com//Upload/PDF/EMI\_statement\_en.pdf)
- 6. The ambient temperature derating of 3.5°C/1000m with fanless models and of 5°C/1000m with fan models for operating altitude higher than 2000m(6500ft).
- Product Liability Disclaimer: For detailed information, please refer to https://www.meanwell.com/serviceDisclaimer.aspx

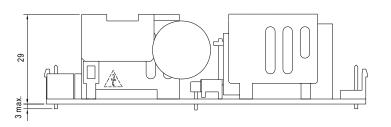




Unit:mm



#### ■ Mechanical Specification FAN ※Note 10CFM Air flow direction Ф CN101 HS1 CN1 HS<sub>2</sub> FS1 4A/250V 50.8 3.175 95.25 101.6



#### AC Input Connector (CN1): JST B3P-VH or equivalent

		,	
Pin No.	Assignment	Mating Housing	Terminal
1	AC/N	IOTAUD	IOT OVILL DAT DA A
2	No Pin	JST VHR or equivalent	JST SVH-21T-P1.1 or equivalent
3	AC/L	or oquiraioni	o. oquiraioni

 $\pm$ : Grounding required

1.HS1,HS2 cannot be shorted.
2.HS1 must have safety isolation distance

with system case.

#### DC Output Connector (CN2): JST B4P-VH or equivalent

Pin No.	Assignment	Mating Housing	Terminal
1,2	+V	JST VHR	JST SVH-21T-P1.1
3,4	-V	or equivalent	or equivalent

#### FAN Connector(CN101): JST B2B-PH-K-S or equivalent

Pin No.	Assignment	Mating Housing	Terminal
1	+12V	JST PHR-2	JST SPH-002T-P0.5S
2	DC COM	or equivalent	or equivalent

\*\*Note: 1. The FAN SUPPLY is designed to serve as the source of the additive external fan for the cooling of the power supply, enabling the full load delivery and assuring the best life span of the product. Please do not use this FAN SUPPLY to drive other devices.

2.The PCB type(Blank type)model delivers EMI Class B for both conducted emission and radiated emission for the power supply, when configured into either Class I (with FG) or Class  $\,\mathrm{II}\,$  (without FG) system.

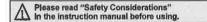
#### ■ Installation Manual

Please refer to: http://www.meanwell.com/manual.html

## DIN W48×H24mm, Indication Only, LCD Timer (Hour Meter)

#### Features

- No additional power due to internal battery
- Signal input method: No-voltage input, voltage input, free voltage input
- Screw terminal type (attaching terminal cover)
- LCD display, backlight model
- Protection structure: IP66



Ordering Information





	$\top$		Backlight	No mark	None
				L	Backlight function
				N	No-voltage (small signal) input
			Input type	v	Voltage input
				F	Free voltage input
		10.1	Power supply	В	Internal lithium battery
		Size		N	DIN W48×H24mm
	Digit			8	9999999 (8-digit)
ltem				LE	Compact LCD Timer

#### Specifications

Model		LE8N-BN	LE8N-BN-L	LE8N-BV	LE8N-BV-L	LE8N-BF	
Digit		8-digit (0 to 999999	99)				
Digit size		W3.4×H8.7mm					
Display me	thod	LCD Zero Blanking	type (character heig	ght size: 8.7mm)			
Operation i	method	Count up					
ower sup	ply	Built-in battery					
Battery life	cycle	Approx, over 10 years at 20°C					
Backlight p	ower supply		24VDC== ±10%	<u>—</u>	24VDC== ±10%	<del>2-2</del>	
nput meth	od	No-voltage input		Voltage input		Free voltage input	
START inp	ut	Residual voltage: m Short-circuit impeda Open-circuit impeda	nce: max. 10kΩ	[H]: 4.5-30VDC [L]: 0-2VDC		[H]: 24-240VAC~/6-240VDC== [L]: 0-2VAC/0-2.4VDC	
RESET input No-voltage input				Voltage input		No-voltage input	
Min. input signal width SIGNAL, RESET input: approx. 20ms			7				
Time specification (TS1) 9999.59.59 (h.m.s),			99999.59.9 (h.m),	999999.59 (h.m)			
Time specification (TS2) 9999.23.9		9999.23.59 (d.h.m),	1992359 (d.h.m), 9999d239 (d.h), 99999999 (s)				
Time speci	fication (TS3)	9999h59.9 (h.m), 9	999h59.9 (h.m), 99999h59 (h.m), 999999.9h (h)				
Time error, ±0.01%							
Temperatu							
External se		SW1*1, SW2*2, SW3*5					
	resistance	Over 100MΩ (at 500VDC megger)					
Dielectric s		2,000VAC 60Hz for 1 min					
/ibration	Mechanical	0.75mm amplitude					
	Malfunction	0.3mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 10 min					
Shock	Mechanical	300m/s <sup>2</sup> (approx. 30					
	Malfunction	100m/s² (approx. 10		direction for 3 times			
	Ambient temp.	-10 to 55°C, storage					
	Ambient humi.	35 to 85%RH, stora	-				
Protection	structure	IP66 (when using w			andard)		
Accessory		Mounting bracket, F	Rubber waterproof r	ing			
Approval		C € c <b>9/3</b> /us					
Weight <sup>™6</sup>		Approx. 96g (appro	x. 50g)				

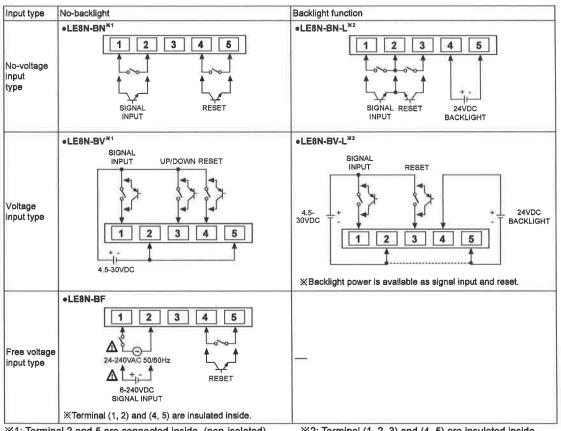
<sup>※1:</sup> SW1 is the front panel RESET key enable/disable set switch.

XEnvironment resistance is rated at no freezing or condensation.

<sup>%2:</sup> SWT is the from paried RESET rey enables detailed and the case/Free voltage input; between the free voltage input terminal and the RESET input terminal, between terminals and the case
%5: The weight includes packaging. The weight in parenthesis is for unit only.

# **Compact LCD Display Timer**

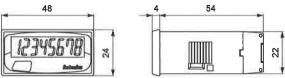
#### Connections



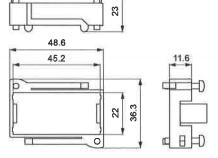
※1: Terminal 2 and 5 are connected inside. (non-isolated)※Use reliable contacts enough to flow 5μA current.

 $\ensuremath{\texttt{\%}}\xspace$  2: Terminal (1, 2, 3) and (4, 5) are insulated inside.

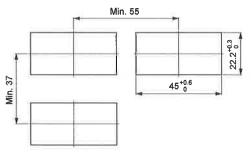
#### Dimensions



#### Bracket



#### Panel cut-out



SENSORS
CONTROLLERS
MOTION DEVICES

SOFTWARE

(J) Temperature Controllers

(L)

(M) Counters

(N) Timera

(O) Digital Panel Meters

(P) Indicators

(Q) Converters

(unit: mm)

(R) Digital Display Units

(S) Sensor Controllers

(T) Switching Mode Power

(U) Recorders

(V) HMIs

(W) Panel PC

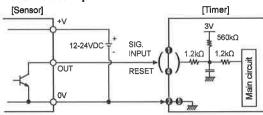
(X) Field Network Devices

## **LE8N Series**

#### Input Connections

#### O No-voltage input (standard sensor: NPN open collector output type)

#### • Solid-state input



When power is applied to terminal No 

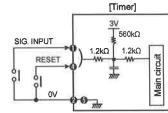
and 

and 

input

i terminal circuit can be broken and a malfunction can occur. (NPN output, PNP output, PNP open collector output type sensor cannot be used.)

#### Contact input

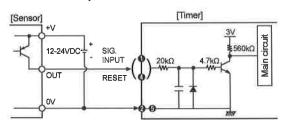


XPlease use reliable contacts enough to flow 3VDC 5µA of current.

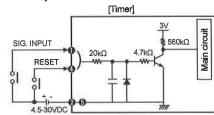
#### ※② and ⑤ are connected inside.

#### O Voltage input (standard sensor: PNP open collector output type)

#### • Solid-state input



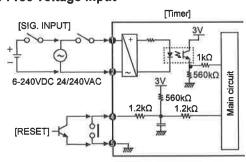
#### Contact input



\*\*Use reliable contacts enough to flow 3VDC 5μA of

※For backlight function model, the input terminals are ●, ● and the GND terminal is ●.

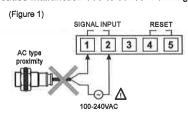
#### O Free voltage input



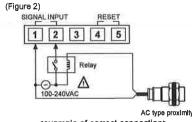
- XAC type proximity sensor cannot be used as the source of input signals.
- XInput terminal (♠, ♠) and reset terminal (♠, ♠) are insulated inside.
- XIt is not possible to reset with AC power or DC power. \*When relay contact is used as the source of RESET signal, please use reliable contacts enough to flow 3VDC 5µA of current.

#### O Input from AC type proximity sensor

In case of free voltage input type, do not connect AC proximity sensors instead of a switch as shown in the figure 1. It may cause malfunction due to sensor's leakage current. Connect a relay as shown in the figure 2.



<example of wrong connection>



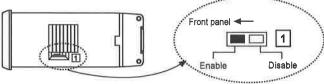
<example of correct connection>

# **Compact LCD Display Timer**

#### Set Switch

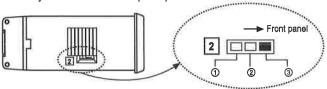
#### 

SW1 is a switch to Enable/Disable the front panel RESET key. ※Factory default: Enable



#### 

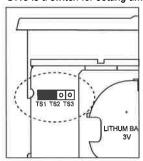
SW2 is a switch for setting time range. \*\*Factory default: 9999.59.59 (h.m.s)

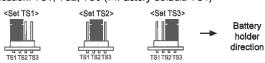


\*\*Refer to "<Time range>" table of SW3 for ①, ②, ③ descriptions.

#### **◎ SW3 setting**

SW3 is a switch for setting time specification. TS1, TS2, TS3 (XFactory default: TS1)



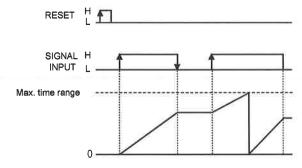


#### <Time range><sup>₭1</sup>

	- Time tenger							
	TS1	TS2	TS3					
0	hour. min.	sec.	hour.					
	9 9 9 9 9 9 5 9	99999999	9999999h					
2	hour. min.	day. hour	hour. min.					
	9 9 9 9 9 5 9 9	9999d239	99999h59					
3	hour. min. sec.	day. hour. min.	hour. min.					
	9999595	9999.23.59	9999h59.9					

%1: Time range is set as SW2, SW3 combination.

## **■ Time Operation**



SENSORS

CONTROLLERS

MOTION DEVICES

SOFTWARE

(K) SSRs

Controllers
(M)
Counters

(N) Timers

(O) Digital Panel Meters

(P) Indicators

(Q) Converters

(R) Digital Display Units

(S) Sensor Controllers

Supplies

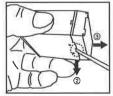
(V) HMIs

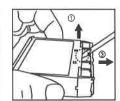
(W)

(X) Fleid Network

### ■ Case Detachment and Battery Replacement

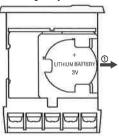
#### © Case detachment





※Hold up Lock part toward ⑤, ② of the product with the tool and pull toward ③ to detach the case. 

#### Battery replacement



- 1. Detach the case.
- 2. Push the battery and detach it toward ①.
- 3. Insert a new battery with correct alignment of polarity pushing it toward opposite of ①.
- ※Since lithium battery is embedded in the product, follow instructions below for safety.

  ⊕Do not charge, short, disassemble, subject it to shock, heat.

  - ②Check the polarity.
    ③Use CR2477 battery.
- (a) Use CR2477 battery.

  (b) Do not solder on a battery directly.

  (c) Insulate a battery with tape to dispose.

  (d) Do not store this unit in the place with the direct sunlight, high temperature and humidity.

  With battery is sold separately.

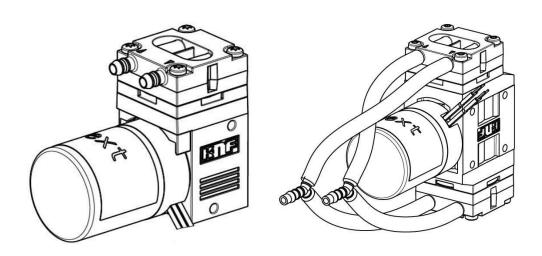
  Please replace a battery by yourself. (sold separately)

  With Do not burn up or disassemble the lithium battery.



# Operating and Installation Instructions

# Micro Diaphragm Gas Sampling Pumps



Type range:

NMP830K_DC HP	NMP830.1.2K_DC HP
NMP830K_DC-B HP	NMP830.1.2K_DC-B HP
NMP830K_DC-B4 HP	NMP830.1.2K_DC-B4 HP

You have selected a high-quality KNF product; the following tips will help you operate it safely, and reliably over a long period of time. Carefully study the Operating and Installation Instructions before using the pumps and observe at all times the relevant instructions to avoid dangerous situations. The manual was produced for the serial pumps stated above. With customer-specified projects (pump types starting with "PJM", "PMM", "PU" or "MPU") there could be differences in detail. For customer-specified projects please therefore take into account any agreed technical specifications, as well as these instructions.

# ( (

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Tel. +1 609 890 8600 Fax +1 609 890 2838 www.knfusa.com

Coı	ntents	Page
1.	About this document	2
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3.	Safety	4
4.	Technical data	6
5.	Assembly and function	10
6.	Operation	12
7.	Servicing	14
8.	Troubleshooting	15
9.	Returns	16
10.	Health and safety clearance and decontamination form	17

#### 1. About this document

# 1.1. Use of the Operating and Installation Instructions

The Operating and Installation Instructions are part of the pump.

→ Forward the Operating and Installation Instructions to any subsequent owners of the pump

#### Project pumps

Customer-specific project pumps (pump models which begin with "PJM", "PMM", "PU", or "MPU") may differ from the Operating and Installation Instructions.

→ In the case of project pumps, take note of any additionally agreed specifications.

#### 1.2. Symbols and markings

#### Warning



#### This symbol indicates a potential danger.

It also indicates the possible consequences of failure to observe the warning. The signal word (e.g. "Warning") indicates the level of danger

→ Here you will see actions for avoiding the danger and potential consequences.

#### **Danger levels**

Signal word	Meaning	Consequences if not observed
DANGER	warns of immedi- ate danger	Consequences are death or serious injury and/or serious property damage.
WARNING	warns of poten- tial danger	Death or serious injury and/or serious damage to property are possible
CAUTION	warns of a poten- tially dangerous situation	Minor injury or damage to property are possible.

Tab. 1

#### Other information and symbols

- → This indicates a required activity (step).
- This indicates the first step of a required activity. Additional consecutively numbered steps follow
- This symbol indicates important information

#### 2. Use

#### 2.1. Intended use

KNF pumps are to transfer, evacuate and compress gases.

#### **Owner's responsibility**

Operating parameters and conditions

Only install and operate the pumps under the operating parameters and conditions described in Chapter 4, Technical data. Only completely installed pumps may be taken into service.

Requirements for transferred medium

Before using a medium, check whether the medium can be transferred danger-free in the specific application case.

Before using a medium, check the compatibility of the materials of the pump head, pump housing, piston seal, piston screw, diaphragm, seals and valves with the medium.

The temperature of the medium must lie within the permissible temperature range (see Chapter 4).

The transferred gas should not contain particles as these can prevent the pump from working correctly. If this cannot be guaranteed, a filter < 50  $\mu$ m with sufficiently large filter area must be used upstream of the pump.

See the type- plate or data sheet for full electrical and pneumatic data.

#### 2.2. Improper use



The pumps must not be operated in an explosive atmosphere.

#### **DANGER**

The pumps are not suitable for transferring dusts and liquids.

Please contact your local KNF partner for special designs that are not included in the technical specification.

An overpressure must not be applied to the suction side of the pump.

## 3. Safety

Observe the safety precautions in Chapters

5. Installation and connection and 6. Operation.

The pumps are built according to the generally recognized rules of technology and in accordance with the pertinent occupational safety and accident prevention regulations. Nevertheless, dangers may occur during their use which may lead to injuries to the user or others, or to damage to the pump or other property.

Only use the pumps when they are in a good technical and proper working order, in accordance with their intended use, observing the safety advice within the Operating and Installation Instructions, at all times.

Personnel

Make sure that only trained and instructed personnel or specially trained personnel work on the pumps. This especially applies to assembly, connection and servicing work.

Make sure that all personnel have read and understood the Operating and Installation Instructions, and in particular the "Safety" chapter.

Working in a safety-conscious manner Handling dangerous media

Always ensure adherence to all pertinent accident prevention and safety regulations when working on and operating the pump.

When transferring dangerous media, observe the safety regulations for handling such media.

Handling combustible media

Be aware that the pumps are not designed to be explosion-proof.

Make sure the temperature of the medium is always sufficiently below the ignition temperature of the medium, to avoid ignition or explosion. This also applies for unusual operational situations.

Note that the temperature of the medium increases when the pump compresses the medium.

Hence, make sure the temperature of the medium is sufficiently below the ignition temperature of the medium, even when it is compressed to the maximum permissible operating pressure of the pump.

If necessary, consider any external sources of energy, such as radiation, that may add heat to the medium.

In case of doubt, consult the KNF customer service.

Notes

Always ensure adherence to all information stickers on the pumps, such as flow direction arrows and type plates, and keep stickers in legible condition.

Environmental protection

All replacement parts should be properly stored and disposed of in accordance with the applicable environmental protection regulations. Observe the respective national and international regulations. This especially applies to parts contaminated with toxic substances.

Disposal

Dispose of all packaging in an environmentally-appropriate manner. The packaging materials are recyclable.



Dispose of end-of-life equipment in an environmentally friendly manner. Use appropriate waste collection systems for the disposal of end-of-life equipment. Used pumps contain valuable recyclable materials.



EU directives/standards

For the purposes of the Machinery Directive 2006/42/EC, pumps are "partly completed machinery", and are therefore to be regarded as not ready for use. Partly completed machinery may not be commissioned until such time as it has been determined that the machine in which the partly completed machinery is to be assembled conforms to the provisions of the Machinery Directive 2006/42/EC. The essential requirements of Annex I of Directive 2006/42/EC (general principles) are applied and observed.

- General Principles No. 1
- No. 1.1.2. / 1.1.3. / 1.3.1. / 1.3.3. / 1.3.4. / 1.4.1. / 1.5.8. / 1.5.9. / 1.7.4. / 1.7.4.1. / 1.7.4.3.

As these partly completed machinery are OEM-models the power supplies and the equipment for disconnecting and switching-off the partly completed machinery respectively have to be considered when mounting as well as over-current and overload protective gear.

In addition a protection against mechanical parts in motion, hot parts, if existing, has to be provided when mounting.



The pumps comply with the fundamental requirements of Directive 2011/65/EU (RoHS2).

Customer service and repairs

All repairs to the pump(s) must be carried out by the relevant KNF customer service team.

Exception service interval: see chapter 7.3.

# 4. Technical data

#### **General parameters**

Parameter	Value
Ambient temperature (°C)	+5°C to + 40°C
	+41°F to + 104°F
Medium temperature (°C)	+5°C to + 40°C
	+41°F to + 104°F
Maximum permissible ambient relative	80 % for temperatures
humidity	up to 31 °C (87.8°F),
	decreasing linearly to
	50 % at 40 °C (104°F)
Storage temperature (°C)	- 20°C to + 70°C
	- 4°F to + 158°F

Tab. 2

#### **Pump Materials of gas-contacting parts**

#### Type designation NMP830KPDC-\_ HP / NMP830.1.2KPDC\_ HP

Components	Material <sup>1)</sup>
Head plate	PPS
Valve plate	EPDM
O-ring	EPDM
Intermediate plate	PPS
Diaphragm	EPDM

Tab. 3

<sup>1)</sup> according DIN ISO 1629 and 1043.1

#### **Characteristics NMP830KPDC HP**

Motor specification		
Supply voltage[V] 5)	12	24
Max. current consumption [A]	0.93	0.47
Connection [-]	Flat plug A 2.8x0.5 DIN46244	
Protection class [-]	IP 20	
Weight 1) [g] / [oz]	185 / 6.53	
Flow rate [I/min] <sup>2), 3)</sup>	5.5	
Max. operating pressure [bar g] / [psi] <sup>2), 3)</sup>	2.1 / 30.5	
Max. vacuum [mbar abs] / [inHg] <sup>2), 3)</sup> 200 / 9		5.9

Tab. 4

#### Characteristics NMP830KPDC-B HP (brushless)

#### B: Brushless motor with internal electronic - 2 wires

Motor Variants		
Supply voltage[V] 5)	12	24
Max. current consumption [A]	1.03	0.52
Connection [-]	Wires AWG24	
Protection class [-]	IP 54	
Weight 1) [g] / [oz]	170 / 6	
Flow rate [l/min] <sup>2), 3)</sup>	5.5	
Max. operating pressure [bar g] / [psi] <sup>2), 3)</sup>	3.0 / 43.5	
Max. vacuum [mbar abs] / [inHg] 2), 3)	x. vacuum [mbar abs] / [inHg] <sup>2), 3)</sup> 200 / 5.9	

Tab. 5

#### Characteristics NMP830KPDC-B4 (brushless)

#### B4: Brushless motor with internal electronic - 4 wires

Motor Variants		
Supply voltage[V] 5)	12	24
Max. current consumption [A]	1.03	0.52
Connection [-]	Wires AWG24	
Protection class [-]	IP 54	
Weight 1) [g] / [oz]	170 / 6	
Flow rate [l/min] <sup>2), 3), 4)</sup> 5.5		5
Max. operating pressure [bar g] / [psi] <sup>2), 3), 4)</sup> 3.0 / 43.5		13.5
Max. vacuum [mbar abs] / [inHg] <sup>2), 3), 4)</sup>	200 / 5.9	

Tab. 6

<sup>&</sup>lt;sup>1)</sup> The weight may differ slightly from the stated value, depending on the version.

<sup>&</sup>lt;sup>2)</sup> Depending on the application level (MASL), ambient temperature, material design of the pump head and the connection hoses used, the flow rates may vary from the values shown.

 $<sup>^{3)}</sup>$  Measured with air at 20°C / 68°F at atmospheric pressure

<sup>4)</sup> at 5V control voltage

<sup>5)</sup> Nominal use

#### Characteristics NMP830.1.2KPDC HP

Motor specification		
Supply voltage[V] 5)	12	24
Max. current consumption [A]	1.48	0.73
Connection [-]	Flat plug A 2.8x0.5 DIN46244	
Protection class [-]	IP20	
Weight 1) [g] / [oz]	340 / 12	
Flow rate [I/min] <sup>2), 3)</sup>	8.0	9.0
Max. operating pressure [bar g] / [psi] 2), 3)	2.1 / 30.5	
Max. vacuum [mbar abs] / [inHg] <sup>2), 3), 4)</sup>	200 / 5.9	

Tab. 7

#### Characteristics NMP830.1.2KPDC-B HP (brushless 2-wires)

#### B: Brushless motor with internal electronic

Motor Variants		
Supply voltage[V] 5)	12	24
Max. current consumption [A]	1.66	0.86
Connection [-]	Wires AWG24	
Protection class [-]	IP 54	
Weight 1) [g] / [oz]	230 / 8.1	
Flow rate [l/min] <sup>2), 3</sup>	10	
Max. operating pressure [bar g] / [psi] <sup>2), 3), 4)</sup>	3.0 / 43.5	
Max. vacuum [mbar abs] / [inHg] <sup>2), 3), 4)</sup> 200 / 5.9		5.9

Tab. 8

#### Characteristics NMP830.1.2KPDC-B4 (brushless 4-wires)

#### B4: Brushless motor with internal electronic and controllability

Motor Variants		
Supply voltage[V] 5)	12	24
Max. current consumption [A]	1.66	0.86
Connection [-]	Wires AWG24	
Protection class [-]	IP 54	
Weight 1) [g] / [oz]	230 / 8.1	
Flow rate [l/min] <sup>2), 3), 4)</sup>	10	
Max. operating pressure [bar g] / [psi] <sup>2), 3), 4)</sup>	ing pressure [bar g] / [psi] <sup>2), 3), 4)</sup> 3.0 / 43.5	
Max. vacuum [mbar abs] / [inHg] <sup>2), 3), 4)</sup> 200 / 5.9		5.9

Tab. 9

<sup>&</sup>lt;sup>1)</sup> The weight may differ slightly from the stated value, depending on the version.

<sup>&</sup>lt;sup>2)</sup> Depending on the application level (MASL), ambient temperature, material design of the pump head and the connection hoses used, the flow rates may vary from the values shown.

<sup>&</sup>lt;sup>3)</sup> Measured with air at 20°C / 68°F at atmospheric pressure

<sup>4)</sup> at 5V control voltage

<sup>5)</sup> Nominal use

# Motor specification B4 (brushless motor with internal electronic)

#### Motor electrical specifications DC-B4 12V / 24V

Electrical connections			
Function	Lead color	Signal name	Size
+ Supply voltage	Red	+ Vs	AWG 24
- Supply voltage	Black	- Vs / GND	AWG 24
Speed control – input signal	White	Vctrl	AWG 24
Frequency output – output signal	Green	FG	AWG 24
DC control input Vctrl			
Control voltage range DC		05	[VDC]
Resistant to surge voltages up to		±28	[VDC]
Threshold voltage		1.5	[VDC]
FG frequency output			
FG pulses per mech. revolution		18	[]
Output level "high" (lout <0.1mA)		4.2 5.4	[V]
Output level "low" (lout <0.1mA)		< 0.5	[V]

Tab. 10

<sup>1)</sup> PWM-signal also possible. Recommended carrier frequency 6-20kHz

## 5. Assembly and function

Only install the pump under the operating parameters and conditions described in Chapter 4, Technical data.

Observe the safety precautions (see Chapter 3).

#### 5.1. Installation

- → Before installation, store the pump at the installation location to bring it up to ambient
- See the data sheet for the mounting dimensions

#### Installation location

- → Make sure that the installation location is dry and the pump is protected against water in the form of rain, spray, splashes and drips.
- → Protect the pump against dust.
- Protect the pump against vibration and impact.

#### Contact and foreign body protection



Risk of physical injury and damage to the pump due to automatic start

→ If the pump overheats and the thermal switch / electronics stops pump operation, the pumps will restart automatically as soon as the motor has had time to cool down.

Take steps to ensure that this cannot produce a hazardous situation

#### 5.2. Electrical connection

- → Only have the pump connected by an authorized specialist
- Only have the pump connected when the power supply is disconnected.
- When connecting the device to a power source, the relevant norms, directives, regulations and technical standards must be observed

#### Connecting the pump

- Make sure that the power supply data match the data on the motor's type plate. The current consumption can be found on the type plate.
- 2. Connect the motor cables. For electrical data see Chapter 4.
- Note the proper polarity.

For DC motors:

red motor cable: -

black motor cable: -

In the case of brushless DC motors: incorrect polarity may damage to the electronics.

#### 5.3. Pneumatic connection

# Connected components

→ Only connect components to the pump that are designed to handle the pneumatic data of the pump (see Chapter 4, Technical data)

#### Hoses

- → Only use hoses that are suitable for the maximum operating pressure of the pump (see Chapter 4)
- → Only use hoses that are chemically resistant to the media being pumped
- → If ambient air is sucked in, use a filter to protect pump from dust

#### 5.3.1. Connecting the pump

- Arrows on the pump head indicate the flow direction.
- 1. Remove the protective caps from the hose connections.
- 2. Connect the suction and pressure lines.
- 3. If the pump is used to build up pressure, make sure that all transition joints between hose and pump are secure in order to ensure that the hoses cannot come off.
- 4. Check that the hoses and transition joints (hose connector/hose) are fitted correctly and securely.
- 5. Check that the system is leak-tight.

#### 6. Operation

- → Operate the pumps only under the operating parameters and conditions described in Chapter 4, Technical data
- → Make sure that the pumps are being used properly (see Chapter 2.1).
- → Avoid improper use of the pumps (see Chapter 2.2)
- → Observe the safety precautions (see Chapter 3).
- → The pump is a component intended to be incorporated into another machine. Before putting into service it must be established that the machinery or systems in which the pump is installed meets the relevant regulations



#### Risk of burning

The drive heats up.

→ Avoid contact with the pump drive.

**CAUTION** 

- → Avoid contact with flammable materials
- Excessive pressure and the inherent dangers thereof can be prevented by placing a bypass line with a pressure relief valve between the pressure and suction side of the pump. Please contact your local KNF partner for further information (www.knf.com).

Pump standstill

→ If the pump stops running, restore the system to normal atmospheric pressure.

For pumps with thermal switch or electronic overload protection:



WARNING

# Risk of physical injury and damage to the pump due to automatic start

If the pump overheats and pump operation is stopped by the thermal switch / electronics, the pumps will restart automatically as soon as the motor has had time to cool down

→ Take steps to ensure that this cannot produce a hazardous situation

Inspection

Regularly inspect the pump for external damage or leaks.

#### Switching the pumps on

- → In order to guarantee that the pump can start every time it is advisable to reduce the back pressure to an acceptable level. This is also the case if there is a short power cut.
- For more specific information contact the KNF specialist

#### Switching the pumps off

→ Ensure that the system is subject to normal atmospheric pressure (release the hydraulic pressure.

# Setting and regulating motor speed

- → The motor speed of the pump, and thus the flow rate, is adjustable and can also be regulated to some extent.
- → For more details, see Chapter 4, Technical data

#### **Duty cycle / impulse operation**

#### Duty cycle

For pressures over 0.5barg / 7.3 psi (NMP830KPDC HP, NMP830.1.2KPDC HP, NMP830.1.2KPDC-B HP, NMP830.1.2KPDC-B4 HP) respective over 0.7barg / 10.2 psi (NMP830KPDC-B HP und NMP830KPDC-B4 HP), the duty cycle must be restricted.

Operation above these borders may influence the life-time.

For more specific information contact the KNF specialist

Contact information: www.knf.com

#### Impulse operation

Short start and stop cycles may adversely affect the service life of the brushed motors



# 7. Servicing

#### 7.1. Servicing schedule

Component	Servicing interval		
Pump	<ul> <li>Regular inspection for external damage or leaks</li> </ul>		

Tab. 11

#### 7.2. Cleaning

#### 7.2.1. Cleaning the pump

The pump, if necessary clean outside with a dry wipe. Do not use cleaning solvents as these may corrode certain plastic or metallic parts.

#### Prior requirements

- Isolate the pump from the power supply.
- Pump must be free of any hazardous substances
- Hoses must be disconnected from the pump

#### 7.3. Service Interval

For operation above defined borders in Chapter 6 / Duty Cycle, maintenance intervals are recommended.

For Service: Spare part kit ID 317273 is available

Contained parts:

Diaphragm 1pcs.O-Ring 2pcs.Valve plate 2pcs.

➣

Assembly instruction is included with the spare parts set.

Please note, spacers below clamping disc and con rod have to be secured. Same spacers have to be reused.

Otherwise function is not guaranteed

# 8. Troubleshooting

Pump does not work				
Cause	Fault remedy			
Pump not connected to power supply	→ Connect pump to power supply			
Power supply is not switched on	→ Switch on power supply			
Thermal switch or pump electronics have responded	→ Disconnect pump from mains power supply.			
	→ Allow pump to cool.			
	→ Identify and eliminate cause of overheating/overload			
Connections or pipes are	→ Check pipes and connections.			
blocked.	→ Remove blockage.			
External valve is closed or filter is blocked	→ Check external valves and filters.			
Diaphragm, valves or gaskets	→ Service according 7.3			
are worn out	→ Contact customer service			

Tab. 12

Flow rate, pressure or vacuum too low					
The pump does not achieve the output specified in the Technical data or the data sheet					
Cause.	Fault remedy				
Components in the system connected to the suction and pressure sides, such as hoses, valves or filters, are causing too much resistance	→ Modify installation, check the cross-sections of components				
Hose connections are not leak tight	<ul> <li>Secure transition joints between hose and hose connections</li> <li>with clamps or clamping elements</li> </ul>				
Particles in the pump	→ Clean the pump head, install suction-side filter if required				
Incorrect interchange of pressure and suction line connections	→ Remove pressure and suction lines and reconnect correctly				
The pump parts are not resistant to the medium to be transferred	→ Replace the pump head with a compatible version				
Diaphragm, valves or gaskets are worn out	<ul><li>→ Service according 7.3</li><li>→ Contact customer service</li></ul>				

Tab. 13

#### Fault cannot be rectified

If you are unable to identify any of the above causes, please send the pump to KNF customer service (see address on last page).

- 1. Isolate the pump from the power supply and remove the pump from the system.
- 2. Clean the pump (see Chapter 7.2.1)
- 3. Send the pump, with completed decontamination declaration (see Chapter 9), to KNF customer service stating the nature of the transferred medium.

#### 9. Returns

#### 9.1. General

Pumps and systems used in laboratories and process-based industries are exposed to a wide variety of conditions. This means that the components contacting pumped media could become contaminated by toxic, radioactive, or otherwise hazardous substances.

For this reason, customers who send any pumps or systems back to KNF must submit a Health and safety clearance and decontamination form in order to avoid a hazardous situation for KNF employees. This Health and safety clearance and decontamination form provides the following information, among other things:

- physiological safety
- whether medium-contacting parts have been cleaned
- whether the equipment has been decontaminated
- media that have been pumped or used

and must declare physiological safety. To ensure worker safety, work may not be started on pumps or systems without a signed Health and safety clearance and decontamination form.

The template for the Health and safety clearance and decontamination form is included with these operating instructions and may also be downloaded from the KNF website <a href="www.knf.com/down-loads">www.knf.com/down-loads</a>.

The customer must specify the device type(s) and serial number(s) in the Health and safety clearance and decontamination form in order to provide for the unambiguous assignment of the Declaration to the device that is sent to KNF.

In addition to the customer's declaration of physiological safety, information about operating conditions and the customer's application are also of importance to ensure that the return shipment is handled appropriately. Therefore, the Health and safety clearance and decontamination form requests this information as well.

#### 9.2. For North American Customers

To ensure the safety of our customers and our associates, KNF Neuberger, Inc. requires that all products returned to their facility include a Return Material Authorization (RMA) number. For complete information on KNF Neuberger Inc. pump repairs, service and maintenance please visit <a href="https://www.knfusa.com/ProductReturns">www.knfusa.com/ProductReturns</a>

# 10. Health and safety clearance and decontamination form

	nd safet	y clearance and deconta	mination form	
		nt and complete (the original mus rned device can be examined.	t accompany the sh	ipment's
Device type:				
Serial number(s):				
			•••••	
Reason for returning th	ne de∨ice (pl	lease describe in detail):		
(The device(s) was(we		- · · · · · · · · · · · · · · · · · · ·		
We confirm that the ab	ovo dovico/	۵/		
	,	») y physiologically unobjectionable r	nedia and that it/they	are free
		ny materials that are harmful to health		, are nee
				_
The devic			□ yes	no 🗆
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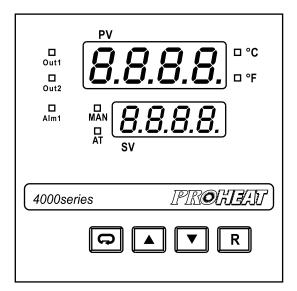


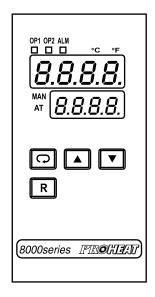
Find our local KNF partner on: www.knf.com



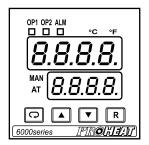
# User's Manual

# PR Controls





4000 Series 1/4 DIN
6000 Series 1/16 DIN
8000 Series 1/8 DIN
Auto-Tune Fuzzy / PID
Process / Temperature Controller





117 East Adam Street LaGrange, KY 40031 502 222-1402 Fax: 502 222-0714 www.proheatinc.com

# Warning Symbol 🛕

This Symbol calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury or damage to or destruction of part or all of the product and system. Do not proceed beyond a warning symbol until the indicated conditions are fully understood and met.

#### Use the Manual

Installers Read Chapter 1, 2System Designer Read All Chapters

• User Read Page 12

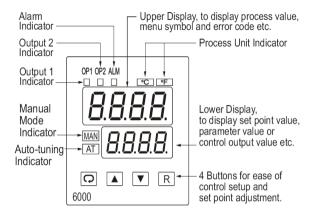
#### NOTE:

It is strongly recommended that a process should incorporate a LIMIT CONTROL which will shut down the equipment at a preset process condition in order to preclude possible damage to products or system.

Information in this user's manual is subject to change without notice.

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#### Ouick Reference Guide



#### KEYPAD OPERATION

SCROLL KEY:

This key is used to select a parameter to be viewed or adjusted.

UP KEY : ▲

This key is used to increase the value of selected parameter.

DOWN KEY: ▼

This key is used to decrease the value of selected parameter.

RESET KEY: R

This key is used to:

- 1. Revert the display to the process value.
- Reset the latching alarm, once the alarm condition is removed.
- 3. Stop the manual control mode , auto-tuning mode and calibration mode.
- 4. Clear the message of communication error and auto-tuning error.
- 5. Restart the dwell timer when the dwell timer has timed out.
- 6. Enter the manual control menu during failure mode.

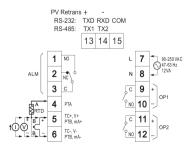
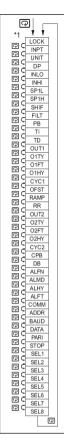
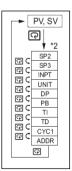


Figure 2.6 Rear Terminal Connection for **6000 Series** 

ADJUSTMENT SEQUENCE	SYMPTOM	SOLUTION
	Slow Response	Decrease PB
(1) Proportional Band (PB)	High overshoot or Oscillations	Increase PB
	Slow Response	Decrease TI
(2) Integral Time ( TI )	Instability or Oscillations	Increase TI
(3) Derivative Time ( TD )	Slow Response or Oscillations	Decrease TD
	High Overshoot	Increase TD

PID Adjustment Guide





#### Set-up Menu

Press key for 3 seconds to enter the set-up menu.

The flow chart shows a complete listing of all parameters. The number of available parameters depends on setup conditions, and should be less than that shown in the flow chart.

#### User Menu

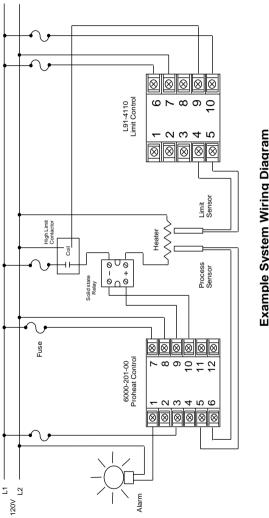
This series control has the flexibility for you to select those parameters which are most significant to your application. These parameters are able to be put in the front of the display sequence for ease of access.

Select the parameters for view in the user menu by using SEL1 – SEL8 contained at the bottom of the setup menu.

Parameter	Parameter	Default
Notation SP1	Description Set point for output 1	Value 77.0°F
SP1	Set point for output 1	
SP3	Set point for output 2	18.0°F 18.0°F
LOCK	Select parameters to be locked	None
INPT	Input sensor selection	Type J °F
UNIT	Input unit selection	
DP INLO	Decimal point selection	1 digit 0°F
INHI	Input low scale value Input high scale value	200.0°F
SP1L		
SP1L SP1H	Low limit of set point value	0°F 1000°F
SHIF	High limit of set point value PV shift value	0.0
FILT		
PB	Filter damping time Proportional band value	.5 sec
		18.0°F 100
TI TD	Integral time value	
OUT1	Derivative time value	25.0
	Output 1 function	Heating
O1TY	Output 1 signal type	Relay
O1FT	Output 1 failure transfer mode	Off 0.2°F
O1HY	Output 1 hysteresis	
CYC1	Output 1 cycle time	18.0
OFST	Offset value for P control	25.0
RAMP	Ramp function selection	None
RR	Ramp rate	0.0
OUT2	Output 2 function	Dev Hi
OOTY	Outsid Online of the c	alarm
O2TY O2FT	Output 2 signal type	Relay
O2F1 O2HY	Output 2 failure transfer mode	0.2°F
CYC2	Output 2 hysteresis Output 2 cycle time	18.0
CPB		100
DB	Cooling prop band value Heating-cooling dead band	0
ALFN	Alarm function	Dev hi
ALFN	Alarm function	alarm
ALMD	Alarm operation mode	Normal
ALHY	Hysteresis control of alarm	Normal
ALFT	Alarm failure transfer mode	On
COMM	Communication function	Modbus
ADDR	Address assignment	WIOGDUS
BAUD	Baud rate	9.6
BAUD	baud rate	9.0
DATA	Data bit count	8
PARI	Parity bit	Even
STOP	Stop bit count	1
RELO	PV retransmission low value	0°F
REHI	PV retransmission high value	200.0°F
SEL1	1st parameter for user menu	INPT
SEL2	2nd parameter for user menu	UNIT
SEL3	3rd parameter for user menu	DP
SEL4	4th parameter for user menu	PB
SEL5	5th parameter for user menu	TI
SEL6	6th parameter for user menu	TD
SEL7	7th parameter for user menu	CYC1
SEL8	8th parameter for user menu	ADDR

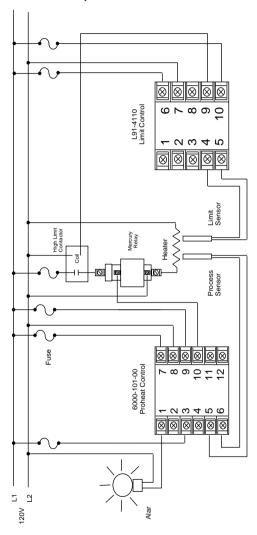
#### Quick Reference Guide

# Quick Reference Guide



Example System Wiring Diagram Solid State Relay

### Quick Reference Guide



Example System Wiring Diagram Mercury Relay

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# Chapter 1 Overview

#### 1-1 General

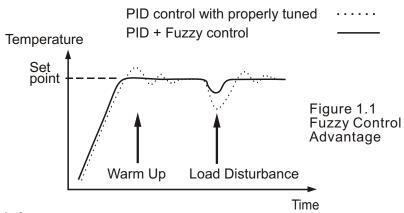
The Fuzzy Logic plus PID microprocessor-based controller series, incorporate two bright, easy to read 4-digit LED displays, indicating process value and set point value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance.

SERIES 6000 is a 1/16 DIN size panel mount controller. SERIES 4000 is a 1/4 DIN size panel mount controller. SERIES 8000 is a 1/8 DIN size panel mount controller. These units are powered by 11-26VAC/VDC or 90-250 VAC supply, incorporating a 2 amp. control relay output as standard. The second output can be used as cooling control, or an alarm. Both outputs can select triac, 5V logic output, linear current or linear voltage to drive external device. There are six types of alarm plus a dwell timer can be configured for the third output. The units are fully programmable for PT100 and thermocouple types J,K, T, E, B, R, S, N, L with no need to modify the unit. The input signal is digitized by using a 18-bit A to D converter. Its fast sampling rate, 5 scans/second, allows the unit to control with greater accuracy and response time.

Digital communications RS-485 or RS-232 are available as an additional option. These options allow the units to be integrated with supervisory control system and software.

A programming port is available for automatic configuration, calibration and testing without the need to access the keys on front panel.

By using proprietary Fuzzy modified PID technology, the control loop will minimize the overshoot and undershoot in a shortest time. The following diagram is a comparison of results with and without Fuzzy technology.



# High Accuracy

This Series controllers are manufactured with custom designed ASIC(Application Specific Integrated Circuit) technology which contains a 18-bit A to D converter for high resolution measurement (true 0.1 F resolution for thermocouple and PT100) and a 15-bit D to A converter for linear current or voltage control output. The ASIC technology provides improved operating performance, low cost, enhanced reliability.

### Fast Sampling Rate

The sampling rate of the input A to D converter reaches 5 times/second. The fast sampling rate allows this series to control fast processes.

### **Fuzzy Control**

The function of Fuzzy control is to adjust PID parameters from time to time in order to make manipulation output value more flexible and adaptive to various processes. The results is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot and undershoot during power-up or external load disturbance.

### Digital Communication

The units are equipped with RS-485 or RS-232 interface card to provide digital communication. By using the twisted pair wires there are at most 247 units can be connected together via RS-485 interface to a host computer.

### **Programming Port**

A programming port is used to connect the unit to a hand-held programmer or a PC for quick configuration, also can be connected to an ATE system for automatic testing & calibration.

#### Auto-tune

The auto-tune function allows the user to simplify initial setup for a new system. A sophisticated algorithm is provided to obtain an optimal set of control parameters for the process, and it can be applied either as the process is warming up (cold start) or as the process has been in steady state (warm start).

#### Lockout Protection

According to your security requirements, one of four lockout levels can be selected to prevent unauthorized changes.

#### **Bumpless Transfer**

Bumpless transfer allows the controller to continue to control by using its previous values if a sensor fails.

#### Soft-start Ramp

The ramping function is performed during power up as well as any time the set point is changed. It can be ramping up or ramping down. The process value will reach the set point with a predetermined constant rate.

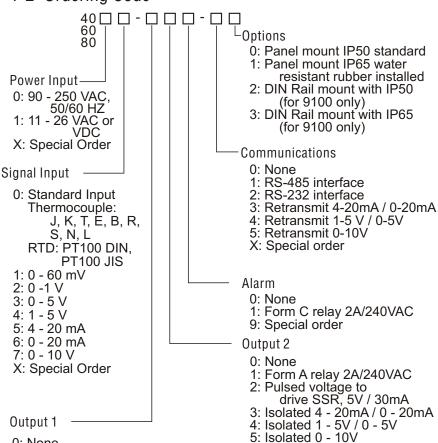
# Digital Filter

A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain application where the process value is unstable.

#### **SEL Function**

The units have the flexibility to select parameters which are most significant so as to put these parameters in the front of display sequence. There are 8 parameters that can be selected to allow the user to build a custom display sequence.

# 1-2 Ordering Code



0: None

1: Relay rated 2A/240VAC

Pulsed voltage to drive SSR, 5V/30mA

3: Isolated 4 - 20mA / 0 - 20mA

4: Isolated 1 - 5V / 0 - 5V

5: Isolated 0 - 10V

6: Triac output 1A / 240VAC,SSR

C: Pulsed voltage to drive SSR, 14V/40mA

X: Special order

5: Isolated 0 - 10V

6: Triac output, 1A / 240VAC, SSR

7: Isolated 20V/25mA transducer power supply

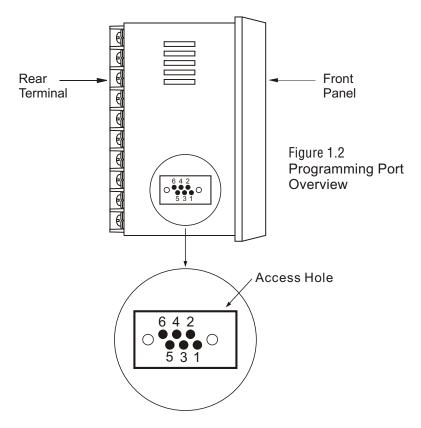
8: Isolated 12V/40mA transducer power supply

9: Isolated 5V/80mA

transducer power supply C: Pulsed voltage to drive SSR, 14V/40mĂ

X: Special order

# 1-3 Programming Port



A special connector can be used to touch the programming port which is connected to a PC for automatic configuration, also can be connected to an ATE system for automatic calibration and testing.

The programming port is used for off-line automatic setup and testing procedures only. Do NOT attempt to make any connection to these pins when the unit is in normal operation.

# 1- 4 Keys and Displays

#### KEYPAD OPERATION

SCROLL KEY: 🙃

This key is used to select a parameter to be viewed or adjusted.

UP KEY : ▲

This key is used to increase the value of selected parameter.

DOWN KEY : ▼

This key is used to decrease the value of selected parameter.

# RESET KEY: R

This key is used to:

- 1. Revert the display to display the process value.
- 2. Reset the latching alarm, once the alarm condition is removed.
- 3. Stop the manual control mode , auto-tuning mode and calibration mode.
- 4. Clear the message of communication error and auto-tuning error.
- 5. Restart the dwell timer when the dwell timer has been time out.
- 6. Enter the manual control menu during failure mode occurs.

ENTER KEY: Press	Ç	for 3 seconds or longer
------------------	---	-------------------------

Press of for 3 seconds to:

- 1. Ener setup menu. The display shows 5EE.
- 2. Enter manual control mode during manual control mode [HRnd] is selected.
- 3. Enter auto-tuning mode during auto-tuning mode  $\boxed{R-E}$  is selected.
- 4. Perform calibration to a selected parameter during the calibration procedure.

Press of for 4.2 seconds to select manual control mode.

Press of for 5.4 seconds to select auto-tuning mode.

Press of for 6.6 seconds to select calibration mode.

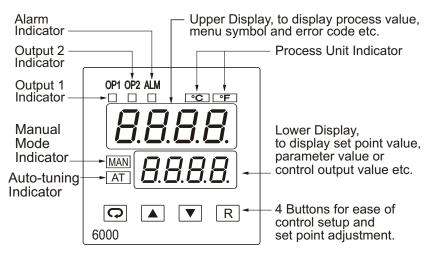
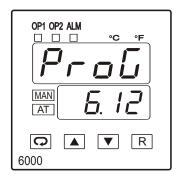


Figure 1.3 Front Panel Description

Table 1.1 Display Form of Characters

Α	R	Ш	E	_	,	Z	C	S	5	Χ	
В	Ь	F	F	J	J	0	0	Т	F	Υ	岁
С	Ĺ	G	ū	K	ħ	Р	P	J	C	Ζ	
С	C	Н	Н	L	L	Q		<b>V</b>	וכ	?	7
D	ď	h	h	М	ī	R	-	W		=	

#### : Confused Character

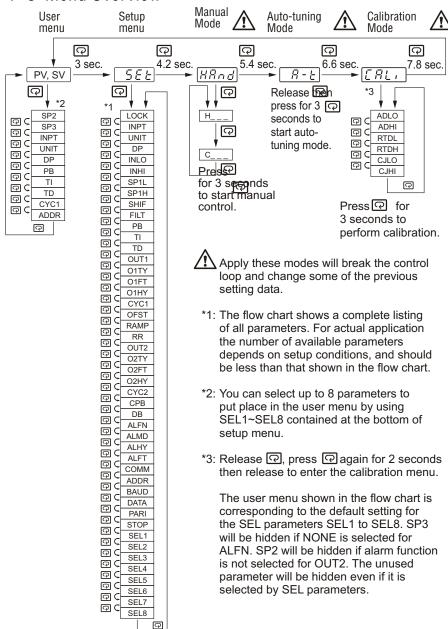


Display program code of the product for 2.5 seconds.

The left diagram shows program no. 6 for 6000 Series with version 12. The program no. for 4000 Series is 12 and the number for the 8000 Series is 11.

Figure 1.4
Display of Initial Stage

### 1-5 Menu Overview



# 1-6 Parameter Descriptions

Parameter Notation	Parameter Description	Range	Default Value
SP1	Set point for output 1	Low: SP1L High :SP1H	25.0 C (77.0 F)
SP2	Set point for output 2 when output 2 performs alarm function	Low: -19999 High :45536	10.0 C (18.0 F)
SP3	Set point for alarm or dwell timer output	Low: -19999 High: 45536	10.0 C (18.0 F)
LOCK	Select parameters to be locked	<ul> <li>O nonE: No parameter is locked</li> <li>1 SEL: Setup data are locked</li> <li>2 uSEr: Setup data and User data except Set point are locked</li> <li>3 FLL: All data are locked</li> </ul>	0
INPT	Input sensor selection  NOTE; Input Selection 11 - 17 of Linear (ma/VDC) Require special order only See Matrix Page 8.	0 J_ŁE: J type thermocouple 1 Ł_ŁE: K type thermocouple 2 Ł_ŁE: T type thermocouple 3 £_ŁE: E type thermocouple 4 b_ŁE: B type thermocouple 5 r_ŁE: R type thermocouple 6 5-ŁE: S type thermocouple 7 r_ŁE: N type thermocouple 8 Ł-ŁE: L type thermocouple 9 PŁ.da: PT 100 ohms DIN curve 10 PŁ.JS: PT 100 ohms DIN curve 11 Ч-20: 4 - 20 mA linear current input 12 0-20: 0 - 20 mA linear current input 13 0-60: 0 - 60 mV linear millivolt input 14 0- I □: 0 - 5 V linear voltage input 16 I-5 □: 1 - 5 V linear voltage input 17 0- 10: 0 - 10 V linear voltage input	1 (0)

Parameter Notation	Parameter Description	Range	Default Value
UNIT	Input unit selection	0	0 (1)
DP	Decimal point selection	0 no.dP: No decimal point  1 I-dP: 1 decimal digit 2 Z-dP: 2 decimal digits 3 3-dP: 3 decimal digits	1
INLO	Input low sale value	Low: -19999 High: 45486	-17.8 C ( 0 F )
INHI	Input high scale value	Low: INLO+50 High: 45536	93.3 C (200.0 F)
SP1L	Low limit of set point value	Low: -19999 High: 45536	-17.8 C (0 F)
SP1H	High limit of set point value	Low: SP1L High: 45536	537.8 C (1000 F)
SHIF	PV shift (offset) value	Low: (-360.0 F) High: (200.0 C)	0.0
FILT	Filter damping time constant of PV	0	2

Parameter Notation	Parameter Description	Range	Default Value
РВ	Proportional band value	Low: 0 High: 500.0 C (900.0 F)	10.0 C (18.0 F)
TI	Integral time value	Low: 0 High: 1000 sec	100
TD	Derivative time value	Low: 0 High: 360.0 sec	25.0
OUT1	Output 1 function	0 r E ur : Reverse (heating ) control action  1 d, r E : Direct (cooling) control action	0
O1TY	Output 1 signal type	0 r E L Y : Relay output 1 55 r d : Solid state relay drive output 2 55 r : Solid state relay output 3 Y - 20 : 4-20 mA current module 4 0 - 20 : 0 - 20 mA current module 5 0 - 1 □ : 0 - 1 ∨ voltage module 6 0 - 5 □ : 0 - 5 ∨ voltage module 7 I - 5 □ : 1 - 5 ∨ voltage module 8 0 - 10 : 0 - 10 ∨ voltage module	0
O1FT	Output 1 failure transfer mode	Select BPLS (bumpless transfer) or 0.0 ~ 100.0 % to continue output 1 control function as the unit fails, or select OFF (0) or ON (1) for ON-OFF control.	0
O1HY	Output 1 ON-OFF control hysteresis	Low: 0.1 High: 50.0 C (90.0 F)	0.1C (0.2 F)
CYC1	Output 1 cycle time	Low: 0.1 High: 90.0 sec.	18.0
OFST	Offset value for P control	Low: 0 High: 100.0 %	25.0
RAMP	Ramp function selection	0 nonE: No Ramp Function 1 nonE: Use unit/minute as Ramp Rate 2 Hr.r: Use unit/hour as Ramp Rate	0

Parameter Notation	Parameter Description	Range	Default Value
RR	Ramp rate	Low: 0 High: 500.0 C (900.0 F)	0.0
OUT2	Output 2 function	0 ロロロE: Output 2 No Function 2 はたけ、: Deviation High Alarm 3 はたしの: Deviation Low Alarm 6 アルけ、: Process High Alarm 7 アルレの: Process Low Alarm 8 じゅっと: Cooling PID Function	2
O2TY	Output 2 signal type	0 rELY: Relay output  1 55 r d: Solid state relay drive output  2 55 r: Solid state relay output  3 4 - 20 : 4 - 20 mA current module  4 0 - 20 : 0 - 20 mA current module  5 0 - 1 □ : 0 - 1 ∨ voltage module  6 0 - 5 □ : 0 - 5 ∨ voltage module  7 1 - 5 □ : 1 - 5 ∨ voltage module  8 0 - 10 : 0 - 10 ∨ voltage module	0
O2FT	Output 2 failure transfer mode	Select BPLS (bumpless transfer) or 0.0 ~ 100.0 % to continue output 2 control function as the unit fails, or select ON (0) or OFF (1) for alarm function.	0
O2HY	Output 2 hysteresis value when output 2 performs alarm function	Low: 0.1 High: 50.0 C (90.0 F)	0.1 C (0.2 F)
CYC2	Output 2 cycle time	Low: 0.1 High: 90.0 sec.	18.0
СРВ	Cooling proportional band value	Low: 50 High: 300 %	100

Parameter Notation	Parameter Description	Range	Default Value
DB	Heating-cooling dead band (negative value= overlap)	Low: -36.0 High: 36.0 %	0
ALFN	Alarm function for alarm output	0 nonE: No alarm function 1 E, nr: Dwell timer action 2 dEH, Deviation high alarm 3 dEL Deviation low alarm 4 dbH, Deviation band out of band alarm 5 dbL Deviation band in band alarm 6 P□H, Process value high alarm 7 P□L Deviation systems alarm 7 P□L Deviation band in band alarm	2
ALMD	Alarm operation mode	0 norā: Normal alarm action 1 LEch: Latching alarm action 2 Hold: Hold alarm action 3 LE.Ho: Latching & Hold action	0
ALHY	Hysteresis control of alarm	Low: 0.1 High: 50.0 C (90.0 F)	0.1 C (0.2 F)
ALFT	Alarm failure transfer mode	0 • Alarm output ON as unit fails  1 • FF : Alarm output OFF as unit fails	0
СОММ	Communication function	0 nppE: No communication 1 rEu: Modbus RTU mode protocol 2 4-20 : 4-20 mA PV Retransmission 3 0-20 : 0-20 mA PV retransmission 4 0-5 : 0-5 VDC PV Retransmission 5 1-5 : 1-5 VDC PV Retransmission 6 0-10 : 0-10 VDC PV Retransmission	1

Parameter Notation	Parameter Description	Range	Default Value
ADDR	Address assignment of digital communication	Low: 1 High: 255	
		0 <b>2.4</b> : 2.4 Kbits/s baud rate	
		1 <b>48</b> : 4.8 Kbits/s baud rate	
		2 <b>9.6</b> : 9.6 Kbits/s baud rate	
BAUD	Baud rate of digital communication	3 <b>/ 4 4</b> : 14.4 Kbits/s baud rate	2
		4 <b>/9.2</b> : 19.2 Kbits/s baud rate	
		5 <b>28.8</b> : 28.8 Kbits/s baud rate	
		6 <b>38.4</b> : 38.4 Kbits/s baud rate	
DATA	Data bit count of digital communication	0 7占, と: 7 data bits 1 <i>日</i> 占, と: 8 data bits	1
PARI	Parity bit of digital communication	0 E LE n : Even parity 1 odd : Odd parity 2 nonE : No parity bit	0
STOP	Stop bit count of digital communication	0 <b>/ b , と</b> : One stop bit 1 <b>2 b , と</b> : Two stop bits	0
RELO	PV Retranmission Low Value	Low: -19999 High: 45486	-17.8 C ( 0 F )
REHI	PV Retranmission High Value	Low: -19999 High: 45486	93.3 C (200.0 F)
SEL1	Select 1'st parameter for user menu	0 nonE: No parameter selected 1 Loc L: LOCK is put ahead 2 n PE: INPT is put ahead 3 un E: UNIT is put ahead 4 dP: DP is put ahead 5 5H, F: SHIF is put ahead 6 PE: PB is put ahead 7 E: TI is put ahead	2

Prameter Notation	Parameter Description	Range	Default Value
SEL1	Select 1'st parameter for user menu	8	2
SEL2	Select 2'nd parameter for user menu	Same as SEL1	3
SEL3	Select 3'rd parameter for user menu	Same as SEL1	4
SEL4	Select 4'th parameter for user menu	Same as SEL1	6
SEL5	Select 5'th parameter for user menu	Same as SEL1	7
SEL6	Select 6'th parameter for user menu	Same as SEL1	8
SEL7	Select 7'th parameter for user menu	Same as SEL1	10
SEL8	Select 8'th parameter for user menu	Same as SEL1	17

Dangerous voltages capable of causing death are sometimes present in this instrument. Before installation or beginning any troubleshooting procedures the power to all equipment must be switched off and isolated. Units suspected of being faulty must be disconnected and removed to a properly equipped workshop for testing and repair. Component replacement and internal adjustments must be made by a qualified maintenance person only.

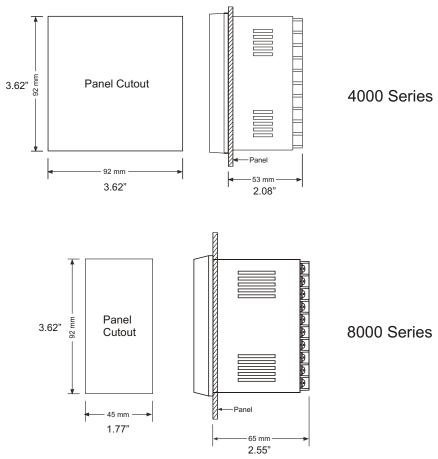
To minimize the possibility of fire or shock hazards, do not expose this instrument to rain or excessive moisture.

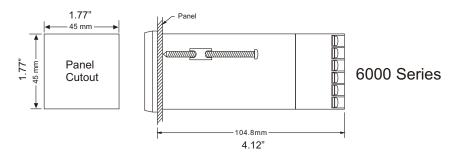
Do not use this instrument in areas under hazardous conditions such as excessive shock, vibration, dirt, moisture, corrosive gases or oil. The ambient temperature of the areas should not exceed the maximum rating specified in Chapter 5.

Upon receipt of the shipment remove the control from the carton and inspect for any shipping damage. If any damage have occured, report and claim with the shipping carrier. Write down the model number, serial number, and date code for future reference when corresponding with our service team. The serial number (S/N) and date code (D/C) are labeled on the box and the housing of control.

Make panel cutout to dimension shown in Figure 2.1. Take both mounting clamps off and insert the control into panel cutout. Re-install the mounting clamps. Gently tighten the screws in the clamp till the controller front panels is fits snugly in the cutout.

Figure 2.1 Mounting Dimensions





# 2 - 3 Wiring Precautions

- \* Before wiring, verify the label for correct model number and options.
- Care must be taken to ensure that maximum voltage rating specified on the label are not exceeded.
- \* It is recommended that power of these units to be protected by fuses or circuit breakers rated at the minimum value possible.
- \* All units should be installed inside a suitably grounded metal enclosure to prevent electrical shock. Installation should be performed under the supervision of a qualified electrician.
- \* All wiring must conform to appropriate standards of good practice and local codes and regulations. Wiring must be suitable for voltage, current, and temperature rating of the system.
- \* Beware not to over-tighten the terminal screws.
- \* Unused control terminals should not be used as jumper points as they may be internally connected, causing damage to the unit.
- Verify that the ratings of the output devices and the inputs as specified in Chapter 5 are not exceeded.

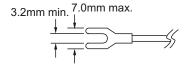


Figure 2.2 Lead Termination for 4000 Series & 8000 Series

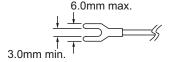


Figure 2.3 Lead Termination for **6000 Series** 

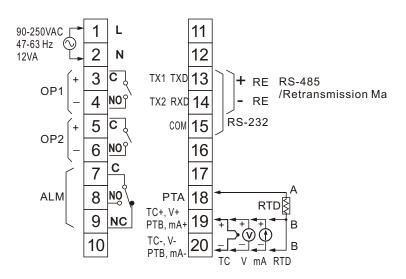


Figure 2.4
Rear Terminal Connection
for **4000 Series** & **8000 Series** 

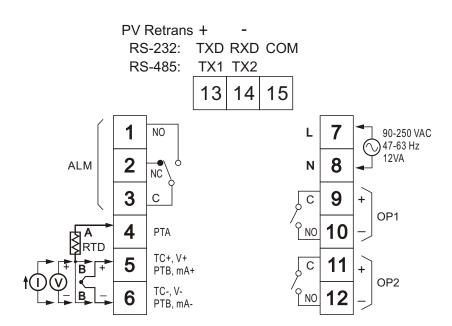


Figure 2.6
Rear Terminal Connection for **6000 Series** 

The controller is supplied to operate at 11-26 VAC / VDC or 90-250 VAC. Check that the installation voltage corresponds with the power rating indicated on the product label before connecting power to the controller.

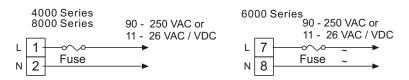


Figure 2.7 Power Supply Connections

This equipment is designed for installation in an enclosure which provides adequate protection against electric shock. The enclosure must be connected to earth ground.

Local requirements regarding electrical installation should be rigidly observed. Consideration should be given to prevent unauthorized access to the power terminals.

Proper sensor installation can eliminate many problems in a control system. The probe should be placed so that it can detect any temperature change with minimal thermal lag. In a process that requires fairly constant heat output, the probe should be placed close to the heater. In a process where the heat demand is variable, the probe should be close to the work area. Some experiments with probe location are often required to find this optimum position.

In a liquid process, the addition of a stiring devise will help to eliminate thermal lag.

In many air heating applications, placing more than one thermocouple in parallel will provide an average temperature reading, producing greater overall accuracy.

Proper sensor type is also a very important factor to obtain precise measurements. The sensor must have the correct temperature range to meet the process requirements. In special processes the sensor might need to have additional options such as leak-proof, antivibration, be un-grounded or have special sheath materials.

Standard sensor limits of error are +/-4 degrees F (+/- 2 degrees C) or 0.75% of sensed temperature (half that for special) plus drift caused by improper protection or an over-temperature occurrence. This error is far greater than controller error and cannot be corrected on the sensor except by proper selection and replacement.

# 2-6 Sensor Input Wiring

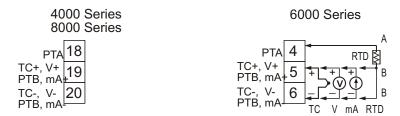
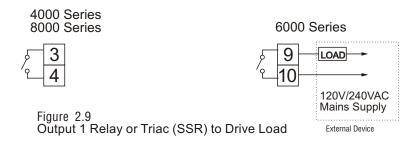


Figure 2.8 Sensor Input Wiring

# 2-7 Control Output 1 Wiring



# 2-7 Control Output 1 Wiring (Cont'd)

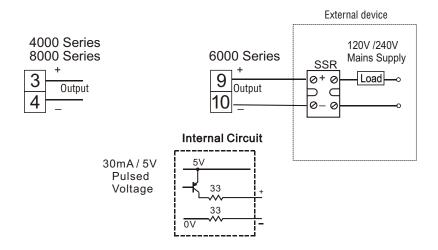
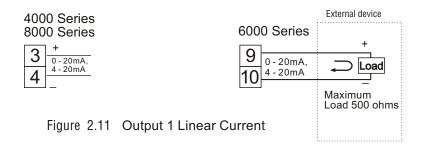
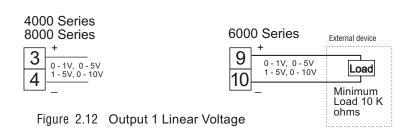
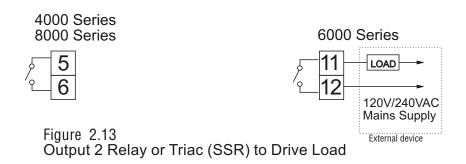


Figure 2.10 Output 1 Pulsed +5 VDC Voltage to Drive SSR





# Control Output 2 Wiring



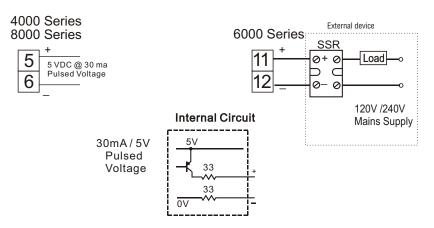
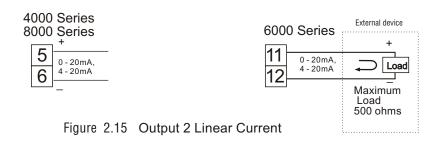
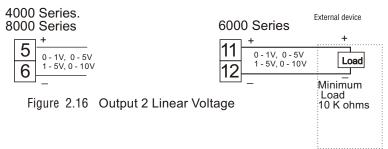


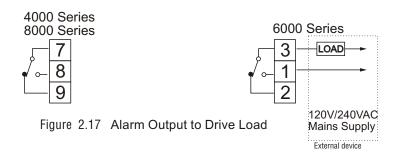
Figure 2.14 Output 2 Pulsed Voltage to Drive SSR



# Control Output 2 Wiring (Cont'd)



# 2-8 Alarm Wiring



### 2-9 Process Retransmission

4000 Series 6000 Series 8000 Series

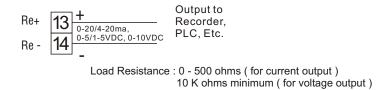


Figure 2.18 Retransmission Output Wiring

### 2-10 Data Communication

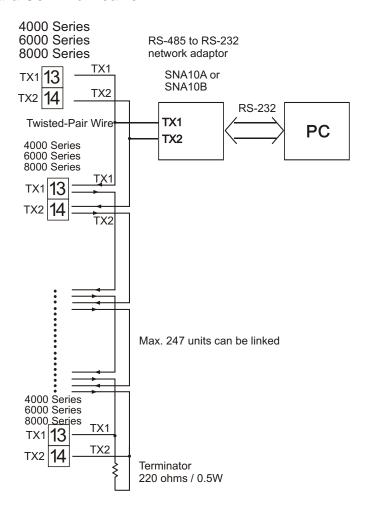


Figure 2.19 RS-485 Wiring

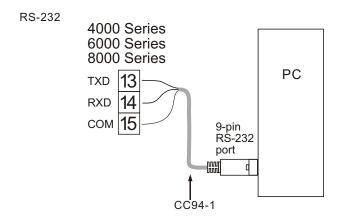


Figure 2.20 RS-232 Wiring

If you use a conventional 9-pin RS-232 cable instead of CC94-1, the cable must be modified according to the following circuit diagram.

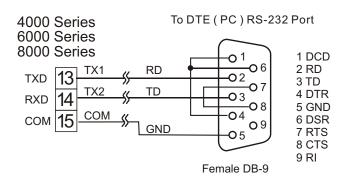


Figure 2.21 Configuration of RS-232

# Chapter 3 Programming

Press for 3 seconds and release to enter setup menu. Press to select the desired parameter. The upper display indicates the parameter symbol, and the lower display indicates the selected value of parameter.

#### 3-1 Lockout

There are four security levels that can be selected by using the LOCK parameter.

If NONE is selected for LOCK, then no parameter is locked.

If **SET** is selected for LOCK, then all setup data are locked.

If **USER** is selected for LOCK, then all setup data as well as user data (refer to **section 1-5**) except set point is locked to prevent from being changed.

If **ALL** is selected for LOCK, then all parameters are locked to prevent from being changed.

# 3-2 Signal Input

INPT: Selects the sensor type or signal type for signal input.

Range: (thermocouple) J, K, T, E, B, R, S, N, L

(RTD) PT.DN, PT.JS

(linear ) 4-20, 0-20, 0-60, 0-1V, 0-5V, 1-5V, 0-10

UNIT: Selects the process unit

Range: C, F, PU( process unit ). If the unit is neither C nor F, then selects PU.

DP: Selects the resolution of process value.

Range: (for T/C and RTD) NO.DP, 1-DP

(for linear ) NO.DP, 1-DP, 2-DP, 3-DP

INLO: Selects the low scale value for the linear type input. INHI: Selects the high scale value for the linear type input.

### How to use INLO and INHI:

IA unit ordered with 4 - 20 mA is setup as INPT=4-20, then if SL specifies the input signal low (ie. 4 mA), SH specifies the input signal high (ie. 20 mA), S specifies the current input signal value, the conversion curve of the process value is shown as follows:

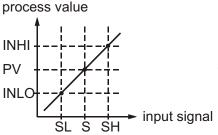


Figure 3.1 Conversion Curve for Linear Type Process Value

Formula:  $PV = INLO + (INHI-INLO \frac{S-SL}{SH-SL}$ 

Example: A 4-20 mA current loop pressure transducer with range 0 - 15 kg/cm<sup>2</sup> is connected to input, then perform the following setup:

INPT = 4 - 20 INLO = 0.00 INHI = 15.00 DP = 2-DP

Of course, you may select other values for DP to alter the resolution.

# 3-3 Control Outputs

There are 4 kinds of control modes can be configured as shown in **Table 3.1** 

Table 3.1 Heat-Cool Control Setup Value

Control Modes	OUT1	OUT2	O1HY	O2HY	СРВ	DB
Heat only	REVR	×	$\Rightarrow$	×	×	×
Cool only	DIRT	×	☆	×	×	×
Heat: PID Cool: ON-OFF	REVR	DE.HI	×	0	×	×
Heat: PID Cool: PID	REVR	COOL	×	×	0	

imes : Not Applicable

:Adjust to met process requirements

☆:Required if ON-OFF control is configured

Heat Only ON-OFF Control : Select REVR for OUT1, Set PB to 0, O1HY is used to adjust dead band for ON-OFF control, The output 1 hysteresis ( O1HY ) is enabled in case of PB = 0 . The heat only on-off control function is shown in the following diagram :

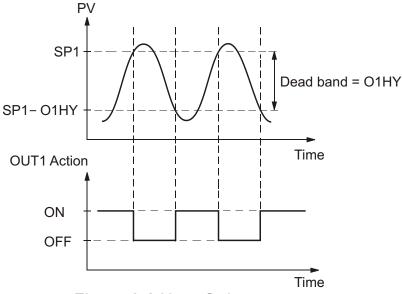


Figure 3.2 Heat Only ON-OFF Control

The ON-OFF control may introduce excessive process oscillation even if hysteresis is minimized to the smallest. If ON-OFF control is set (ie. PB = 0), TI, TD, CYC1, OFST, CYC2, CPB, DB will be hidden and have no function to the system. The auto-tuning mode and bumpless transfer will be disabled too.

Heat only P ( or PD ) control : Select REVR for OUT1, set TI to 0, OFST is used to adjust the control offset ( manual reset ). O1HY is hidden if PB is not equal to 0. OFST Function : OFST is measured by % with range 0 - 100.0 %. In the steady state ( ie. process has been stabilized ) if the process value is lower than the set point a definite value, say 5 LC, while 20 LC is used for PB, that is lower 25 %,

then increase OFST 25 %, and vice versa. After adjusting OFST value, the process value will be varied and eventually, coincide with set point. Using the P control (TI set to 0), the auto-tuning is disabled. Refer to section 3-12 "manual tuning" for the adjustment of PB and TD. Manual reset (adjust OFST) is not practical because the load may change from time to time and OFST would require repeated changes. Selecting the PID option will prevent this issue.

Heat only PID control: Selecting REVR for OUT1, PB and TI should not be zero. Operate auto-tuning for the new process, or set PB, TI and TD with historical values. See section 3-11 for auto-tuning operation. If the control result is still unsatisfactory, then use manual tuning to improve the control. See section 3-12 for manual tuning. The unit contains a sophisticated PID and Fuzzy algorithm to eliminate overshoot when the control is properly tuned.

Cool only control:ON-OFF control, P ( PD ) control and PID control can be used for cool control. Set OUT1 to DIRT ( direct action ). The other functions for cool only ON-OFF control, cool only P ( PD ) control and cool only PID control are same as descriptions for heat only control except that the output variable ( and action ) for the cool control is inverse to the heat control.

NOTE: The ON-OFF control may result excessive overshoot and undershoot problems in the process. The P ( or PD ) control will result in a deviation process value from the set point. It is recommended to use PID control for the Heat-Cool control to produce a stable and zero offset process value.

Other Setup Required: O1TY, CYC1, O2TY, CYC2, O1FT, O2FT O1TY & O2TY are set in accordance with the types of OUT1 & OUT2 installed. CYC1 & CYC2 are selected according to the output 1 type (O1TY) & output 2 type (O2TY). Generally, selects 0.5 ~ 2 sec. for CYC1, if SSRD or SSR is used for O1TY; 10 ~ 20 sec. if relay is used for O1TY, and CYC1 is ignored if linear output is used. Use similar selections for CYC2.

You can use the auto-tuning program for new processes or directly set the appropriate values for PB, TI & TD according to historical data for the repeated systems. If the control behavior is still inadequate, then use manual tuning to improve the control. See section 3-12 for manual tuning.

CPB Programming: The cooling proportional band is measured by % of PB with range 50~300. Initially set 100% for CPB and examine the cooling effect. If cooling action should be enhanced then decrease CPB, if cooling action is too strong then increase CPB. The value of CPB is related to PB and its value remains unchanged throughout the auto-tuning procedures.

Adjustment of CPB is related to the cooling media used. If air is used as the cooling media, adjust CPB to 100%. If oil is used as cooling media, adjust CPB to 125%. For water, adjust CPB to 250%.

DB Programming: Adjustment of DB is dependent on the system requirements. If more positive value of DB ( greater dead band ) is used, an unwanted cooling action can be avoided but an excessive overshoot over the set point will occur. If more negative value of DB ( greater overlap ) is used, an excessive overshoot over the set point can be minimized but an unwanted cooling action will occur. It is adjustable in the range -36.0% to 36.0 % of PB. A negative DB value shows an overlap area over which both outputs are active. A positive DB value shows a dead band area over which neither output is active.

Output 2 ON-OFF Control (Alarm function): Output 2 can also be configured as an alarm. There are 4 kinds of alarm functions that can be selected for output 2; these are: DE.HI (deviation high alarm ), DE.LO (deviation low alarm ), PV.HI (process high alarm ) and PV.LO (process low alarm ). Refer to Figure 3.3 and Figure 3.4 for the description of deviation alarm and process alarm.

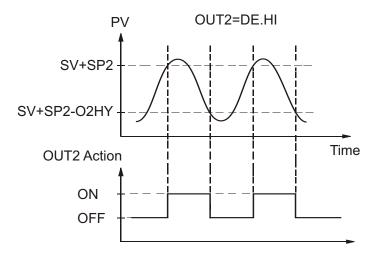
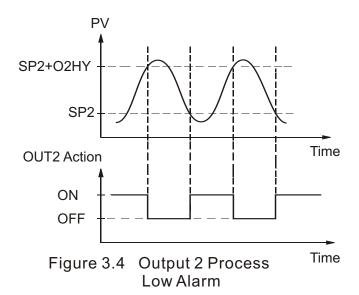


Figure 3.3 Output 2 Deviation Time High Alarm



#### 3-4 Alarm

The controller has one alarm output. There are 6 types of alarm functions and one dwell timer that can be selected, and four kinds of alarm modes (ALMD) that are available for each alarm function (ALFN). Besides the basic alarm output, output 2 can also be configured as an alarm. But output 2 only provides 4 kinds of alarm functions and only the normal alarm mode is available for this alarm.

A process alarm sets two absolute trigger levels. When the process is higher than SP3, a process high alarm ( PV.HI ) occurs, and the alarm is off as the process is lower than SP3-ALHY. When the process is lower than SP3, a process low alarm ( PV.LO ) occurs and the alarm is off as the process is higher than SP3+ALHY. A process alarm is independent of set point.

A deviation alarm alerts the user when the process deviates too far from set point. When the process is higher than SV+SP3, a deviation high alarm (DE.HI) occurs and the alarm is off as the process is lower than SV+SP3-ALHY. When the process is lower than SV+SP3, a deviation low alarm (DE.LO) occurs and the alarm is off as the process is higher than SV+SP3+ALHY. Trigger level of deviation alarm is moving with set point.

A deviation band alarm presets two trigger levels relative to set point. The two trigger levels are SV+SP3 and SV - SP3 for alarm. When the process is higher than ( SV+SP3 ) or lower than ( SV - SP3 ), a deviation band high alarm ( DB.HI ) occurs. When the process is within the trigger levels, a deviation band low alarm (DB.LO) occurs.

In the above descriptions SV denotes the current set point value for control which is different from SP1 as the ramp function is performed.

There are four types of alarm modes available for each alarm function, these are: Normal alarm, Latching alarm, Holding alarm and Latching/Holding alarm. They are described as follows:

Normal Alarm: ALMD = NORM

When a normal alarm is selected, the alarm output is de-energized in the non-alarm condition and energized in an alarm condition.

Latching Alarm: ALMD = LTCH

If a latching alarm is selected, once the alarm output is energized, it will remain unchanged even if the alarm condition is cleared. The latching alarm is reset when the RESET key is pressed, once the alarm condition is removed.

Holding Alarm: ALMD = HOLD

A holding alarm prevents an alarm from power up. The alarm is enabled only when the process reaches the set point value. Afterwards , the alarm performs same function as normal alarm.

Latching / Holding Alarm : ALMD = LT.HO

A latching / holding alarm performs both holding and latching function. The latching alarm is reset when the RESET key is pressed, once the alarm condition is removed.

Alarm Failure Transfer is activated as the unit enters failure mode. Alarm will go on if ON is set for ALFT and go off if OFF is set for ALFT. The unit will enter failure mode when sensor break occurs or if the A-D converter of the unit fails.

## 3-5 Configure User Menu

This series has the flexibility for you to select those parameters which are most significant to your application. These parameters are able to be put in the front of display sequence for ease of access.

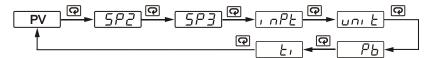
SEL1~SEL8: Selects the parameter for view and change in the user menu.

Range: LOCK, INPT, UNIT, DP, SHIF, PB, TI, TD, O1HY, CYC1, OFST, RR, O2HY, CYC2, CPB, DB, ADDR, ALHY

When using the up-down key to select the parameters, you may not obtain all of the above parameters. The number of visible parameters is dependent on the setup condition. The hidden parameters for the specific application are also deleted from the SEL selection.

#### Example:

OUT2 selects DE.LO PB= 100.0 SEL1 selects INPT SEL2 selects UNIT SEL3 selects PB SEL4 selects TI SEL5~SEL8 selects NONE Now, the upper display scrolling becomes :

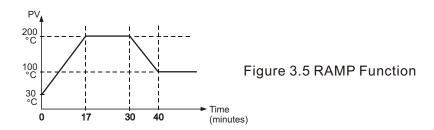


## 3-6 Ramp

The ramping function is performed during power up as well as any time the set point is changed. Choose MINR or HRR for RAMP, the unit will perform the ramping function. The ramp rate is programmed by adjusting RR. The ramping function is disabled as soon as the failure mode, the manual control mode, the auto-tuning mode or the calibration mode occurs.

### **Example without Dwell Timer**

Select MINR for RAMP, selects C for UNIT, selects 1-DP for DP, Set RR= 10.0. SV is set to 200 C initially, and changed to 100 C after 30 minutes since power up. The starting temperature is 30 C. After power up the process is running like the curve shown below:



Note: When the ramp function is used, the lower display will show the current ramping value. However it will revert to show the set point value as soon as the up or down key is touched for adjustment. The ramping value is initiated to process value either as power up or RR and /or set point are changed. Setting RR to zero means no ramp function at all.

#### 3-7 Dwell Timer

The alarm output can be configured as dwell timer by selecting TIMR for ALFN . As the dwell timer is configured, the parameter SP3 is used for dwell time adjustment. The dwell time is measured in minutes ranging from 0.1 to 4553.6 minutes. Once the process reaches the set point the dwell timer starts to count down until zero ( time out ). The timer relay will remain unchanged until time out. The dwell timer operation is shown in the following diagram.

After time out the dwell timer will be restarted by pressing the RESET key.

The timer stops to count during the manual control mode, failure mode, calibration period and auto-tuning period.

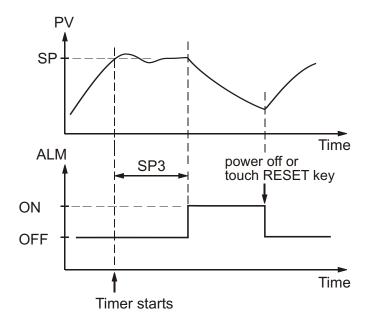


Figure 3.6 Dwell Timer Function

If alarm is configured as dwell timer, ALHY and ALMD are hidden.

### 3-8 PV Shift

In certain applications it is desirable to shift the controller display value from its actual value. This can be easily accomplished by using the PV shift function.

The SHIF function will alter PV only.

Example: If process variable is reading a value of 195 degrees and needs to match another indicator reading 200. The value of +5 can be installed in the SHIFT parameter. This will now ADD a 5 degree value to the current reading, allowing the controller to read 200 degrees. A negative value can also be used to subtract from controller current reading.

## 3-9 Digital Filter

In certain applications the process value is too unstable to be read. To improve this a programmable low pass filter incorporated in the controller can be used. This is a first order filter with time constant specified by FILT parameter . The default value of FILT is 0.5 sec. before shipping. Adjust FILT to change the time constant from 0 to 60 seconds. 0 second represents no filter is applied to the input signal. The filter is characterized by the following diagram.

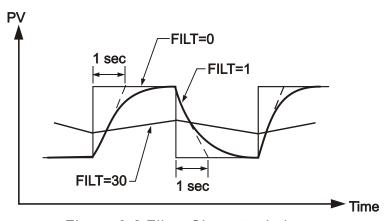


Figure 3.8 Filter Characteristics

#### Note

The Filter is available only for PV, and is performed for the displayed value only. The controller is designed to use unfiltered signal for control even if Filter is applied. A lagged (filtered) signal, if used for control, may produce an unstable process.

## 3-10 Failure Transfer

The controller will enter failure mode as one of the following conditions occurs:

- SBER occurs due to the input sensor break or input current below 1mA if 4-20 mA is selected or input voltage below 0.25V if 1-5 V is selected.
- 2. ADER occurs due to the A-D converter of the controller failing.

The output 1 and output 2 will perform the failure transfer functions as the controller enters failure mode.

Output 1 Failure Transfer, if activated, will perform:

- If output 1 is configured as proportional control ( PB≠0 ), and BPLS is selected for O1FT, then output 1 will perform bumpless transfer. Thereafter the previous averaging value of MV1 will be used for controlling output 1.
- 2. If output 1 is configured as proportional control ( PB<sub>7</sub>0 ), and a value of 0 to 100.0 % is set for O1FT, then output 1 will perform failure transfer. Thereafter the value of O1FT will be used for controlling output 1.
- If output 1 is configured as ON-OFF control ( PB=0 ), then output 1
  will transfer to off state if OFF is set for O1FT and transfer to on
  state if ON is set for O1FT.

Output 2 Failure Transfer, if activated, will perform:

- If OUT2 is configured as COOL, and BPLS is selected for O2FT, then output 2 will perform bumpless transfer. Thereafter the previous averaging value of MV2 will be used for controlling output 2.
- 2. If OUT2 is configured as COOL, and a value of 0 to 100.0 % is set for O2FT, then output 2 will perform failure transfer. Thereafter the value of O2FT will be used for controlling output 2.
- If OUT2 is configured as alarm function, and OFF is set for O2FT, then output 2 will transfer to off state, otherwise, output 2 will transfer to the on state if ON is set for O2FT.

Alarm Failure Transfer is activated as the controller enters failure mode. Thereafter the alarm will transfer to the ON or OFF state which is determined by the set value of ALFT.

## 3-11 Auto-tuning



The auto-tuning process is performed at set point.

The process will oscillate around the set point during tuning process. Set the set-point to a lower value if overshooting beyond the normal process value is likely to cause damage.

The auto-tuning is applied in cases of :

Initial setup for a new process

The set point is changed substantially from the previous autotuning value

The control result is unsatisfactory \*

#### Operation:

- 1. The unit has been installed normally.
- Set the correct values for the setup menu of the unit.
   But don't use a zero value for PB and TI, otherwise, the auto-tuning program will be disabled. The LOCK parameter should be set at NONE.
- Set the set point to a normal operating value or a lower value if overshooting beyond the normal process value is likely to cause damage.
- 4. Press and hold until R L appears on the display.
- 5. Press of for at least 3 seconds. The AT indicator will begin to flash and the auto-tuning procedure is beginning.

#### NOTE:

The ramping function, if used, will be disabled once auto-tuning is proceeding.

The auto-tuning mode is disabled as soon as either failure mode or manual control mode occurs.

## Procedures:

The auto-tuning can be applied either as the process is warming up ( Cold Start ) or as the process has been in steady state ( Warm Start ).

After the auto-tuning procedures are completed, the AT indicator will cease to flash and the unit revert to PID control by using its new PID values. The PID values obtained are stored in the nonvolatile memory.

## | 名ととこ Auto-Tuning Error

If auto-tuning fails an ATER message will appear on the upper display in cases of :

- If PB exceeds 9000 ( 9000 PU, 900.0 F or 500.0 C ).
- or if TI exceeds 1000 seconds.
- or if set point is changed during auto-tuning procedure.

## Solutions to REE

- 1. Try auto-tuning once again.
- 2. Don't change set point value during auto-tuning procedure.
- 3. Don't set zero value for PB and TI.
- 4. Use manual tuning instead of auto-tuning. ( See section 3-12 ).
- 5. Touch RESET key to reset [REE] message.

# 3 - 12 Manual Tuning

In some applications using auto-tuning to tune a process may be inadequate for the control requirement. You should then try manual tuning.

If the control performance using auto-tuning is still unsatisfactory, apply additional PID values show on the next page.

ADJUSTMENT SEQUENCE	SYMPTOM	SOLUTION
	Slow Response	Decrease PB
(1) Proportional Band ( PB )	High overshoot or Oscillations	Increase PB
	Slow Response	Decrease TI
(2) Integral Time ( TI )	Instability or Oscillations	Increase TI
(3) Derivative Time ( TD )	Slow Response or Oscillations	Decrease TD
	High Overshoot	Increase TD

Table 3.2 PID Adjustment Guide

Figure 3.9 shows the effects of PID adjustment on process response.

## 3-13 Manual Control

#### Operation:

To enable manual control the LOCK parameter should be set to NONE, then press  $\bigcirc$  for 4.2 seconds  $\boxed{HRng}$   $\boxed{---}$  ( Hand Control ) will appear on the display. Release key and depress Press  $\bigcirc$  for 3 seconds then the MAN indicator will begin to flash and the lower display will show  $\boxed{H_{---}}$  The controller now enters the manual control mode.  $\boxed{H_{---}}$  indicates output control variable for output 1, and  $\boxed{L_{---}}$  indicates control variable for output 2. Now you can use up-down key to adjust the percentage values for the heating or cooling output.

The controller performs open loop control as long as it stays in manual control mode.

#### Exit Manual Control

press [R] key the controller will revert to its normal display mode.

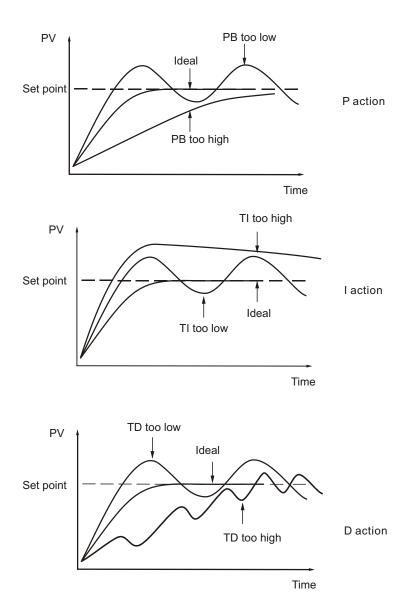


Figure 3.9 Effects of PID Adjustment

#### 3 - 14 Data Communication

The controllers support RTU mode of Modbus protocol for data communication. Other protocols are not available for the series.

Two types of interface are available for Data Communication. These are RS-485 and RS-232 interface. Since RS-485 uses a differential architecture to drive and sense signal instead of a single ended architecture which is used for RS-232, RS-485 is less sensitive to the noise and thus suitable for a longer distance communication. RS-485 can communicate without error over 1 km distance while RS-232 is not recommended for a distance over 20 meters.

Using a PC for data communication is convenient approach. The signal is transmitted and received through the PC communication Port (generally RS-232). Since a standard PC may not support a RS-485 port, a network adaptor (such as SNA10A) will need to be used to convert RS-485 to RS-232 for a PC if RS-485 is required for data communication. Multiple RS-485 units (up to 247 units) can be connected to one RS-232 port.

#### Setup

Enters the setup menu.

Select RTU for COMM . Set individual address as for those units which are connected to the same port.

Set the Baud Rate (BAUD), Data Bit (DATA), Parity Bit (PARI) and Stop Bit (STOP) such that these values are accordant with PC setup conditions.

## 3 - 15 Process Retransmission

The controllers support a optional ma/VDC output (retransmit) of the process variable. The program parameters to scale the ma/VDC signal are RELO and REHI, respectively for low and high scale. For example, using a 4/20 ma retransmission option to represent a temperature of 0/200 F unit would be setup as;

RELO = 0 for 4 ma equals 0 F

REHI = 200 for 20 ma equals 200 F

This output would typically go to a recorder, PLC, indicator etc.

# Chapter 4 Calibration

no not proceed through this section unless there is a definite need to re-calibrate the controller. Otherwise, all previous calibration data will be lost. Do not attempt recalibration unless you have appropriate calibration equipment. If calibration data is lost, you will need to return the controller to your supplier who may charge you a service fee to re-calibrate the controller.

The Entering calibration mode will break the control loop. Verify that the system is acceptable to apply calibration mode.

#### Equipment needed before calibration:

- (1) A high accuracy calibrator (Fluke 5520A Calibrator recommended) with following functions:
  - 0 100 mV millivolt source with +/-0.005 % accuracy
  - 0 10 V voltage source with +/-0.005 % accuracy
  - 0 20 mA current source with +/-0.005 % accuracy
  - 0 300 ohm resistant source with +/-0.005 % accuracy
- (2) A test chamber providing 25 C 50 C temperature range
- (3) A switching network (SWU16K, optional for automatic calibration )
- (4) A calibration fixture equipped with programming units (optional for automatic calibration )
- (5) A PC installed with calibration software FDC-Net and Smart Network Adaptor SNA10B (optional for automatic calibration)

The calibration procedures described in the following section are a step by step manual procedures.

Since it needs 30 minutes to warm up an unit before calibration, calibrating the unit one by one is guite inefficient. An automatic calibration system for small quantity as well as for unlimited quantity is available. Consult factory.

## Manual Calibration Procedures

- \* Perform step 1 to enter calibration mode.
- Step 1. Set the Lock parameter to the unlocked condition (LOCK=NONE).

Press and hold the scroll key until LRL appears on the display, then release the scroll key. Press the scroll key for 2 seconds then release,the display will show RdL and the unit enters calibration mode.

- \* Perform step 2 to calibrate Zero of A to D converter and step 3 to calibrate gain of A to D converter.
- Step 2. Short the thermocouple input terminals, then press the scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise, if the display didn't blink or if the obtained value is equal to -199.9 or 199.9, then the calibration failed.
- Step 3. Press scroll key until the display shows [AdA]. Send a 60 mV signal to the thermocouple input terminals in correct polarity. Press scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise, if the display didn't blink or if the obtained value is equal to -199.9 or 199.9, then the calibration failed.
  - \* Perform both steps 4 and 5 to calibrate RTD function (if required) for input.

Step 4. Press scroll key until the display shows <u>r \( \frac{d \( L \)}{L} \) . Send a 100 ohms signal to the RTD input terminals according to the connection shown below:</u>

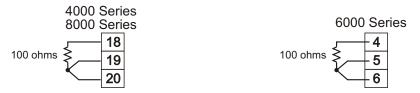


Figure 4.1 RTD Calibration

Press scroll key for at least 3 seconds. The display will blink a moment, otherwise the calibration failed.

- Step 5. Press scroll key and the display will show FEDH . Change the ohm's value to 300 ohms .Press scroll key for at least 3 seconds. The display will blink a moment and two values are obtained for RTDH and RTDL ( step 4 ). Otherwise, if the display didn't blink or if any value obtained for RTDH and RTDL is equal to -199.9 or 199.9, then the calibration failed.
  - \* Perform step 6 to calibrate offset of cold junction compensation, if required.
- Step 6. Setup the equipments according to the following diagram for calibrating the cold junction compensation.

  Note that a "K" type thermocouple must be used.

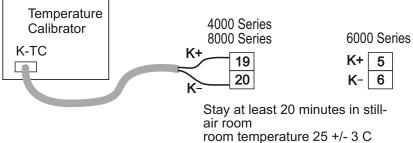


Figure 4.2 Cold Junction Calibration Setup

The temperature calibrator is configured as K type thermocouple output with internal compensation. Send a 0.00 C signal to the unit under calibration.

The unit under calibration is powered in a still-air room with temperature 25 +/-3 C. Stay at least 20 minutes for warming up. Perform step 1 stated above, then press scroll key until the display shows Luca . Press up/down key to obtain 40.00.

Press scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise, if the display didn't blink or if the obtained value is equal to -5.00 or 40.00, then the calibration failed.

- \* Perform step 7 to calibrate gain of cold junction compensation if required.
- Step 7. Setup the equipments same as step 6. The unit under calibration is powered in a still-air room with temperature 50 +/-3 C. Stay at least 20 minutes for warming up . The calibrator source is set at 0.00 C with internal compensation mode.

Perform step 1 stated above, then press scroll key until the display shows [\_\_\_\_\_\_\_\_\_]. Press the scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise, if the display didn't blink or if the obtained value is equal to -199.9 or 199.9, then the calibration failed.

This setup is performed in a high temperature chamber, hence it is recommended to use a computer to perform the procedures.

- Input modification and recalibration procedures for a linear voltage or a linear current input:
- Remove R60(3.3K) and install two 1/4 W resistors RA and RB on the control board with the recommended values specified in the following table.

The low temperature coefficient resistors should be used for RA and RB.

Input Function	RA	RB	R60
T/C, RTD, 0~60mV	Х	X	3.3K
0 ~ 1 V	61.9K	3.92K	X
0 ~ 5V, 1 ~ 5V	324K	3.92K	Х
0 ~ 10 V	649K	3.92K	Х
0~20mA, 4~20mA	39 <sub>ohm</sub>	3.01 <sub>ohm</sub>	Х

- 2. Perform Step 1 and Step 2 to calibrate the linear input zero.
- 3. Perform Step 3 but send a span signal to the input terminals instead of 60mV. The span signal is 1V for 0~1V input, 5V for 0~5V or 1~5V input, 10V for 0~10V input and 20mA for 0~20mA or 4~20mA input.
- \* Final step

Step 8. Set the LOCK value to your desired function.

# Chapter 5 Specifications

#### Power

90 - 250 VAC, 47 63 Hz, 12VA, 5W maximum

11 - 26 VAC / VDC, 12VA, 5W maximum

### Input

Resolution: 18 bits

Sampling Rate: 5 times / second

Maximum Rating: -2 VDC minimum, 12 VDC

maximum.

(1 minute for mA input)

Temperature Effect: +/-1.5uV/ C for all inputs

except

mA input.

+/-3.0uV/ C for mA input

Lead Resistance Effect:

T/C: 0.2uV/ohm

3-wire RTD: 2.6 C/ohm of resistance difference of two

leads.

2-wire RTD: 2.6 C/ohm of resistance sum of two leads

Burn-out Current: 200 mA Common Mode Rej: 120dB Normal Mode Rei: 55dB

Sensor Break Detection:

Sensor open for TC, RTD and mV inputs,

Sensor short for RTD input below 1 mA for 4-20 mA input,

below 0.25V for 1 - 5 V input, unavailable for

other inputs.

Sensor Break Responding Time:

Within 4 seconds for TC, RTD and mV inputs. 0.1 second for

4-20 mA and 1 - 5 V inputs.

# Characteristics:

Туре	Range	Accuracy @ 25 C	Input Impedance
J	-120 C 1000 C (-184 F 1832 F)	+/-2 C	2.2 MΩ
K	-200 C 1370 C (-328 F 2498 F)	+/- 2C	2.2 MΩ
Т	-250 C 400 C (-418 F 752 F)	+/- 2C	2.2 MΩ
E	-100 C 900 C (-148 F 1652 F)	+/- 2C	<b>2.2 M</b> Ω
В	0°C-1800 C ( 32 F -3272 F)	+/- 2C	<b>2.2</b> MΩ
R	0°C-1767.8 C ( 32 BF- 3214 F )	+/- 2C	<b>2.2 M</b> Ω
S	0°C- 1767.8 C ( 32 BF- 3214 F )	+/- 2C	<b>2.2</b> MΩ
N	-250 C 1300 C (-418 F 2372 F)	+/- 2C	<b>2.2</b> MΩ
L	-200 C 900 C (-328 F 1652 F)	+/- 2C	<b>2.2 M</b> Ω
PT100 ( DIN )		+/-0.4 C	1.3 ΚΩ
PT100 ( JIS )	-200 C 600 C (-328 F 1112 F)	+/-0.4 C	1.3 ΚΩ
mV	-8mV 70mV	+/-0.05 %	2.2 MΩ
mA	-3mA 27mA	+/-0.05 %	70.5Ω
V	-1.3V 11.5V	+/-0.05 %	<b>650 K</b> Ω

Output 1 / Output 2

Relay Rating: 2A/240 VAC, life cycles 200,000

for resistive load.

Pulsed Voltage: Source Voltage 5V,

current limiting resistance 66.

Linear Output Characteristics

Ω

Туре	Zero Tolerance	Span Tolerance	Load Capacity
4-20 mA	3.8-4 mA	20-21 mA	$500\Omega$ max.
0-20 mA	0 mA	20-21 mA	500Ω max.
0 ~ 5 V	0 V	5 ~ 5.25 V	10 KΩ min.
1 ~ 5 V	0.95 ~ 1 V	5 ~ 5.25 V	10 KΩ min.
0 ~ 10 V	0 V	10 ~10.5 V	10 KΩ min.

Linear Output

Resolution: 15Bits

Output Regulation: 0.02 % for full load change Output Settling Time: 0.1 sec. (stable to 99.9 %)

Isolation Breakdown Voltage: 1000 VAC

Temperature Effect: +/-0.01 % of SPAN / LC

Triac (SSR) Output

Rating: 1A / 240 VAC
Inrush Current: 20A for 1 cycle
Min. Load Current: 50 mA rms
Max. Off-state Leakage: 3 mA rms
Max. On-state Voltage: 1.5 V rms

Insulation Resistance: 1000 Mohms min. at 500 VDC

Dielectric Strength: 2500 VAC for 1 minute

### DC Voltage Supply Characteristics (Installed at Output 2)

Туре	Tolerance	Max. Output Current	Ripple Voltage	Isolation Barrier
20 V	+/-0.5 V	25 mA	0.2 Vp-p	500 VAC
12 V	+/-0.3 V	40 mA	0.1 Vp-p	500 VAC
5 V	+/-0.15 V	80 mA	0.05 Vp-p	500 VAC

Alarm

Alarm Relay: Form C Rating

2A/240VAC, 200,000 cycles for resistive load.

Alarm Functions: Dwell timer, PV High / Low Alarm,

Deviation High / Low Alarm,

Deviation Band High / Low Alarm Alarm Mode: Normal, Latching, Hold, Latching / Hold.

Dwell Timer: 0.1 - 4553.6 minutes

**Data Communications** 

Interface: RS-232 ( 1 unit ), RS-485 ( up to 247 units )

Protocol: Modbus Protocol RTU mode

Address: 1 - 247

Baud Rate: 2.4 ~ 38.4 Kbits/sec

Data Bits: 7 or 8 bits

Parity Bit: None, Even or Odd

Stop Bit: 1 or 2 bits Comm Buffer: 160 bytes Analog Retransmission

Functions: Process Variable

Output Signal: 4-20 mA, 0-20 mA, 0 - 5V, 1 - 5V, 0 - 10V

Resolution: 15 bits

Accuracy: +/-0.05 % of span +/-0.0025 %/ C Load Resistance: 0 - 500 ohms (for current output)

10 K ohms minimum (for voltage output)

Regulation: 0.01 % for full load change Settling Time: 0.1 sec. (stable to 99.9 %)

Breakdown Volts: 1000 VAC min.
Linearity Error: +/-0.005 % of span
Temp Effect: +/-0.0025 % of span / C

Saturation Low: 0 mA ( or 0V )

Saturation High: 22.2 mA ( or 5.55V, 11.1V min. )
Output Range: 0-22.2mA(0-20mA or 4-20mA)

0-5.55V ( 0 - 5V, 1 - 5V ) 0 - 11.1 V ( 0 - 10V ) User Interface

Display: Dual 4-digit LED Displays

Keypad: 4 keys

Programming Port: For automatic setup, calibration

and testing

Communication Port: Connection to PC for

supervisory control

Control Mode

Output 1: Reverse ( heating ) or direct ( cooling )

action

Output 2: PID cooling control, cooling P band

50~300% of PB, dead band -36.0 ~

36.0 % of PB

ON-OFF: 0.1 - 90.0 (F) hysteresis control

(P band = 0)

P or PD: 0 - 100.0 % offset adjustment

PID: Fuzzy logic modified

Proportional band 0.1 ~ 900.0 F. Integral time 0 - 1000 seconds Derivative time 0 - 360.0 seconds

Cycle Time: 0.1 - 90.0 seconds

Manual Control: Heat (MV1) and Cool (MV2)
Auto-tuning: Cold start and warm start

Failure Mode: Auto-transfer to manual mode

while

sensor break or A-D converter damage

Ramping Control: 0 - 900.0 F/minute or

0 - 900.0 F/hour ramp rate

Digital Filter

Function: First order

Time Constant: 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60

seconds programmable

Environmental & Physical

Operating Temperature: -10 C to 50 C Storage Temperature: -40 C to 60 C

Humidity: 0 to 90 % RH (non-condensing)
Insulation Resistance: 20 Mohms min. (at 500 VDC)
Dielectric Strengt: 2000 VAC, 50/60 Hz for 1 minute
Vibration Resistance: 10 - 55 Hz, 10 m/s for 2 hours

Shock Resistance: 200 m/s (20 g)

Moldings: Flame retardant polycarbonate

Dimensions:

4000 Series: 96mm(W) X 96mm(H) X 65mm(D),

53 mm depth behind panel

6000 Series: 48mm(W) X 48mm(H) X 116mm(D),

105 mm depth behind panel

8000 Series: 48mm(W) X 96mm(H) X 80mm(D),

65 mm depth behind panel

Weight: 4000 Series: 250 grams

6000 Series: 150 grams 8000 Series: 210 grams

Agency Approvals

UL Pending CSA Pending

Protective Class:

IP65 for panel with additional option IP50 for panel without additional option

Ip20 for terminals and housing with protective cover.

EMC: EN61326

# Table A.1 Error Codes and Corrective Actions

Error Code		Error Description	Corrective Action
4	Er04	Illegal setup values have been used: Before COOL is used for OUT2, DIRT ( cooling action ) has already been used for OUT1, or PID mode is not used for OUT1 ( that is PB = 0, and / or TI = 0 )	Check and correct setup values of OUT2, PB, TI and OUT1. IF OUT2 is required for cooling control, the control should use PID mode ( PB $_7$ 0, TI $_7$ 0) and OUT1 should use reverse mode (heating action), otherwise, don't use OUT2 for cooling control.
10	Er 10	Communication error: bad function code	Correct the communication software to meet the protocol requirements.
11	Er 11	Communication error: register address out of range	Don't issue an over-range register address to the slave.
14		Communication error: attempt to write a read-only data or a protected data	Don't write a read-only data or a protected data to the slave.
15	Er 15	Communication error: write a value which is out of range to a register	Don't write an over-range data to the slave register.
	26 01.5	Rととこ Fail to perform auto-tuning function	The PID values obtained after auto-tuning procedure are out of range. Retry auto-tuning.
26			2.Don't change set point value during auto-tuning procedure.
			3.Use manual tuning instead of auto-tuning.
		4. Don't set a zero value for PB.	
			5. Don't set a zero value for TI.
			6. Touch RESET key
29	6676	EEPROM can't be written correctly	Return to factory for repair.
30	EJEr	Cold junction compensation for thermocouple malfunction	Return to factory for repair.
39	5 <i>6</i> Er	Input sensor break, or input current below 1 mA if 4-20 mA is selected, or input voltage below 0.25V if 1 - 5V is selected	Replace input sensor.
40	RdEr	A to D converter or related component(s) malfunction	Return to factory for repair.

# Warranty

Proheat Inc. makes no warranty or representations of any sort regarding the fitness for use, merchantability, fitness for a particular purpose or the application of its products by the purchaser. The selection, application or use of Proheat Inc. products is the purchaser's responsibility.

Proheat Inc. controls are warranted to be free from functional defects in material and workmanship for **TWO YEARS** after delivery to the first purchaser.

Proheat Inc.'s sole responsibility under the warranty, at Proheat Inc.'s option, is limited to replacement or repair, free of charge, or refund of purchase price within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse or abuse.

No claims will be allowed for any damages or losses, whether direct, indirect, incidental, special or consequential. Specifications are subject to change without notice. In addition, Proheat Inc. reserves the right to make changes without notification to purchaser to materials or processing that do not affect compliance with any applicable specifications.

There are no expressed or implied warranties extending beyond the warranty herein.

#### RETURN MATERIAL AUTHORIZATION:

Please contact Proheat Inc. for Return Material Authorization number prior to any returns.

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