

# Operation Manual

Installation Manual  
Operation Manual  
Maintenance Manual  
Specifications & References

## AIR LEAK TESTER LS-R902



### Installation Manual

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Installation Manual

1 INTRODUCTION

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# 1 Introduction

Thank you for purchasing the Air Leak Tester LS-R902 Series.



LS-R902 is a differential pressure decay air leak tester designed for industrial use.

This manual provides installation, operating and maintenance instructions for LS-R902 Series. Read this operation manual carefully before using this product, and retain it for future reference.


## 2 Safety Precautions

This section provides how to use the product safely and avoid injuries to the operators or damages to your assets. Please handle the product according to these instructions and observe the following symbols that appear in this manual:

### [Explanations of the signs]

Signs	Explanation
 <b>WARNING</b>	Failure to take or avoid a specific action could result in death or serious physical harm to the user.
 <b>CAUTION</b>	Failure to take or avoid a specific action could result in minor physical harm to the user, or in property damage.

### [Explanations of the symbols]

△ This symbol denotes a warning/caution to alert the users. A specific explanation of the potential danger and what must be done to avoid it follows. (Example:  Electrical shock hazard)



## WARNING

- 1) Make sure the product is connected to ground for the power cord. Neglecting it could result in electrical shock hazards. Do not ground the product to a gas pipe. It could result in fires or electrical shock hazards.
- 2) If the metal part of the power plug or surrounding area is dusty, clean it thoroughly with a dry cloth. Neglecting it could result in fires or electrical shock hazards.
- 3) Make sure there is enough clearance to connect and/or disconnect the power cord from the power inlet of the product.
- 4) Do not use voltages other than those for which the product is rated. It could result in fires or electrical shock hazards.
- 5) If the product has been dropped or damaged, switch it off and disconnect the power cord from the power inlet of the product. Neglecting it could result in fires or electrical shock hazards.
- 6) Do not apply air pressure in excess of the pressure rating of the product. Excessive pressure input could cause major component failure and/or injury.
- 7) Should foreign matter such as water or oil get inside the product, switch off the power immediately and disconnect it from the power inlet of the product. Neglecting it could result in fires or electrical shock hazards. Use extra caution when installing the product in an environment where water or oil exists nearby.
- 8) This product is not customer-serviceable. Customer servicing could result in fires or electrical shock hazards.
- 9) Replace a fuse after turning off the power of the main unit and disconnecting the power cord from the power inlet of the product. Use a fuse equivalent to the current one for replacement. Using a different fuse could result in fires or electrical shock hazards.
- 10) Discontinue using the product immediately under the following circumstances:
  - The product smokes.
  - The product emits abnormal noises.
  - The product has developed problems not covered in the Operation Manual.
  - The product cannot be operated as indicated in the Operation Manual.

To avoid electrical shock hazards or physical harm, disconnect the power cord and remove the pressure source from the product. Neglecting it could result in fires or electrical shock hazards.



## CAUTION

- 1) Do not use the product in places that are damp, that are exposed to direct sunlight or that are outside the temperature range of 5°C to 45°C. Using the product in such environments could result in malfunctions or failures.
- 2) To avoid damage to the power cord, which could result in fires or electrical shock hazards, observe these precautions: It could result in fires or electrical shock hazards.
  - Do not damage, modify or apply undue force to the power cord.
  - Before servicing the product, disconnect the power cord from the power inlet of the product.
  - Do not handle the power cord with wet hands.
  - When disconnecting the power cord, do not pull on the cord.
- 3) Mount the product securely on a structure with enough load capacity. Do not install the product on the insecure foundation or in places with vibration to avoid overturns and injuries.
- 4) Ensure the correct cable connection. Incorrectly connected cables could result in damage to the product and surrounding hardware.
- 5) Do not step on top of the product or place containers filled with liquids, oil or soapy water, or the like on it. Spills may result, causing physical harm, electrical shock hazard, rust or other damage.
- 6) Should the LCD become damaged, avoid skin contact with the liquid contained inside. It could cause inflammation. Wash with running water in case of skin contact.
- 7) Do not disassemble the product other than replacing the designated consumable parts. The product could malfunction, resulting in physical harm or electrical shock hazards.
- 8) Do not mount or remove the parts exposed to air pressure such as pipes while a pressure source is connected to the product. It could result in physical harm.  
Wear a safety goggle to protect your eyes.
- 9) When a leak test has been completed, unclamp the tested part only after all pressure has been released from the product. Residual pressure could result in physical harm.
- 10) Hold its bottom to keep it from dropping when transferring the product. Do not lift the product by gripping its components on the rear panel such as the stop valves.
- 11) Put on steel-toe boots when transferring the product for shipping, installation, dismantling. Neglecting it could result in physical harm by dropping the product.
- 12) Wipe out the product lightly with a dry and soft cloth for maintenance. When the product is with heavy dirt, dilute the neutral detergent with water, soak the cloth in the detergent, squeeze the cloth, and wipe the dirt out. Do not use organic solvent.
- 13) Handle the product according to the instructions in this operation manual. Otherwise the protection provided by the equipment may be impaired.
- 14) Do not remove the cover of the LS-R902 main unit.  
Otherwise the LS-R902 could be damaged due to electrical shock or short-circuit.

### 3 Notes

- 1) The information in this document is subject to change without notice to allow for performance or feature upgrades.
- 2) This document may not be reproduced in whole or in part without prior approval of the publisher.
- 3) We are not responsible for the items tested using the product or for any consequences resulting from the tests.
- 4) This product comes with the self-check feature to detect certain improper settings and/or operations, and any malfunctions of components to minimize incorrect pass/fail judgment. However, the scope of monitoring by self-checking is limited.
- 5) This product is a differential pressure decay air leak tester adopting the master comparison method. Please note that when using the product in an inappropriate environment, there are risks of incorrect fail judgments due to various effects such as leakage from the sealing fixture, part deformation, temperature changes in the part and/or fixture.
- 6) Users are encouraged to consult their local Cosmo representatives directly for any questions regarding the use of this product.

# 2

## INSTALLATION AND SETUP

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# 1 Unpacking

When you receive the LS-R902, unpack and check for the transport damage.

## 1.1 Accessories

Item	Q'ty
Power cord	1
Control I/O connector: MSTB 2,5 / 16-STF-5,08 (Phoenix Contact)	2
Inspection record / Traceability related documents	1 each
Operation manual CD (Installation manual / Operation manual / Maintenance manual / Specifications & References)	1

## 1.2 Items to Be Prepared By the Customer

### For installation:

For mounting LS-R902 with Quick mounting bracket: M4 screws (4)
Pipe for pneumatic connection
Pipe for connecting the tested part and reference master to LS-R902

### For external device connection:

Control I/O cable
24 VDC Power source




### For storing leak test data and/or test parameters:

USB memory
Computer
RS-232C serial communication cable (commercially-available product)
USB serial conversion adapter (When the PC does not have an RS-232 communication port on it)

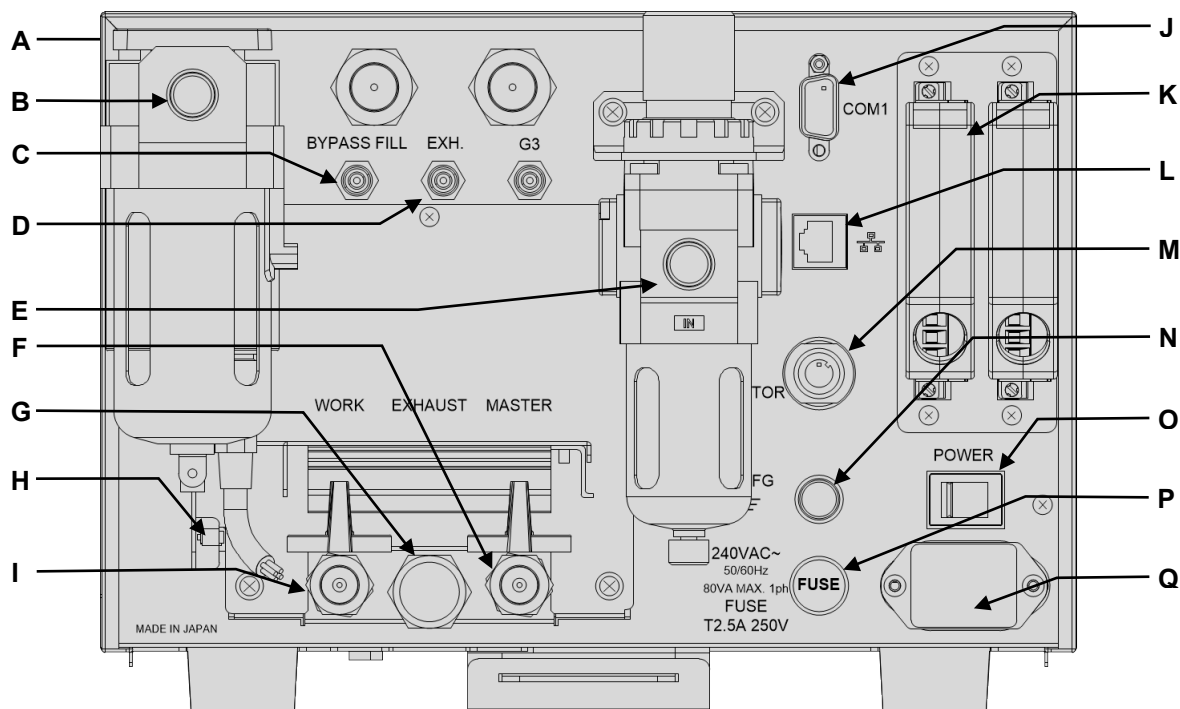
## 2 Part Identifications

### 2.1 Front Panel



- A LCD Touchscreen:**  
All the settings are entered through the touch screen. Leak testing can be done manually as well.
- B RS-232C:**  
Serial communication, RS-232C (Front), port. Data are output in the designated format. (9-pin male)
- C  (USB port):**  
Test Data, Waveform Data and Mastering Data are output in CSV format. Firmware can be upgraded using this port.
- D Auto-Leak Calibrator (ALC):**  
ALC is equipped for the ALC models.
- E  (Maintenance port):**  
Do not remove the plug in usual measurement.
- F  (Calibration port):**  
Connect a Leak Master to this port for daily maintenance.
- G Quick Mounting Bracket:**  
Using this bracket, LS-R902 can be installed and removed easily with two M4 screws.

## 2.2 Rear Panel



- A G3:** Pilot pressure port for External Exhaust valve  
(Push-to-connect fitting 4 mm)
- B TEST PRESSURE:** Test pressure port
- C BYPASS FILL:** (Option)  
Pilot pressure port for fill valve for Bypass circuit unit (Push-to-connect fitting 4 mm)
- D EXH.:** (Option)  
Pilot pressure port for exhaust valve for Bypass circuit unit (Push-to-connect fitting 4 mm)
- E PILOT PRESSURE:** Pilot pressure port  
Connect clean air regulated between 400 to 700 kPa
- F MASTER:** MASTER-side stop valve  
A port to connect a reference (Master). Leave the valve opened except for maintenance.
- G EXHAUST:** Silencer for exhaust  
Air is exhausted from this port after a leak test.
- H Stop Valve Monitoring Switch with a valve cover:**  
When the valve(s) is closed, the cover won't close and the switch is not pressed. This is to prevent leak testing with the stop valves closed. When the valves are open and the cover is closed, the switch is turned on.

- I WORK:** WORK-side stop valve  
A port to connect a tested part (Work). Leave the valve opened except for maintenance.
- J COM 1:** Serial communication, RS-232C (Rear), port. Data are output in the designated format.  
(9-pin male)
- K CONTROL I/O:** (Phoenix contact):  
External device is connected to control LS-R902 externally.  
Left side: Output **B** Right side: Input **A**
- L** 10/100 BASE-T Connector
- M EP REGULATOR:** (Option)  
Electro-Pneumatic regulator connector
- N FG** Grounding
- O POWER:** Power switch
- P FUSE:** Fuse (T2.5A 250V)
- Q 100 to 240 VAC~:** Power inlet

### NOTE

The symbol “~” for “100 to 240 VAC~” denotes alternating current.



## 3 Installation

### 3.1 Environment of Leak Tester and Leak Test Stand

#### Location of Leak Tester to Avoid Temperature Fluctuation

- Avoid direct sunlight.
- Avoid direct wind due to doors opening and closing.
- Avoid direct wind from heating and cooling vents.

When above cannot be avoided, use a curtain. However, it's not good to cover the whole test stand area completely because of temperature fluctuations that could occur in the tested parts. Therefore, partial covering will give better result.

#### Effects of Plant Temperature on Leak Testing

- Do not put the leak test station right after heating, cooling, welding or washing process.
- If the temperatures of the floor and test bench are different, and the tested parts are taken from the floor, heat transfer will take place between the parts and the fixture. This will cause an error.

The tested parts should be stored at the same level as the test bench in order to keep the temperature the same.

### 3.2 Installation of LS-R902 with Quick Mounting Brackets



#### CAUTION

Hold its bottom to keep it from dropping when transferring the product. Do not lift the product by gripping its components on the rear panel such as the stop valves.



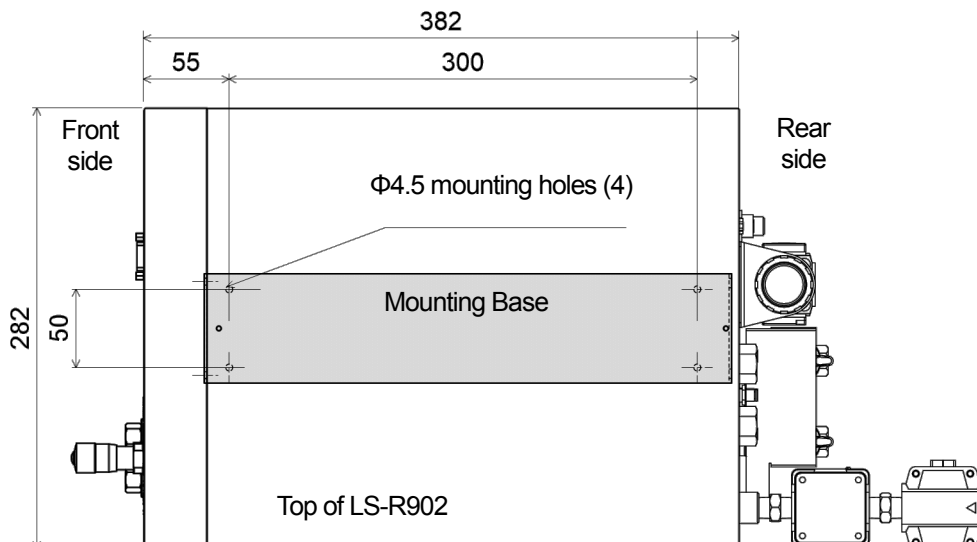
#### CAUTION

Mount the product securely on a structure with enough load capacity. Do not install the product on the insecure foundation or in places with vibration to avoid overturns and injuries.

LS-R902 comes with mounting brackets that can be installed/removed from the base with two screws.

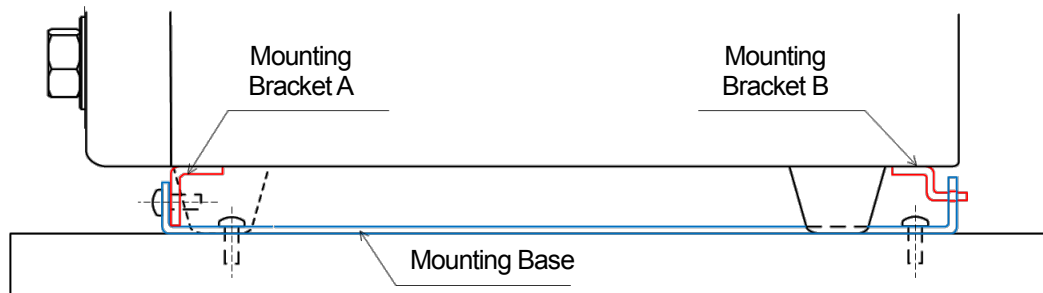
#### Mounting Base

The mounting base is loosely attached to the bottom of LS-R902. Remove it from the tester and mount it with four M4 screws on the test bench where LS-R902 is to be mounted. The mounting surface has to be flat and smooth. The figure below shows the position of LS-R902 when mounted on the mounting base. Mount the mounting base on the test bench as shown below. The M4 screws are not enclosed with LS-R902.

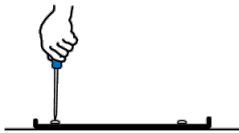


## How to Mount

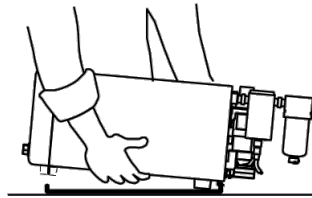
Two mounting brackets are attached to the bottom of the LS-R902, A in front and B in back.



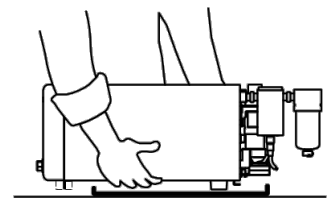
Mount by the following procedure:



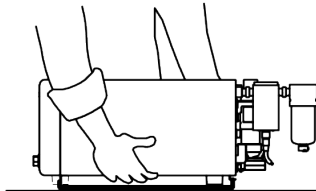
Mount the "Mounting Base" on a leak test stand.



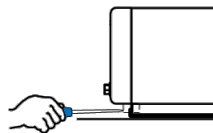
Place the LS-R902 with the Brackets A and B attached a little toward the front of where the LS-R902 is to be mounted.



Insert the bracket B to the rear latch of the mounting base while lifting the front of the LS-R902.



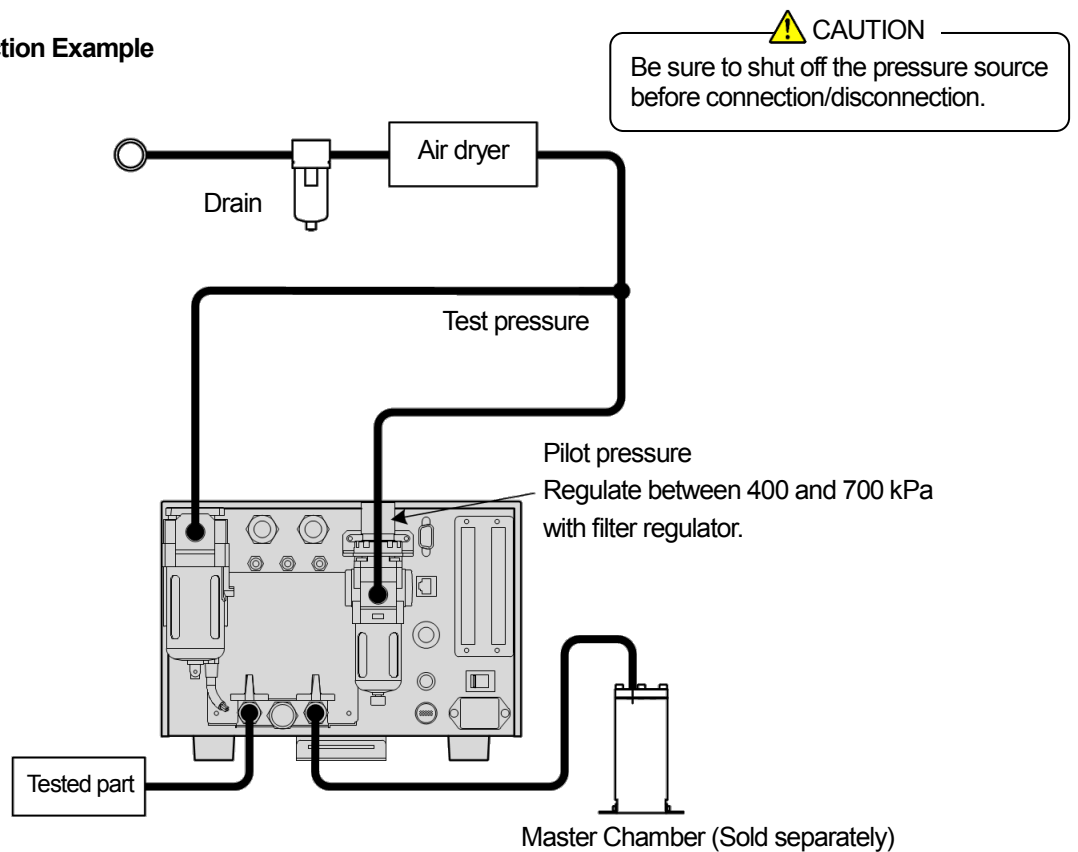
Lower the LS-R902 where the Bracket A gets behind the front latch of the mounting base and align the screw holes.



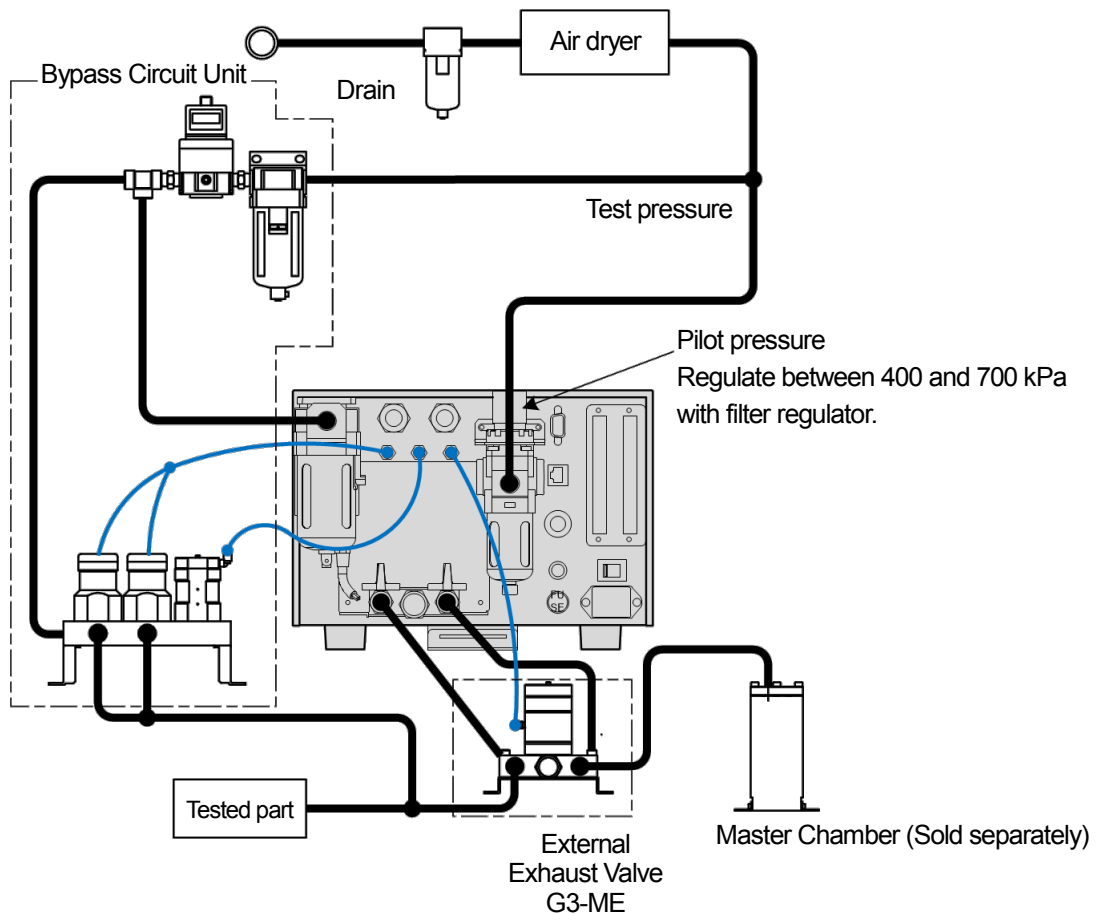
Mount the LS-R902 with two M4 screws.

### 3.3 Pneumatic Hookups

#### Standard Connection Example



#### Optional Equipment Connection



### Pressure Connection Precautions

- The source pressure must be clean and dry. When there is water or oil inside of the plant compressor, an oil mist separator must be used. When there is a lot of water and oil in the compressor, use two or more separators.
- The lubricated air source should never be connected to the tester. Oil-contaminated air source should never be connected to the tester.
- Avoid direct wind from cooling vents. It may cause due condensation inside the pipes.
- When using an oil lubricated vacuum pump:  
A solenoid valve which opens to atmosphere should be used to prevent oil from entering the leak tester when the pump is turned off.  
The tester should also be installed at a higher level than the vacuum pump.

#### NOTE

Once the Differential Pressure Sensor (DPS) is contaminated, the offset becomes off causing frequent Fails.  
Contact Cosmo for repair in those cases.

- Sufficiently higher than the test pressure and stable.
- Has enough flow capacity.
- Should be regulated to at least 100 kPa higher than the test pressure.

### Test Pressure Connection

**Port:** TEST PRESSURE ("IN" on Oil mist separator) Port Size: Rc 1/4

Pressure Range		Pressure Source	
Micro Low (L02)	Up to 20 kPa	Connect the pressure source as follows: <ul style="list-style-type: none"> <li>• Sufficiently higher than the test pressure and stable.</li> <li>• Has enough flow capacity.</li> <li>• Should be regulated to at least 100 kPa higher than the test pressure.</li> </ul>	L02: Up to 200 kPa
Low (L)	Up to 100 kPa		L: Up to 500 kPa
Low (LR)	Up to 95 kPa		LR: Up to 200 kPa
Medium (M/MR)	Up to 800 kPa		M: Up to 1 MPa MR: Up to 1 MPa
High (H20)	Up to 2.0 MPa	Connect a pressure source regulated to the air filter.	
Extremely High (H49)	Up to 4.9 MPa		
Vacuum (V)	Down to -100 kPa	Connect a vacuum pump <div> <b>NOTE</b>              Be sure that water or oil won't enter from vacuum pump           </div>	
Vacuum (VR)	Down to -75 kPa		

### Pilot Pressure Connection

Pilot pressure is to activate the air-operated valves.  
Regulate between 400 and 700 kPa.

**Port:** PILOT PRESSURE Port Size: Rc 1/4

### 3.4 Piping for Tested part (Work) and Master

#### Select pipes considering the following:

Cosmo recommends rigid nylon pipes that do not expand by air pressure.

- The higher the test pressure is, the thicker the pipes should be, and the larger the part volume is, the larger the pipe diameter should be.
- For small volume parts (approx. 1000 mL or less), use compression type fittings but avoid using push-on type. However, for the piping whose diameter is 12 mm (1/2 in) or larger, push-on (one-touch) type fittings should be used because insert-type fittings tends to be loosen over time.
- Make the pipes as short as possible. For the parts with small volume, use the pipes with small diameter.
- Pipes for WORK and MASTER sides should be the same length and material if the Mastering compensation is not used.
- Vacuum type models require large diameter pipes. For case of high vacuum, use pipes with smooth internal surface.

Mount the pipes so that they don't move during leak tests.

#### Recommended Pipe (For test pressure of 800 kPa or lower)

Manufacturer: Nitta Corporation

Inch size: N2-1 (for test pressure 200 kPa or lower), N2-2

Millimeter size: N2-4

Manufacturer: SMC Corporation

T Series

#### For the test pressure 800 kPa or higher:

Use steel pipes such as stainless steel.

Select a steel pipe based on its intensity.

### 3.5 Power Source

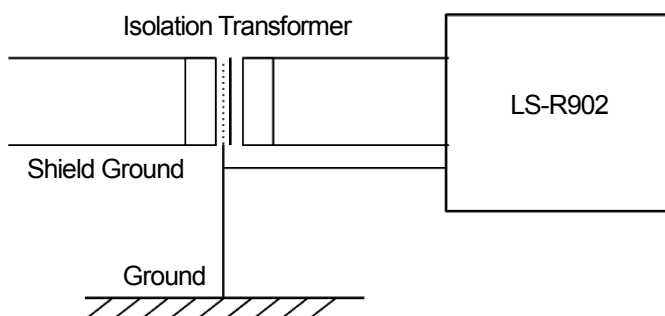
Connect to the power with the enclosed power cord. Required power source is AC 100 - 240 V  $\pm$ 10%. Make sure the product is connected to ground. Use the enclosed power cord for the cases the power source is 125 VAC or lower.



CAUTION

#### Electric Shock

Applying power greater than specified could lead electric shock or fire.



#### NOTE

Connect a power line that is free from sources of noise.  
Use a noise suppressing isolation transformer if noise comes from the power line. Grounding the F.G. pin may reduce noises as well.

### 3.6 Control I/O Connector

The control I/O port interfaces the leak tester to external devices such as PLC.



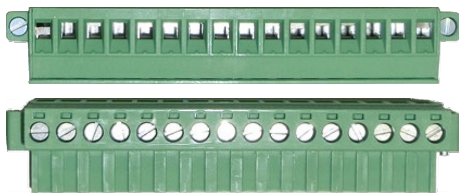
CAUTION

#### Electric Shock

Be sure to turn off the main power before wiring.

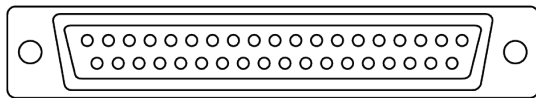
- A twisted pair cable preferably with shield should be used and should be separated from the power line.
- The length should be as short as possible without slack.
- Twisting the common line with the signal lines will help reduce noise.

#### Phoenix Contact I/O Connector (Standard)



Strip off the insulation of the wire and insert it into the connector terminal and tighten the screw on the side.

#### D-SUB Connector (Special Spec.)



Connect wires to the terminal with soldering.



CAUTION

Mishandling of the soldering iron could result in burns or fire. Be sure to follow its instruction.

Refer to “3 INTERFACE” for the details. 

## 4 Turning on Power for the First Time

Turn on the power with the power switch on the rear panel.  
Let the power on for 5 minutes or longer for a warm-up before starting leak test.

The tester defaults to the initial Language select screen when turning on the power for the first time.  
Select a language and tap **Enter**.



LS-R902 will show the home screen in the selected language.  
(Default is Standard Measurement Screen)

#### NOTE

Tapping **Back** on the Home screen opens the Main Menu Screen.

# 3

## INTERFACE

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# 1 Control I/O Port

The control I/O port interfaces LS-R902 to an external device with the capabilities to control and receive the test results remotely. This port allows the tester to be integrated into a completely automated line.

## 1.1 Standard Control I/O Port: Phoenix Contact

### Connector Model

Leak Tester Side: DFK-MSTBVA 2,5/16-GF-5,08 (PHOENIX CONTACT)

Cable Side: MSTB 2,5/16-STF-5,08 (PHOENIX CONTACT)

### Connector Pin Assignment


		Input		
	PIN#	Function	TYPE	
1A	1A	START	Input NO	*1
	2A	STOP	Input NO/NC	
	3A	CHG HOLD	Input NO	*2
	4A	MASTERING/ DRIFT CLEAR *1	Input NO	
	5A	K(Ve) CHECK	Input NO	*3
	6A	Calibration Valve Open/Close	Input NO	
	7A	CH# 6 *2	Input NO	*4
	8A	CH# 5 *2	Input NO	
	9A	CH# 4 *3	Input NO	*5
	10A	CH# 3 *3	Input NO	
	11A	CH# 2 *3	Input NO	
	12A	CH# 1 *3	Input NO	
	13A	CH# 0 *3	Input NO	
	14A	Reserved		
	15A	Reserved		
	16A	External DC Power input		
		Output		
	PIN#	Function	TYPE	
16A	1B	STAGE #0	Output NO	
	2B	STAGE #1	Output NO	
	3B	ERROR	Output NO	
	4B	Reserved		
	5B	Pass	Output NO	
	6B	UL FAIL	Output NO	
	7B	MASTERING REQUEST	Output NO	
	8B	STBY *4	Output NO	
	9B	BUSY	Output NO	
	10B	END	Output NO	
	11B	TIME EXTENSION *5	Output NO	
	12B	LL2 FAIL	Output NO	
	13B	LL FAIL	Output NO	
	14B	UL2 FAIL	Output NO	
	15B	Common Return for all outputs		
	16B	Reserved		

(NO: Normally Open / NC: Normally Closed)

\*1 When the Drift Compensation is enabled, receiving this signal resets the current Drift compensation value. When the Mastering Compensation is enabled, receiving this signal starts the Mastering value sampling process and resets the previous Mastering value.

\*2 CH#5 and CH#6 are enabled when the option RX11 is selected.

\*3 Input the necessary BCD codes.

**1.6 Channel Code** 

\*4 Only in Remote mode, this signal is transmitted when the tester is ready to start measurement after the power is turned on.

\*5 This signal is transmitted when the test time is extended due to NR (Noise Reduction) or Mastering value sampling. Use the signal to disable the cycle timer over alarm if necessary.

#### NOTE

Never short the pins marked "Reserved". It could result in damage to the product.



## 1.2 Control I/O Port D-SUB Connector (Special Spec.)

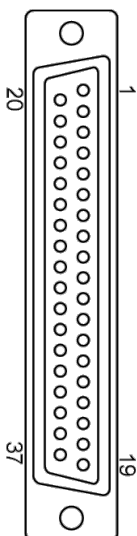
### Connector Model

Leak Tester Side: XM3C-3722 (OMRON)


Cable Side: XM3D-3721 (OMRON)

### Connector Pin Assignment

			(NO: Normally Open / NC: Normally Closed)		
PIN#	Function	TYPE	PIN#	Function	TYPE
20	CH# 4 *1	Input NO	1	Reserved	
21	CH# 3 *1	Input NO	2	START	Input NO
22	CH# 2 *1	Input NO	3	STOP	Input NO/NC
23	CH# 1 *1	Input NO	4	CHG HOLD	Input NO
24	CH# 0 *1	Input NO	5	MASTERING/DRIFT CLEAR *3	Input NO
25	Reserved		6	K(Ve) CHECK	Input NO
26	Reserved		7	Calibration Valve Open/Close	Input NO
27	Reserved		8	CH# 6 *1	Input NO
28	Reserved		9	CH# 5 *1	Input NO
29	Reserved		10	External DC Power input	
30	Reserved		11	STBY *4	Output NO
31	UL2 FAIL	Output NO	12	MASTERING REQUEST	Output NO
32	LL FAIL	Output NO	13	UL FAIL	Output NO
33	LL2 FAIL	Output NO	14	PASS	Output NO
34	TIME EXTENSION *2	Output NO	15	Reserved	
35	END	Output NO	16	ERROR	Output NO
36	BUSY	Output NO	17	STAGE #1	Output NO
37	Reserved		18	STAGE #0	Output NO
			19	Common Return for all outputs	



Soldered Side

\*1 Input the necessary BCD codes. **1.6 Channel Code** 

CH#5 and CH#6 are enabled when the option RX11 is selected.

\*2 This signal is transmitted when the test time is extended due to NR (Noise Reduction) or Mastering value sampling. Use the signal to disable the cycle timer over alarm if necessary.

\*3 When the Drift Compensation is enabled, receiving this signal resets the current Drift compensation value. When the Mastering Compensation is enabled, receiving this signal starts the Mastering value sampling process and resets the previous Mastering value.

\*4 Only in Remote mode, this signal is transmitted when the tester is ready to start measurement after the power is turned on.

#### NOTE

Never short the pins marked "Reserved". It could result in damage to the product.

### External power

Operational power supply is required to use the Control I/O port.

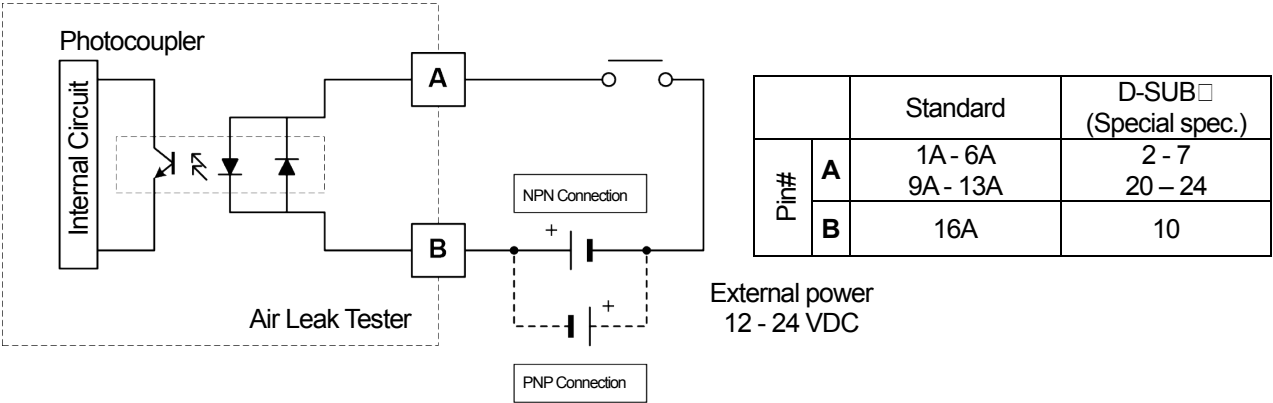
Rated input voltage: DC12 - 24 V  $\pm 10\%$ , 0.2 A MAX.

1.3 Input Specifications

Photocoupler diode input  
Input impedance: 3 kΩ  
Input current: 10 mA typ. (24 VDC)

Wiring

Input Circuit

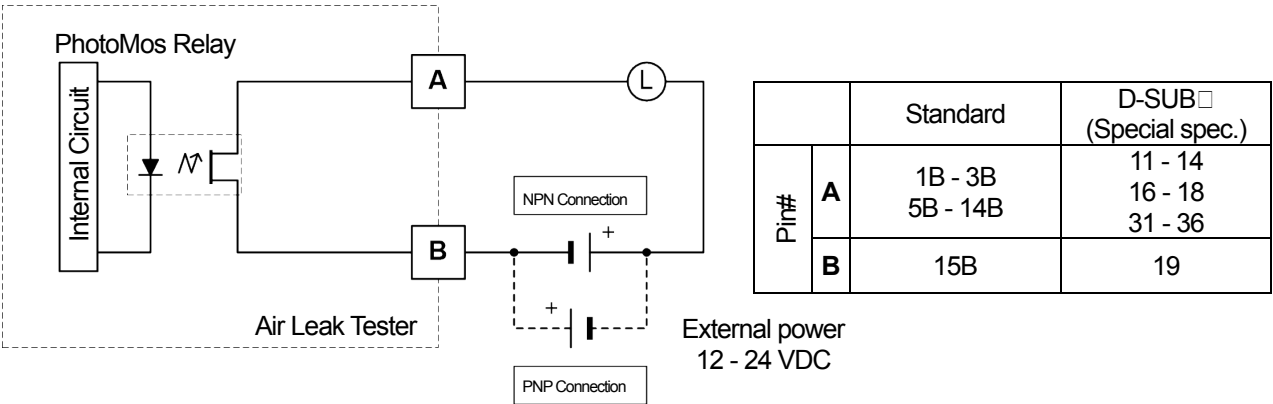


1.4 Output Circuit

Open Collector Output  
Maximum switching capacity: 100 mA/24 V  
For the Phoenix Contact connector, the total current of each group of the pins from 1B to 7B and pins from 9B to 14B should be 200 mA or less.  
For the D-SUB connector, the total current of the pins from 12 to 18 or pins from 31 to 36 should be 200 mA or less.  
Residual voltage while ON: 2 V max.

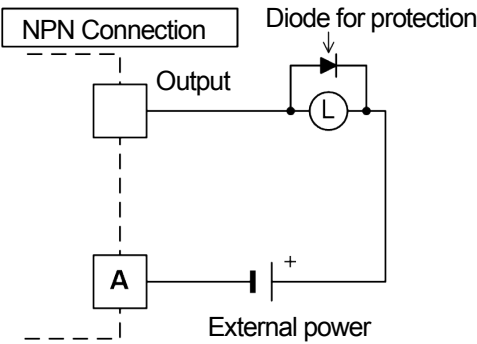
Wiring

Output Circuit

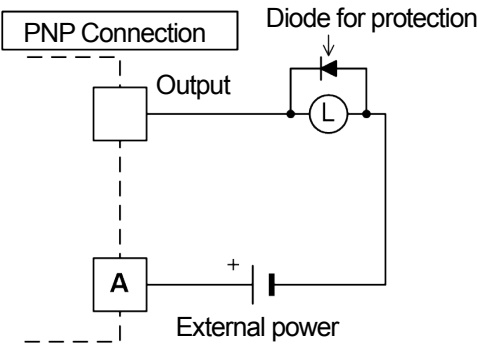


Protection of Output Load

When using the output induction load (such as relay, motor etc.), arrange the diode for protection.



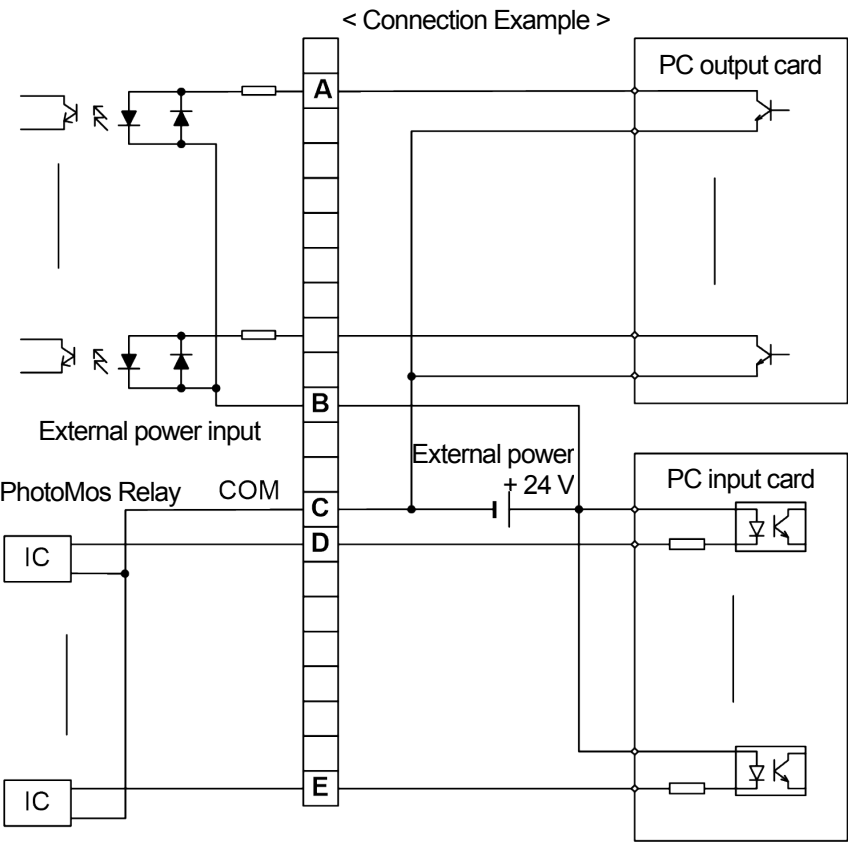
	Standard	D-SUB (Special spec.)
Pin#	15B	19



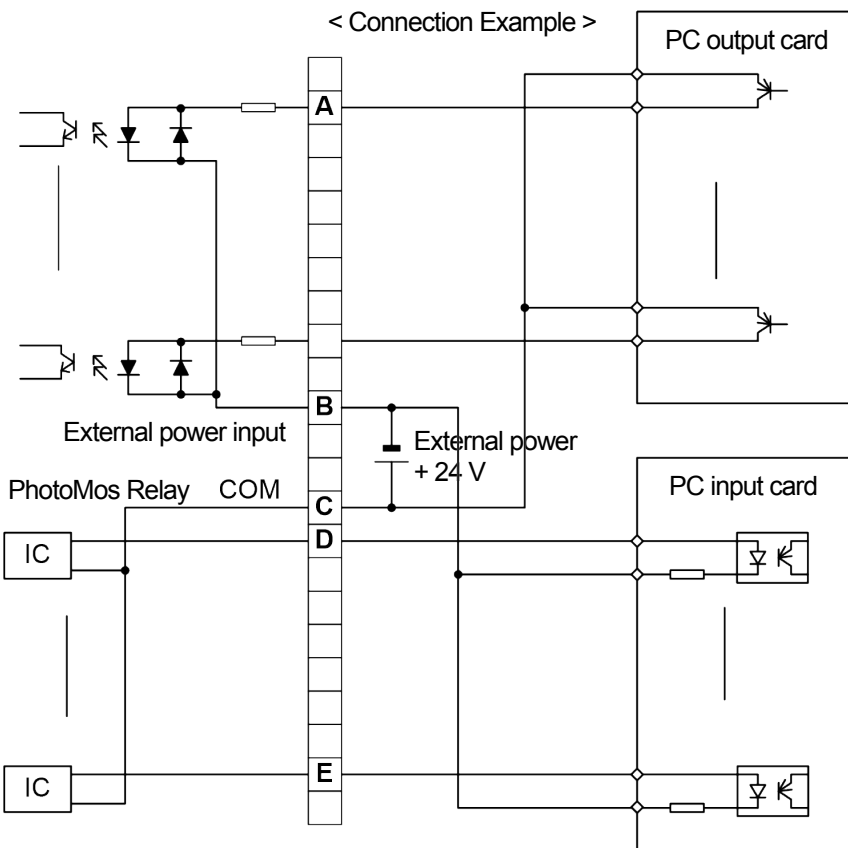
	Standard	D-SUB (Special spec.)
Pin#	15B	19

1.5 Typical PLC Connection

NPN-type input/output circuit configuration of LS-R902



PNP-type input/output circuit configuration of LS-R902



## 1.6 Channel Code

Pins 7A through 13A (For D-SUB, pins 20 through 24 and 8 to 9) are used for switching channel automatically by external device. Channel can be changed by entering BCD codes to those pins. Pin 7A (For D-SUB, pin 20) is the most significant bit (MSB). Pin 13A (For D-SUB, pin 24) is the least significant bit (LSB).

CH	CH#6	CH#5	CH#4	CH#3	CH#2	CH#1	CH#0
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	ON	OFF
-							
9	OFF	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	OFF	ON	OFF	ON	ON
-							
14	OFF	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	OFF	ON	ON	ON	ON
16	OFF	OFF	ON	OFF	OFF	OFF	OFF
-							
29	OFF	OFF	ON	ON	ON	OFF	ON
30	OFF	OFF	ON	ON	ON	ON	OFF
31	OFF	OFF	ON	ON	ON	ON	ON
-							
32 *1	OFF	ON	OFF	OFF	OFF	OFF	OFF
33 *1	OFF	ON	OFF	OFF	OFF	OFF	ON
34 *1	OFF	ON	OFF	OFF	OFF	ON	OFF
-							
69 *1	ON	OFF	OFF	OFF	ON	OFF	ON
70 *1	ON	OFF	OFF	OFF	ON	ON	OFF
71 *1	ON	OFF	OFF	OFF	ON	ON	ON
-							
97 *1	ON	ON	OFF	OFF	OFF	OFF	ON
98 *1	ON	ON	OFF	OFF	OFF	ON	OFF
99 *1	ON	ON	OFF	OFF	OFF	ON	ON
	64	32	16	8	4	2	1

Weight of each bit

\*1 When the option RX11 (100CH) is selected.

## 1.7 Stage Number Output

Leak test stages can be identified from combinations of Stage #0 and Stage #1.

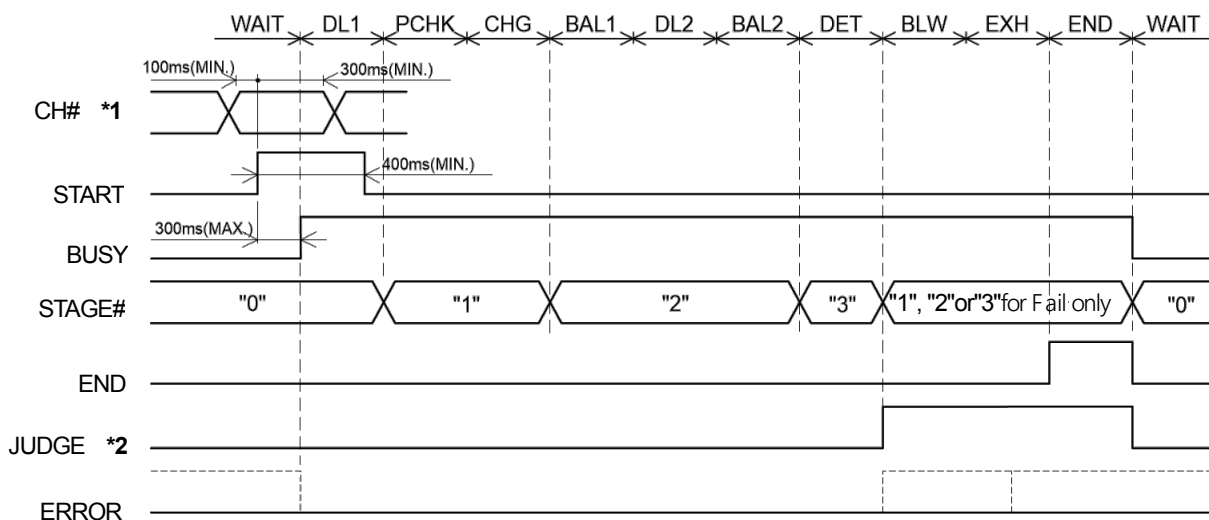
Stage	Stage #1	Stage #0	Stage #
WAIT, DL1	OFF	OFF	"0"
PCHK - CHG	OFF	ON	"1"
BAL1, DL2, BAL2	ON	OFF	"2"
DET	ON	ON	"3"
BLW - END	Hold	Hold	See <b>NOTE</b>

### NOTE

The stage # in which a Fail judgment is made, or a Stop signal is received, is held from BLW through END stages. (No output for a Pass judgment). For instance, if a Fail judgment is made during BAL2, the stage # in END stage is "2." This makes sorting defected parts easier.

## 1.8 Signal Timing Charts

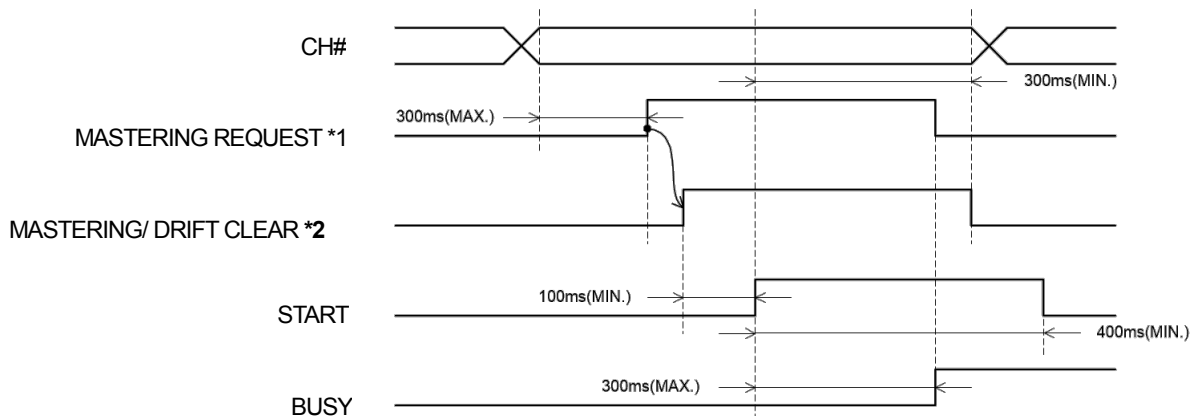
Leak Test Timing Chart



\*1 CH # includes CH #, K(Ve) CHECK, MASTERING / DRIFT CLR, and Calibration Valve Open/Close signals.

\*2 JUDGMENT includes PASS, UL FAIL, LL FAIL, UL2 FAIL and LL2 FAIL signals.

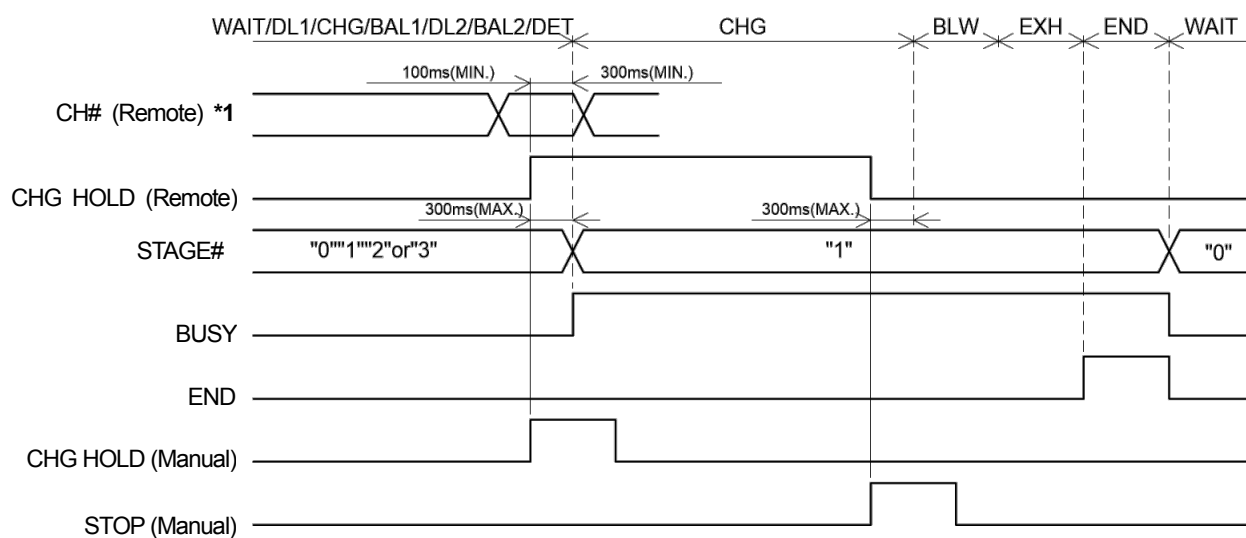
Mastering Timing Chart



\*1 MASTERING REQUEST signal is output from the LS-R902.

\*2 MASTERING/DRIFT CLEAR signal is externally input to the LS-R902.

### Charge Hold Timing Chart



\*1 CH # is acceptable in the WAIT stage, but not in any other stage.

## 1.9 Checking Wiring with I/O Monitor

This can be used to check if the wire connection to external devices is correct.

First, unlock settings and switch to Manual mode after power is turned on.

Refer to **"4 BASIC TOUCH SCREEN OPERATIONS"**

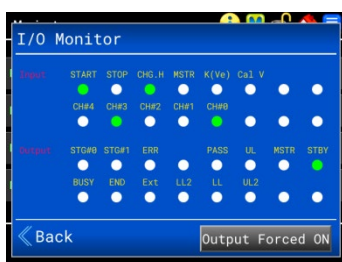
**Go to:**

**Back** > Lock > Settings Unlock > Enter a passcode and tap **Enter** > **Back**

> "Switching to Manual Mode OK to continue?" > **Yes**

Then **Go to:** Maint > I/O Monitor

#### Input



The pins lit green are receiving the signals.

#### Output



- 1) Forcing output signals.  
**Go to: Output Forced ON**  
> "Forcing Output Signal OK to continue?" > **Yes**
- 2) Tap the pin(s) to be checked and signal(s) is(are) transmitted.
- 3) Tapping the pins again resets the signals.
- 4) Clearing Forced output signals.  
**Go to: Output Forced ON**  
> "Clearing Forced Output Signal OK to continue?" > **Yes**

## 2 RS-232C Serial Interface Port

This interface port is an asynchronous half duplex serial interface based on EIA-232. This interface provides communication with external devices such as computers. (NULL-MODEM mode direct connections) Through this port, the LS-R902 transmits leak test data after every test execution.

The LS-R902 does not accept any commands from the host; it only transmits leak test data.

All the signals are transmitted at the beginning of the END stage.

For setting the communication parameters, **go to:** System > System Settings > **RS-232C(R) / RS-232C(F)**

### 2.1 RS-232C Interface

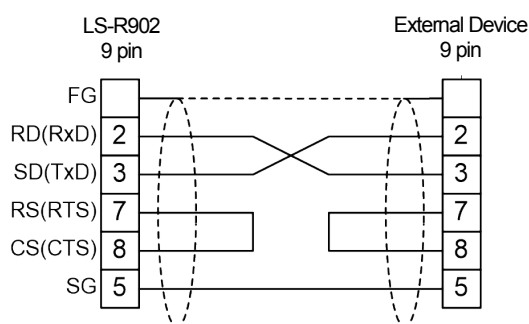
Data transmission	Half duplex
Baud rate	9600, 19200, 38400, 57600, 115200
Start bit	1 bit
Data Length	7 or 8 bits
Parity	Non-parity, even number or odd number
Stop Bit	1 or 2 bits

#### Connector pin assignment (DB-9P)

Pin#	Name	Function
2	RxD	Received Data
3	TxD	Transmitted Data
5	SG	Signal Ground

### 2.2 Interface Cable Wiring Example

- Interface cable wiring diagram (COM1)  
D-SUB 9-pin female 1/4 inch screw threads #4 to 40





## 2.3 Formats of RS-232C Output

The LS-R902 supports nine (9) output formats.

Data output is available from the two RS-232C ports on the front and rear panels.

For selecting a format, **go to:** System > System Settings > RS-232C(R) / RS-232C(F) > Format

T format	Fixed-length output of DET leak data only
ID Format	Fixed-length output: leak limits, DET leak and other data (Default format)
I Format	Fixed-length output: leak limits, DET leak and other data
DT Format	Fixed-length output: Date, Time and other data
K Format	Fixed-length output: Detection method, K(Ve), DET leak data and other data
L Format	Fixed-length output: BAL2 leak, DET leak and other data
M Format	Fixed-length output: DET leak, Stage timers and other data
P Format	Format for RS232C Printer RS-232C can be used.
D Format	Fixed-length output: Test data is transmitted every 100 ms.

## 2.4 Data Format

- All output data is coded in ASCII numeric characters.
- A block of output data begins with ASCII code "#" (23H), and ends with a sequence of a carriage return (0DH).
- All output data are separated by spaces (20H).
- The checksum field is in hexadecimal notation and proceeded by the ASCII code ":" (3AH).
- A field with 3-digit integer data is preceded by two zeros, and does not include a decimal point.
- $\Delta P$  and leak rate value may not match due to compensation.

### NOTE

Differential pressure reading when an error occurs is +999.

### NOTE

\_ (underscore) represents space in the tables below.

### T format

#zz_00_J_±LLL.L : GG CR						
Data field	Code	Data type	Unit	Min.	Max.	Note
Tester ID	z	2-digit decimal	--	00	99	
Result	J	ASCII code (1-digit hexadecimal)	--	1	D	1: LL FAIL 2: Pass 4: UL FAIL 9: LL2 FAIL C: UL2 FAIL D: Error
Leak	L	Floating point	Leak unit	± 0.000	± 00999	
Checksum	G	2-digit hexadecimal	--	00	FF	


**ID Format (Default format)**

#zz_00_J_±LLL.LLL_±AAA.AAA_±BBB.BBB_±DDD.DDD_±PPP.PPP_±EEE.EEE_±FFF.FFF_CC : GG CR						
Data field	Code	Data type	Unit	Min.	Max.	Note
Tester ID	z	2-digit decimal	--	00	99	
Result	J	ASCII code (1-digit hexadecimal)	--	1	D	1: LL FAIL 2: Pass 4: UL FAIL 9: LL2 FAIL C: UL2 FAIL D: Error
Leak	L	Fixed point	Leak unit	± 000.000	± 999.999	
DET UL	A	Fixed point	Leak unit	± 000.000	± 999.999	
DET LL	B	Fixed point	Leak unit	± 000.000	± 999.999	
ΔP	D	Fixed point	Pa	± 000.000	± 999.999	
Test pressure	P	Fixed point	Test press unit	± 000.000	± 999.999	
TP UL	E	Fixed point	Test press unit	± 000.000	± 999.999	
TP LL	F	Fixed point	Test press unit	± 000.000	± 999.999	
CH#	C	2-digit decimal	--	00	31 (99)	( ): RX11
Checksum	G	2-digit hexadecimal	--	00	FF	

**I Format**

#zz_00_J_±LLL.LLL_±AAA.AAA_±BBB.BBB_±DDD.D_±PPP.PPP_±EEE.EEE_±FFF.FFF_C : GG CR						
Data field	Code	Data type	Unit	Min.	Max.	Note
Tester ID	z	2-digit decimal	--	00	99	
Result	J	ASCII code (1-digit hexadecimal)	--	1	D	1: LL FAIL 2: Pass 4: UL FAIL 9: LL2 FAIL C: UL2 FAIL D: Error
Leak	L	Fixed point	Leak unit	± 000.000	± 999.999	
DET UL	A	Fixed point	Leak unit	± 000.000	± 999.999	
DET LL	B	Fixed point	Leak unit	± 000.000	± 999.999	
ΔP	D	Fixed point	daPa	± 000.0	± 999.9	
Test pressure	P	Fixed point	Test press unit	± 000.000	± 999.999	
TP UL	E	Fixed point	Test press unit	± 000.000	± 999.999	
TP LL	F	Fixed point	Test press unit	± 000.000	± 999.999	
CH#	C	1 character	--	0	V	0 to 9, A to V, Z
Checksum	G	2-digit hexadecimal	--	00	FF	

**DT Format**

ig: 0001, -9.50, -9.50, +.000, -0009.50, 96.1, END, 00, OK, 13-03-25, 00:00:00 CR		
Data field	Example	
Stage Timer	0001	Fixed to "0001".
Leak	-9.50	Floating point
DPS Raw Output	-9.50	Floating point
Comp Value	+.000	Floating point
ΔP	-0009.50	Fixed point
Test pressure	96.1	Floating point
END	END	Fixed to "END"
CH#	00	2-digit decimal
Result	PASS	Refer to the table Result Symbols in <b>2.6 Printer</b> . 
Date	13-03-25	YY-MM-DD
Time	00:00:00	HH:MM:SS

**K Format**

#zz,MM,J,±LLL.LLL,±AAA.AAA,±BBB.BBB,±SSS.SSS,±PPP.PPP,±EEE.EEE,±FFF.FFF,CC,±KKK.KKK,±yyy.yyy,XX,RRRR,YYYY-MM-DD,HH:MM:SS,;GG CR

Data field	Code	Data type	Unit	Min.	Max.	Note
Tester ID	Z	2-digit decimal	--	00	99	
Measurement Mode	M	2-digit decimal	--			00: Leak Test 01: Mastering 02: K(Ve) check 03: NR
Result	J	ASCII code (1-digit hexadecimal)	--	1	D	1: LL FAIL 2: Pass 4: UL FAIL 9: LL2 FAIL C: UL2 FAIL D: Error
Leak	L	Fixed point	Leak unit	± 000.000	± 999.999	
DET UL	A	Fixed point	Leak unit	± 000.000	± 999.999	
DET LL	B	Fixed point	Leak unit	± 000.000	± 999.999	
Comp Value	S	Fixed point	Leak unit	± 000.000	± 999.999	
Test pressure	P	Fixed point	Test press unit	± 000.000	± 999.999	
TP UL	E	Fixed point	Test press unit	± 000.000	± 999.999	
TP LL	F	Fixed point	Test press unit	± 000.000	± 999.999	
CH#	C	2-digit decimal	--	00	31 (99)	() : RX11
K(Ve) Auto Setup	K	Fixed point	K(Ve) Unit	± 000.000	± 999.999	
K(Ve) Value	y	Fixed point	K(Ve) Unit	+ 000.000	+999.999	
K(Ve) Check	X	2-digit decimal	%	00	30	00 to 30 every 1%
Error Code	R	4-digit hexadecimal	--			*1
Date		YYYY-MM-DD	--	--	--	
Time		HH:MM:SS	--	--	--	
Checksum	G	2-digit hexadecimal	--	00	FF	

**\*1 Codes for errors and Corresponding Errors of LS-R902**

Error Code	Description
4000	ERROR 11 to 15 Air Operated Valve Error
1000	ERROR 17 Blockage Check Error
0800	K(Ve) Check Fail
0400	ERROR 24 K(Ve) Value Out of Range
0200	ERROR 2: PS Output Out of Range
0100	Large Leak
0080	ERROR 3 Improper Test Pressure, ERROR 4 BAL1 Lost Test Pressure
0040	ERROR 5 Leak Limit Settings Error
0008	ERROR 22 Stop Valves Closed
0004	ERROR 21 DPS Stopped Oscillating
0001	ERROR 23 Mastering Error
0000	Pass

**L Format**

#zz_00_J_±LbLbLb.Lb_±LdLdLd.Ld : GG CR						
Data field	Code	Data type	Unit	Min.	Max.	Note
Tester ID	z	2-digit decimal	--	00	99	
Result	J	ASCII code (1-digit hexadecimal)	--	1	D	1: LL FAIL 2: Pass 4: UL FAIL 9: LL2 FAIL C: UL2 FAIL D: Error
Leak (BAL2)	Lb	Floating point	Leak unit	± 0.000	± 00999	
Leak (DET)	Ld	Floating point	Leak unit	± 0.000	± 00999	
Checksum	G	2-digit hexadecimal	--	00	FF	

**M Format**

#zz_CC_RR_J_±LLL.LLL_±PPP.PPP_±DDD.DDD_±KKK.KKK_HHH.H_III.I_www.w_NNN.N_OOO.O_QQQ.Q_vvv.v_SSS.S_TTT.T_UUU.U_VVV.V_WWW.W_xxx.x_ll_pp_kk_±ccc.ccc_±ddd.ddd_±hhh.hhh_±aaa.aaa_±bbb.bbb_±iii.iii_±EEE.EEE_±FFF.FFF_ee_ff_gg_jj_±mmm.mmm_±nnn.nnn_±ooo.ooo_±qqq.qqq_±rrr.rrr_±sss.sss_t_uu_±YYY.YYY_±ZZZ.ZZZ_YYMMDD_HHMMSS: GG CR						
Data field	Code	Data type	Unit	Min.	Max.	Note
Tester ID	z	2-digit decimal	--	00	99	
CH#	C	2-digit decimal	--	00	31 (99)	( ): RX11
Error Code	R	2-digit decimal	--	00	99	*1
Result	J	ASCII code (1-digit hexadecimal)	--	1	D	1: LL FAIL 2: Pass 4: UL FAIL 9: LL2 FAIL C: UL2 FAIL D: Error
Leak	L	Fixed point	Leak unit	- 999.999	+ 999.999	
Test pressure	P	Fixed point	Test press unit	- 999.999	+ 999.999	
ΔP	D	Fixed point	Pa	-999.999	+999.999	
K(Ve)	K	Fixed point	K(Ve) Unit	-999.999	+999.999	
DL1	H	Fixed point	Second	000.0	999.9	
CHG	I	Fixed point	Second	000.0	999.9	
BAL1	w	Fixed point	Second	000.0	999.9	
BAL2	N	Fixed point	Second	000.0	999.9	
DET	O	Fixed point	Second	000.0	999.9	
BLW	Q	Fixed point	Second	000.0	999.9	
END	v	Fixed point	Second	000.1	999.9	
EXH	S	Fixed point	Second	000.0	999.9	
MB1	T	Fixed point	Second	000.0	999.9	
MB2	U	Fixed point	Second	000.0	999.9	
PCHK	V	Fixed point	Second	000.0	999.9	*2
PCHG	W	Fixed point	Second	000.0	999.9	
PEXH	x	Fixed point	Second	000.0	999.9	
Leak unit	l	2-digit decimal	--	00	16	*3
Test Press Unit	p	2-digit decimal	--	00	08	*3
K(Ve) Unit	k	2-digit decimal	--	00	03	*3
BAL UL	c	Fixed point	Leak unit	-999.999	+999.999	
BAL LL	d	Fixed point	Leak unit	-999.999	+999.999	
DET (UL2)	h	Fixed point	Leak unit	-999.999	+999.999	
DET (UL)	a	Fixed point	Leak unit	-999.999	+999.999	

DET (LL)	b	Fixed point	Leak unit	-999.999	+999.999	
DET (LL2)	i	Fixed point	Leak unit	-999.999	+999.999	
TP UL	E	Fixed point	Test press unit	-999.999	+999.999	
TP LL	F	Fixed point	Test press unit	-999.999	+999.999	
Press Monitor	e	2-digit decimal	--	00	01	
Comp Type	f	2-digit decimal	--	00	02	*3
Mastering Iterations	g	2-digit decimal	--	00	20	
Number of Samples	j	2-digit decimal	--	00	20	
Drift Comp	m	Fixed point	Leak unit	-999.999	+999.999	
Mastering Comp	n	Fixed point	Leak unit	-999.999	+999.999	
D. Comp Upper Limit	o	Fixed point	Leak unit	-999.999	+999.999	
D. Comp Lower Limit	q	Fixed point	Leak unit	-999.999	+999.999	
M. Comp Upper Limit	r	Fixed point	Leak unit	-999.999	+999.999	
M. Comp Lower Limit	s	Fixed point	Leak unit	-999.999	+999.999	
Press Inlet	t	1-digit decimal	--	0	1	Fixed to 00
NR Iterations	u	2-digit decimal	--	00	20	
EP Precharge	Y	Fixed point	Test press unit	-999.999	+999.999	
EP Pressurization	Z	Fixed point	Test press unit	-999.999	+999.999	
Date		YYMMDD	--	--	--	
Time		HHMMSS	--	--	--	
Checksum	G	2-digit hexadecimal	--	00	FF	

**\*1 Codes for errors and Corresponding Errors of LS-R902**

Error Code	Description
00	Not Error (Pass/Fail)
01	ERROR 23: Mastering Error
02	ERROR 52: AD Communication Error
03	ERROR 21: DPS Stopped Oscillating
04	ERROR 22: Stop Valves Closed
05	ERROR 5: Leak Limit Settings Error
08	ERROR 3: Improper Test Pressure    ERROR4: BAL1 Lost Test Pressure
10	ERROR 2: PS Output Out of Range
15	ERROR 11 to15: Air Operated Valve Error
16	ERROR 53: I/O Communication Error
17	ERROR 3: Zero "0" was set to the Lower Limit (TP LL).
21	ERROR 17: Blockage Check Error

**\*2** Fixed to a value from 0.2 to 999.9 [s] for the pneumatic circuits that have the stage and 0.0 [s] for those that don't have the stage.

**\*3 Leak Unit, Test Pressure Unit, K(Ve) Unit and Compensation Type**

	Description
Leak Unit	<b>00:</b> Pa, <b>01:</b> kPa, <b>02:</b> mmH <sub>2</sub> O, <b>03:</b> inH <sub>2</sub> O, <b>04:</b> mmHg, <b>05:</b> mL/s, <b>06:</b> mL/min, <b>07:</b> in <sup>3</sup> /min, <b>08:</b> in <sup>3</sup> /d, <b>09:</b> L/min, <b>10:</b> ft <sup>3</sup> /h, <b>11:</b> Pa·m <sup>3</sup> /s, <b>12:</b> E-3 Pa·m <sup>3</sup> /s, <b>13:</b> Pa/s, <b>14:</b> Pa/min, <b>15:</b> *Pa/s, <b>16:</b> *Pa/min
Test Pressure Unit	<b>00:</b> kPa, <b>01:</b> MPa, <b>02:</b> psi, <b>03:</b> kg/cm <sup>2</sup> , <b>04:</b> bar, <b>05:</b> mbar, <b>06:</b> mmHg, <b>07:</b> cmHg, <b>08:</b> inHg.
K(Ve) Unit	<b>00:</b> mL, <b>01:</b> L, <b>02:</b> in <sup>3</sup> , <b>03:</b> ft <sup>3</sup>
Comp Type	<b>00:</b> No Compensation, <b>01:</b> Drift Compensation / Fixed Compensation, <b>02:</b> Mastering Compensation / Drift & Mastering Compensation

**P Format**Refer to **2.6 Printer**.**D Format**

ig: 0001, -9.50, -9.50, +.000, -9.50, 96.1, CHG, 00 CR

Data field	Example	
Stage Timer	0001	4-digit decimal
Leak	-9.50	Floating point, The unit is the specified unit.
DPS Raw Output	-9.50	Floating point
Comp Value	+.000	Floating point
ΔP	-9.50	Fixed point
Test pressure	96.1	Floating point
Stage	CHG	Refer to "6 SETUP" for the details.
CH#	00	2-digit decimal

**2.5 Checksum**

Checksum is two's complement of the value that adds every ASCII code in the calculation range from "#" to ".".

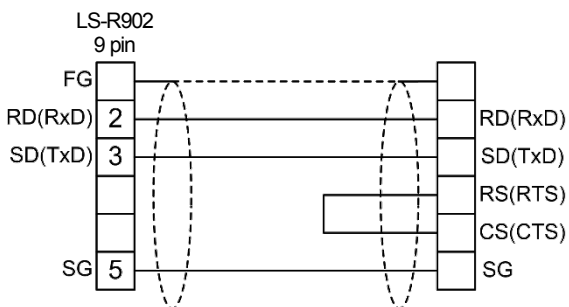
Calculation example: T format

Character number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Transmitted data	#	0	0		0	0		2		-	0	0	0	.	4	:	3	2	CR
ASCII	HEX	23	30	30	20	30	30	20	32	20	2D	30	30	30	2E	34	3A		D
Code	DEC	35	48	48	32	48	48	32	50	32	45	48	48	48	46	52	58		13

		DEC notation	HEX notation	Lower two digits		Note
		(DEC)	(HEX)	HEX notation	BIN notation	
	Sum	718	2CE	CE	11001110	Sum of every ASCII code
Calculation of data strings	Complement	-719	D31	31	110001	Complement of the sum
	Two's complement	-718	D32	32	110010	Adds 1 to the complement value
Checksum		32				

**2.6 Printer**

Use a printer that can print 80 characters or more in one line, and that can print character fonts. Also, use a cable whose length is 3 m or shorter.

**Printer Cable Wiring**

Change settings for the printer to the follows:  
 CR: Carriage Return  
 Baud Rate: 9600 (bps)

### Data Dumping

Data is printed out after every leak test.

#### Print Out Fields

Field	Example	
DATE	12-12-01	Date the test was completed (yy-mm-dd)
TIME	11:14:21	Time the test was completed
CH#	00	Channel number in which the test was done
TOTAL#	00000116	Quantity of parts that have been tested
PRESSURE	+97.8 kPa	Test pressure measured
dP[Pa]	+5.59	The detected differential pressure drop
COMP[Pa]	+5.77	Amount of compensation (in Leak Unit)
LEAKAGE	+ .000 mL/min	Calculated leak rate (after compensation)
RESULT	OK	Judgment of whether part is within the programmed leak limits (Pass). If there is an error detected during the leak test, an error symbol will be printed.

#### Result Symbols in Leak Test Data Print Out and D Format

Result Symbol	Description
OK	Pass
OK(M)	Mastering Pass
CHG +NG , CHG -NG	CHG Large Leak UL, CHG Large Leak LL
UL NG* , LL NG*	BAL2 Large Leak UL/BAL2 UL/DL2 Large Leak UL BAL2 Large Leak LL/BAL2 LL/DL2 Large Leak LL
UL NG , LL NG	DET UL, DET LL
UL2 NG , LL2 NG	DET UL2/DET Large Leak UL, DET LL2/DET Large Leak LL
PS OV!	ERROR 2: PS Output Out of Range
TP <> !	ERROR 3: Improper Test Pressure
P.Lo=0	ERROR 3: Zero "0" was set to the Lower Limit (TP LL).
B1TP<>!	ERROR 4: BAL1 Lost Test Pressure
LIMIT!	ERROR 5: Leak Limit Settings Error
AV ?!1	ERROR 11: Air Operated Valve Error 1
AV ?!2	ERROR 12: Air Operated Valve Error 2
AV ?!4	ERROR 14: Air Operated Valve Error4
AV ?!5	ERROR 15: Air Operated Valve Error 5
DPS ?!	ERROR 21: DPS Stopped Oscillating
V CLS!	ERROR 22: Stop Valves Closed
MCMP<>!	ERROR 23: Mastering Error
SLV0!	ERROR 52: AD Communication Error
SLV1!	ERROR 53: I/O Communication Error
FRAMc !	ERROR 61: FRAM Checksum Error

## 3 USB Port

Data speed is USB1.

Use the USB memory formatted to FAT16 or FAT32 file system.

### NOTE

Do not connect an USB memory infected with a virus to LS-R902.  
Cosmo will not be responsible for malfunction of LS-R902 due to virus infection via USB Memories.

### 3

#### What data can be stored or copied to USB Memory from LS-R902

- Parameters in one file (CSV copy to USB) in Settings Menu
- Live Test Data Recording (Test Data, Waveform Data, Mastering Data) in System Menu
- Test Data Copy in Analysis Menu
- Parameter Backup for Restore (Except SPAN and Compensation value)
- Entire System Backup for Restore (Except SPAN and Compensation value)
- Operation Manual in Miscellaneous Menu

#### What data in USB Memory can be written to LS-R902

- Parameter Backup data
- System Backup data



### Attention

When restoring (copying) the test parameters saved in a USB memory to other LS-R902, use the "Selective Restore".  
Using "Restore All" overwrites some crucial information such as span values of the differential pressure sensor and pressure sensor, resulting in incorrect measurement.

## 4 LAN Port

FTP server is planned to be equipped in the future.



## Operation Manual

# 4

## BASIC TOUCH SCREEN OPERATIONS

<b>1</b>	<b>Turn On Power.....</b>	<b>40</b>
<b>2</b>	<b>Go to Sub Menus, Pages and Items.....</b>	<b>40</b>
<b>3</b>	<b>Go Back to the Previous Page .....</b>	<b>41</b>
<b>4</b>	<b>Settings Lock / Unlock.....</b>	<b>41</b>
4.1	Unlock / Lock Settings.....	41
<b>5</b>	<b>Switch the Operation Mode between Remote and Manual.....</b>	<b>42</b>
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7.4	Enter a date (Date, Replacement Date (Battery) and Next Inspection Date) .....	44
7.5	Enter time (hour, minute and date).....	44

# 1 Turn On Power

Turn on the power with the power switch on the rear panel.  
The Home screen will be displayed on the LCD.  
(Default is Standard measurement screen)

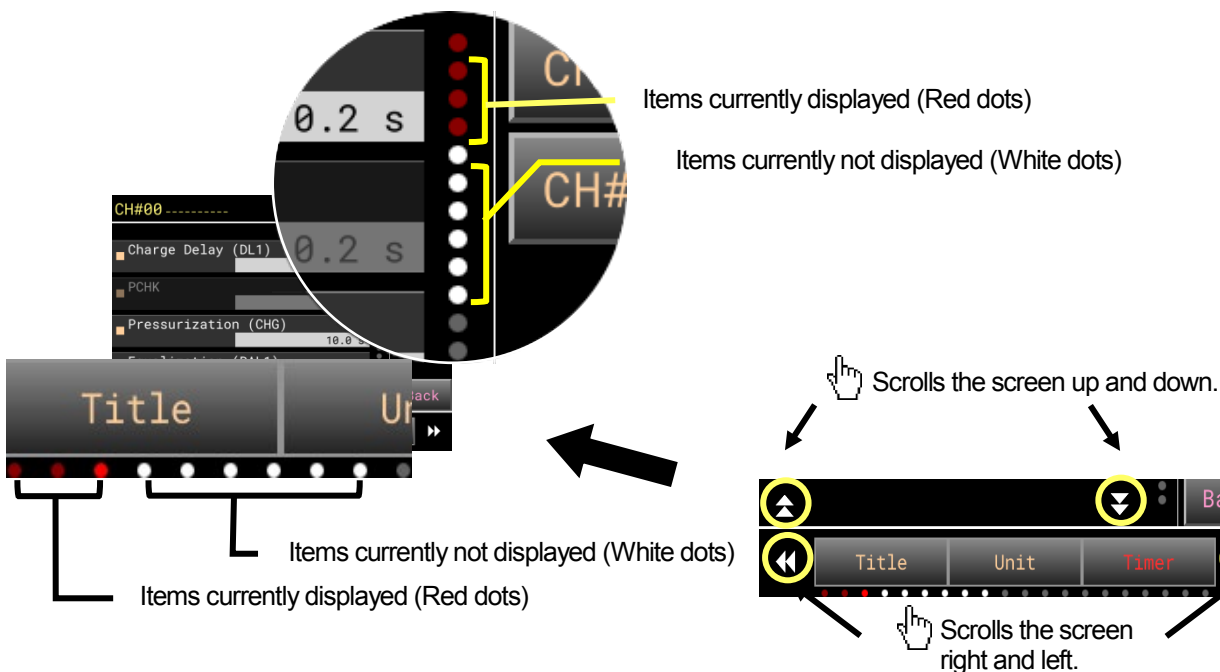
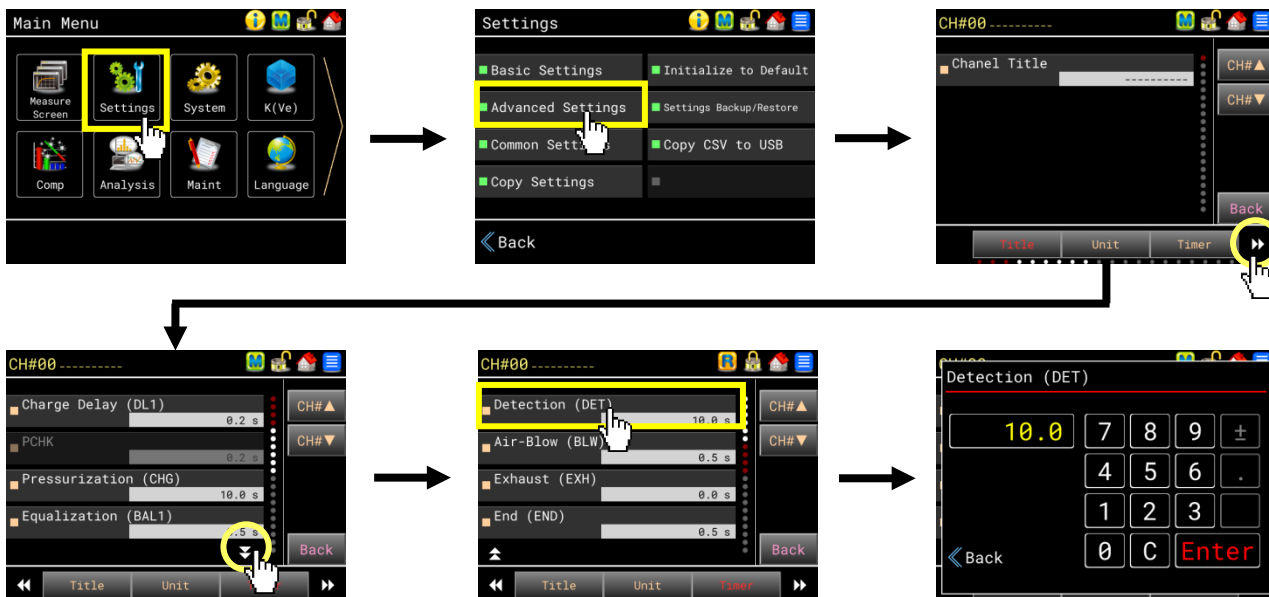
## NOTE

Tapping **Back** on the Home screen opens the Main Menu Screen.

Let the power on for 5 minutes or longer for a warm-up before starting leak tests.

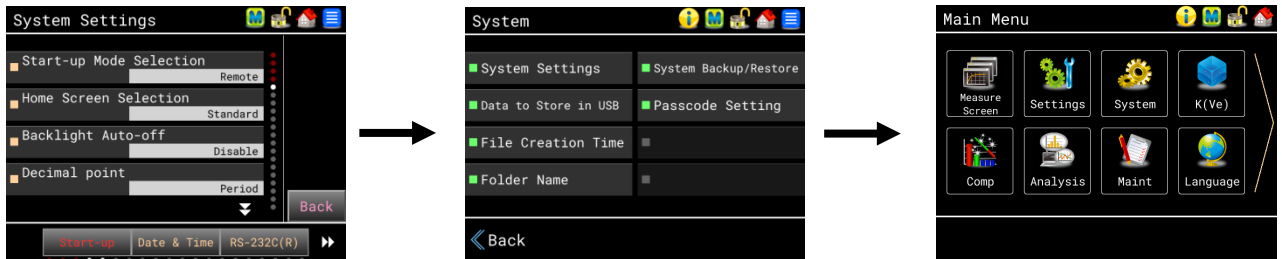
# 2 Go to Sub Menus, Pages and Items

All sub menus are accessible from the Main Menu, which consists of 2 pages.  
Tapping an icon or an item button goes to the next page.



### 3 Go Back to the Previous Page

Tap **Back**.



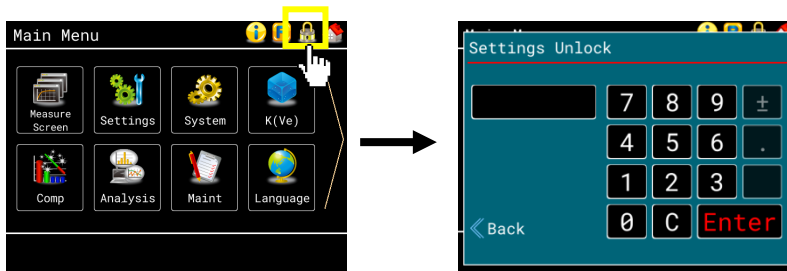
#### NOTE

Tapping **Back** on the Home screen that was displayed when the power is turned on opens the Main menu.

4

## 4 Settings Lock / Unlock

Unlocking the settings enables settings change. (Settings cannot be changed when it's locked)  
Tapping the Lock icon pops up Settings Unlock window.



#### NOTE

Use the Lock icon at the top of the Main Menu only to unlock or lock the settings.

### 4.1 Unlock / Lock Settings

#### Unlocking settings




**Go to:** Main Menu > Lock > Settings Unlock > Enter the passcode (Default: 0000) > **Enter**

#### Locking settings



**Go to:** Main Menu > Lock > The key is locked.

## 5 Switch the Operation Mode between Remote and Manual

When the power is turned on, the operation mode will default to the currently set operation mode. (Default is Remote.) To switch the operation mode, Tap  on the upper right of the Main Menu after unlocking settings.

### Switch from Remote to Manual




Main Menu > **Rem/Man** > “Switch to Manual OK to continue?” > **Yes**  
**R** on the upper right turns to **M**.

### Switch from Manual to Remote



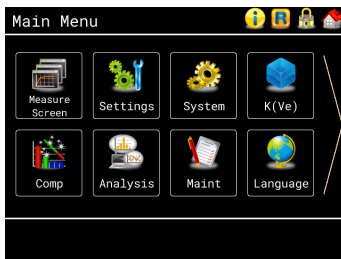
Main Menu > **Rem/Man** > “Switch to Remote OK to continue?” > **Yes**  
**M** on the upper right turns to **R**.


#### NOTE

Tapping  on the Home screen while settings are locked displays “Settings Unlock” screen. Enter the passcode. A message asking whether to switch to Remote Mode appears.

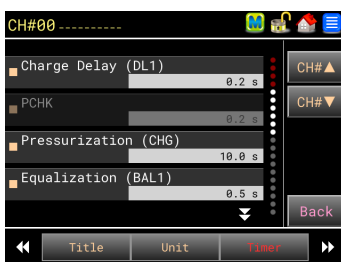
## 6 Go to Home Screen

### 6.1 From Main Menu Screen




Tap  on the upper right corner.

### 6.2 Directly From a Setting Screen (Shortcut)




This is a shortcut to open the Home screen without going through the Main Menu.

Tap  on the upper right corner.  
 This is convenient for searching the most appropriate test parameters by performing leak tests repeatedly.

6.3 To Main Menu from a Measure Screen or Setting Screen



Tapping once the icon displays the Main Menu. It is unnecessary to tap the **Back** several times to go back to the Main Menu.

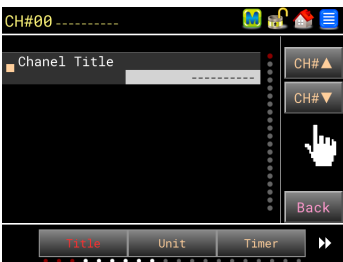
Tap  on the upper right corner.

7 Settings Operations

NOTE

Settings change is disabled while the settings are locked.  
Please unlock settings.  
**Go to:** Lock > Settings Unlock

7.1 Change channels



Channel I number ascends by tapping **CH#▲** as CH#1 > CH#2 > CH#3...  
Channel number descends by tapping **CH#▼** as CH#31>CH#30>CH#29...

NOTE

The channel defaults to 00 when the power is turned on.  
However, in Manual mode, the channel defaults to the one displayed when the power was turned off the last time.

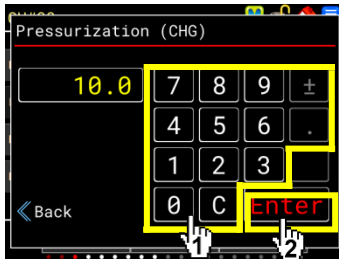
7.2 Select an Option From Multiple Selections



This is the settings for the items which are selected from multiple options.  
Tap an item to set and a popup window for the options opens.

- 1) The option with a red square is currently selected.  
Select an item and its square becomes yellow
- 2) Press **Enter** to complete the selection.

### 7.3 Enter a value with the numeric keypad

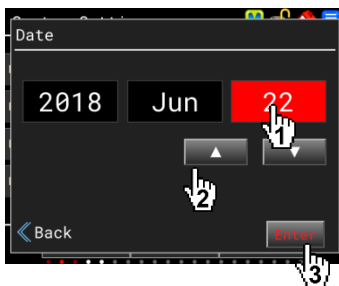


This is the settings for the items for which values are entered using the numeric keypad.

Tap an item to set and a popup window with a numeric keypad opens.

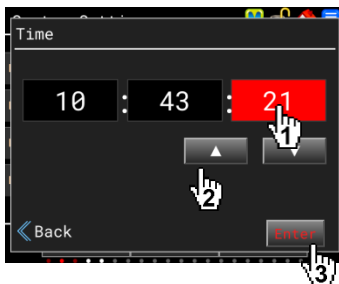
- 1) Tap **C** to clear the current value and enter a value.
- 2) Tap **Enter** to complete the selection.

### 7.4 Enter a date (Date, Replacement Date (Battery) and Next Inspection Date)



- 1) Select an item to change among year, month and date. The selected item is highlighted.
- 2) Tap ▲ ▼ to change the numbers.
- 3) **Enter** to complete.

### 7.5 Enter time (hour, minute and date)



- 1) Select an item to change among hour, minute and second. The selected item is highlighted.
- 2) Tap ▲ ▼ to change the numbers.
- 3) **Enter** to complete.

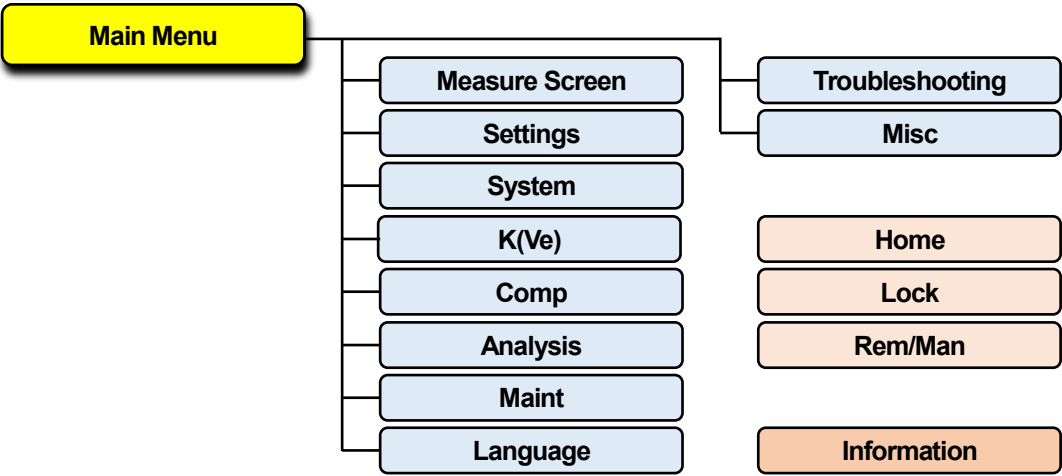
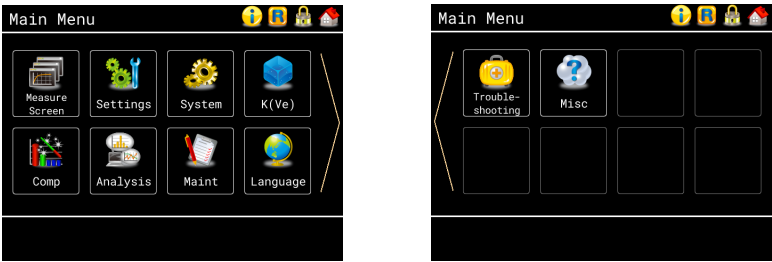
# 5


## SCREEN LIST


<b>1</b>	<b>Main Menu .....</b>	<b>46</b>	<b>6</b>	<b>Comp Menu .....</b>	<b>63</b>
<b>2</b>	<b>Measurement Screen Menu .....</b>	<b>47</b>	6.1	Mastering Settings .....	63
2.1	Measurement Screens (Remote) .....	47	6.2	Mastering Display .....	64
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2.6	Measurement Screen Description: Test Result Log (Manual) .....	51	7.1	Counter .....	66
2.7	Measurement Screen Description: X-Chart (Manual) .....	51	7.2	X-Chart/List .....	66
2.8	Customize Screen .....	51	7.3	Waveform .....	66
<b>3</b>	<b>Settings Menu .....</b>	<b>52</b>	<b>8</b>	<b>Maint (Maintenance) Menu .....</b>	<b>67</b>
3.1	Basic Settings .....	53	8.1	Memory Handling .....	67
3.2	Advanced Settings .....	54	8.2	Error Log .....	67
3.3	Common Settings .....	57	8.3	I/O Monitor .....	67
3.4	Copy Settings .....	57	8.4	Touch-screen .....	68
3.5	Initialize to Default .....	57	8.5	Inspection .....	68
3.6	Settings Backup/Restore .....	58	8.6	Calibration Reminder .....	68
3.7	Copy CSV to USB .....	58	8.7	Inspection Items .....	68
<b>4</b>	<b>System Menu .....</b>	<b>59</b>	8.8	Reboot .....	68
4.1	System Settings .....	59	<b>9</b>	<b>Language Menu .....</b>	<b>69</b>
4.2	Data to Store in USB .....	61	<b>10</b>	<b>Troubleshooting Menu .....</b>	<b>69</b>
4.3	File Creation Time .....	61	10.1	Error List .....	69
4.4	Folder Name .....	61	10.2	Large Leak List .....	69
4.5	System Backup/Restore .....	61	10.3	Frequent (+) Fails .....	69
4.6	Passcode Setting .....	61	10.4	Frequent (-) Fails .....	70
<b>5</b>	<b>K(Ve) Menu .....</b>	<b>62</b>	<b>11</b>	<b>Misc (Miscellaneous) Menu .....</b>	<b>70</b>
5.1	K(Ve) Settings .....	62	11.1	System Version .....	70
5.2	K(Ve) Automatic Setup .....	62	11.2	Calculation Tools .....	70
5.3	K(Ve) Check .....	63	11.3	Common Peripherals .....	70
			11.4	Copy Operation Manual .....	70

# 1 Main Menu


This is the main menu. It consists of two screen pages. All sub menus are accessible from this screen.

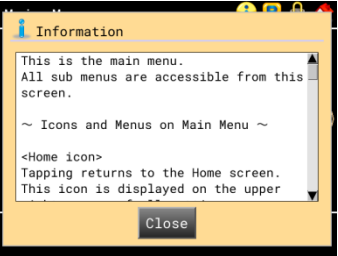


**Home**  Tapping the icon returns to the Home screen.  
To set the Home screen, **go to:** System > System Settings > Start-up > Home Screen Select

**Lock**  Lock and unlock settings.

**Rem/Man**  Toggles Remote and Manual for measurements.

**Information** 



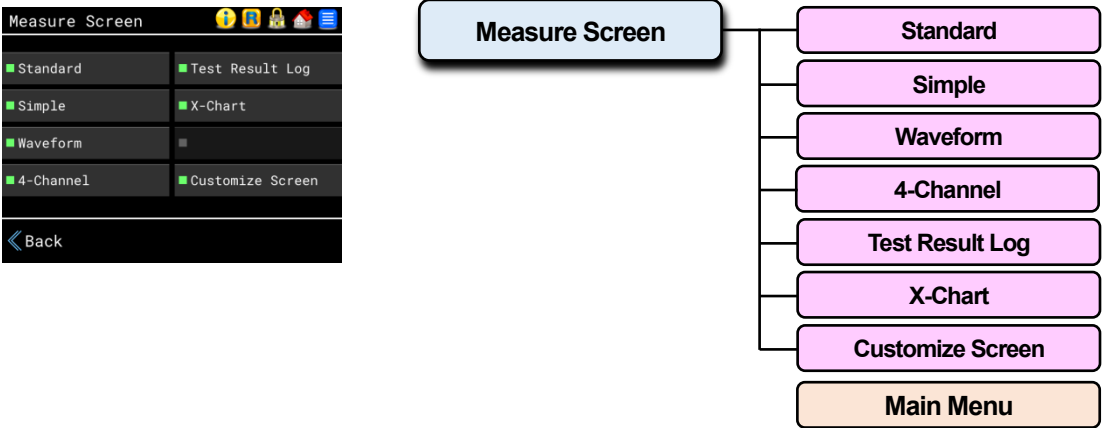
Tapping the icon opens information for each menu.




# 2 Measurement Screen Menu

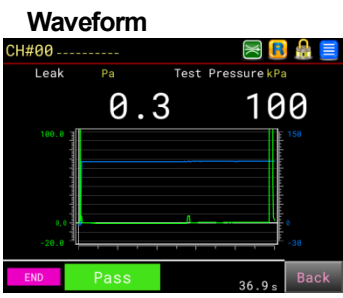
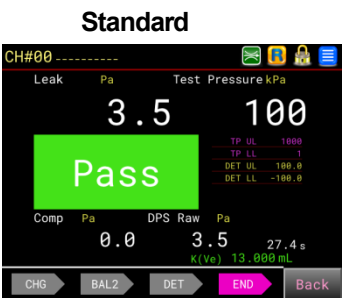


There are 6 measurement screens, Standard, Simple, Waveform, 4-Channel, Test Result Log and X-Chart. The screens can be switched while a test is in progress.



 The Main Menu icon is displayed in each screen except the Language screen.

## 2.1 Measurement Screens (Remote)



**4-Channel**

CH#24 -----

CH#	Leak Pa	Test Pressure kPa	Pass
00	1.0	100	Pass
08	2.3	100	Pass
16	1.7	100	Pass
24	1.0	100	Pass

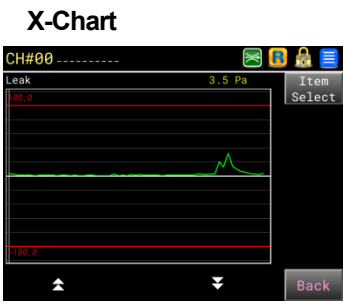
END 27.4 s Back

**Test Result Log**

CH#00 -----

No.	DET Leak	Judgment	Time
50	12.1	Pass	17:03:32
51	31.8	Pass	10:19:21
52	14.3	Pass	10:38:15
53	9.1	Pass	10:38:51
54	6.4	Pass	10:39:20
55	5.0	Pass	10:39:48
56	3.2	Pass	10:40:17
57	2.8	Pass	10:40:46
58	2.0	Pass	10:41:14
59	3.5	Pass	10:41:57

Back



**Customize Screen**

Customize Screen

Leak K(Ve)

Compensation Value DET UL / DET LL

DPS Raw Output TP UL / TP LL

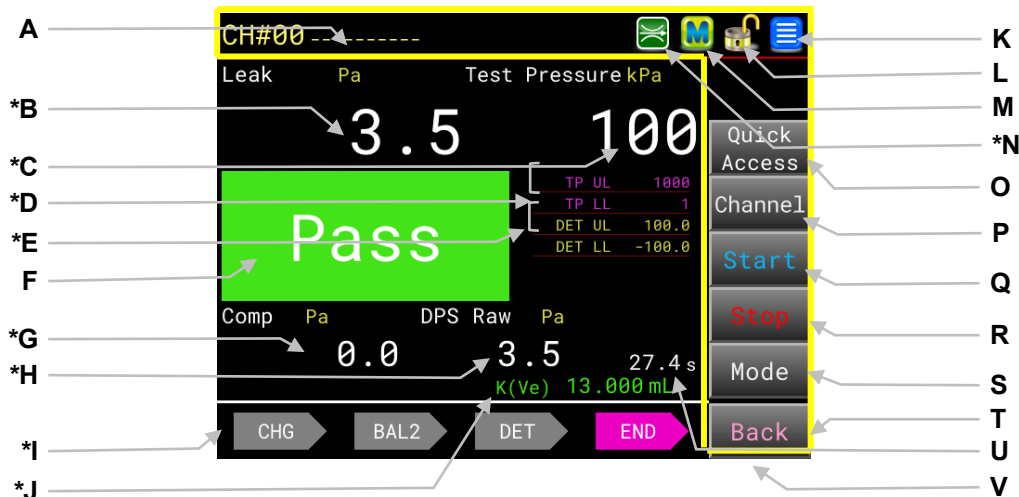
Test Pressure Measuring Time

Back Enter

## 2.2 Measurement Screen Description: Standard (Manual)

Usually manual mode measurement is performed for initial test parameter settings.  
Unlock the settings and toggle the operation mode to Manual.  
The items marked with \* can be Display or Hidden in Customize Screen.

This is the only screen that displays all the items selectable in the Customize Screen.  
The boxed off section is the same for all the measurement screens.



- A** **CH#**: Channel number and title (Up to 20 letters are allowed for the channel title.)
- B** **Leak**: Leak in a selected unit
- C** **Test Pressure**: Test pressure in a selected unit
- D** **TP UL / TP LL**: Upper and lower limits for test pressure
- E** **DET UL / DET LL**: Upper and lower limits for leak in Detection stage.
- F** **Pass/Fail Judgment**: Displayed after a test.
- G** **Comp**: Current compensation value
- H** **DPS Raw**: Raw output of the Differential Pressure Sensor
- I** **Stage**: The current stage
- J** **K(Ve)**: The current K(Ve) value
- K** **Main Menu**: Main Menu icon
- L** **Lock**: Settings Unlock / Lock icon
- M** **Remote/Manual**: **R** for Remote and **M** for Manual

- N** : Green when the Calibration port valve on the front panel ( ) is closed and orange when it's opened.
- O** **Quick Access**: Screens, such as Advanced Settings and Comp can be directly accessed.
- P** **Channel**: Channel selection
- Q** **Start**: Start key. Starts measurement that was selected in the **Mode**.  
Measurement ends after one cycle or is aborted with **Stop**. For Charge hold, LS-R902 keeps pressurizing until **Stop** is tapped.
- R** **Stop**: Stop key. Aborts the measurement or Charge hold.
- S** **Mode**: Mode key. Menu to select a measurement from Leak Test, Mastering, Charge Hold, Automatic Setup, Blockage Data Sample and Auto-Repeat.
- T** **Back**: When power is turned on tapping it goes to the Main Menu and other time, goes back to the previous screen.
- U** **Stage Timer**: Timer for each stage. Total timer is displayed in idle state.
- V** **Buttons**: Displayed only in the Manual Mode.

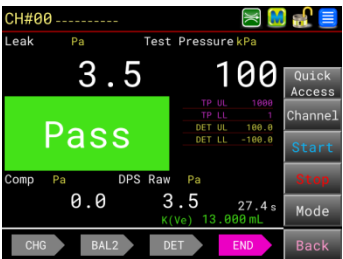
Channel Selection




The channel selection window will pop up by tapping **Channel**.

Channel number descends by tapping **CH#▼** as CH#31>CH#30>CH#29...  
Channel number ascends by tapping **CH#▲** as CH#1>CH#2>CH#3...

Calibration Valve Description



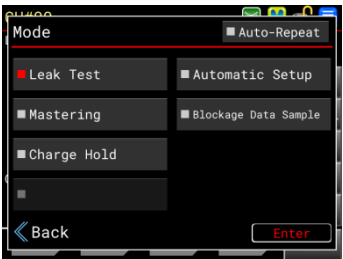
This is used only when the calibrator model is J.  
Green when the Calibration port valve on the front panel (✂) is closed and orange when it's opened. 

This is for checking the Fail Judgment performance by connecting a Leak Master for Fail judgment.

**NOTE**

Although the icon is displayed when the calibrator model is K (ALC is mounted), it cannot be used in the same way as model J.

Mode Description



A measurement to perform has to be selected from the following 6 before performing a measurement.

**Leak Test:** Air Leak Test

**Mastering:** Mastering value sampling

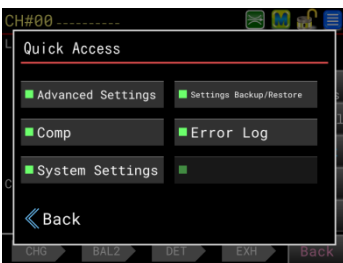
**Charge Hold:** Keeps pressurizing until **Stop** is tapped.

**Automatic Setup:** Primary timers are automatically set for initial setups.

**Blockage Data Sample:** Samples the non-blocked data.

**Auto-Repeat:** Repeats the selected measurement: Leak Test, Mastering or Blockage Data Sample. Select Auto-Repeat after selecting the type of measurement.

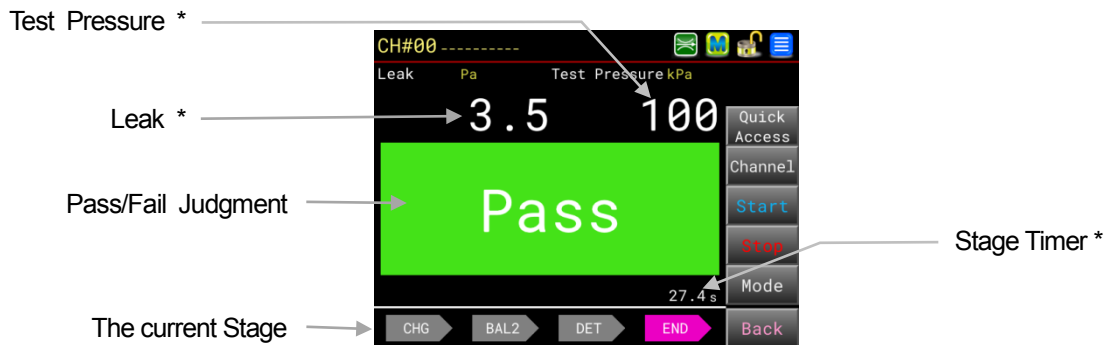
Quick Access



Jumps to the screen selected from:  
Advanced Settings  
Comp  
System Settings  
Settings Backup/Restore  
Error Log

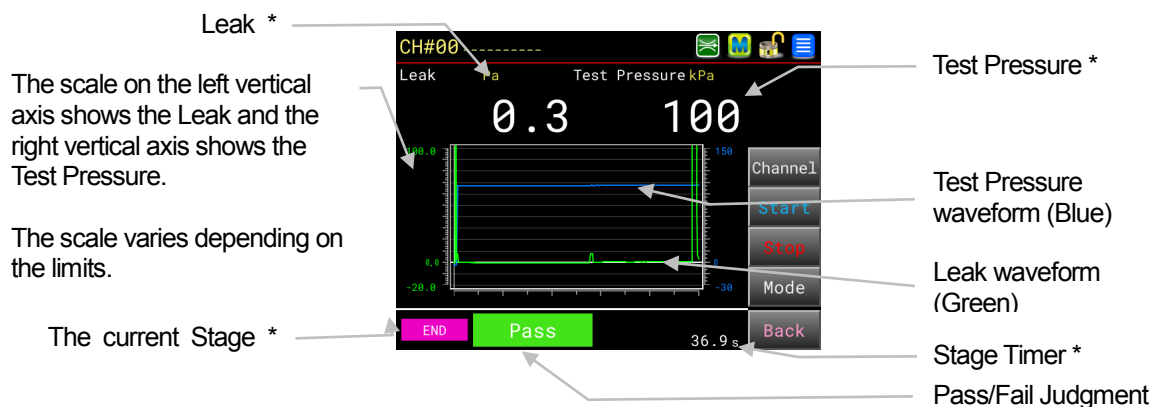
## 2.3 Measurement Screen Description: Simple (Manual)

Simple Pass/Fail display with the test pressure and leak.



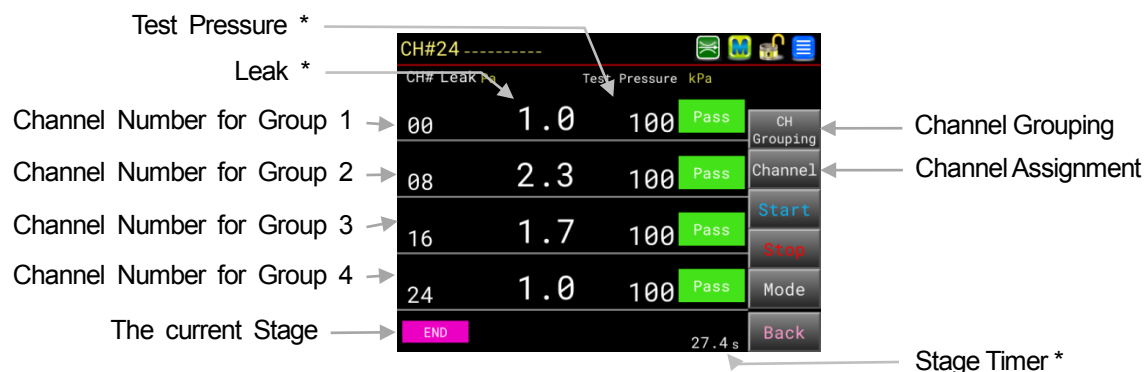
## 2.4 Measurement Screen Description: Waveform (Manual)

Applied test pressure and measured Leak are displayed in graphs. The blue line indicates Test Pressure and the green line indicates Leak.



## 2.5 Measurement Screen Description: 4-Channel (Manual)

Displays up to 4 channels per group of 8 out of 32 channels divided into 4 from 0 to 31 in order. Channels of your choice can be assigned to a group of your choice by tapping **CH Grouping**. This is useful for the cases where multiple cavities on one tested part are tested in a sequence. Entering Stop signal resets all the displayed test results.

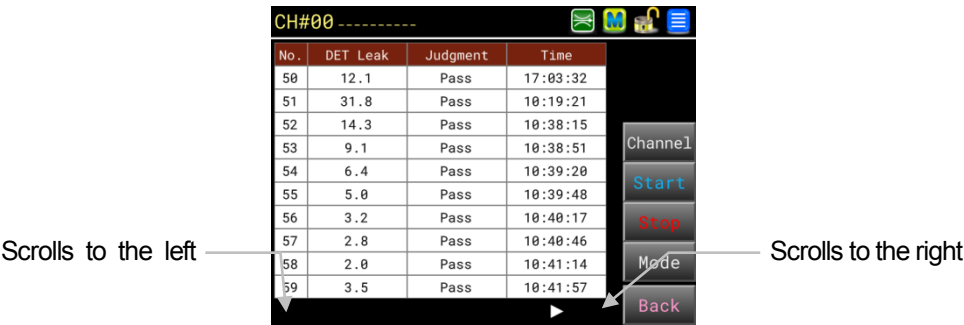


Refer to "7 OPERATIONS LISTED BY PURPOSE" for the details.



2.6 Measurement Screen Description: Test Result Log (Manual)

List of the last 10 test logs that can be viewed during leak tests. The list is updated after every test.



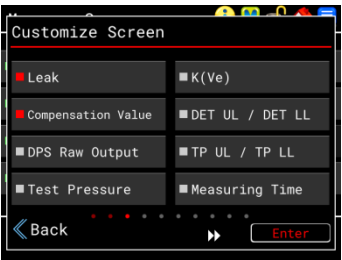
2.7 Measurement Screen Description: X-Chart (Manual)

Test trend of all the stored test logs of the channel of your choice are displayed in a graph. (Up to 5000 logs are stored in all 32 channels)  
The graph is updated after every test.  
Graphed item is selectable by tapping **Item Select**.

5



2.8 Customize Screen

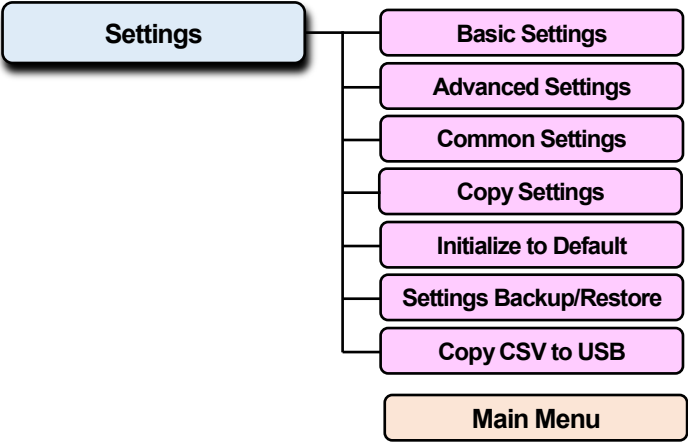
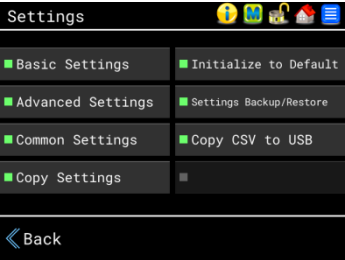


Refer to "6 SETUP" for the details.

# 3 Settings Menu

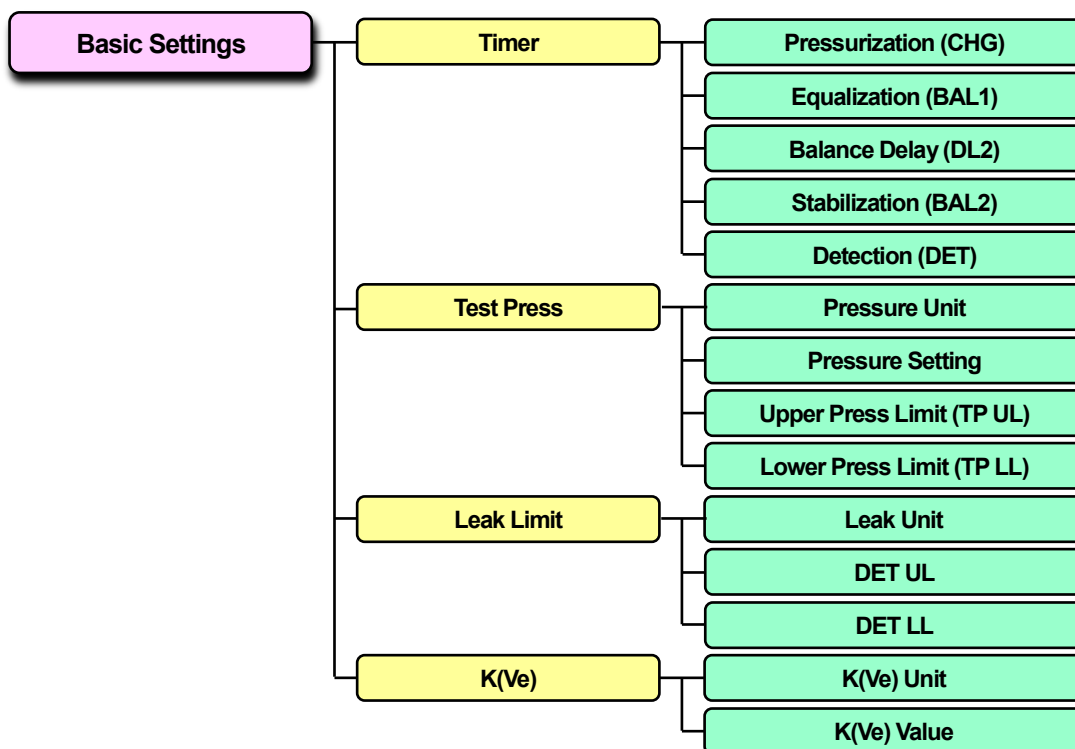


Go to this menu to program the leak test parameters.



### 3.1 Basic Settings

Minimum settings for leak test. Setting these items enables a simple leak test.

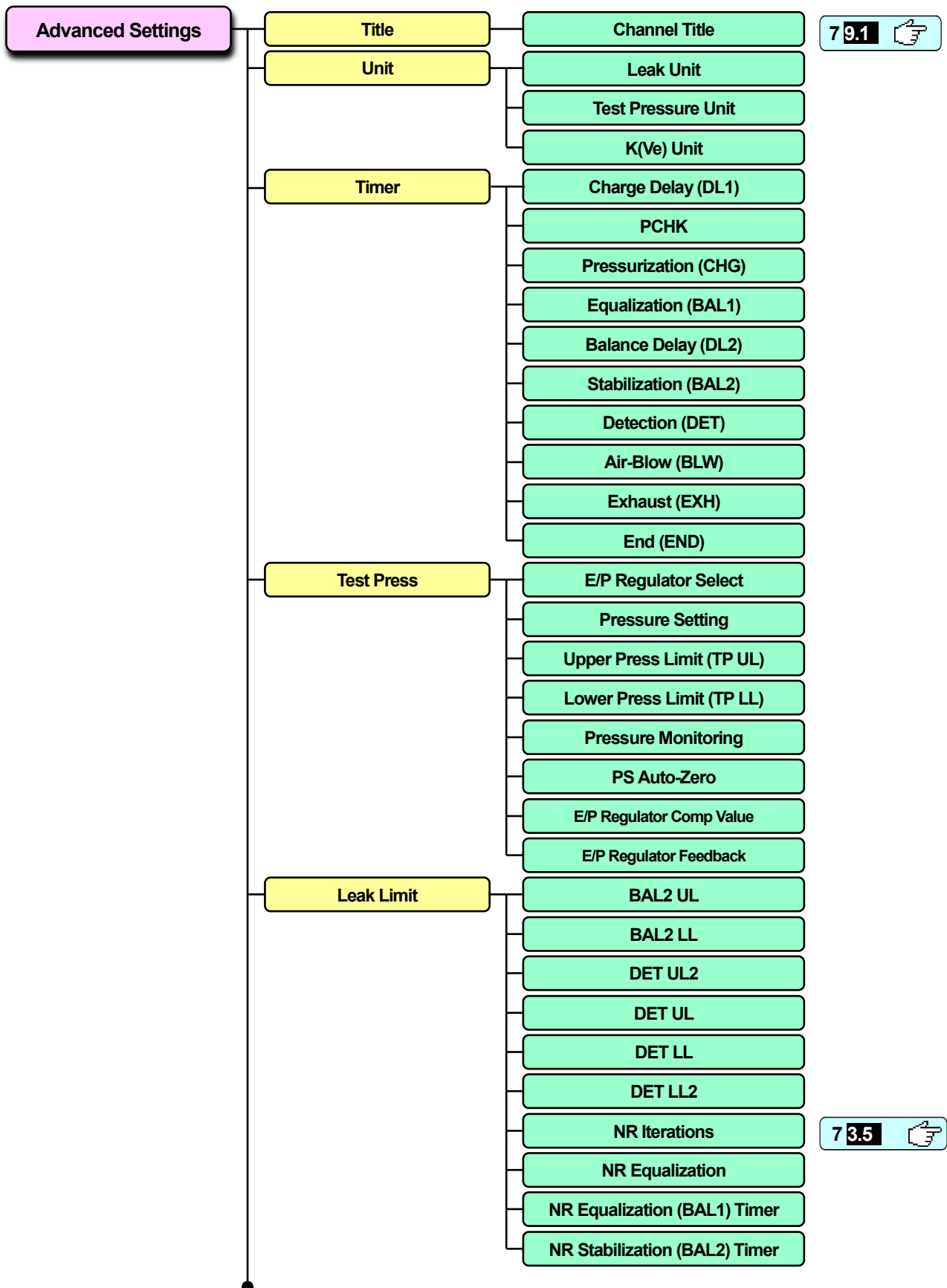


Timer	Pressurization (CHG)	0 to 999.9 [s]
	Equalization (BAL1)	
	Stabilization (BAL2)	
	Detection (DET)	
Test Press	Pressure Unit	kPa, MPa (psi, kg/cm <sup>2</sup> , bar, mbar, mmHg, cmHg, inHg, mmH <sub>2</sub> O) *1
	Pressure Setting	Pressure applied to tested part (WORK) and reference part (MASTER)
	Upper Press Limit (TP UL)	Varies depending on the test pressure range and unit.
	Lower Press Limit (TP LL)	
Leak Limit	Leak Unit	Pa, kPa, mL/s, mL/min, L/min, Pa·m <sup>3</sup> /s, E-3 Pa·m <sup>3</sup> /s, Pa/s, Pa/min, *Pa/s, *Pa/min (mmH <sub>2</sub> O, inH <sub>2</sub> O, mmHg, in <sup>3</sup> /min, in <sup>3</sup> /d, ft <sup>3</sup> /h) *1
	DET UL	Small leak limit for WORK side during DET stage
	DET LL	Small leak limit for MASTER side during DET stage
K(Ve)	K(Ve) Unit	Unit for K(Ve) value. Enter K(Ve) Unit if known.
	K(Ve) Value	Enter K(Ve) value if known.

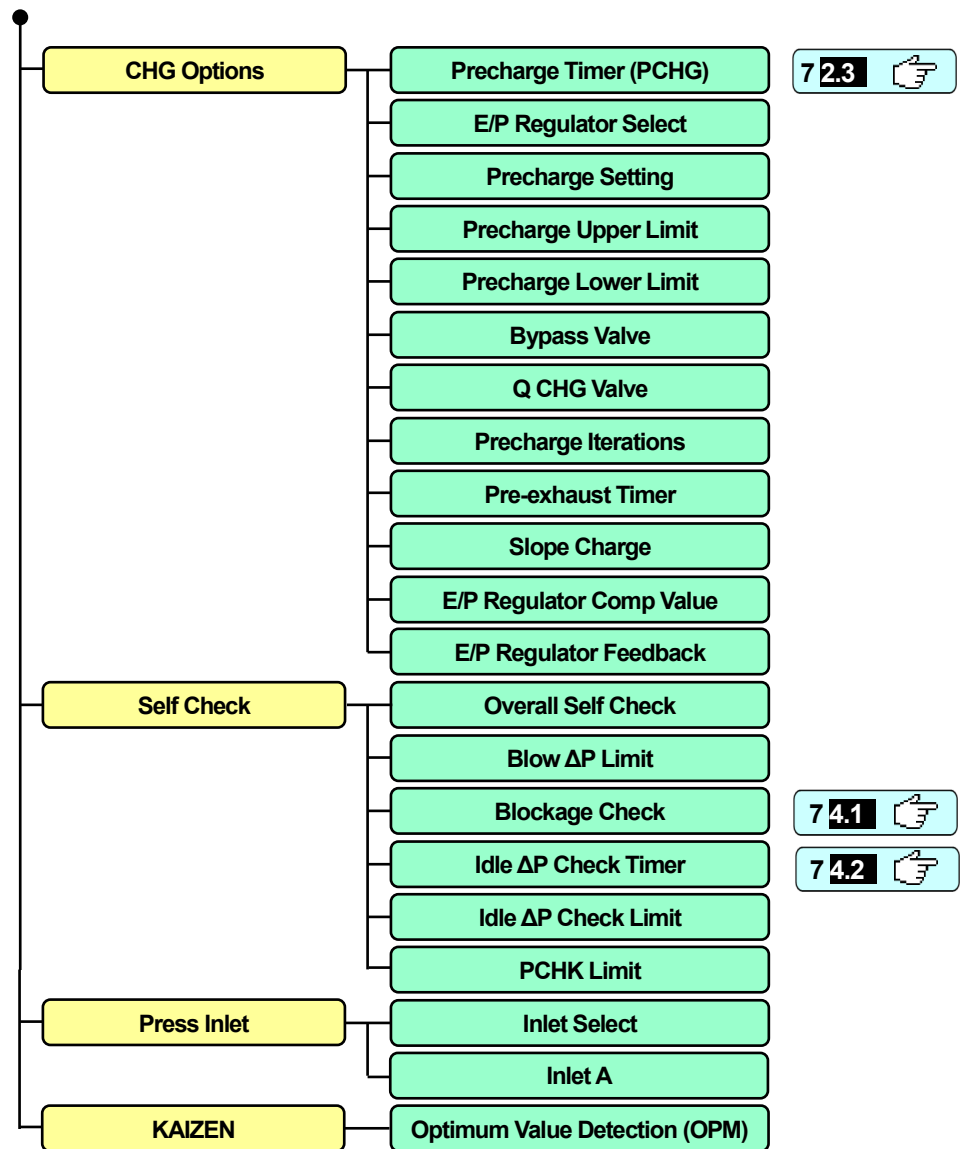
\*1 The units in ( ) are not available for SI unit restriction models.

## 3.2 Advanced Settings

All the leak test settings including the basic settings







Title	Channel Title	Up to 20 letters are allowed.
Unit	Leak Unit	Pa, kPa, mL/s, mL/min, L/min, Pa·m³/s, E-3 Pa·m³/s, Pa/s, Pa/min, *Pa/s, *Pa/min (mmH₂O, inH₂O, mmHg, in³/min, in³/d, ft³/h) *1
	Test Pressure Unit	kPa, MPa (psi, kg/cm², bar, mbar, mmHg, cmHg, inHg, mmH₂O) *1
	K(Ve) Unit	mL, L (in³, ft³) *1
Timer	Charge Delay (DL1)	0 to 999.9 [s]
	PCHK	Fixed to a value from 0.2 to 999.9 [s] for the pneumatic circuits that have the stage and 0.0 [s] for those that don't have the stage.
	Pressurization (CHG)	0 to 999.9 [s]
	Equalization (BAL1)	
	Balance Delay (DL2)	
	Stabilization (BAL2)	
	Detection (DET)	
	Air-Blow (BLW)	
	Exhaust (EXH)	
	End (END)	0.1 to 999.9 [s]

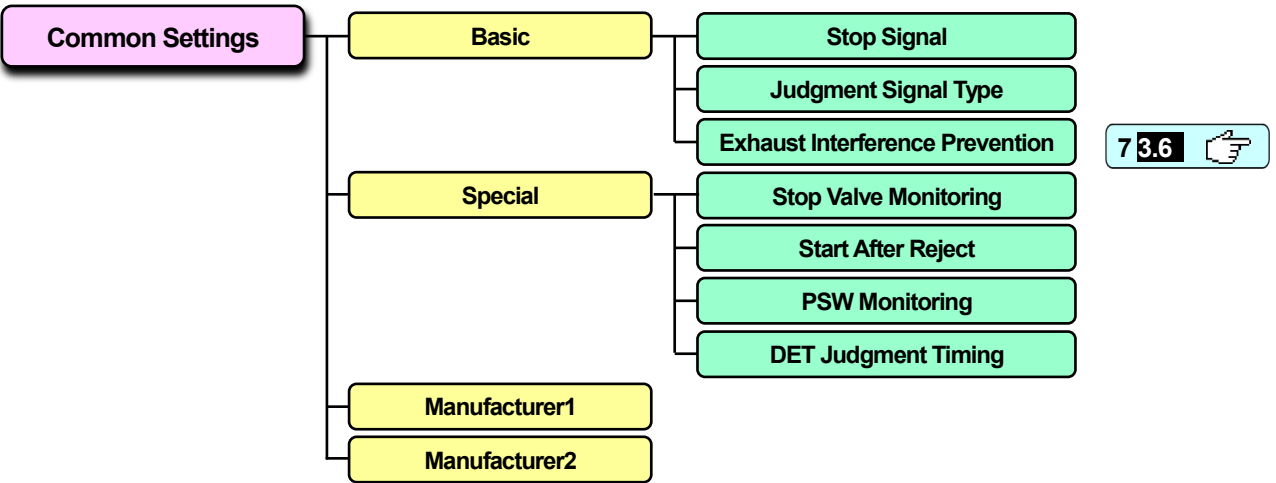
\*1 The units in ( ) are not available for SI unit restriction models.

Test Press	E/P Regulator Select	EP/1
	Pressure Setting	Pressure applied to tested part (WORK) and reference part (MASTER)
	Upper Press Limit (TP UL)	Monitors the test pressure. Criteria for detecting Large leak from sealing fixture.
	Lower Press Limit (TP LL)	Limits are allowed to be negative figures when [Secondary Rise] is selected for the Inlet.
	Pressure Monitoring	Disable, Enable Pressure Monitoring with Upper/Lower test pressure limits.
	PS Auto-Zero	Disable, Enable
	EP Regulator Comp Value	Used when there is a difference between the specified test pressure value and the displayed value.
	E/P Regulator Feedback	PS value will be fed back to the E/P Regulator.
Leak Limit	BAL2 UL	Upper leak limit for WORK side during BAL2 stage
	BAL2 LL	Lower leak limit for MASTER side during BAL2 stage
	DET UL2	Medium leak limit for WORK side during DET stage which should be greater than DET UL.
	DET UL	Small leak limit for WORK side during DET stage
	DET LL	Small leak limit for MASTER side during DET stage
	DET LL2	Medium leak limit for MASTER side during DET stage which should be smaller than DET LL.
	NR Iterations	Settable Range: 1 to 20 Setting it to 1 allows two-level limit setting. NR is enabled when the iterations are set to 2 or larger.
	NR Equalization	Disable, Enable When enabled, the NR Equalization (BAL1) Timer and NR Stabilization (BAL2) Timer can be set before Noise Reduction where normal detection is repeated.
	NR Equalization (BAL1) Timer	0.0 to 999.9 [s]
	NR Stabilization (BAL2) Timer	
CHG Options	Precharge Timer (PCHG)	For testing a large volume part with a low test pressure.
	E/P Regulator Select	EP/1
	Precharge Setting	Available only for E/P regulator models.
	Precharge Upper Limit	
	Precharge Lower Limit	
	Bypass Valve	Disable, Enable      Bypass Circuit Unit is sold separately.
	Q CHG Valve	Not available for this model
	Precharge Iterations	1 to 20
	Pre-exhaust Timer	0.0 to 999.9 [s]      Varies depending on the test specifications.
	Slope Charge	Disable, Enable When enabled, pressure is gradually charged to the specified value of precharge pressure within the time of Precharge Timer.
	EP Regulator Comp Value	The rate of precharge compensation by E/P Regulator.
	E/P Regulator Feedback	PS value will be fed back to the E/P Regulator.
Self Check	Overall Self Check	Enable, Disable
	Blow ΔP Limit	Check the pneumatic circuit of LS-R902
	Blockage Check	Check the blockage of external valves.    0 to 500 % Set to 0 to disable the feature.
	Idle ΔP Check Timer	Check the fill valve during idle state.
	Idle ΔP Check Limit	
	PCHK Limit	1%, 0.5%
Press Inlet	Inlet Select	Not available for this model
	Inlet A	Pressure / Vacuum / Secondary Rise
KAIZEN	Optimum Value Detection (OPM)	Disable, Enable

3.3

Common Settings

Common settings for all the channels



Basic	Stop Signal	Normally Open, Normally Closed	
	Judgment Signal Type	Pulse, Hold	
	Exhaust Interference Prevention	Disable, Enable	
Special	Stop Valve Monitoring	Disable, Enable	Do not change the settings
	Start After Reject	Start only, Stop then Start	Normally "Start only"
	PSW Monitoring	Disable, Enable	Available only for H49, H20 and L02 models
	DET Judgment Timing	End of DET, Abort at Limit	
Manufacturer1		Settings cannot be changed.	
Manufacturer2		Settings cannot be changed.	

3.4

Copy Settings

Test parameters of a channel can be copied to other channels.

Refer to **"7 OPERATIONS LISTED BY PURPOSE"** for the details.

3.5

Initialize to Default

Default settings are copied to the channels of your choice.

Refer to **"7 OPERATIONS LISTED BY PURPOSE"** for the details.

### 3.6 Settings Backup/Restore

The current test parameters can be restored easily from backup after changing them temporarily.

- ☐ Backup
  - ☐ Restore
  - ☐ LS-R900Restore
- 

Restore All

Selective Restore

Refer to **“7 OPERATIONS LISTED BY PURPOSE”** for the details. 

### 3.7 Copy CSV to USB

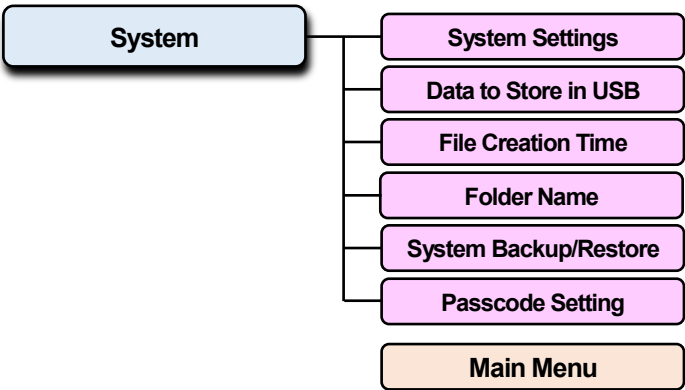
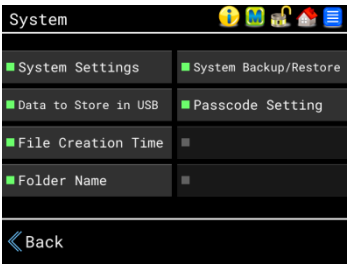
All the current test parameters are copied to USB Memory in the csv format.

Refer to **“7 OPERATIONS LISTED BY PURPOSE”** for the details. 

# 4 System Menu



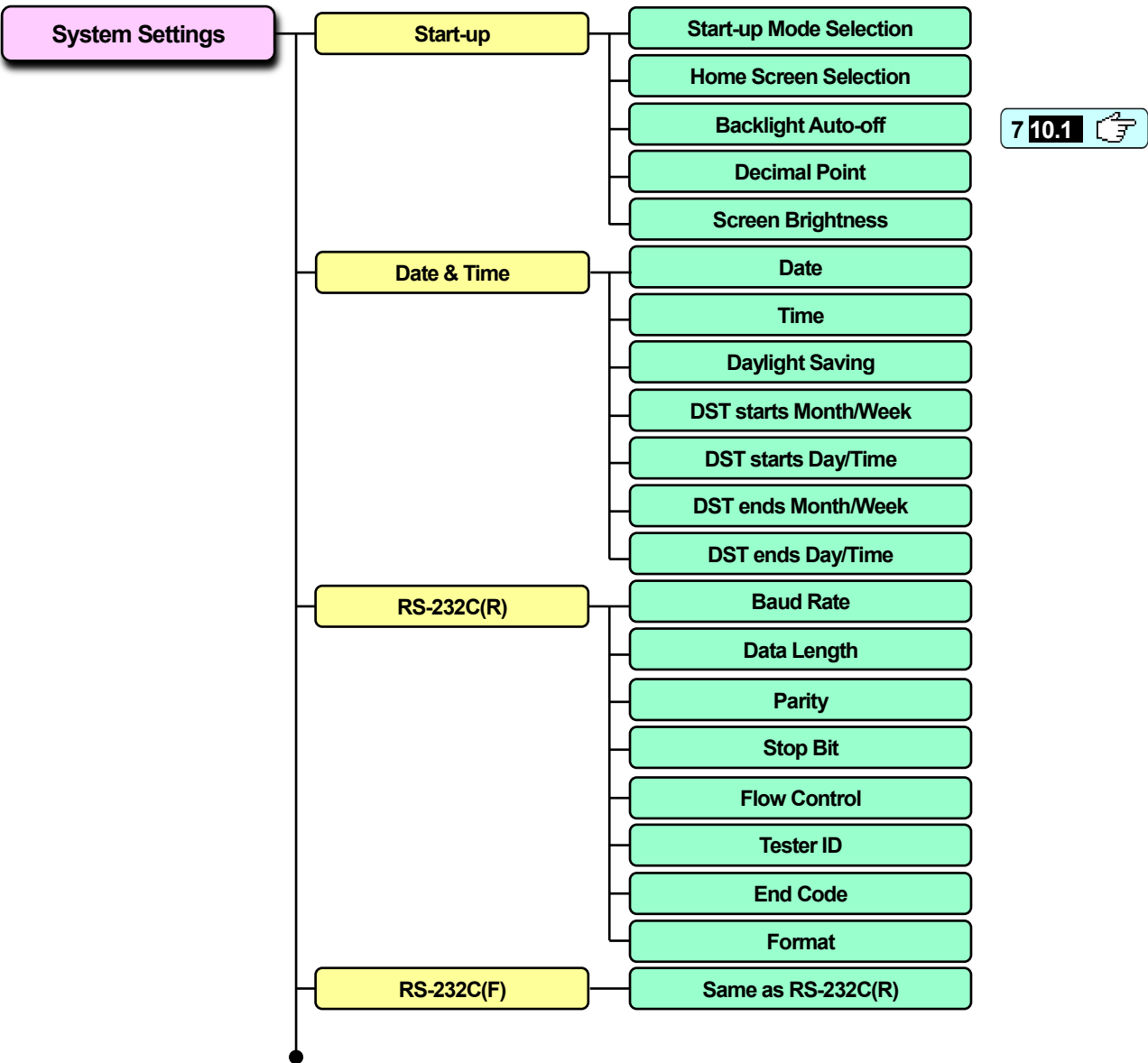
Menu to program the start-up settings, calendar feature and data output and to perform System Backup/Restore.

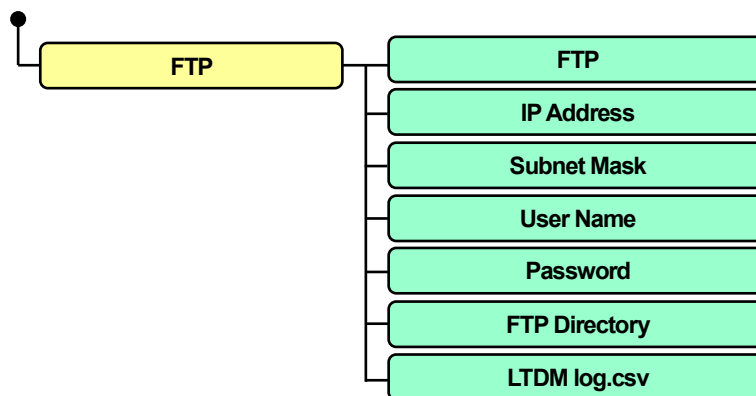


## 4.1 System Settings

Menu to set Start-up conditions, Date and Time and RS-232C

5





Start-up	Start-up Mode Selection	Remote / Manual
	Home Screen Selection	Selectable: Standard, Simple, Waveform, Custom, 4-Channel, Test Result Log, X-Chart
	Backlight Auto-off	Touch-screen backlight goes off if it is not touched for the programmed period. Disable, 1, 5, 10, 30, 60, 120, 240 [min]
	Decimal Point	Period or comma can be selected depending on the language.
	Screen Brightness	The brightness can be adjusted in the range from 1 to 100. 0: Dark 100: Bright
Date & Time	Date	Select year, month and date YYYY-MM-DD
	Time	Select hour, minute and second HH:MM:SS
	Daylight Saving	Disable, Enable DST feature
	DST starts Month/Week	Month: Mar, Apr / Sep, Oct, Nov Week: 1st, 2nd, 3rd, 4th, 5th
	DST starts Day/Time	Day: Sun, Sat Time: 0:00, 1:00, 2:00, 3:00
	DST ends Month/Week	Month: Feb, Mar, Apr / Sep, Oct, Nov Week: 1st, 2nd, 3rd, 4th, 5th
	DST ends Day/Time	Day: Sun, Sat Time: 0:00, 1:00, 2:00, 3:00, 4:00
RS-232C(R)	Baud Rate	9600, 19200, 38400, 57600, 115200
	Data Length	7 or 8 bits
	Parity	None, Even, Odd
	Stop Bit	1 or 2 bits
	Flow Control	None
	Tester ID	An ID will be assigned to each tester when more than one tester is used.
	End Code	<CR><LF>, <CR>, <LF>
	Format	Selectable: T Format, ID Format, I Format, DT Format K Format, L Format, M Format, P Format, D Format
RS-232C(F)	Same as RS-232C (R)	
FTP	FTP	FTP server is planned to be equipped. Currently not available.
	IP Address	
	Subnet Mask	
	User Name	
	Password	
	FTP Directory	
	LTDM log.csv	

## 4.2 Data to Store in USB

Menu to select data to be backed up to USB memory from [Test Data], [Waveform Data], and [Mastering Data].  
(Multiple selections allowed)

Data is stored at the end of each test automatically. File format is CSV.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

- ☐ Test Data (A new file is created once a day. Refer to the next section.)
- ☐ Waveform Data (A new file is created once an hour.)
- ☐ Mastering Data (A new file is created once a month.)

## 4.3 File Creation Time

Menu to set the time to create a new file in a USB memory for storing [Test Data].  
Set the time to create a new file.

A file is created once a day at the programmed hour and data is update at the end of each test automatically.

## 4.4 Folder Name

The folder name can be set to the folder to be stored in the USB memory.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

## 4.5 System Backup/Restore

The current system settings can be restored easily to another tester from backup for the purpose of replacing testers when some trouble happens.

- ☐ Backup
- ☐ Restore
- ☐ LS-R900Restore

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

## 4.6 Passcode Setting

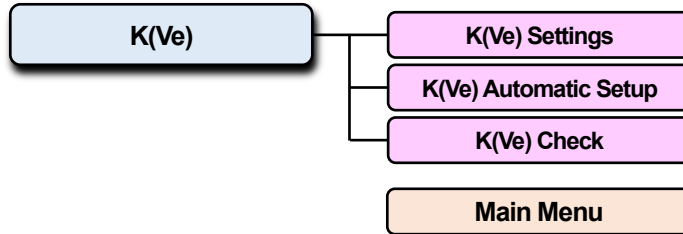
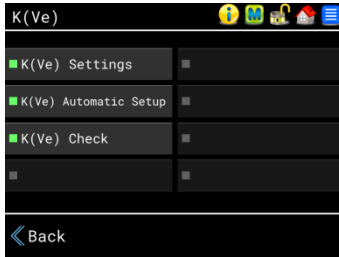
A passcode of your choice can be set. The passcode must be 4-digit number. Default is 0000.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

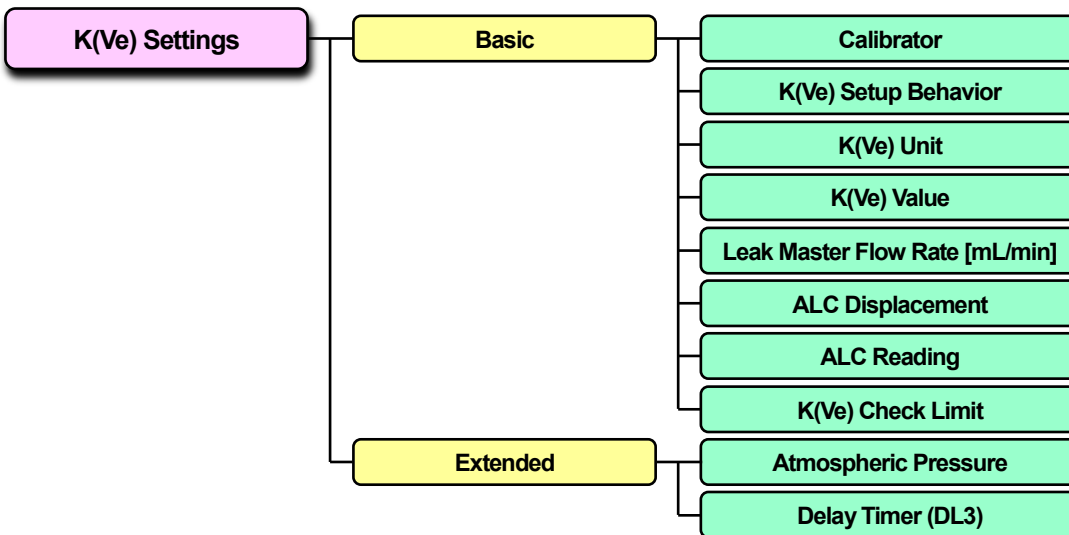
# 5 K(Ve) Menu



LS-R902 computes leakage based on the measurement of the pressure difference between the non-leaking master and the tested part. K(Ve) is "leak coefficient" which is used for converting measured differential pressure into a flow rate. This menu is to program the settings and carrying out the K(Ve) Automatic Setup.



## 5.1 K(Ve) Settings



Basic	Calibrator	ALC, LC1, LC2, LC4, Leak Master, QLC
	K(Ve) Setup Behavior	3-phase, 1-phase, Mastering
	K(Ve) Unit	mL, L (in <sup>3</sup> , ft <sup>3</sup> ) *1
	K(Ve) Value	K(Ve) can be manually entered. K(Ve) is entered automatically through K(Ve) Automatic Setup.
	LM Flow Rate [mL/min]	Enter Leak Master flow rate.
	ALC Displacement	Enter displacement of ALC/LC/QLC.
	ALC Reading	Enter ALC reading (turns)
	K(Ve) Check Limit	Set K(Ve) Check Limit in percentage (%).
Extended	Atmospheric Pressure	Fixed to 101325 [Pa]
	Delay Timer (DL3)	Enter time intervals to be provided between each phase when the 3-phase mode is selected in K(Ve) Setup Behavior.

\*1 The units in ( ) are not available for SI unit restriction models.

## 5.2 K(Ve) Automatic Setup

Menu to perform K(Ve) Automatic Setup

Refer to "7 OPERATIONS LISTED BY PURPOSE" for the details.

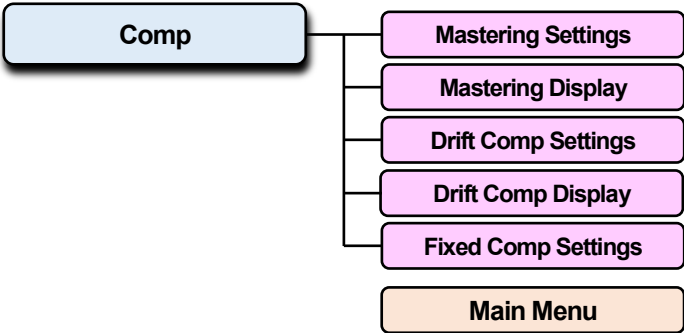
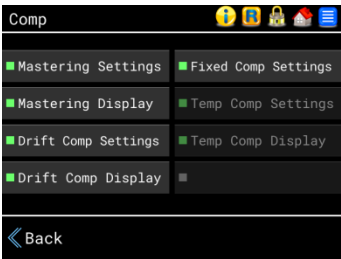


5.3 K(Ve) Check

Menu to perform K(Ve) check manually.  
LS-R902 compares K(Ve) measured with a known good part to the K(Ve) stored in memory.  
An error is displayed if the difference exceeds the tolerance.  
This can be used for daily sensitivity checks.

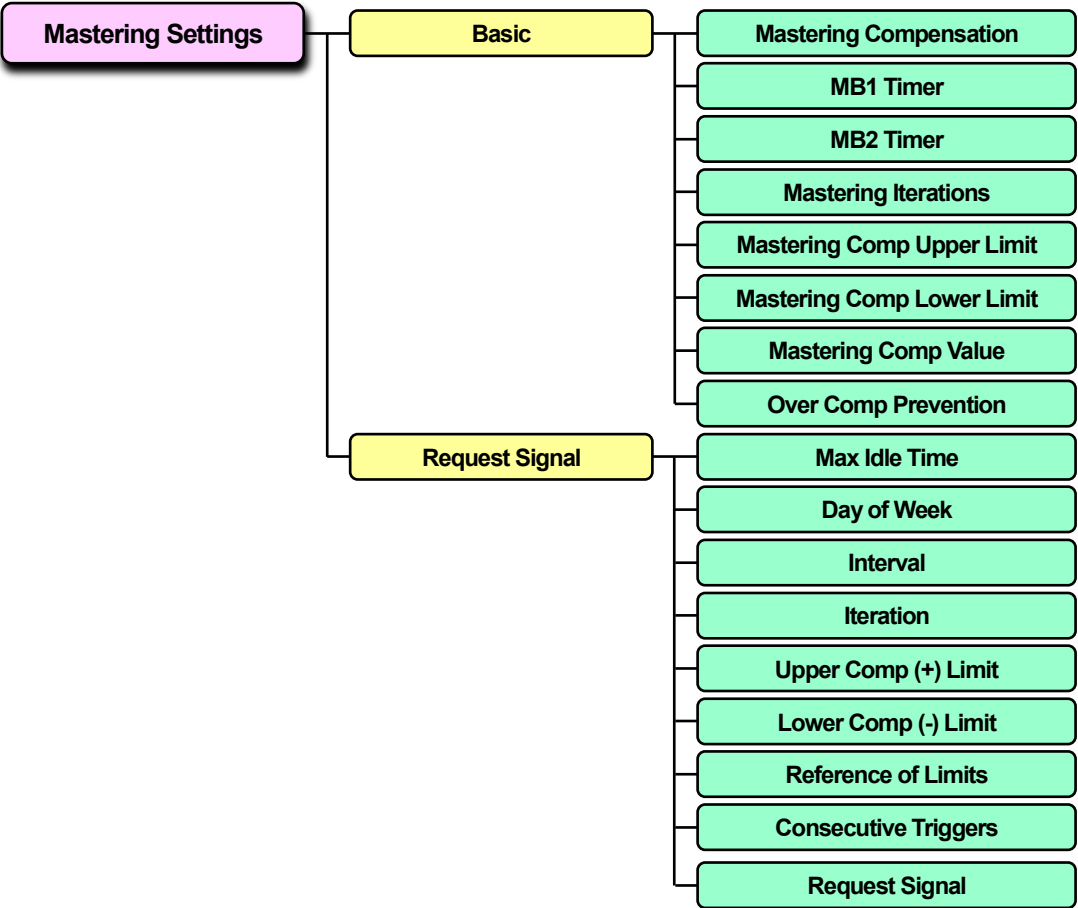
Refer to “8 MAINTENANCE” for the details. 

6 Comp Menu



5

6.1 Mastering Settings



Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

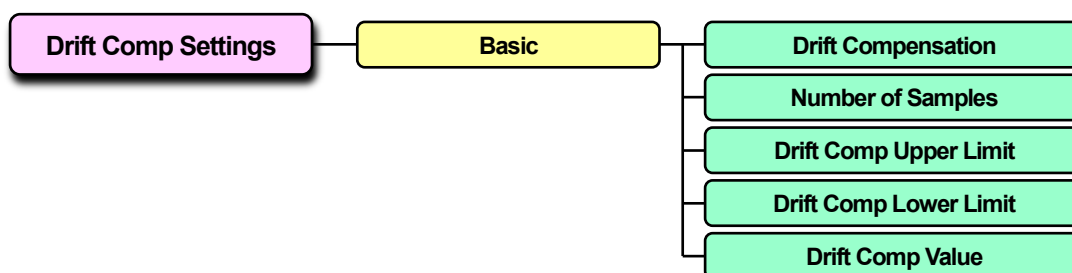
Basic	Mastering Compensation	Disable, Enable Mastering Compensation feature
	MB1 Timer	BAL1 timer for Mastering: 0 to 999.9 [s] Recommended timer: 1.0 [s]
	MB2 Timer	BAL2 timer for Mastering: 0 to 999.9 [s] Recommended timer: 2.0 [s]
	Mastering Iterations	0 to 99 Normally 5 times
	Mastering Comp Upper Limit	0 to $\pm 999.9$ (programmed unit) Mastering Upper/Lower limits.
	Mastering Comp Lower Limit	Normally 120 to 150% of DET UL/LL
	Mastering Comp Value	Mastering Comp value can be entered automatically or manually.
	Over Comp Prevention	Prevents over compensation.
Request Signal	Max Idle Time	Idle time in production line. Exceeding the time transmits Mastering Request Signal.
	Day of Week	Repeatedly transmits Mastering Request Signal at the beginning of the
	Interval	programmed day of week for the programmed number of times with the
	Iterations	programmed interval.
	Upper Comp (+) Limit	Upper leak limit for transmitting Mastering Request Signal.
	Lower Comp (-) Limit	Lower leak limit for transmitting Mastering Request Signal.
	Reference of Limits	Select the Reference of Limits for Mastering Request Signal. Zero or Mastering Comp Value.
	Consecutive Triggers	Transmits Mastering Request Signal if Leak exceeds the limits consecutively for the programmed number of times.
	Request Signal	Disable, Enable Set Enable or Disable of the Mastering Request Signal.

## 6.2 Mastering Display

Displays up to 20 DET data. The display can be toggled between the table and bar graph by tapping **List** / **Graph**.

Measurements can be performed on this screen in manual mode.

## 6.3 Drift Comp Settings



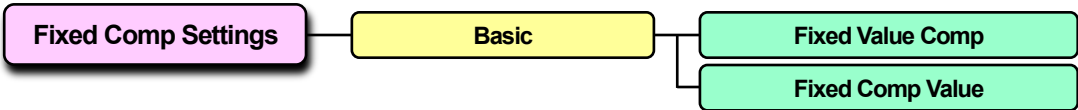
Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

Basic	Drift Compensation	Disable, Enable	Drift compensation feature
	Number of Samples	0 to 20	
	Drift Comp Upper Limit	0 to 999.9	Set Upper/Lower limits of compensation value.
	Drift Comp Lower Limit	When the unit is Pa, a value of up to $\pm 999.999$ can be used.	
	Drift Comp Value	Drift Comp Value can be entered automatically or manually.	

6.4 Drift Comp Display

Displays up to 20 sampled data. The display can be toggled between the table and bar graph by tapping List/Graph. Measurements can be performed on this screen in manual mode.

6.5 Fixed Comp Settings



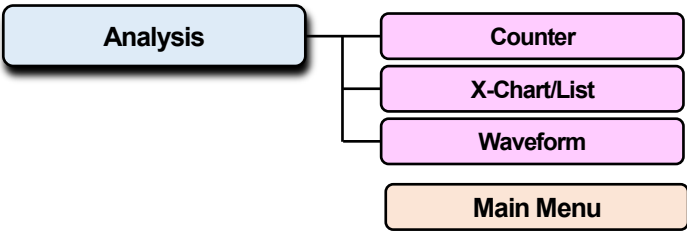
Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

Basic	Fixed Value Comp	Disable, Enable	Fixed value compensation feature
	Fixed Comp Value	Compensation value is manually entered.	

# 7 Analysis Menu



Menu to view the statistics of test results in figures and charts.



## 7.1 Counter

Counter is displayed by a channel.

Tapping **Reset** resets the counter of the displayed channel.

## 7.2 X-Chart/List

List/Chart toggles the display between List and Chart.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details.

## 7.3 Waveform

The last test result is displayed in a waveform. Waveform data is selectable from the followings:  
DPS Raw w/o A/Z, Test Pressure, Leak, DPS Raw

- Changes scale of Y axis.
- Changes scale of X axis
- Scrolls the chart right and left

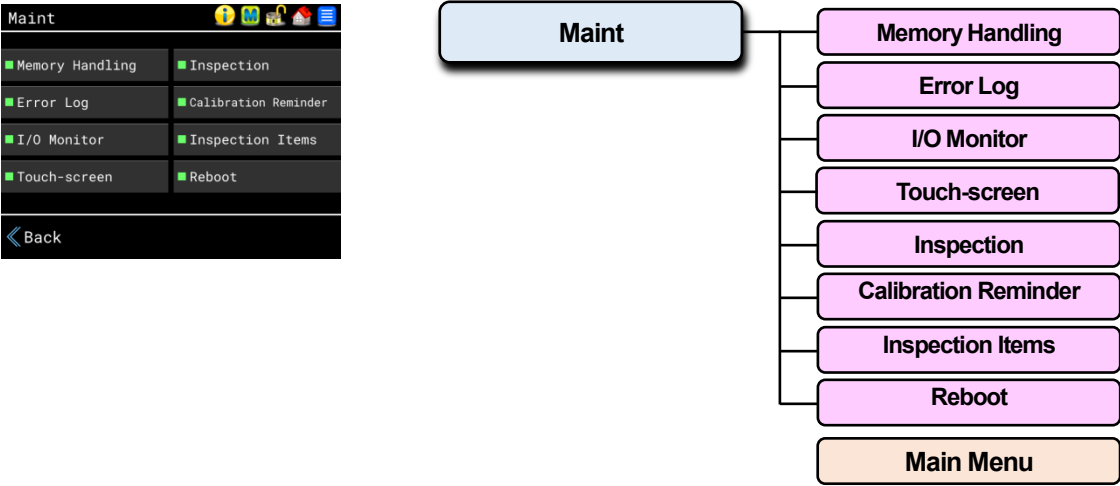
How to read the chart The beginning of each stage is shown with a colored vertical line as the follows:  
Yellow: Equalization (BAL1), Pink: Stabilization (BAL2), Brown: Pressurization (CHG)  
Orange: Detection (DET), Blue: Air-Blow (BLW)  
Cyan: Other stages, Gray: Grid every 1 [s]

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details.

# 8 Maint (Maintenance) Menu



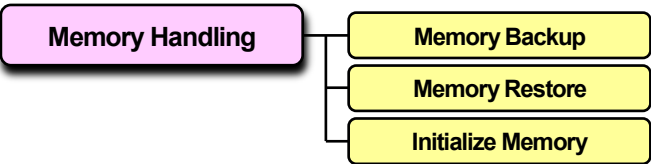
Go to this menu for LS-R902 maintenance.  
The maintenance should be done only by maintenance engineers.



5

## 8.1 Memory Handling

Use when an error occurred in LS-R902.



Refer to “8 MAINTENANCE” for the details.

## 8.2 Error Log

Displays Error Log.

## 8.3 I/O Monitor

I/O signals can be monitored on this screen.

InPut  
The pins receiving signals light green.

OutPut  
The pins transmitted signals light green.

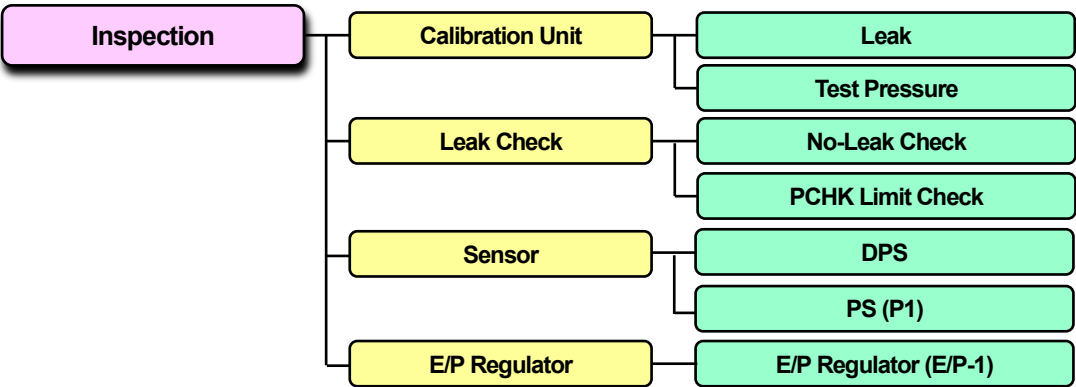
Refer to “3 INTERFACE” for the details.

8.4 Touch-screen

Touch-screen can be adjusted when it is off.

Refer to “8 MAINTENANCE” for the details. 

8.5 Inspection



Calibration Unit	Leak	Pa, kPa (mmH <sub>2</sub> O, inH <sub>2</sub> O, mmHg) *1
	Test Pressure	kPa, MPa (psi, kg/cm <sup>2</sup> , bar, mbar, mmHg, cmHg, inHg) *1
Leak Check	No-Leak Check	Perform a No-Leak Check of LS-R902 itself.
	PCHK Limit Check	Check the PCHK Limit.
Sensor	DPS	Adjust DPS offset and check the span
	PS (P1)	Adjust PS offset and check the span
E/P Regulator	E/P Regulator (E/P-1)	Adjust E/P regulator

\*1 The units in ( ) are not available for SI unit restriction models.

8.6 Calibration Reminder

Menu to set the next calibration date by entering the date of calibration conducted and how many months you wish to wait till the next calibration. A reminder will pop up 1 month before the programmed date.  
The next calibration date can be set up to 36 months from the date of Calibration. Setting it to 0 months disables the reminder.

8.7 Inspection Items

Displays Daily, Monthly and Annual inspection points.

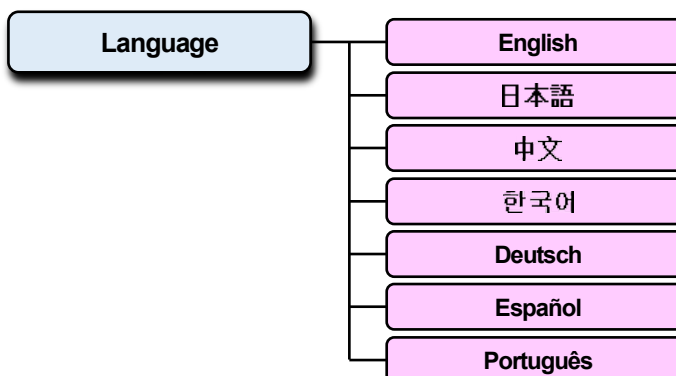
8.8 Reboot

LS-R902 can be rebooted.

## 9 Language Menu



Menu to select a language. Seven languages, English, Japanese, Chinese, Korean, Spanish, Germany, and Portuguese are available.



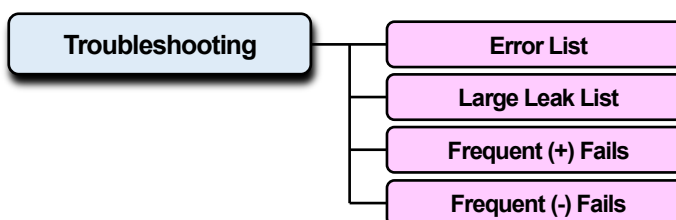
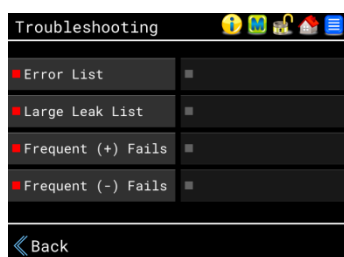
Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details.

## 10 Troubleshooting Menu



5

Menu to view the troubleshooting  
The maintenance job should be done by maintenance technicians.



### 10.1 Error List

Displays the Error List. Probable causes and treatments for the Errors can be checked.

Refer to “9 TROUBLESHOOTING” for the details.

### 10.2 Large Leak List

Displays the probable causes and treatments for Large Leaks.

Refer to “9 TROUBLESHOOTING” for the details.

### 10.3 Frequent (+) Fails

Displays the probable causes and treatments for frequent fails on the WORK-side.

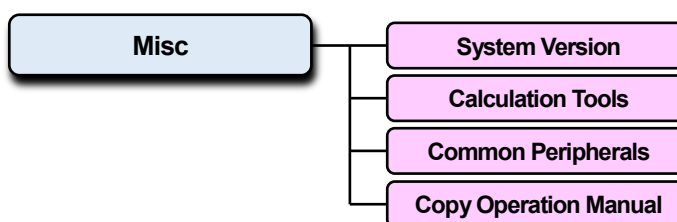
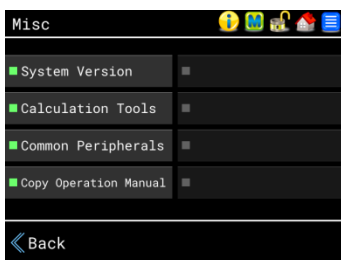
Refer to “9 TROUBLESHOOTING” for the details.

## 10.4 Frequent (-) Fails

Displays the probable causes and treatments for frequent fails on the MASTER-side.

Refer to “9 TROUBLESHOOTING” for the details. 

# 11 Misc (Miscellaneous) Menu



## 11.1 System Version

Menu to view or update System Version.  
The firmware is upgraded in this menu.

## 11.2 Calculation Tools

Menu to calculate Q, Ve, ΔP and T3  
by simply entering known variables.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

## 11.3 Common Peripherals

Introducing Common Peripherals for Air Leak Tester.

## 11.4 Copy Operation Manual

Menu to copy the operation manual to USB memory.  
A manual (PDF file) in a language of your choice will be copied to USB memory.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 



# 6

## SETUP

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# 1 Initial Setups

This section provides the required initial setups before using LS-R902.



## Attention

Settings unlocking is required to change settings.


Toggling to Manual mode is required to execute a measurement manually.

## 1.1 Operation Mode when the power turns on

Select an operation mode when the power is turned on from Remote (Rem) and Manual (Man).

**Go to:** System > System Settings > Start-up > Start-up Mode Selection

## 1.2 Home Screen

Select the Home Screen which displays when power is turned on or when  is tapped.

**Go to:** System > System Settings > Start-up > Home Screen Selection

## 1.3 Set Date

Set the current date.

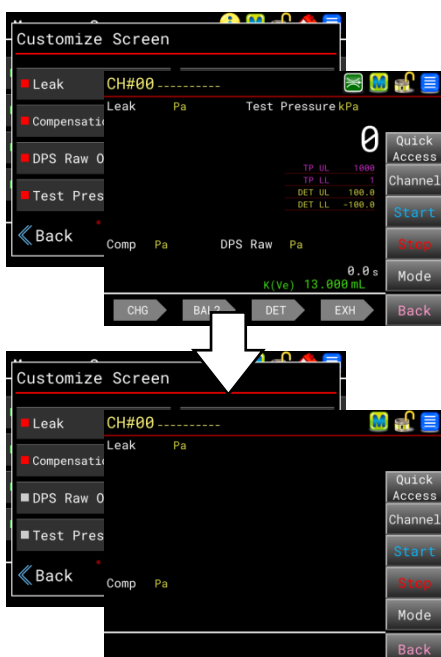
**Go to:** System > System Settings > Date & Time > Date

## 1.4 Set Time

Set the current time.

**Go to:** System > System Settings > Date & Time > Time

## 1.5 Customize Screen



Items to display for four measurement screens, Standard, Simple, Waveform and 4-Channel are selectable.

The selection in this screen reflects to all four screens.

All items are selected to be displayed as default.

- 1) Tap unnecessary items and the red mark turns white.
- 2) Tap Enter to complete the selection.

## NOTE

The selected items are marked red.

## 2 Perform a Simple Air Leak Test



### Attention

Settings unlocking is required to change settings.

Toggling to Manual mode is required to execute a measurement manually.

A simple Air Leak Test can be performed by programming the Basic Settings

**Go to:** Settings > Basic Settings > Timer / Test Press / Leak Limit / K(Ve)

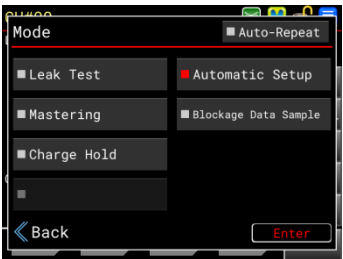
### 2.1 Timers



#### Manual Entry

Timer settings vary depending on test conditions. The following is an example. Normally, setting long Pressurization (CHG) and Stabilization (BAL2) timers helps reduce drift and improve test accuracy.

- 1) **Go to:** Settings > Basic Settings > Timer
- 2) Enter 40 [s] for Pressurization (CHG)
- 3) Enter 30 [s] for Equalization (BAL1)
- 4) Enter 5 [s] for Stabilization (BAL2)
- 5) Enter 1 to 10 [s] for Detection (DET)  
(Under condition where the Pressurization and Stabilization timers are sufficiently long.)

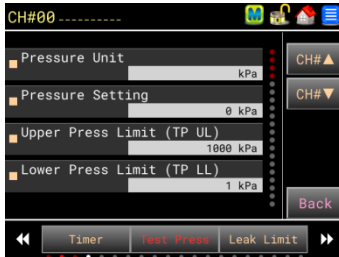


#### Automatic Setup

This is an initial setup support feature for persons who have few or no experiences of setting up Air Leak Tester.

Refer to “4 Automatic Setup” in this chapter.

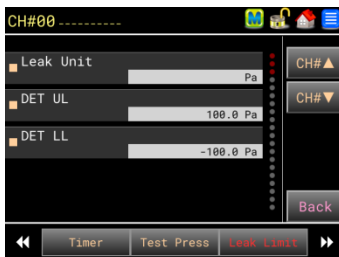
## 2.2 Test Pressure



Set the parameters according to your test specifications. Pressure limits are for monitoring the applied pressure during the Pressurization stage to detect large leak. Besides, if a large leak occurs in the system, LS-R902 can detect it before tester proceeds to Stabilization (BAL2) and Detection (DET) stages.

- 1) Settings > Basic Settings > **Test Press**
- 2) Select a pressure unit.
- 3) Enter target test pressure in Pressure Setting  
Precision regulator: Adjust the pressure to the target.  
Electro-pneumatic regulator: The pressure will be regulated to the entered pressure.
- 4) Enter Upper Press Limit (TP UL).
- 5) Enter Lower Press Limit (TP LL).

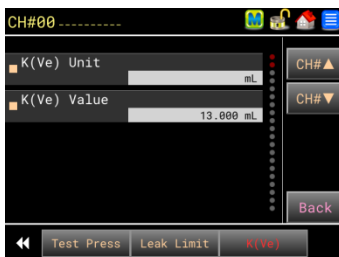
## 2.3 Leak Limit



Set the parameters according to your test specifications. Settings > Basic Settings > **Leak Limit**

- 1) Select a leak unit.
- 2) Enter DET UL.
- 3) Enter DET LL.

## 2.4 K(Ve)



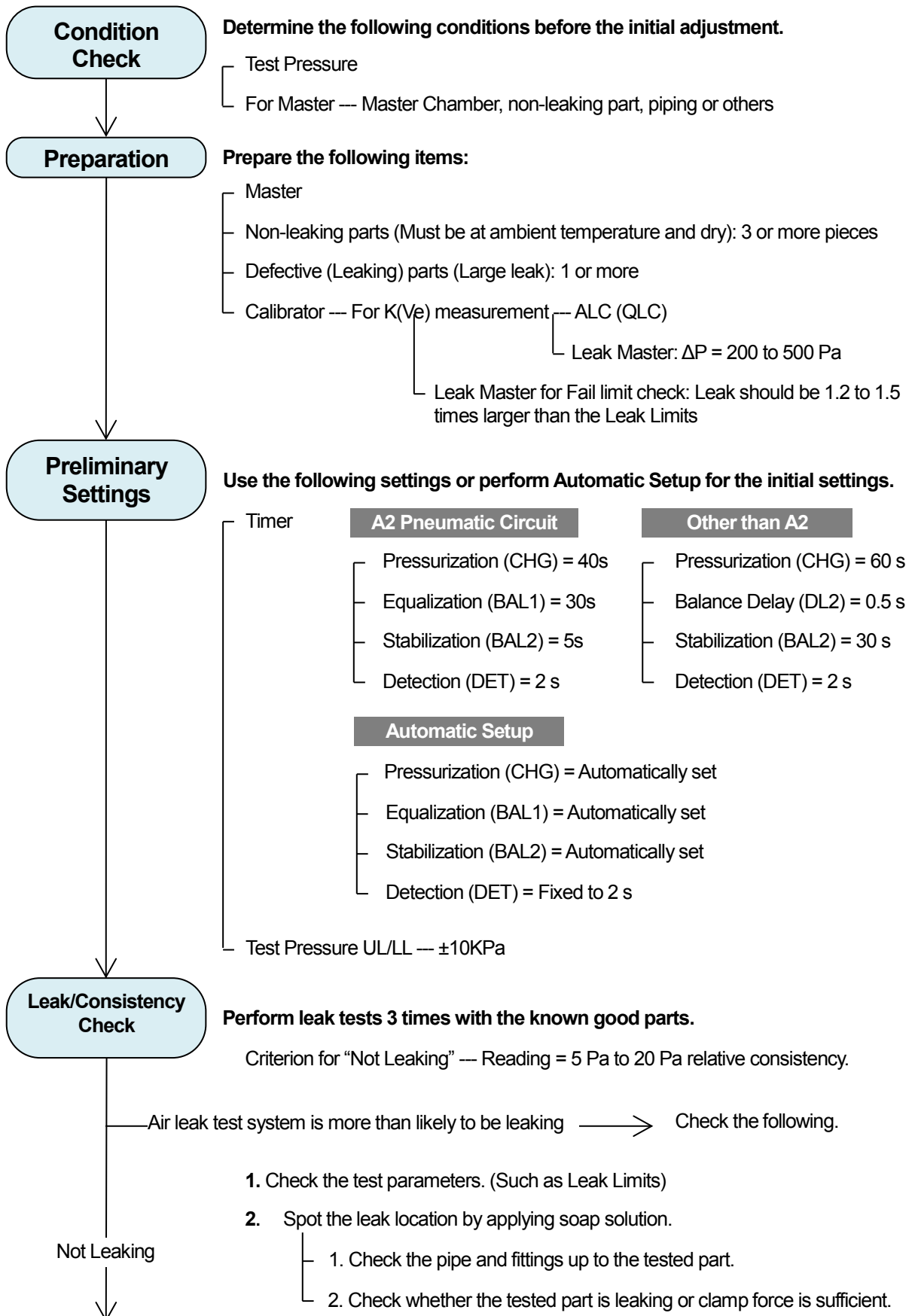
Enter K(Ve) Unit and Value if known.  
Settings > Basic Settings > **K(Ve)**

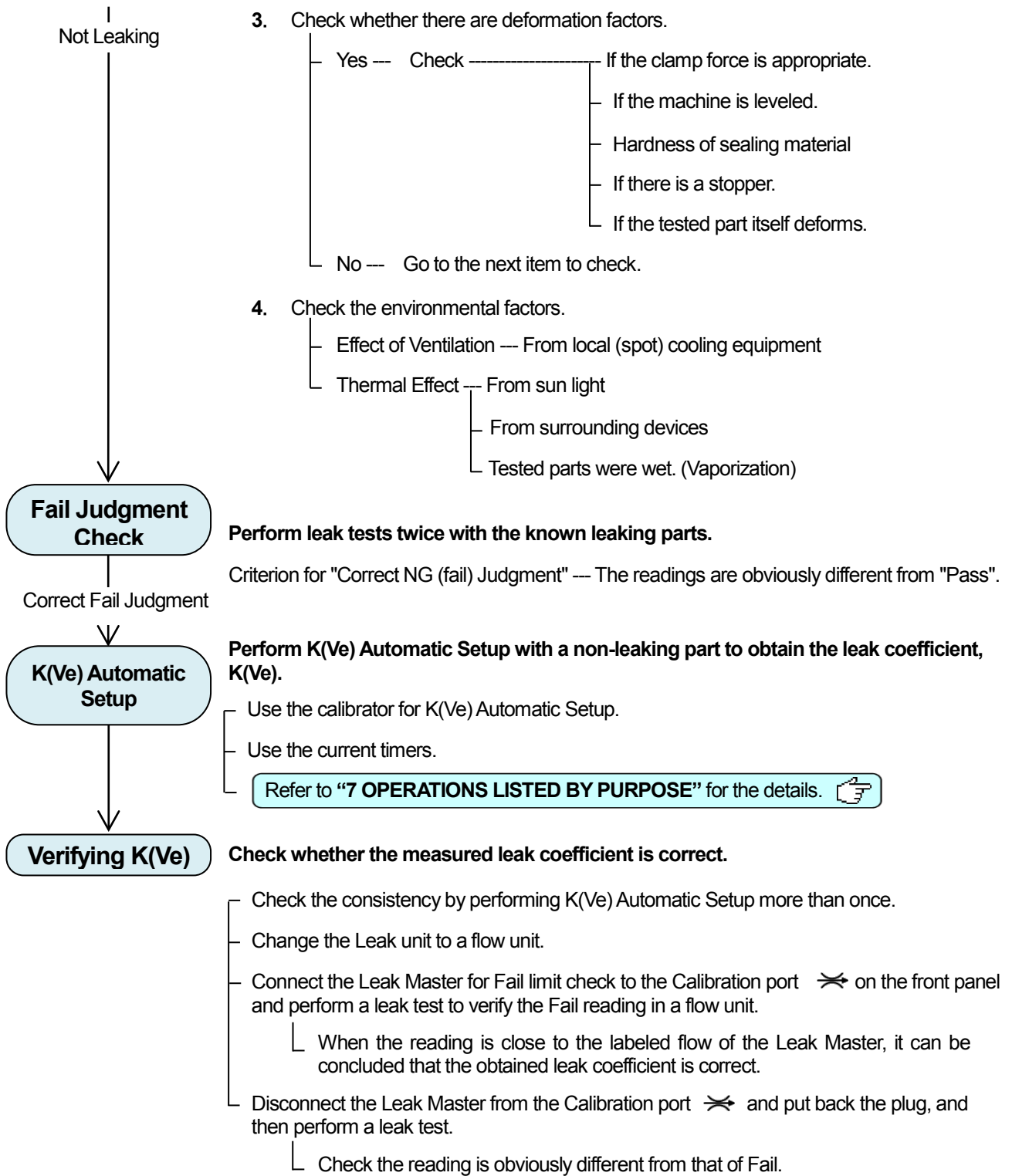
- 1) K(Ve) Unit > Select a unit.
- 2) K(Ve) Value > Enter K(Ve) value if known > Enter

### 3 Flow for Initial Adjustment

LS-R902 computes leakage based on the measurement of the pressure difference between the non-leaking master and the tested part.

K(Ve) is "leak coefficient" which is used for converting measured differential pressure into a flow rate.

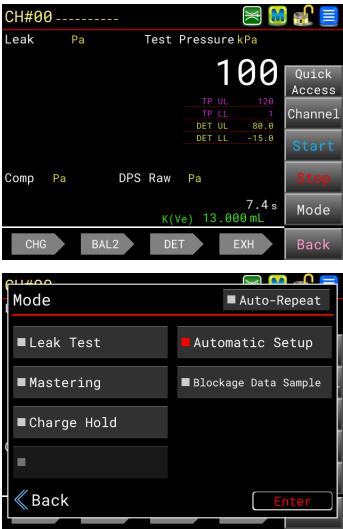




The followings should be done after the initial adjustment is completed:

- 1) Determine the optimum cycle time.
- 2) Verify repeatability in test results.
- 3) Enter all the required test parameters.
- 4) System Backup

# 4 Automatic Setup



Pressurization (CHG), Equalization (BAL1) and Stabilization (BAL2) timers are automatically set by this feature. Detection (DET) timer is fixed to 5 [s].

- 1) Set a known non-leaking part.
- 2) Set the test pressure.
- 3) **Go to:** Measure Screen > Select a measurement screen > **Mode** > Select Automatic Setup > **Enter**
- 4) Tap **Start** to start the Automatic Setup.  
Pressurization (CHG), Equalization (BAL1) and Stabilization (BAL2) timers are automatically set. DET timer is fixed to 5 [s]. Test pressure limit will be also automatically set at  $\pm 10\%$  of the set test pressure.
- 5) Change the mode to Leak Test.  
**Go to:** **Mode** > Leak Test > **Enter**

# 5 System Backup

Perform the system backup after all the test parameters are entered and setup is completed.

## NOTE

The backup data is only for restoring the test system and cannot be viewed on computers.

## 5.1 System Backup

Perform System backup to prepare for restoring the test system in case of trouble in the future.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

## 6 Notation of Air Leak Test Stages and Limits

Symbols are used for Leak test stages and Limits as follows:



Stages

Stage	Symbol
Idle state	WAIT
Charge Delay	DL1
Precharge	Pre CHG
Pressurization	CHG
Equalization	BAL1
Balance Delay	DL2
Stabilization	BAL2
Detection	DET
Air-Blow	BLW
Exhaust	EXH
Pre-exhaust	Pre EXH
End Delay	DL3
End	END
Equalization for Mastering	MB1
Stabilization for Mastering	MB2

Limits

Limit	Symbol
Stabilization Upper Limit	BAL2 UL
Stabilization Lower Limit	BAL2 LL
Detection Upper Limit 2	DET UL2
Detection Upper Limit	DET UL
Detection Lower Limit	DET LL
Detection Lower Limit 2	DET (LL2)

## 7 Air Leak Test Result List

Display	Criteria	
Pass	DET LL < <b>Leak</b> < DET UL	
DET UL2	DET UL2 ≤ <b>Leak</b>	
DET LL	DET LL2 < <b>Leak</b> ≤ DET LL	
DET UL	DET UL ≤ <b>Leak</b> < DET UL2	
DET LL2	<b>Leak</b> ≤ DET LL2	
BAL2 UL	BAL2 UL ≤ <b>Leak</b>	
BAL2 LL	<b>Leak</b> ≤ BAL2 LL	
CHG Large Leak WORK side	Differential pressure exceeds ±300 Pa in CHG.	<div>Refer to “9 TROUBLESHOOTING” for the details. </div>
CHG Large Leak MASTER side		
DL2 Large Leak WORK side	For L02 test pressure model: Differential pressure exceeds ±50% of Accuracy Guaranteed Range in DL2. For other test pressure models: The differential pressure exceeds the maximum value of A/D conversion in the stages. With the test pressure at 16 kPa or less, the differential pressure exceeds the test pressure.	
DL2 Large Leak MASTER side		
BAL2 Large Leak WORK side	Differential pressure exceeds the maximum value of A/D conversion in BAL2 or DET.	
BAL2 Large Leak MASTER side		
DET Large Leak WORK side		
DET Large Leak MASTER side		
Error XX	<div>Refer to “9 TROUBLESHOOTING” for the details. </div>	



# 7

## OPERATIONS LISTED BY PURPOSES

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2.2	Set Mastering Compensation .....	84	7.2	Analysis: Waveform .....	99
2.3	Bypass Charge (Option) .....	87	<b>8</b>	<b>Backup and Restore .....</b>	<b>100</b>
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Attention -----  
Settings unlocking is required to change settings.  
Toggling to Manual mode is required to execute a measurement manually.

# 1 Display Measured Differential Pressure in a Leak Rate Unit

## What To Do

- Obtain K(Ve) value through K(Ve) Automatic Setup or manually calculate and enter K(Ve) value.

LS-R902 computes leakage based on the measurement of the pressure difference between the non-leaking master and the tested part. K(Ve) is "leak coefficient" which is used for converting measured differential pressure into a flow rate.

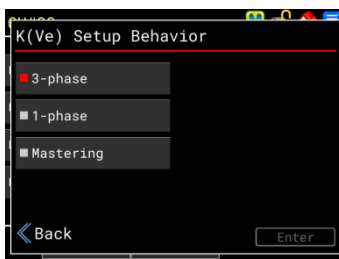
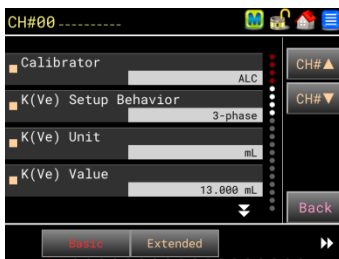
## 1.1 K(Ve) Automatic Setup

A tool called calibrator is used for K(Ve) Automatic Setup. There are two types of calibrator, Leak Master and Auto Leak Calibrator (ALC).

- 1) Connect a Reference Master to MASTER port.  
Master should be a Master Chamber or known non-leaking part.
- 2) Connect a known non-leaking part to the WORK port.
- 3) Check the test pressure by using CHG Hold. **Go to:** K(Ve) > K(Ve) Automatic Setup > **CHG Hold**
- 4) K(Ve) > K(Ve) Settings > **Basic** > K(Ve) Setup Behavior  
> Select a behavior from 3-phase, 1-phase and Mastering.

### NOTE

Mastering for the K(Ve) Setup Behavior can be selected only when the calibrator used for K(Ve) Automatic Setup is ALC, LC or QLC.



- 3-phase: LS-R902 will cycle through a leak test three times.  
Phase 1 is a warm-up, in phase 2 Compensation value is measured, and in Phase 3, the leak calibrator introduces preset volume change/leak into the system creating a differential pressure which allows for the automatic setup of K(Ve). The compensation value measured in phase 2 is used in phase 3.
- 1-phase: LS-R902 will cycle through one sequence and calculate the system volume K(Ve).  
If Drift Compensation is enabled and the compensation value is stored in the Memory, the measured value is compensated by the value.
- Mastering: K(Ve) Automatic Setup is preceded by Mastering Sampling. The current settings are used for the Mastering Sampling. The sampled Mastering value is subtracted from the measured value, which becomes K(Ve).  
Make sure that test data gets stabilized by Mastering.

**Models with ALC (Type K)**

- 1) Check whether Calibrator is set to ALC. **Go to:** K(Ve) > K(Ve) Settings > **Basic** > Calibrator
- 2) Enter ALC displacement  $\Delta V$ .  
**Go to:** **Basic** > ALC Displacement  $\Delta V$ .  
ALC Displacement is calculated with the following formula.

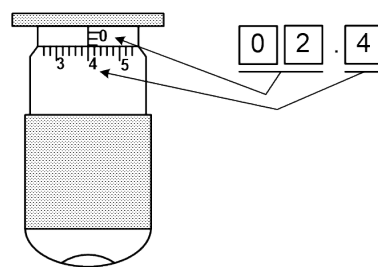
$$\Delta V = \frac{\Delta P \times V}{(101.3 + P) \times 10^3}$$

$\Delta V$ : ALC Displacement [mL]  
 $V$ : Approximate volume of tested part [mL]  
 $P$ : Test Pressure [kPa]  
 $\Delta P$ : Differential Pressure [Pa]

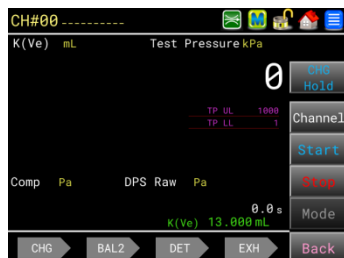
$\Delta P$  should be 50 to 80 % of the accuracy guaranteed range of DPS. For standard range,  $\Delta P$  should be between 500 and 800Pa since the accuracy guaranteed range is 1000Pa.



- 3) Enter either ALC Displacement or ALC Reading. Entering either value changes the other value..  
Adjust the ALC to the target revolutions. This diagram shows the ALC set at 2.4 revolutions.

Reading and Displacement of ALC			
	Max Variation	Min reading	Variation when reading is 2.4
ALC-05	0.5 mL	0.001 mL	0.120 mL
ALC-1	1 mL	0.002 mL	0.240 mL
ALC-4	4 mL	0.008 mL	0.960 mL
ALC-10	10 mL	0.02 mL	2.40 mL



- 4) Start K(Ve) Automatic Setup **Go to:** **Back** > K(Ve) Automatic Setup > **Start**  
After measurement is completed, LS-R902 will show the K(Ve) value.
- 5) Change the Leak Unit to a Flow rate unit.  
**Go to:** Settings > Advanced Settings > **Unit** > Leak Unit

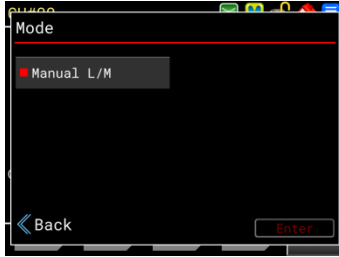
**Models with Leak Master (Type J)**

- 1) Remove the plug from the Calibration port  and connect a Leak Master.
- 2) Check whether Calibrator is set to Leak Master.  
**Go to:** K(Ve) > K(Ve) Settings > **Basic** > Calibrator
- 3) Enter the Flow Rate of the connected Leak Master in mL/min.  
**Go to:** K(Ve) > K(Ve) Settings > **Basic** > Leak Master Flow Rate [mL/min].
- 4) Start K(Ve) Automatic Setup **Go to:** **Back** > K(Ve) > K(Ve) Automatic Setup > **Start**  
After measurement is completed, LS-R902 will show the K(Ve) value.
- 5) Change the Leak Unit to a Flow rate unit.  
**Go to:** Settings > Advanced Settings > **Unit** > Leak Unit
- 6) Remove the Leak Master from the Calibration port  and put the plug back on firmly.

**NOTE**

Leak Master can be left on the calibration port. In that case, make sure dust will not accumulate inside.

### Use Leak Master on Standard Model (without Calibrator)



- 1) Check whether Calibrator is set to Leak Master.  
**Go to:** K(Ve) > K(Ve) Settings > **Basic** > Calibrator
- 2) Enter the Flow Rate of the connected Leak Master in mL/min.  
**Go to:** K(Ve) > K(Ve) Settings > **Basic** > Leak Master Flow Rate [mL/min].
- 3) Select Manual Leak Master  
**Go to:** **Back** > K(Ve) > K(Ve) Automatic Setup > **Mode** > Manual L/M.
- 4) Start K(Ve) Automatic Setup  
**Go to:** **Back** > K(Ve) Automatic Setup > **Start**

### K(Ve) Setup Behavior: 3-phase

- 1) Start K(Ve) Automatic Setup. **Go to:** Back > K(Ve) Automatic Setup > **Start**
- 2) After 2 phases of tests, LS-R902 will be in idle state. Remove the plug from Calibration port ➤ and connect the Leak Master.
- 3) Resume measurement. **Start** > LS-R902 resumes K(Ve) Automatic Setup.  
After measurement is completed, LS-R902 will show the K(Ve) value.
- 4) Change the Leak Unit to a Flow rate unit. **Go to:** Settings > Advanced Settings > **Unit** > Leak Unit
- 5) Remove the Leak Master from the Calibration port ➤ and put the plug back on firmly.

### K(Ve) Setup Behavior: 1-phase:

- 1) Remove the plug from the Calibration port ➤ and connect a Leak Master.
- 2) Start K(Ve) Automatic Setup. **Go to:** Back > K(Ve) Automatic Setup > **Start**  
After measurement is completed, LS-R902 will show the K(Ve) value.
- 3) If Drift Comp Feature is enabled and a compensation value is stored in the Memory, the measured value is compensated by the value.
- 4) Change the Leak Unit to a Flow rate unit. **Go to:** Settings > Advanced Settings > **Unit** > Leak Unit
- 5) Remove the Leak Master from the Calibration port ➤ and put the plug back on firmly.

#### NOTE

K(Ve) Automatic Setup with a Leak Master could be also performed on the Models with ALC.  
In that case, make sure to adjust the ALC to 0 revolutions.

#### NOTE

Contact Cosmo for using manual calibrator (LC) or Quick Leak Calibrator (QLC) for K(Ve) Automatic Setup.

## 1.2 Manual Entry of K(Ve) Value (Leak Coefficient)

Manually enter the calculated K(Ve)

**Go to:** K(Ve) > K(Ve) Settings > **Basic** > K(Ve) Value

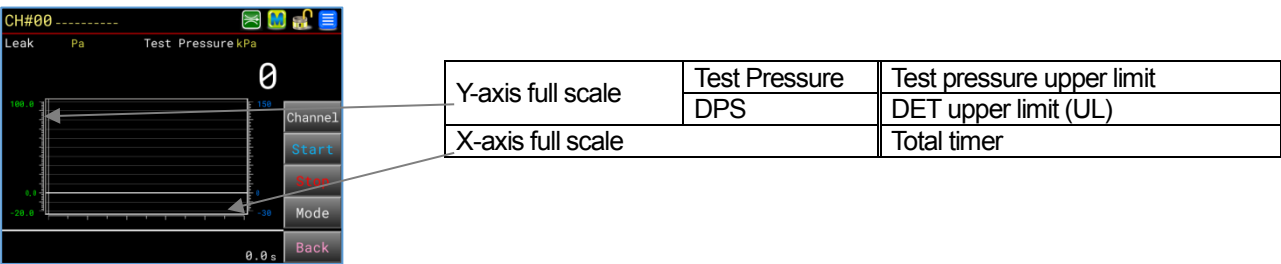
# 2 Reduce Cycle Time

## What To Do

- Use Waveform in Measure Screen
- Use Mastering Compensation
- Use Bypass Circuit Unit (Option)
- Use Waveform in Analysis Menu

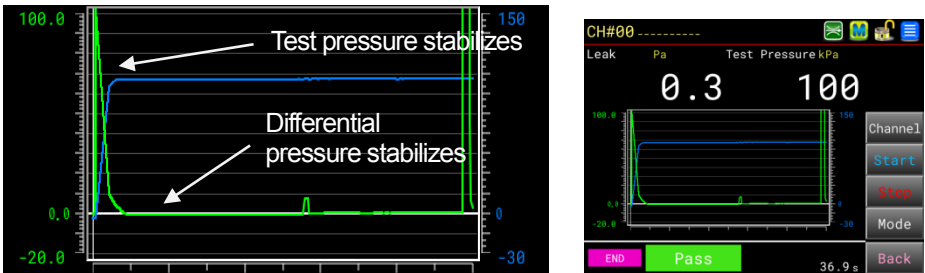
### 2.1 Use Measure Screen: Waveform

The measured Differential pressure and test pressure during leak test can be visualized in this measurement screen. Stabilization can be verified to reduce cycle time.



#### Reducing Pressurization (CHG) Timer

- 1) Set Home screen to Waveform for convenience of operation.  
**Go to:** System > System Settings > **Start-up** > Home Screen Selection > Waveform
- 2) The total timer is the full scale of X-axis. Check the total cycle timer and calculate per how many seconds scales are marked.  
**Go to:** Settings > Advanced Settings > **Timer**
- 3) Execute Leak test a few times. **Go to:** > **Mode** > Select Leak Test > **Start**
- 4) After measurement is completed, check the waveform to see if CHG timer can be reduced. For instance, if current CHG timer is 30 s but DPS stabilized in 20 s, the CHG timer can be reduced to 20 s.



- 5) Go back to the Settings Menu and change the CHG timer. **Go to:** **Back** > Timer > Pressurization (CHG)
- 6) Go back to the waveform screen and execute leak test several times to check the repeatability.
- 7) Repeat procedure 3) to 6) to find the shortest cycle time.

#### NOTE

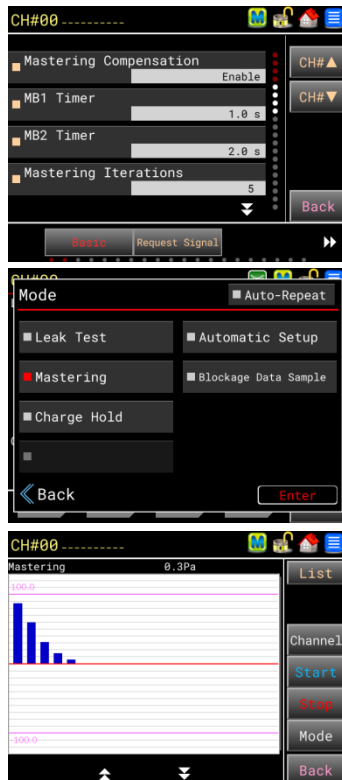
Similar but more analytic procedure can be performed in the waveform in Analysis Menu.


**Refer to 7.2 Analysis Waveform for the details.**

## 2.2 Set Mastering Compensation

The measured pressure change in a leak test typically contains both the true leakage and drift errors due to adiabatic compression and changes in the ambient temperature. The pressure change due to leakage remains constant, while the drift portion decreases to zero. In other words, it reaches a completely stable state, over time. Therefore, when the detect stage is repeated a number of times, the measured pressure changes become more and more stable, and thus the true leak amount is finally measured.

Mastering compensation feature is Disabled as default.



- 1) Connect a Reference Master to MASTER port.  
Master should be a Master Chamber or known non-leaking part.
- 2) Connect a known non-leaking part to the WORK port.
- 3) Set the necessary test parameters  
**Go to:** Comp > Mastering Settings > **Basic**
- 4) Select a channel.
- 5) Enable Mastering Compensation Feature **Go to:** Mastering Compensation > Enable
- 6) Set Mastering Equalization timer to 1.0 [s] and Mastering Stabilization timer to 2.0 [s].  
Set Mastering Iterations to 5.
- 7) Go to the Home screen by tapping .
- 8) **Mode** > Select Mastering > **Enter**
- 9) **Start** > Mastering Value Sampling will be executed.
- 10) Check the Mastering graph **Go to:** Main Menu > Comp > Mastering Display > Graph  
Check the Mastering graph
- 11) An ideal Mastering graph shows DET data gradually decreases and becomes constant close to 0.



### Attention

#### Mastering Process

After normal leak test, the MB1, MB2 and DET stages are repeated for the specified number of iterations.

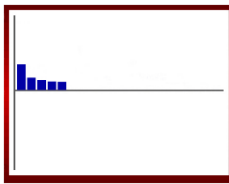
#### Mastering Value Sampling

Mastering process to sample Mastering value.

#### Mastering Compensation

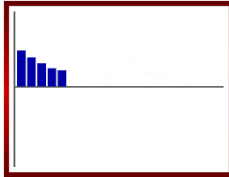
A compensation feature that measured data is compensated by Mastering Value obtained through the Mastering Value Sampling.

### How to verify Mastering Data



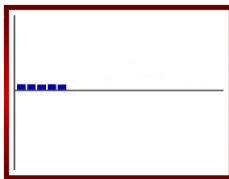
Data stops decreasing and eventually becomes constant.

Ideal



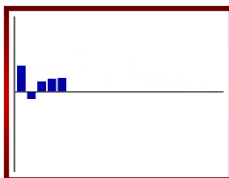
Data continues to decline. Increase the number of iterations.

Try again



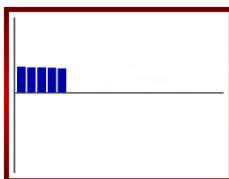
Data is stable and constant. CHG and BAL1 timers can be reduced.

Decent



Data is drastically changing. Extend CHG and BAL1 timer settings.

Need to improve the condition



Data does not decrease. There may be leak in the system.

Need to improve the condition

- 12) Check the seals, part and fittings for possible leaks when the Mastering data is not close to ideal. If there is no leak, increase the Mastering Iterations.
- 13) Execute Mastering Value Sampling again. **Go to:** Mastering Display > **Start**
- 14) If increasing Mastering Iteration does not stabilize the data, extend CHG, MB1 and MB2 timers  
**Go to:** Settings > Advanced Settings > **Timer** > Pressurization (CHG)  
**Go to:** Comp > Mastering Settings > MB1 Timer / MB2 Timer
- 15) Execute Mastering Value Sampling again. **Go to:** Mastering Display > **Start**
- 16) Verify the graph is close to ideal.  
Toggle the display to List and record first DET Data. **Go to:** **List** > Record the first DET Data
- 17) Enter Compensation Limits  
**Go to:** **Back** > Mastering Settings > **Basic** > Mastering Comp Upper Limit  
> Enter value approx. 1.2 to 1.5 of the recorded value > **Enter**  
**Go to:** **Back** > Mastering Settings > **Basic** > Mastering Comp Lower Limit > Enter 0 > **Enter**

### When to execute a Mastering Value Sampling

A Mastering Value Sampling must be executed when the test parameters change, environmental conditions change, or the drift portion shifts significantly.

- Beginning of the first shift  
At the beginning of the morning shift (when the machine is turned on) it is expected that environmental conditions will be significantly different from those at the time when the last Mastering was performed on the previous working day. Also the first two hours of the morning shift are typically when these conditions may change frequently, therefore, the Mastering Value Sampling may need to be initiated a few times during this period.
- After a long break  
During shift changes, breaks, or long waits for tested parts, etc., the ambient air temperature, fixtures, or conditions of the parts themselves may vary. After such occasions, executing a Mastering Value Sampling is recommended.

- **Production Part Changeover**  
For production lines that produce multiple parts, each part should be assigned to a specific leak tester channel (CH). Therefore, a Mastering Value Sampling is required on the new channel immediately after the model changeover.
- **When the test parameters have been altered**  
A Mastering Value Sampling is required when some test parameters are changed
- **When Fail occurs consecutively**  
The seals in the fixture may be damaged in this case, assuming that a production line is unlikely to produce defective parts consecutively. Since the test result of a Mastering Value Sampling shows almost true leakage, it would help in determining if these Fail Judgments are from leaks or from fluctuations due to drift.

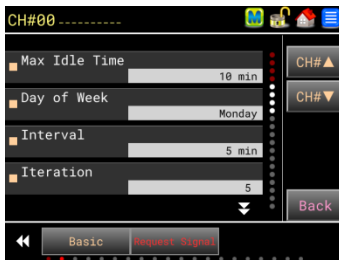
### Performing Mastering Value Sampling

When using the Mastering Compensation in air leak testing, execute Mastering Value Sampling right before starting leak tests.

Mastering can be executed periodically or when the system falls in a preset condition using Mastering Request Signal. Mastering Value Sampling can be executed externally through I/O port as well.

Refer to “3 INTERFACE” for the details. 

### Set the Condition to transmit Mastering Request signal.



Set each condition

**Go to:** Comp > Mastering Settings > Request Signal

### Mastering Over Comp Prevention



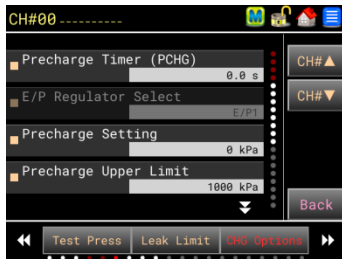
When the Mastering Value in the last iteration of Mastering Value Sampling is a negative value, the value is calculated as 0 to prevent over compensation.



**Go to:** Comp > Mastering Settings > Basic > Over Comp Prevention > Enable > Enter



## 2.3 Bypass Charge (Option)



Program the followings:

**Go to:** Settings > Advance Settings > **CHG Options**

- Precharge Timer (PCHG)
- Precharge Setting
- Precharge Upper Limit / Precharge Lower Limit
- Bypass Valve > Enable

## 2.4 Analysis: Waveform

Refer to **7.2 Analysis Waveform** for the details. 

# 3 Enhance Test Result Reliability

### What To Do

- Use Mastering Compensation
- Use Drift Compensation
- Use Fixed Compensation
- Use Mastering and Drift Compensation together
- Use Noise Reduction
- Use Exhaust Interference Prevention feature
- Use E/P Regulator Feedback
- Use Optimum Value Detection (OPM)

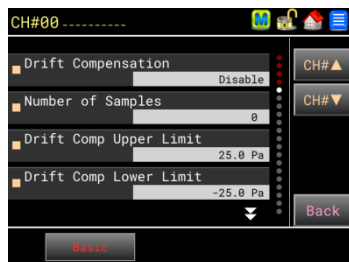
## 3.1 Set Mastering Compensation

Refer to **2.2 Setting Mastering Compensation** for the details. 

### 3.2 Set Drift Compensation

Drift Compensation is a statistical compensation method. A running average of the latest Pass parts is used as a compensation value to keep track of moderate changes in the drift portion, such as those caused by gradual room temperature changes.

In this system, an average value of the previously sampled leak test data of Pass part is used as the average of the measurement error. This value is subtracted from the measured leakage of the current leak result. The number of values used in the calculation of this running average is Number of Samples. When accurate data is not available or the test environment changes rather rapidly, the combined use of Mastering compensation is recommended. This generates the Mastering value that can be used as the initial compensation value for the Drift compensation.



Drift Compensation feature is Disable as default. To execute Drift Compensation, change the setting.

- 1) **Go to:** Comp > Drift Comp Settings > **Basic**
- 2) Select a Channel.
- 3) Drift Compensation > Enable > **Enter**
- 4) **Go to:** Number of Samples > Enter (5) \* > **Enter**
- 5) **Go to:** Drift Comp Upper Limit > Enter (50 to 80%)\* of the leak limit > **Enter**
- 6) **Go to:** Drift Comp Lower Limit > Enter (0.0)\* > **Enter**

#### NOTE

The figures in ( ) \* are recommended.

### 3.3 Set Fixed Compensation

Fixed Compensation is used when environmental conditions are stable. It is recommended to use after verifying the environmental conditions are stable using Drift Compensation feature.

Enter a compensation value which is subtracted from the measured data.



Fixed Compensation feature is Disable as default. To execute Fixed Compensation, change the setting.

- 1) **Go to:** Comp > Fixed Comp. Settings > **Basic**
- 2) Enable Fixed Value Comp
- 3) Fixed Comp Value > Enter a value > **Enter**

### 3.4 Use Mastering Comp with Drift Comp

When both Mastering Comp and Drift Comp feature are Enable (Number of samples must be set 2 or larger.), the Mastering value obtained by the Mastering value sampling is used as the initial compensation value for Drift compensation in a normal leak test.

The compensation value for the second test is the mean value of the Mastering value and the raw data of the first test. If the number of the samples is set to 3, the running average of the latest 3 measured raw data is taken as a compensation value for the fourth test, so that the system learns to update the compensation value continuously.

1st test: Displayed value = 1st raw data – {Mastering value}

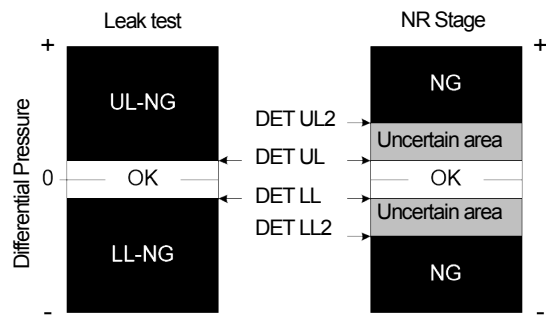
2nd test: Displayed value = 2nd raw data – {(1st raw data + Mastering value) / 2}

3rd test: Displayed value = 3rd raw data – {(2nd + 1st raw data + Mastering value) / 3}



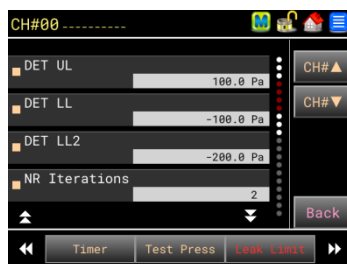
5th test: Displayed value = 5th raw data – {(4th + 3rd raw data + 2nd raw data) / 3}

### 3.5 Set Noise Reduction



Noise ratio over measurement increases when leak limits are lowered and/or test time is shortened, which may be a cause to increase false rejection of good parts. In order to reduce the false rejection, Noise Reduction (NR) feature eliminates the noise by repeating the DET stage when the measured differential pressure falls in the previously set uncertain judgment region. This feature is useful where there is a high percentage of noise presence caused by temperature or volume changes. It helps obtaining more critical judgment.

LS-R902 permits setting another sets of leak limits for DET stage, DET(UL2) and DET(LL2) which are called Noise Reduction (NR) limits, besides DET(UL) and DET(LL) limits. The ranges between those two sets of limits are considered as uncertain judgment regions. While NR feature is enabled, NR process automatically starts right after the normal leak test cycle when a measured leak data in DET stage falls in the uncertain judgment region. In the NR process, DET stage is repeated for the previously set number of times and a judgment is made, however, leak test ends instantaneously if Pass judgment is made before repeating the set number. The number of iterations of DET stage can be set up to 20. Setting the iteration number to 1 disables the NR feature.



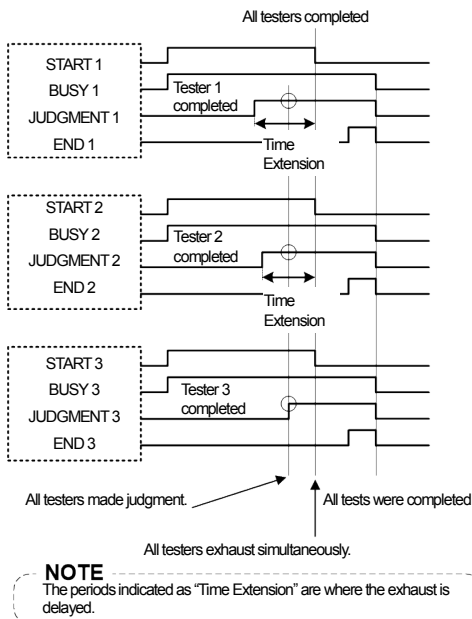
- 1) **Go to:** Settings > Advanced Settings > Leak Limit > NR Iterations > Enter 2 or larger number > **Enter**
- 2) Set DET UL2 > **Enter**
- 3) Set DET LL2 > **Enter**

#### NOTE

Setting the iteration number to 1 disables the NR feature. In this case, those NR limits, DET UL2 and DET LL2, can be simply used as additional limits. With these, defected parts can be sorted out according to the degree of leakage.

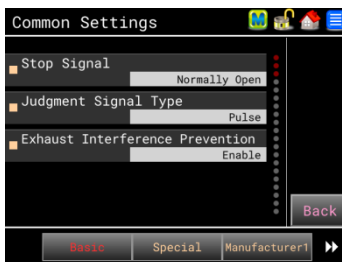
When a Compensation feature is enabled, the compensation value is not deducted in and after the 2nd Noise Reduction. There may be cases where the Compensation feature and Noise Reduction cannot be used together. By enabling the NR Equalization and setting values to the NR Equalization Timer and NR Stabilization Timer, the compensation value is considered, making it possible to make effective use of Noise Reduction feature.

### 3.6 Set Exhaust Interference Prevention



When using several leak testers to measure different cavities on the same part simultaneously, some interference may occur when one leak tester finishes its cycle while the other(s) are still in the leak test process. This is called "Exhaust Interference." Exhaust interference can cause jumps in the leak tester readout during the exhaust of one of the other testers, both in normal leak test and Mastering Value Samplings. In order to prevent this, all leak testers on the station must be synchronized with one another before exhausting air.

With this firmware, the leak tester will keep holding the test pressure in the part even after it makes the judgment, as long as the START signal is turned on. As soon as the START signal turns off, the test pressure will be vented to the atmosphere. In order to utilize this feature, the PLC must be programmed in such a way that it would hold the START signal until it receives the judgment signal of every tester in its control. There are two types of Exhaust Interference Prevention. One is interference among the pneumatic circuits of its own system. The other is interference with other leak testers.



**Go to:** Settings > Common Settings > **Basic** > Exhaust Interference Prevention > Enable > **Enter**

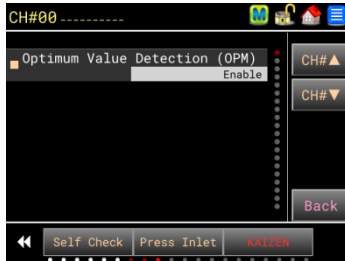
### 3.7 Set E/P Regulator Feedback



When E/P Regulator Feedback is set in E/P Regulator models, the PS value is fed back to the E/P Regulator during Pressurization (CHG) in leak test so that the test pressure can be adjusted.

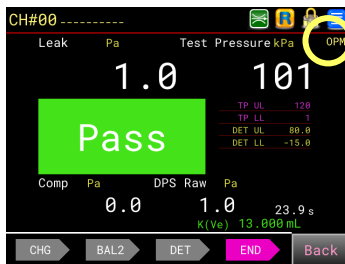
- 1) **Go to:** Settings > Advance Settings > **Test Press** > E/P Regulator Feedback or  
**Go to:** Settings > Advance Settings > **CHG Options** > E/P Regulator Feedback
- 2) Enter a numerical value and press **Enter** to complete.  
The range is 0 to 90 %. Setting 0 % disables the E/P Regulator Feedback. (For example, when a value of 40 % is set with the CHG timer set to 10.0 s, the pressure difference 4 seconds after starting Pressurization is checked to regulate the E/P Regulator.)  
Regulation accuracy:  $\pm 2$  % full scale of PS or less

### 3.8 Set Optimum Value Detection (OPM)



Optimum Value Detection (OPM) is effective when the differential pressure occurring in DET is a decay waveform.  
If the decay waveform becomes closer to stabilization (convergence), variation and the average value will be small.

**Go to:** Settings > Advanced Settings > KAIZEN > Optimum Value Detection (OPM) > Enable  
Tap **Enter** to complete.



When the Optimum Value Detection (OPM) is enabled, the following functions are added.

- "OPM" is displayed at the upper right of the screen.
- In the test data (csv) to be stored in USB, "LEAK TEST OPM" is added to the "MODE".
- In the P format output from the RS-232C ports, an asterisk (\*) is added after the unit. (Example: Pa\*, mL/min)

## 4 Enhance Test Reliability

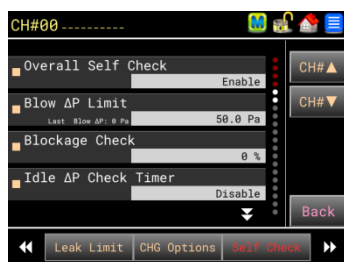
### What To Do

- Set Blockage Check
- Set Idle  $\Delta$ P Check

### 4.1 Set Blockage Check

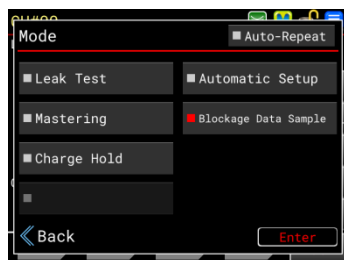
Check the blockage of external pneumatic (valves) circuit of LS-R902.  
Measure and register the normal state and detect the blockage.

#### To set the tolerance



**Go to:** Settings > Advanced Settings > **Self Check** > Blockage Check > Set the tolerance in percentage. > **Enter**  
Smaller the ratio is the harsher the criteria. Setting it to 0% disables the feature.

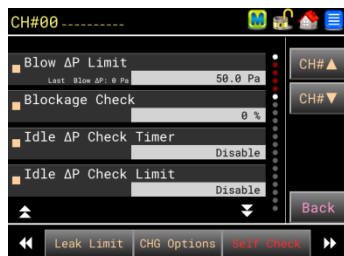
#### Blockage Data Sample



**Go to:** Measure Screen > Select a measurement screen > **Mode** > Blockage Data Sample > **Enter**

Tap **Start** to start the Blockage Data Sample. The normal state is registered if the result is **Pass**.

### 4.2 Set Idle $\Delta$ P Check (Self Check)



LS-R902 checks if fill valve is closed during idle state.

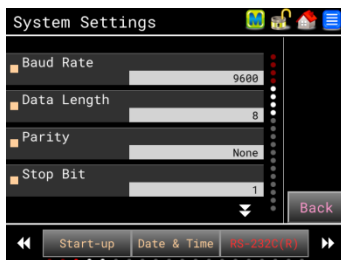
**Go to:** Settings > Advanced Settings > **Self Check**  
> Idle  $\Delta$ P Check Timer  
> Idle  $\Delta$ P Check Limit

## 5 Manage Data on Computer

### What To Do

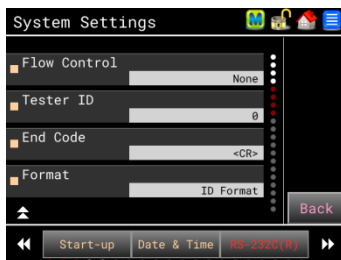
- Program Serial Communication settings.
- Select Data to store in USB Memory.
- Backup the current programmed test parameters.
- Name the folder where data are stored

### 5.1 Program RS-232C Settings



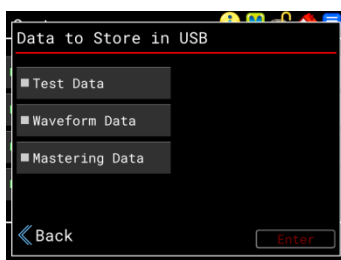
Test results along with various data can be transmitted through RS-232C port in a format of your choice.

**Go to:** System > System Settings > **RS-232C(R)** / **RS-232C(F)**  
Set each item and press Enter.



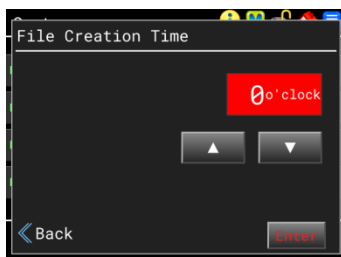
Refer to “3 INTERFACE” for the details. 

### 5.2 Collect Data in USB Memory



Data to store in USB Memory can be selected from Test Data, Waveform Data and Mastering Data. More than one can be selected.

**Go to:** System > Data to Store in USB  
> Select Data to store in USB Memory (More than one can be selected)  
> **Enter**



When Test Data is selected above, a new file is created once a day at the programmed time. Set time to create a new file for Test Data by using ▲ and ▼. Usually timer is set any time between the last shift and the first shift.

#### NOTE

Leave the USB Memory on the USB port all the time for the data collection.

## Viewing the Stored Data in USB

Data stored in USB can be checked.

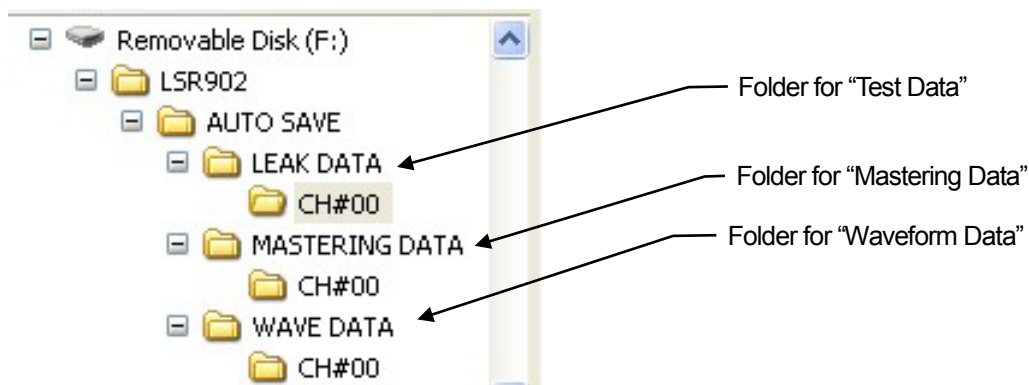
All the data are stored in csv format. The data can be managed using software applicable to csv.

File name

Data files are automatically saved under names containing the date and time.

Pull out the USB memory from LS-R902 and connect it to your computer.

The file can be viewed on a computer.



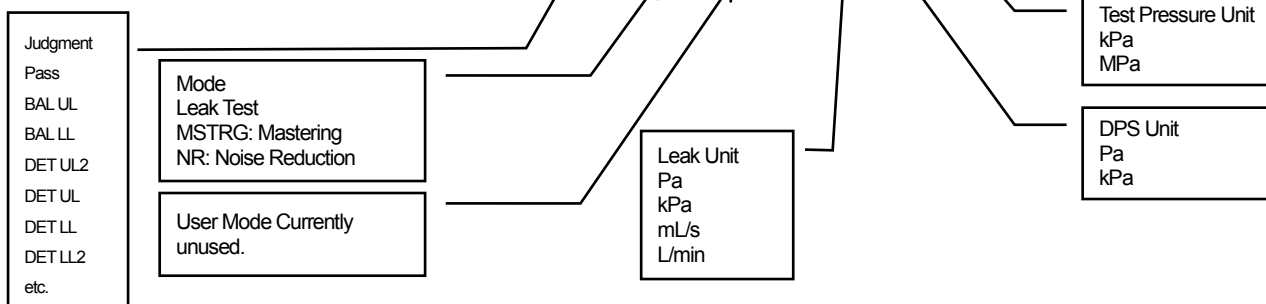
## Test Data

Name of file: 20180524\_00\_CH#00.csv (\_ represents a space)

2018	0524	00	CH#00	.csv
Year	Month Date	Hour	Channel	File format

## Data Example

FILE NAME LSR902/AUTO SAVE/LEAK DATA/CH#00/20180524 00 CH#00.csv															
CH#	BAL Le	DET Le	Comp	Masteri	DPS Ra	Test Pr	Judgme	Mode	User M	Leak U	DSPRa	TPress	DET UL	DET LL	Date
0	+0.000	+0.000	+0.000	+1.0	-0.000	-9.0	Pass	Leak Te	OFF	mL/min	Pa	kPa	800	- 800	2013/0
0	+0.000	+0.000	+0.000	+1.0	-0.000	-9.0	OK	MASTE	OFF	mL/min	Pa	kPa	800	- 800	2013/0





## Waveform Data

Name of file: 20180524\_09\_CH#00.csv ( \_ represents a space)  
2018      0524      09      CH#00      .csv  
 Year      Month Date      Hour      Channel      File format

## Data Example

FILE NAME	LSR902/AUTO SAVE/WAVE DATA/CH#00/20180524 09 CH#00.csv				
DATE	2013/01/24 9				
Sample#	Test Press	DPS Raw w/o	DPS Raw [Pa]	Leak	Stage
1	1.627	-11.432	-11.432	-11.432	DL1
2	1.646	-10.212	-10.212	-10.212	CHG
3	1.678	-8.352	-8.352	-8.352	CHG
4	1.654	-14.577	-14.577	-14.577	BAL1
5	1.674	-17.359	-17.359	-17.359	BAL1
6	1.674	-1.211	-17.359	-17.359	BAL2
7	1.674	388.48	388.48	-17.359	DET
8	1.674	410.823	410.823	-17.359	DET
9	1.674	410.823	410.823	-17.359	DET

Stage  
 1: Charge Delay  
 CHG: Pressurization  
 (Including Pre-charge)  
 BAL1: Equalization  
 BAL2: Stabilization  
 DET: Detection  
 BLW: Air-Blow  
 EXH: Exhaust  
 etc.

Leak  
 Selected Unit

DPS Raw [Pa]  
 Unit is fixed to [Pa]

DPS Raw w/o A/Z [Pa]  
 Unit is fixed to [Pa]

Test Pressure  
 Unit is fixed to k[Pa]

## Mastering Data

Name of file: 201805CH#00.csv  
2018      05      CH#00      .csv  
 Year      Month      Channel      File format

## Data Example

FILE NAM	LSR902/AUTO SAVE/MASTERING DATA/CH#00/201805CH#00.csv										
DATE											
Mastering	Loop1	Loop2	Loop 3	Loop 4	Loop 5	Loop 6	Loop 7	Loop 8	Loop 9	.....	Loop20
-0.2	0.9	1.1	1.1	1.1	1.2						

## File Creation Time

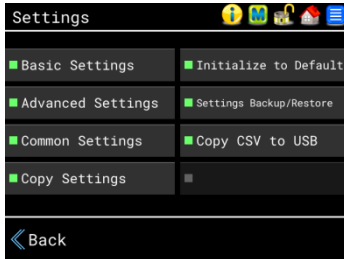
- Test Data: A new file is created once a day at preset hour. (System > File Creation Time)
- Waveform Data: A new file is created every 1 hour.
- Mastering Data: A new file is created once a month

## Copying the Test logs in the internal memory of LS-R902 to USB

Refer to **7.1 Use X-Chart** for the details.



### 5.3 Copy Test Parameters to USB Memory



The current test parameters can be copied in a csv file to USB memory. Insert a USB Memory into the USB port on the front panel.

**Go to:** Settings > Copy CSV to USB

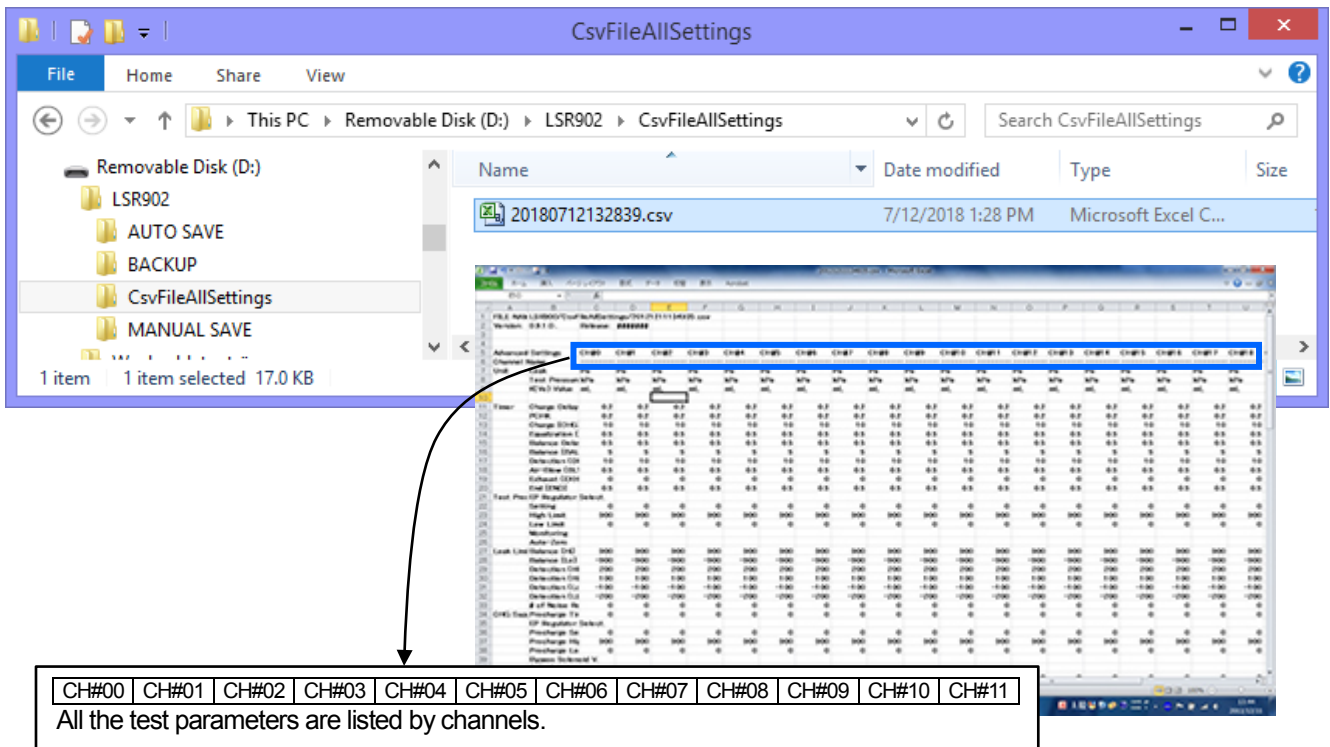
“Copying Test Parameters to USB Memory in csv format OK to continue?” >

**Yes**

“Test Parameter copy in progress” appears on the screen.

“Test Parameter copy Completed” > **OK**

Unplug the USB Memory from LS-R902.



#### Folder and Files

The backup data is stored in a folder “CsvFileAllSettings” that is automatically created in LSR902 folder. The file name is the date and time the file was created (YYYYMMDDHHMMSS.csv)

Path: Removable Disc¥LSR902¥CsvFileAllSettings¥20180511115231.csv

### 5.4 Name the Folder where Data are Stored



System > Folder Name

The keyboard is displayed.

Tap **AC** and then enter.

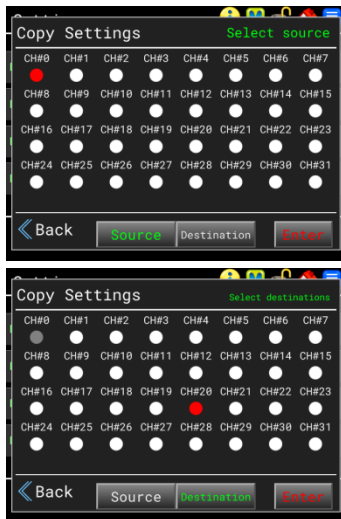
Up to 20 characters including alphabets, numbers and symbols can be set.

## 6 Program Parameters for the Similar Tested Parts

### What To Do

- Copy Settings
- Initialize to Default

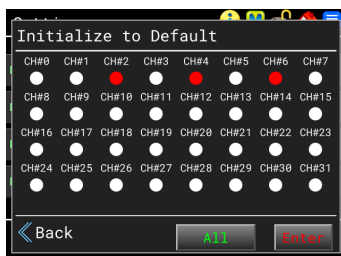
### 6.1 Copy Settings



Test parameters of a channel can be copied to other channels.

- 1) **Go to:** Settings > Copy Settings
- 2) **Source** > Select a source channel
- 3) **Destination** > Select destination channel(s)  
More than one channel can be selected.
- 4) **Enter** > "Initiating Settings-Copy OK to continue?"  
> **Yes**

### 6.2 Initialize to Default



Default parameters can be copied to other channels.

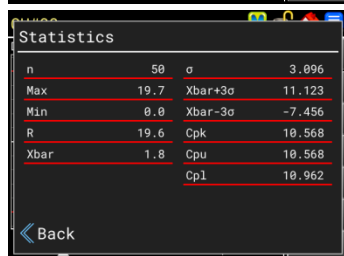
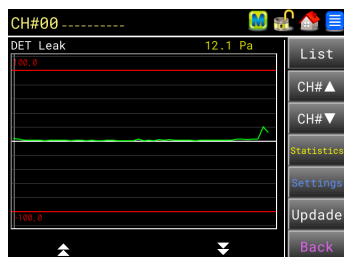
- 1) **Go to:** Settings > Initialize to Default
- 2) Select destination channel(s) > **Enter**  
More than one channel can be selected.
- 3) "Initializing to Default OK to continue?"  
> **Yes**

## 7 Analyze Measured Data

### What To Do

- Use X-Chart to view daily trends and simple statistic of the test data.
- Use Waveform to view the last leak test result in a waveform.

### 7.1 Use X-Chart/List



LS-R902 stores up to 5000 test logs in all 32 channels. All the test logs in the channel of your choice are displayed in figures (oldest data at the top) or a chart (oldest data on the left). Leak test logs after opening this menu will not be displayed unless **Update** is tapped.

This is useful for viewing daily trends and simple statistics of the test results without using a computer.

**List/Chart:** Toggles the display between List and Chart.

**Statistics:** Displays simple statistics of the extracted data. (Xmax, Xmin,  $\sigma$ , Cpk/Cpu/Cpl, etc.)

**Settings:** Program the extracted condition of the test result logs used in the statistics and X-chart.

#### Sample Range

Specify the range of sample data by setting the data numbers to Start and End. The data numbers are shown at the left side in the List.

Larger numbers indicate newer data. Check the numbers, and set to Start and End. The no. set to Start must be smaller than the no. set to End.

Setting example

Start 81 End 95: Specified range of data

Example of special settings (When 0 is set to Start and/or End, the range can be specifically set as below.)

Start 0 End 0: All data

Start 0 End 15: 15 data from the oldest data

Start 15 End 0: From data No.15 to the latest data

Start -15 End 0: 15 data back from the latest data

#### Sample Type

Select a sample Type from DET Leak or DPS Raw output

#### Select Data

Select from All data (including errors), Pass only, Pass /UL/LL or Pass/UL2/UL/LL/LL2.

**USB:** Copies the extracted logs in the memory to USB memory.

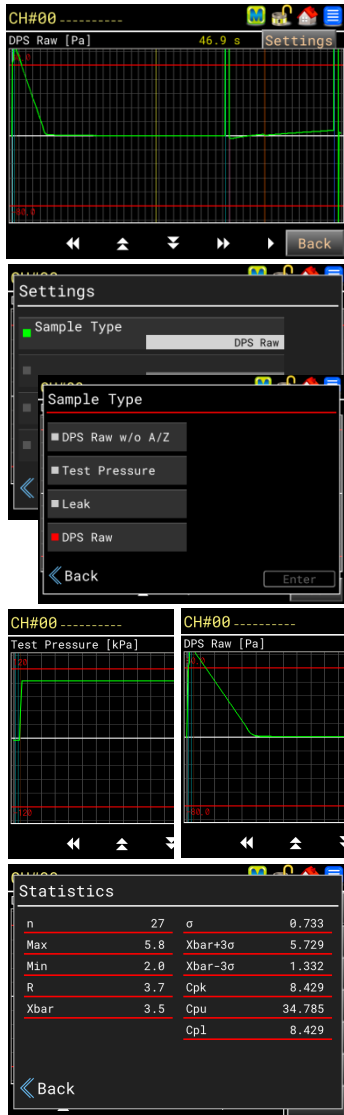
Fields of the data are same as the TEST DATA in System Menu but the folder name is MANUAL SAVE instead of AUTO SAVE (LSR900¥MANUAL SAVE¥LEAK DATA/CH#)

**Reset:** Resets all the test logs in memory.

**Update:** Updates the log display. Leak test logs after opening this menu will not be displayed unless **Update** is tapped.

## 7.2 Analysis: Waveform

This menu is useful for determining the ultimate cycle time.



- 1) First, execute Automatic Setup to set provisional timers.  
**Go to:** Measure Screen > Standard > **Mode** > Automatic Setup > **Enter** > **Start**
- 2) Execute a leak test with the current test parameter to obtain a waveform data.  
**Go to:** Measure Screen > **Mode** > Leak Test > **Enter** > **Start**
- 3) Go to Waveform in Analysis menu.  
**Go to:** Analysis > Waveform
- 4) Select DPS Raw for the Waveform data.  
**Go to:** **Settings** > Sample Type > DPS Raw > **Enter** > **Back**
- 5) Zoom in the display to check when the DPS raw output stabilizes by tapping  $\gg$ . Grid is drawn every 1 second.
- 6) Switch the display to Test Pressure to check when it stabilizes.  
**Go to:** **Settings** > Sample Type > Test Pressure > **Enter** > **Back**
- 7) Between the DPS raw output and Test pressure, whichever takes longer to stabilize should be the standard.  
(Mostly it takes longer for DPS output to stabilize than test pressure.)
- 8) Determine and set the CHG timer by adding 3 seconds to the time the data stabilizes.  
**Go to:** **Back** > **Back** > Settings > Advanced Settings > Timer > Pressurization (CHG)  
In this example, it takes DPS raw output 7 seconds to stabilize. Then Pressurization timer should be 10 seconds (7 + 3 seconds)
- 9) Execute leak tests 5 times with 30 second intervals in between.
- 10) Check R (Range),  $\sigma$  (Standard Deviation) and Cpk to see the data is within your leak specifications.  
**Go to:** Analysis > X-Chart/List > **Statistics**  
R: Range (Max-Min)  
Rough standard: within 20% of the leak spec.  
Standard Deviation  
Cpk: Process Capability Index The smaller value of Cpu and Cpl is displayed.

### NOTE

Similar but simpler procedure can be done in the Waveform in Measurement screen Menu.

Refer to **2.1 Use Measure Screen Waveform**

### If the results are good

Verify the repeatability with the determined parameters.

### If the results are not within the leak specifications

If the results are not within the specifications, extend CHG timer and repeat the process from 9) until the test results fall in the specification with repeatability.

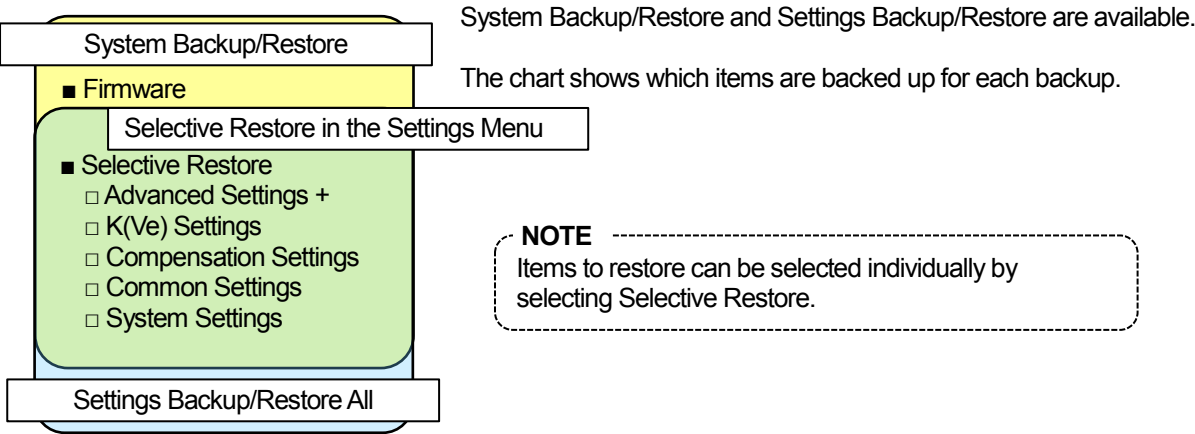
### If the cycle time has to be reduced more

Reduce CHG and BAL1 timers and repeat the process from 9) to see the results fall within the specification with repeatability with the reduced timers.

# 8 Backup and Restore

## What To Do

- Restoring test parameters after changing them temporarily: Settings Backup/Restore
- Preparing for replacing LS-R902 for some trouble: System Backup/Restore
- Restoring when folder name has been changed



## 8.1 Restore Test Parameters



Test parameters can be saved to USB memory for backup, which can be restored at a later date. The current test parameters can be restored easily from backup after changing them temporarily. Settings can be restored to other LS-R902 using Selective Restore.

## Settings Backup

- 1) Connect a USB memory to the USB port on the front panel.
- 2) **Go to:** Settings > Settings Backup/Restore > Backup  
"Initiating Test Parameter Backup OK to continue?" > **Yes**

**NOTE**  
Backup data is only for restoring the test parameters to the LS-R902 and cannot be viewed on computers.

### Restore All in Settings Restore



- 1) Connect a USB memory to the USB port on the front panel.
- 2) **Go to:** Settings > Settings Backup/Restore > Restore > Restore All > "Initiating Test Parameter Restore OK to continue?" > **Yes**

#### NOTE

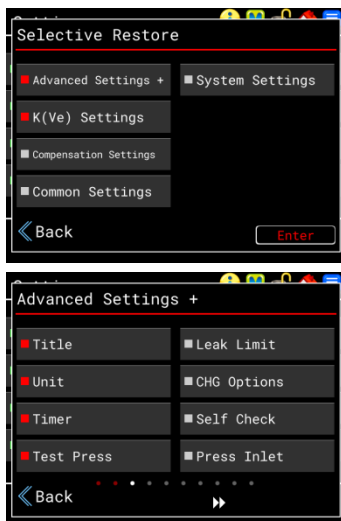
Mastering Value and Compensation Value are reset by Settings Restore.



#### Attention

When restoring (copying) the test parameters saved in a USB memory to other LS-R902, use the "Selective Restore". Using "Restore All" overwrites some crucial information such as span values of the Differential Pressure Sensor and Pressure Sensor, resulting in incorrect measurement.

### Selective Restore



This feature can be used to copy the settings from an LS-R902 to other LS-R902.

Items selected among the backup from the source tester can be restored selectively to the destination tester.

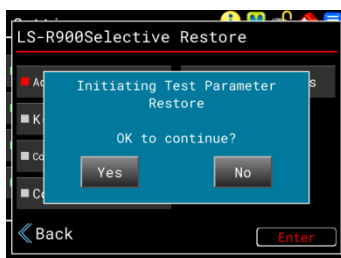
However, this feature requires full understanding that there are items affecting each other such as timers, leak limits and K(Ve) value.

- 1) Connect a USB memory to the USB port on the front panel.
- 2) **Go to:** Settings > Settings Backup/Restore > Restore > Selective Restore > Select items to restore > **Enter** > "Initiating Test Parameter Restore OK to continue?" > **Yes**

#### NOTE

Further items can be selected in Advanced Settings +.

### Restore LS-R900 parameters



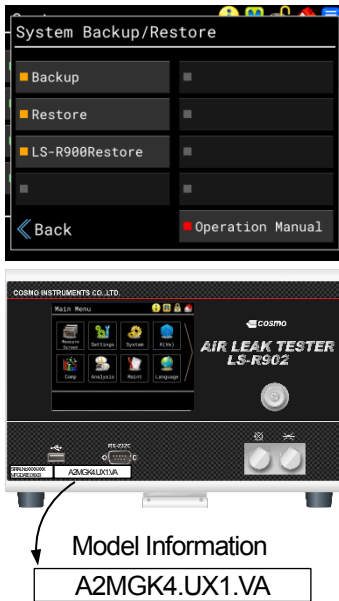
When Settings Backup of LS-R900 is done without changing the folder name, replacement of LS-R900 with LS-R902 can be easily done.

- 1) Connect the USB memory storing the LS-R900 parameters to the LS-R902.
- 2) **Go to:** Settings > Settings Backup/Restore > LS-R900Restore > Selective Restore > Select items to restore > **Enter** > "Initiating Test Parameter Restore OK to continue?" > **Yes**

#### NOTE

If the folder name was changed in the backup of LS-R900, change the folder name back to "LSR900" on a PC so that replacement of LS-R900 with LS-R902 can be done.

## 8.2 Prepare for Replacing LS-R902



Perform System backup to prepare for restoring the test system in case of trouble in the future.

### System Backup

- 1) Connect a USB memory to the USB port on the front panel.
- 2) **Go to:** System > System/Backup/Restore > Backup  
 "Initiating System Backup OK to continue?" > **Yes**

#### NOTE

To back up the Operation Manual, select "Operation Manual".

### System Restore

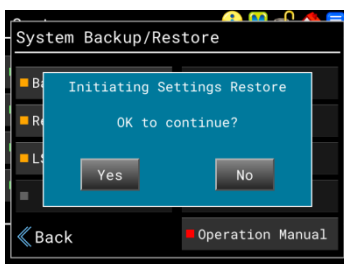
- 1) Connect a USB memory to the USB port on the front panel.
- 2) **Go to:** System > System Backup/Restore > Restore  
 "Initiating System Restore OK to continue?" > **Yes**



#### Attention

Backup data can be restored to other LS-R902 only when the testers are of the same model. Be sure to compare the model information on the front panel of the LS-R902 to ensure that they are the same.

## Replacing LS-R900 with LS-R902



When System Backup of LS-R900 is done without changing the folder name, replacement of LS-R900 with LS-R902 can be easily done.

- 1) Connect the USB memory storing the LS-R900 parameters to the LS-R902.
- 2) **Go to:** System > System Backup/Restore > LS-R900Restore  
 "Initiating Settings Restore OK to continue?" > **Yes**

#### NOTE

If the folder name was changed in the backup of LS-R900, change the folder name back to "LSR900" on a PC so that replacement of LS-R900 with LS-R902 can be done.



#### Attention

Backup data can be restored to LS-R902 from LS-R900 only when the testers are of the same model. Be sure to compare the model information on the front panel of the LS-R902 to ensure that they are the same.



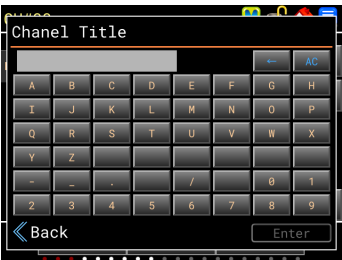
# 9 Other Settings

## 9.1 Name Channels

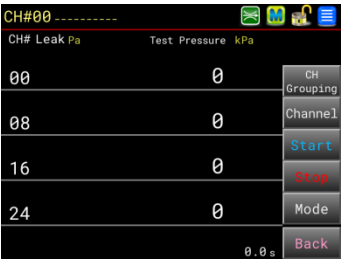


Each channel can be named.  
Naming the channels makes it easier to manage programmed test parameters.

**Go to:** Settings > Advanced Settings > Title > Channel Title  
Keyboard appears.  
Tap **AC** and then enter.  
Up to 20 characters including alphabets, numbers and symbols can be set.



## 9.2 Assign Channels for Each Group for 4-Channel Measurement Screen



**CH Grouping** appears on the right side of the screen when opening 4-Channel measurement screen in the Manual mode.  
Channels of your choice can be assigned to a group of your choice by tapping the button.

**Go to:** Measure Screen > 4-Channel > CH Grouping  
> Tap a group to change the channel assignment  
> Select channels of your choice > **Enter** > **Back**



### 9.3 Compensate E/P Regulator



The output value of the E/P Regulator can be compensated by setting the E/P Regulator Comp Value.

Since compensation can be done for each channel, different test pressure settings can be made in detail for the channels.

**Go to:** Settings > Advanced Settings > Test Press > E/P Regulator Comp Value  
The numerical keypad is displayed.

Enter the compensation value > **Enter**

When the displayed test pressure is higher than the test pressure setting, input the value for the amount exceeding the test pressure setting. When the displayed test pressure is lower than the test pressure setting, input the value for the amount falling below the test pressure setting.

For example, when the test pressure setting is 100 kPa and the displayed test pressure is 97 kPa, set -3.

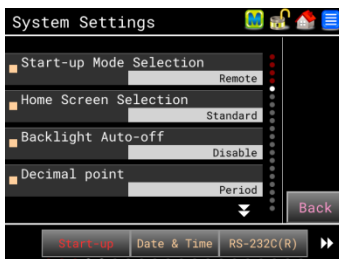
When the test pressure setting is 100 kPa and the displayed test pressure is 103 kPa, set 3.

For adjustment when the last digit of the displayed test pressure fluctuates, set a numerical number after the decimal point.

Also for precharge, the E/P Regulator Comp Value can be set.

## 10 Other Features

### 10.1 Backlight Auto-off



The backlight of LS-R902 goes off automatically when the touch-screen is not touched for a programmed period of time.

Unlock settings and toggle to Manual mode.

**Go to:** System > System Settings > **Start-up** > Backlight Auto-off

> Select the duration > **Enter**

(Disable, 1 minute, 5 minutes, 10 minutes, 30 minutes, 60 minutes, 120 minutes, 240 minutes)

### 10.2 Select a Language

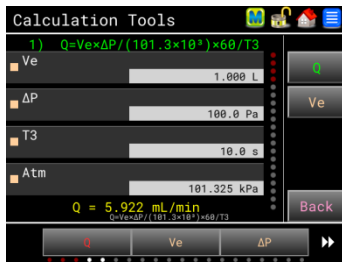


Select a display language from English, Japanese, Chinese, Korean, Spanish, German, and Portuguese.

**Go to:** Language > Select a language and tap **Enter**.

The screen changes to the Main Menu displayed in the selected language.

### 10.3 Calculation Tools

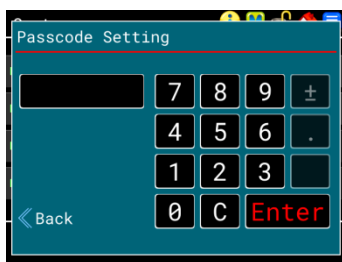


This is Menu to calculate Leak rate, Equivalent Internal Volume, Differential Pressure, Detection Time, and Atmospheric pressure.

**Go to:** Misc > Calculation Tool

Q: Leak Rate [mL/min]  
 Ve: Equivalent internal volume [mL]  
 ΔP: Differential Pressure [Pa]  
 T3: Detection Time [s]  
 Atm: Atmospheric pressure (101325 Pa)

### 10.4 Change the Passcode



Passcode of your choice can be set.

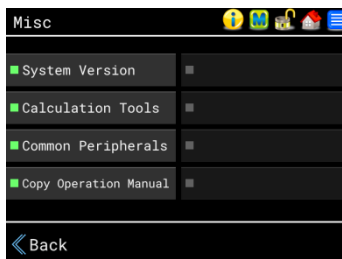
**Go to:** System > Passcode Setting

Tap **C** and enter a 4-digit passcode.  
 Tap **Enter** to complete.

#### NOTE

Do not forget the passcode.  
 If you forget it, operations such as changing the settings cannot be done.

### 10.5 Copy Operation Manual to USB Memory



The Operation Manual can be copied to USB memory.

- 1) Insert a USB Memory into the USB port on the front panel.
- 2) **Go to:** Misc > Copy Operation Manual > **Enter**
- 3) Select a language.
- 4) **Enter** > "Copying to USB OK to continue?"  
 > **Yes**
- 5) Unplug the USB Memory from LS-R902

The operation manual is a PDF file.

The file can be viewed on a computer with Adobe Reader

The operation manual will be copied in a folder "OP MANUAL" that is automatically created in LS-R902 folder.



# 11 Maintain Reliable Test Results

## 11.1 Daily Inspection Points

Let the power on for 5 minutes or longer for a warm-up before starting inspections.

- 1) Check Filter/Mist Separator  
Drain any accumulated water and check the conditions of the element.  
Look for water/oil residues around the exhaust port.
- 2) Check the test pressure.  
Make sure that the regulator is adjusted to the correct pressure.
- 3) Pass/Fail Check  
Run a known good part on the machine to see the part passes.  
Then, apply a properly rated Leak Master and run another test to see the part fails.

### NOTE

Water, oil, or other contaminants entering the Leak Tester through the air pressure source causes the largest majority of breakdowns in the Leak Tester. If contaminants are found in the oil mist separator, it is strongly recommended to install an air dryer or additional in-line filters.  
Once the Leak Tester is contaminated, the pneumatic circuit will have to be overhauled for cleaning, and DPS replacement may be required.

## 11.2 K(Ve) Check

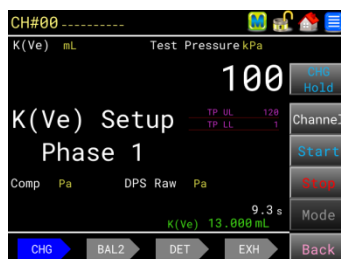
Compares K(Ve) measured with a reference master tested part to the K(Ve) stored in memory. LS-R902 displays an error if the difference exceeds the tolerance. This can be used for daily sensitivity checks. K(Ve) Check behavior should be the same behavior as the K(Ve) Automatic Setup for the current K(Ve).

### K(Ve) Check Limit

Setting a tolerance in percentage ( $\pm$ ) to the K(Ve) currently stored in memory.

**Go to:** K(Ve) > K(Ve) Settings > Basic > K(Ve) Check Limit

### Manual Operation



- 1) Go to K(Ve) Check screen **Go to:** K(Ve) > K(Ve) Check
- 2) K(Ve) Check starts by tapping **Start**.

### Remote Operation

Transmit K(Ve) Check signal and Start Signals through control I/O port.

### Results of K(Ve) Check

Lower than LL	Within the Limits	Larger than UL
DET LL	Pass	DET UL

### When the Result was Fail (DET LL / DET UL)

Perform K(Ve) Check after checking the following and executing Mastering if the result was DET LL or DET UL.

- Tested part**  
 Check whether the tested part used for K(Ve) Check was the same reference master part used for K(Ve) Automatic Setup.
- Leak**  
 Check the sealing surface for contaminants.
- If test results are not relatively consistent.**  
 Normally extending Pressurization (CHG) timer or Equalization (BAL1) timer will help stabilize the pressure and consequently the test result will be consistent.

## 12 Upgrading Firmware



LS-R902 can be upgraded by users.  
 LS-R902 of the latest program can be used.

For upgrading, read Cosmo's homepage.  
 Before upgrading, carefully read the procedure for upgrading.

#### URL

<https://www.cosmo-k.co.jp/english/document-download/>



# Maintenance Manual

## 8 MAINTENANCE

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Periodic Inspection and Calibration helps maintain the accuracy of LS-R902 and prevent malfunction. Performing the following inspection is highly recommended.



**Attention**  
Settings unlocking is required to change settings.  
Toggling to Manual mode is required to execute a measurement manually.

## 1 Daily Inspection Points

Let the power on for 5 minutes or longer for a warm-up before starting inspections.

- 1) Check Filter/Mist Separator  
Drain any accumulated water and check the conditions of the element.  
Look for water/oil residues around the exhaust port.
- 2) Check the test pressure.  
Make sure that the regulator is adjusted to the correct pressure.
- 3) Pass/Fail Check  
Run a known good part on the machine to see the part passes.  
Then, apply a properly rated Leak Master and run another test to see the part fails.

### NOTE

Water, oil, or other contaminants entering the Leak Tester through the air pressure source causes the largest majority of breakdowns in the Leak Tester. If contaminants are found in the oil mist separator, it is strongly recommended to install an air dryer or additional in-line filters.  
Once the Leak Tester is contaminated, the pneumatic circuit will have to be overhauled for cleaning, and DPS replacement may be required.

## 2 Monthly Inspection Points

- 1) Check the oil mist separators and the filter.
- 2) Check all the programmed test parameters and the test pressure.
- 3) Leak check of the leak tester  
Conduct a No-Leak check with the MASTER- and WORK-side stop valves closed.  
**Go to:** Maint > Inspection > Leak Check > No-Leak Check
- 4) Check the PS offset.  
**Go to:** Maint > Inspection > Sensor > PS (P1)



### 3 Annual Inspection Points

Contact your local Cosmo representative for scheduling Annual Calibration Service. The following items will be inspected and calibrated.

- 1) Check the oil mist separators and the filter.
- 2) Leak check of the leak tester
- 3) Check the DPS offset.
- 4) Check the DPS span
- 5) Check the PS offset.
- 6) Check the PS span.

## 4 Features for Maintenance

### 4.1 K(Ve) Check

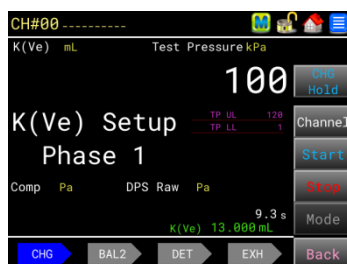
Compares K(Ve) measured with a reference master tested part to the K(Ve) stored in memory. LS-R902 displays an error if the difference exceeds the tolerance. This can be used for daily sensitivity checks. K(Ve) Check behavior should be the same behavior as the K(Ve) Automatic Setup for the current K(Ve).

#### K(Ve) Check Limit

Setting a tolerance in percentage ( $\pm$ ) to the K(Ve) currently stored in memory.

**Go to:** K(Ve) > K(Ve) Settings > Basic > K(Ve) Check Limit

#### Manual Operation



- 1) Go to K(Ve) Check screen **Go to:** K(Ve) > K(Ve) Check
- 2) K(Ve) Check starts by tapping **Start**.

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#### Remote Operation

Transmit K(Ve) Check signal and Start Signals through control I/O port.

#### Results for K(Ve) Check

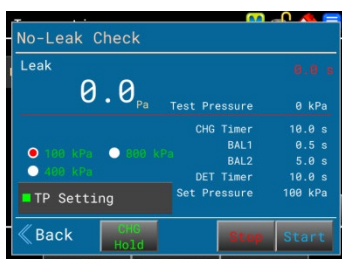
Lower than LL	Within the Limits	Larger than UL
DET LL	Pass	DET UL

### When the Result was Fail (DET LL / DET UL)

Perform K(Ve) Check after checking the following and executing Mastering if the result was **DET LL** or **DET UL**.

- **Tested part**  
Check whether the tested part used for K(Ve) Check was the same reference master part used for K(Ve) Automatic Setup.
- **Leak**  
Check the sealing surface for contaminants.
- **If test results are not relatively consistent.**  
Normally extending Pressurization (CHG) timer or Equalization (BAL1) timer will help stabilize the pressure and consequently the test result will be consistent.

## 4.2 No-Leak Check



No-Leak Check is a leak check of LS-R902 itself.

- 1) Close the WORK- and MASTER-side stop valves on the rear panel.
- 2) **Go to:** Maint > Inspection > **Leak Check** > No-Leak Check
- 3) Check whether the displayed test pressure is appropriate.
- 4) Tap **Start** to start a No-Leak Check.
- 5) Timers are fixed to the follows:  
CHG=10.0s BAL1=0.5s BAL2=5.0s DET=10.0s  
LS-R902 is not leaking if the result is within  $\pm 10$  Pa. If not, contact Cosmo for repair.
- 6) Tap **Stop**.
- 7) Open both the WORK- and MASTER-side stop valves.

## 4.3 DPS Offset Adjustment






- 1) **Go to:** Maint > Inspection > **Sensor** > DPS
- 2) Check whether the sensor is open to the atmosphere.
- 3) Tap **Offset**.
- 4) Check whether the reading is within the tolerance.  
Contact Cosmo for repair if the DPS reading exceeds the Offset Limit.

## 4.4 DPS Span Check



**CAUTION**  
Normally DPS Span calibration will be performed by Cosmo. Persons who have been specially trained by Cosmo can perform it as well, but in that case, Cosmo does not guarantee the calibrated value.

- 1) Remove the plugs from  (Calibration port) and  Maintenance port).
- 2) Disconnect the air pressure source from Test pressure port and make sure that the air is completely exhausted from the pneumatic circuit of the tester. Leave the pilot pressure source as it is.
- 3) Connect the pressure generation source of calibration equipment to the  Maintenance port.
- 4) Unlock settings and toggle to Manual mode.
- 5) **Go to:** Maint > Inspection > **Sensor** > DPS
- 6) Perform DPS offset adjustment.
- 7) Close the WORK- and MASTER-side stop valves on the rear panel.
- 8) Tap **Start** and pressurize LS-R902 with the calibration equipment.
- 9) DPS reading will be displayed on the screen of LS-R902.
- 10) Compare the readings displayed on LS-R902 and displayed on the calibration equipment.

## 4.5 PS Offset Adjustment




- 1) **Go to:** Maint > Inspection > **Sensor** > PS (P1)
- 2) Check whether the sensor is open to the atmosphere.
- 3) Tap **Offset**.
- 4) Check whether the reading is within the tolerance. Contact Cosmo for repair if the PS reading exceeds the Offset Limit.

## 4.6 PS Span Check



**CAUTION**  
Normally DPS Span calibration will be performed by Cosmo. Persons who have been specially trained by Cosmo can perform it as well, but in that case, Cosmo does not guarantee the calibrated value.

- 1) Remove the plug from  (Maintenance port) and connect the calibration equipment that is appropriate for the model to the Maintenance port.
- 2) Leave the air pressure source connected to the Test pressure port but regulate the pressure to 0.
- 3) Unlock settings and toggle to Manual mode.
- 4) **Go to:** Maint > Inspection > **Sensor** > PS (P1)
- 5) Perform PS offset adjustment.
- 6) Close the WORK- and MASTER-side stop valves on the rear panel.
- 7) Tap **Start** and pressurize LS-R902 with the calibration equipment.
- 8) PS reading will be displayed on the screen of LS-R902.
- 9) Compare the readings displayed on LS-R902 and displayed on the calibration equipment.

## 4.7 E/P Regulator Adjustment





The E/P Regulator can be adjusted only when, after the PS offset is adjusted and the PS span is checked, it is confirmed that both values are correct.

### Zero-check of E/P Regulator unit

Open the pressure source to the atmosphere, and check that the indicator of E/P Regulator displays “000”.

### E/P Regulator Adjustment



- 1) Check that the plugs of  (Calibration port) and  (Maintenance port) are closed.
- 2) Close the WORK- and MASTER-side stop valves on the rear panel.
- 3) Maint > Inspection > EP Regulator > E/P Regulator (E/P1)
- 4) Pressure Setting > Set 80% of the Range.
- 5) Tap **Start** and tap   to adjust the PS output to the pressure setting.
- 6) Tap **Enter** and tap **Stop**.

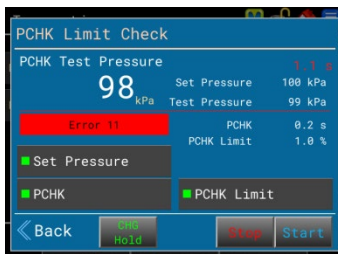
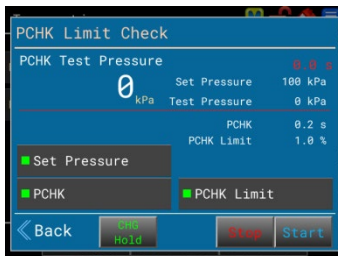
#### NOTE

When the E/P Regulator Comp Value has been set, after span adjustment of E/P Regulator, make sure to check the compensation value of each channel.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

## 4.8 PCHK Limit Check

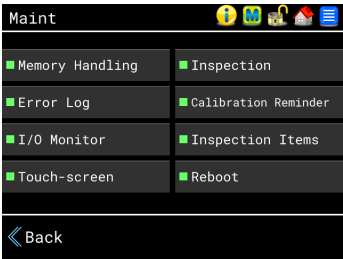
For Intelligent 2 Pneumatic Circuit models, PCHK Limit Check is carried out to further strengthen the Self Check



- 1) Connect non-leaking tested parts to the WORK port and MASTER port on the rear panel. Master Chamber can be used for the Master.
- 2) **Go to:** Maint. > Inspection > Leak Check > PCHK Limit Check
- 3) The default setting of the PCHK timer is 0.2 secs. and the PCHK Limit 1 %.
- 4) In the default state, press **Start** to carry out PCHK Limit Check..
- 5) When **ERROR 11** occurs, the tester is properly operating.
- 6) If **ERROR 11** does not occur, PCHK Limit is not properly functioning. Check the PCHK test pressure and the pressure of PCHK Limit and increase the PCHK time or set 0.5 % to the PCHK Limit to make judgment condition stricter.
- 7) When **ERROR 11** has occurred about 5 times in a stable manner after setting the **PCHK** and **PCHK Limit**, the setup of the PCHK timer and PCHK Limit is complete.
- 8) The PCHK timer can also be set as below:  
**Go to:** Settings > Advanced Settings > Timer  
PCHK Limit can also be set as below:  
**Go to:** Settings > Advanced Settings > Self Check

# 5 Touch-Screen Adjustment

The touch-screen of LS-R902 may get off over the course. This can be adjusted easily.

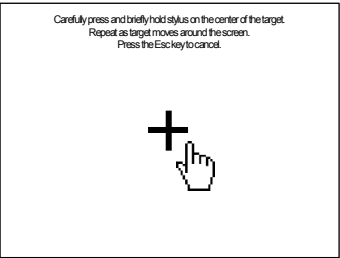


**Go to:** Maint > Touch-screen > “Starting Touch-screen adjustment. OK to continue?” > **Yes**

“+” appears in the center of the screen along with the following instruction on the top. Press the center of the “+” in the order of center > upper left > upper right > lower right > lower left.

OK to continue?” > **Yes**

Rebooting    OK to continue?” > **Yes**



Unless the “+” is correctly pressed, the “+” does not move and the “OK to continue?” does not appear.

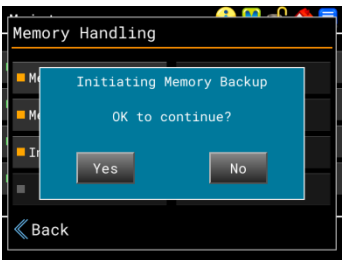
**NOTE**

Use a stylus to press “+” correctly.

# 6 Memory Handling

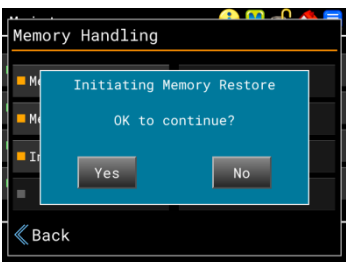
The internal memory of LS-R902 contains calendar, Compensation V (Man), Mastering Value (Man), Counter, X-Chart/List and Error Log. Memory Handling includes Memory Backup, Memory Restore and Initialize Memory.

## 6.1 Memory Backup



**Go to:** Maint > Memory Handling > Memory Backup > “Initiating Memory Backup OK to continue?” > **Yes**

## 6.2 Memory Restore

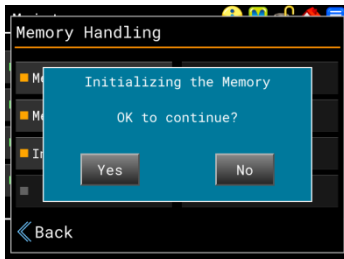


**Go to:** Maint > Memory Handling > Memory Restore > “Initiating Memory Restore OK to continue?” > **Yes**

### 6.3 Initialize Memory

Items cleared by Initialize Memory

- Compensation V (Man)
- Mastering Value (Man)
- Counter
- X-Chart/List
- Error Log



Unlock settings and toggle to Manual mode.

**Go to:** Maint > Memory Handling > Initialize Memory

> “Initializing the Memory OK to continue?” > **Yes**

### 6.4 ERROR 61 FRAM Checksum Error

This error occurs if any of the following values is unusual.  
If this error occurs, never execute Memory Backup.

- Compensation V (Man)
- Mastering Value (Man)
- Counter
- X-Chart/List
- Error Log

#### NOTE

Do not execute  
Maint > Memory Handling > Memory Backup after ERROR 61.


### 6.5 How to Troubleshoot ERROR 61

Initialize Memory.

Maint > Memory Handling > Initialize Memory

#### NOTE

The error code on the measurement screen is not canceled only by Initialize Memory.  
For canceling the error code:

Refer to “9 TROUBLESHOOTING” for the details. 

### 6.6 If ERROR 61 Occurs Right After Initialize Memory

If the error occurs right after Initialize Memory, some internal electrical part may be malfunctioned.  
Contact Cosmo for repair.  
Execute System Backup before contacting us.

**Go to:** System > System Backup/Restore > Backup

# 9

## TROUBLESHOOTING

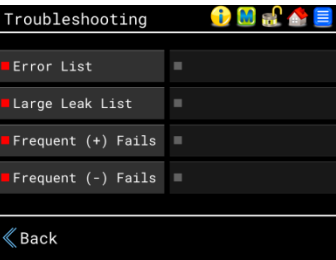
<b>1</b>	<b>When an Error Occurred .....</b>	<b>118</b>
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# 1 When an Error Occurred

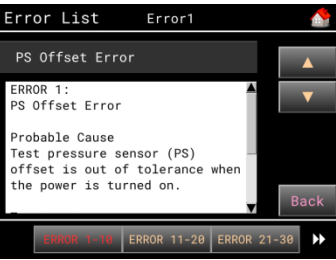
The error code is displayed when an error occurs.  
The error description, probable causes and the treatments are displayed by tapping the displayed code.



# 2 Error List

Menu to view descriptions, probable causes and treatments and all the errors.



Troubleshooting > Error List



The errors are divided every 10 codes.  
Tapping   goes forward or back within 10 errors.



### 3 Error Messages and Treatments

#### 3.1 ERROR 1: PS Offset Error

<b>Timing:</b>	During power-on check procedure
<b>Criteria:</b>	Pressure sensor (PS) offset exceeds $\pm 2\%$ of its range.
Probable Cause	Treatment
Test pressure sensor (PS) offset is out of tolerance when the power is turned on.	Adjust the PS offset. <b>Go to:</b> Maint > Inspection > Sensor > PS(P1) Contact Cosmo for repair if the offset exceeds $\pm 2\%$ of the sensor range.

#### Output Signal Timing Chart

▼ During power-on check procedure

PIN#		Function	TYPE	WAIT
Standard	D-SUB			
1B	18	STAGE #0	NO	
2B	17	STAGE #1	NO	
3B	16	ERROR	NO	
5B	14	Pass	NO	
6B	13	UL FAIL	NO	
9B	36	BUSY	NO	
10B	35	END	NO	
12B	33	LL2 FAIL	NO	
13B	32	LL FAIL	NO	
14B	31	UL2 FAIL	NO	

#### 3.2 ERROR 2 PS Output Out of Range

**Timing:** At the end of Pressurization (CHG) or Precharge (PCHG) stage

**Criteria:** Test pressure exceeds the sensor range in CHG or PCHG stage.

Probable Cause	Treatment
Test pressure sensor (PS) was pressurized exceeding the sensor full-scale.	Adjust the test pressure. Pay extra attention for low pressure models.
Test pressure sensor (PS) offset is out of tolerance.	Adjust the PS offset. <b>Go to:</b> Maint> Inspection> Sensor> PS    Contact Cosmo for repair if the offset exceeds $\pm 2\%$ of the sensor range.
Cable disconnection or malfunction of the test pressure sensor (PS)	Contact Cosmo for repair.

#### Output Signal Timing Chart

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BLW	EXH	END	WAIT
Standard	D-SUB												
1B	18	STAGE #0	NO										
2B	17	STAGE #1	NO										
3B	16	ERROR	NO										
5B	14	Pass	NO										
6B	13	UL FAIL	NO										
9B	36	BUSY	NO										
10B	35	END	NO										
12B	33	LL2 FAIL	NO										
13B	32	LL FAIL	NO										
14B	31	UL2 FAIL	NO										

#### NOTE

When the error occurred in PCHG, stages only in gray areas are applicable. When it occurred in CHG stage, the stages in shaded areas with diagonal lines are also applicable.

### 3.3 ERROR 3 Improper Test Pressure

**Timing:**  
**Test pressure too low:** At the end of Pressurization (CHG) □  
**Test pressure too high:** Always monitored □  
**Precharge pressure too low:** At the end of Precharge (PCHG) □  
**Precharge pressure too high:** Always monitored

**Criteria:** Test pressure exceeds upper or lower limit in CHG or PCHG stage.

Probable Cause	Treatment
"0" is set to the lower limit	Set a numerical number other than "0" to the lower limit.
Upper and Lower limits for Test pressure or Precharge are too close or inappropriate.	Set larger limits. For test pressure limits: □ <b>Go to:</b> Settings > Advanced Settings > Test Press □ > Upper Press Limit (TP UL) / Lower Press Limit (TP LL) □ <b>For Precharge limits:</b> □ <b>Go to:</b> Settings > Advanced Settings > CHG Options □ > Precharge Upper Limit / Precharge Lower Limit
Pressurization time is insufficient. (When pressure is lowered.)	Extend CHG timer. <b>Go to:</b> Settings > Advanced Settings > Timer > Pressurization (CHG)
Precharge time is insufficient. (When Precharge pressure is lowered.)	Extend PCHG timer. <b>Go to:</b> Settings > Advanced Settings > CHG Options > Precharge Timer (PCHG)
Fluctuation or a drop in the source pressure	Check the source pressure or the regulator setting. Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Leaks from gaskets, part and fittings	Check the gaskets, part and fittings for possible leaks.
Malfunction of the test pressure sensor (PS)	Contact Cosmo for repair.

**Output Signal Timing Chart**

At the end of PCHG ▼

▼ At the end of CHG

PIN#		Function	TYPE										
Standard	D-SUB			WAIT	DL1	PCHK	PCHG	PEXH	CHG	BLW	EXH	END	WAIT
1B	18	STAGE #0	NO										
2B	17	STAGE #1	NO										
3B	16	ERROR	NO										
5B	14	Pass	NO										
6B	13	UL FAIL	NO										
9B	36	BUSY	NO										
10B	35	END	NO										
12B	33	LL2 FAIL	NO										
13B	32	LL FAIL	NO										
14B	31	UL2 FAIL	NO										

#### NOTE

When the error occurred in PCHG, stages only in gray areas are applicable. When it occurred in CHG stage, the stages in shaded areas with diagonal lines are also applicable.

### 3.4 ERROR 4 BAL1 Lost Test Pressure

**Timing:** At the end of Equalization (BAL1)  
**Criteria:** Programmed Test pressure lower limit

Probable Cause	Treatment
Leaks from gaskets, part and fittings	Check the gaskets, part and fittings for possible leaks.
Pilot pressure is not stable, or the regulator is not adjusted properly.	Adjust the pilot pressure between 400 kPa and 700 kPa. Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Malfunction of the solenoid valve, SV4, or air-operated valve, AV3.	Contact Cosmo for repair.

#### Output Signal Timing Chart

▼ At the end of BAL1

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	BLW	EXH	END	WAIT
Standard	D-SUB													
1B	18	STAGE #0	NO											
2B	17	STAGE #1	NO											
3B	16	ERROR	NO											
5B	14	Pass	NO											
6B	13	UL FAIL	NO											
9B	36	BUSY	NO											
10B	35	END	NO											
12B	33	LL2 FAIL	NO											
13B	32	LL FAIL	NO											
14B	31	UL2 FAIL	NO											

### 3.5 ERROR 5 Leak Limit Settings Error

**Timing:** At the end of Balance Delay (DL2)  
 At the end of Equalization (BAL1)  
 At the end of Detection (DET)

**Criteria:** The absolute value of the sum of BAL2 UL and DET UL is greater than the absolute value of the test pressure.  
 The absolute value of the sum of BAL2 LL and DET LL is greater than the absolute value of the test pressure.

Probable Cause	Treatment
The absolute value of the sum of BAL2 UL and DET UL is greater than the absolute value of the test pressure.	Check the Leak Limit. <b>Go to:</b> Settings > Advanced Settings > Leak Limit > BAL2 UL/DET UL
The absolute value of the sum of BAL2 LL and DET LL is greater than the absolute value of the test pressure.	Check the Leak Limit. <b>Go to:</b> Settings > Advanced Settings > Leak Limit > BAL2 LL/DET LL

#### Output Signal Timing Chart

At the end of DL2, BAL1 and DET

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
1B	18	STAGE #0	NO														
2B	17	STAGE #1	NO														
3B	16	ERROR	NO														
5B	14	PASS	NO														
6B	13	UL FAIL	NO														
9B	36	BUSY	NO														
10B	35	END	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

### 3.6 ERROR 10 DPS Offset Error

**Timing:** During power-on check procedure

**Criteria:** Differential Pressure sensor (DPS) offset exceeds  $\pm 30\%$  of its range.

Probable Cause	Treatment
Differential pressure sensor (DPS) offset is out of range when the power is turned on.	Adjust the DPS offset. <b>Go to:</b> Maint > Inspection > Sensor > DPS □ Contact Cosmo for repair if the offset exceeds $\pm 30\%$ of the sensor range.

#### Output Signal Timing Chart

▼ During power-on check procedure

PIN#		Function	TYPE	WAIT
Standard	D-SUB			
1B	18	STAGE #0	NO	
2B	17	STAGE #1	NO	
3B	16	ERROR	NO	
5B	14	Pass	NO	
6B	13	UL FAIL	NO	
9B	36	BUSY	NO	
10B	35	END	NO	
12B	33	LL2 FAIL	NO	
13B	32	LL FAIL	NO	
14B	31	UL2 FAIL	NO	

### 3.7 ERROR 11: Air Operated Valve Error 1

**Timing:** At the end of PCHK

**Criteria:** Test pressure sensor (PS) offset exceeds  $\pm 1\%$  of the sensor range.

Probable Cause	Treatment
Pilot pressure is not stable, or the regulator is not adjusted properly.	Adjust the pilot pressure between 400 kPa and 700 kPa. Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Test pressure sensor (PS) offset exceeds $\pm 1\%$ of the sensor range.	Adjust the PS offset or enable Auto-Zero feature to reset the pressure residue of the previous test. <b>PS Offset:</b> <b>Go to:</b> Maint. > Inspection > Sensor > PS (P1) <b>PS Auto-Zero:</b> <b>Go to:</b> Settings > Advanced Settings > Test Press > PS Auto-Zero > Enable
Charge Delay (DL1) timer is too short	Set the DL1 timer to 0.2 s or longer. <b>Go to:</b> Settings > Advanced Settings > Timer > Charge Delay (DL1)
Malfunction of the test pressure sensor (PS), solenoid valve or air-operated valve.	Contact Cosmo for repair.

#### Output Signal Timing Chart

▼ At the end of PCHK

PIN#		Function	TYPE	WAIT	DL1	PCHK	BLW	EXH	END	WAIT
Standard	D-SUB									
1B	18	STAGE #0	NO							
2B	17	STAGE #1	NO							
3B	16	ERROR	NO							
5B	14	Pass	NO							
6B	13	UL FAIL	NO							
9B	36	BUSY	NO							
10B	35	END	NO							
12B	33	LL2 FAIL	NO							
13B	32	LL FAIL	NO							
14B	31	UL2 FAIL	NO							

### 3.8 ERROR 12: Air Operated Valve Error 2

**Timing:** At the end of Pressurization (CHG) or Precharge (PCHG) stage

**Criteria:** Auto-zero of PS is smaller than 1% of the sensor range at the end of CHG

Probable Cause	Treatment
Pilot pressure is not stable, or the regulator is not adjusted properly.	Adjust the pilot pressure between 400 kPa and 700 kPa. Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Pressure source is disconnected.	Check the pressure source and the regulator setting.
Test pressure is too low for high pressure models, H20 and H49.	Adjust the test pressure within the test pressure range.
Malfunction of the test pressure sensor (PS), solenoid valve or air-operated valve.	Contact Cosmo for repair.

#### Output Signal Timing Chart

At the end of PCHG ▼

▼ At the end of CHG

PIN#		Function	TYPE										
Standard	D-SUB			WAIT	DL1	PCHK	PCHG	PEXH	CHG	BLW	EXH	END	WAIT
1B	18	STAGE #0	NO										
2B	17	STAGE #1	NO										
3B	16	ERROR	NO										
5B	14	Pass	NO										
6B	13	UL FAIL	NO										
9B	36	BUSY	NO										
10B	35	END	NO										
12B	33	LL2 FAIL	NO										
13B	32	LL FAIL	NO										
14B	31	UL2 FAIL	NO										

#### NOTE

When the error occurred in PCHG, stages only in gray areas are applicable. When it occurred in CHG stage, the stages in shaded areas with diagonal lines are also applicable.

### 3.9 ERROR 14 Air Operated Valve Error 4

**Timing:** At the end of Air-Blow (BLW)

**Criteria:** The differential pressure during Air-Blow did not reach the Blow  $\Delta$ P Limit.

Probable Cause	Treatment
Pilot pressure is not stable, or the regulator is not adjusted properly.	Adjust the pilot pressure between 400 kPa and 700 kPa. Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Air-Blow (BLW) timer is too short or Blow $\Delta$ P Limit is too high.	Extend the Air-Blow (BLW) timer or lower the Blow $\Delta$ P Limit. <b>Air-Blow (BLW) Timer:</b> <b>Go to:</b> Settings > Advanced Settings > Timer > Air-Blow (BLW) <b>Blow <math>\Delta</math>P Limit</b> <b>Go to:</b> Settings > Advanced Settings > Self Check > Blow $\Delta$ P Limit
Malfunction of the test pressure sensor (PS), solenoid valve or air-operated valve.	Contact Cosmo for repair.

#### Output Signal Timing Chart

▼ At the end of BLW

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
1B	18	STAGE #0	NO														
2B	17	STAGE #1	NO														
3B	16	ERROR	NO														
5B	14	Pass	NO														
6B	13	UL FAIL	NO														
9B	36	BUSY	NO														
10B	35	END	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

### 3.10 ERROR 15: Air Operated Valve Error 5

**Timing:** At the end of Equalization (BAL2) Only for High press and External Press.

**Criteria:** Pressure switch monitoring the pilot pressure for the Balance (BAL) valve is not activated.

Probable Cause	Treatment
Pilot pressure is not stable, or the regulator is not adjusted properly.	Adjust the pilot pressure between 400 kPa and 700 kPa. Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Malfunction of the pressure switch monitoring the pilot pressure for the Balance (BAL) valve.	Contact Cosmo for repair. As a provisional measure, the pressure switch monitoring can be disabled. <b>Go to:</b> Settings > Common Settings > Special > PSW Monitoring > Disable

#### Output Signal Timing Chart

▼ At the end of BAL2

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	BLW	EXH	END	WAIT
Standard	D-SUB															
1B	18	STAGE #0	NO													
2B	17	STAGE #1	NO													
3B	16	ERROR	NO													
5B	14	Pass	NO													
6B	13	UL FAIL	NO													
9B	36	BUSY	NO													
10B	35	END	NO													
12B	33	LL2 FAIL	NO													
13B	32	LL FAIL	NO													
14B	31	UL2 FAIL	NO													

### 3.11 ERROR 16: Air Operated Valve Error 6

**Timing:** During idle state

**Criteria:** DPS offset exceeded the Idle ΔP Check limit within the programmed Idle ΔP Check Time

Probable Cause	Treatment
DPS offset exceeded its monitoring limit while the air leak tester is in idle state.	Adjust the DPS offset. <b>Go to:</b> Maint > Inspection > Sensor > DPS□ Contact Cosmo for repair if the offset exceeds ±30% of the sensor range.
Exhaust time is insufficient.	Extend Idle ΔP Check Timer or Exhaust timer. Idle ΔP Check Timer:□ <b>Go to:</b> Settings > Advanced Settings > Self Check > Idle ΔP Check Timer□ Exhaust timer:□ <b>Go to:</b> Settings > Advanced Settings > Timer > Exhaust (EXH)
Malfunction of the fill valve: SV1 or AV1	Contact Cosmo for repair.

#### Output Signal Timing Chart

▼ During idle state

PIN#		Function	TYPE	WAIT
Standard	D-SUB			
1B	18	STAGE #0	NO	
2B	17	STAGE #1	NO	
3B	16	ERROR	NO	
5B	14	Pass	NO	
6B	13	UL FAIL	NO	
9B	36	BUSY	NO	
10B	35	END	NO	
12B	33	LL2 FAIL	NO	
13B	32	LL FAIL	NO	
14B	31	UL2 FAIL	NO	

### 3.12 ERROR 17: Blockage Check Error

**Timing:** At the end of Pressurization (CHG)

**Criteria:** The Blockage data exceeded the programmed tolerance sampled Blockage Check data in the Memory.

Probable Cause	Treatment
Something is blocking the air way of the external pneumatic circuits (valves).	Check the external pneumatic circuit (valves)

#### Output Signal Timing Chart

▼ At the end of CHG

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BLW	EXH	END	WAIT
Standard	D-SUB												
1B	18	STAGE #0	NO										
2B	17	STAGE #1	NO										
3B	16	ERROR	NO										
5B	14	Pass	NO										
6B	13	UL FAIL	NO										
9B	36	BUSY	NO										
10B	35	END	NO										
12B	33	LL2 FAIL	NO										
13B	32	LL FAIL	NO										
14B	31	UL2 FAIL	NO										

### 3.13 ERROR 21: DPS Stopped Oscillating

**Timing:** Always monitored  
**Criteria:** DPS stopped oscillating.

Probable Cause	Treatment
Malfunction of the DPS or power source or cable disconnection	Contact Cosmo for repair.

#### Output Signal Timing Chart ▼ During power-on check procedure

PIN#		Function	TYPE	WAIT
Standard	D-SUB			
1B	18	STAGE #0	NO	
2B	17	STAGE #1	NO	
3B	16	ERROR	NO	
5B	14	PASS	NO	
6B	13	UL FAIL	NO	
9B	36	BUSY	NO	
10B	35	END	NO	
12B	33	LL2 FAIL	NO	
13B	32	LL FAIL	NO	
14B	31	UL2 FAIL	NO	

### 3.14 ERROR 22: Stop Valves Closed

**Timing:** At the end of PCHK At the end of PCHK (At the end of each stage If closed during measurement)  
**Criteria:** The stop valve monitoring switch is ON/OFF

Probable Cause	Treatment
Stop valves of WORK and MASTER ports are closed, which disturbs the cover from closing. (The stop valve monitoring switch is not pressed.)	Open the stop valves.
If the error occurs even though the stop valves are opened, the stop valve monitoring switch may be malfunctioned.	Contact Cosmo for repair. As a provisional measure, the stop valve monitor can be disabled. <b>Go to:</b> Settings> Common Settings> Special> Stop Valve Monitor> Disable

#### Output Signal Timing Chart ▼ At the end of PCHK

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	BLW	EXH	END	WAIT
Standard	D-SUB											
1B	18	STAGE #0	NO									
2B	17	STAGE #1	NO									
3B	16	ERROR	NO									
5B	14	PASS	NO									
6B	13	UL FAIL	NO									
9B	36	BUSY	NO									
10B	35	END	NO									
12B	33	LL2 FAIL	NO									
13B	32	LL FAIL	NO									
14B	31	UL2 FAIL	NO									



### 3.15 ERROR 23: Mastering Error

**Timing:** At the end of the last iteration of DET for Mastering value sampling

**Criteria:** Leak data at the end of the last DET iteration exceeded the Mastering Limit in the Mastering Sampling.

Probable Cause	Treatment
Pressurization and stabilization time is insufficient.	Extend Pressurization (CHG) timer and/or Equalization (BAL1) timer. <b>Go to:</b> Settings > Advanced Settings > Timer > Pressurization(CHG)/ Equalization(BAL1)
MB1(Mastering Equalization) timer, MB2(Mastering Stabilization) timer and/or Mastering Iterations are inappropriate.	Check the each setting. <b>Go to:</b> Comp > Mastering Settings> Basic > MB1 Timer/ MB2 Timer/ Mastering Iterations <b>Ref:</b> The recommended settings for MB1 and MB2 timers are 0.5 s. Make sure that the last DET data is not a negative figure.
Upper and Lower limits for Mastering are inappropriate.	Set larger limits. <b>Go to:</b> Comp > Mastering Settings > Basic > Mastering Comp Upper Limit / Mastering Comp Lower Limit <b>Ref:</b> Typically the Mastering limits are set to be about 120 to 150% of the 1st DET in a Mastering value sampling. Default: $\pm 250$ [Pa]

#### Output Signal Timing Chart

Last iteration of DET for Mastering value sampling ▼

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
1B	18	STAGE #0	NO														
2B	17	STAGE #1	NO														
3B	16	ERROR	NO														
5B	14	Pass	NO														
6B	13	UL FAIL	NO														
9B	36	BUSY	NO														
10B	35	END	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

### 3.16 ERROR 24 K(Ve) Value Out of Range

**Timing:** The last DET in K(Ve) Automatic Setup

**Criteria:** Calculated K(Ve) exceeded 100L.

Probable Cause	Treatment
The current K(Ve) settings does not match the calibrator used for K(Ve) Automatic Setup causing the measured value exceeding 100L.	Check the settings for the calibrator. The items to be set vary depending on the calibrator used for K(Ve) Automatic Setup. <b>ALC:</b> ALC Displacement or ALC Reading <input type="checkbox"/> <b>Leak Master:</b> LM Flow [mL/min]

#### Output Signal Timing Chart

At the end of last DET in K(Ve) Automatic Setup ▼

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
1B	18	STAGE #0	NO														
2B	17	STAGE #1	NO														
3B	16	ERROR	NO														
5B	14	Pass	NO														
6B	13	UL FAIL	NO														
9B	36	BUSY	NO														
10B	35	END	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

### 3.17 ERROR 25 Leak Limit Out of Range

**Timing:** The last DET in K(Ve) Automatic Setup

**Criteria:** K (Ve) Leak limits exceeded the DPS range after K(Ve) Automatic Setup

Probable Cause	Treatment
Leak limits exceeded the DPS range after executing the K(Ve) Automatic Setup.	Change the Leak unit to a pressure unit and perform K(Ve) Automatic Setup again. <b>Go to:</b> Settings > Advanced Settings> Unit > Leak Unit

#### Output Signal Timing Chart

At the end of last DET in K(Ve) Automatic Setup ▼

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
1B	18	STAGE #0	NO														
2B	17	STAGE #1	NO														
3B	16	ERROR	NO														
5B	14	Pass	NO														
6B	13	UL FAIL	NO														
9B	36	BUSY	NO														
10B	35	END	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

### 3.18 ERROR 52 to ERROR 70 System Errors

Usually system errors (ERROR 52 to ERROR 70) are caused by malfunction of electrical components.

#### System Errors (Timing: At the start of measurement)

Error Code	Description
ERROR 52	AD Communication Error
ERROR 53	I/O Communication Error
ERROR 60	microSD Card Error
ERROR 61	FRAM Checksum Error
ERROR 67	Subnetwork Error
ERROR 68	Fieldbus Error
ERROR 70	TCU Error

Reboot LS-R902 or tap **Stop** on a measurement screen to cancel the error message. Contact Cosmo for repair after executing System Backup.

Refer to “7 OPERATIONS LISTED BY PURPOSE” for the details. 

#### Canceling the Error Message

- 1) Switch the operation mode to Manual(M).
- 2) Tap **Stop** on a measurement screen to cancel the error message.  
Rebooting LS-R902 also cancels the error.  
Or **go to**: Maint > Reboot

#### Output Signal Timing Chart

▼ At the start of measurement

PIN#		Function	TYPE	WAIT	DL1
Standard	D-SUB				
1B	18	STAGE #0	NO		
2B	17	STAGE #1	NO		
3B	16	ERROR	NO		
5B	14	Pass	NO		
6B	13	UL FAIL	NO		
9B	36	BUSY	NO		
10B	35	END	NO		
12B	33	LL2 FAIL	NO		
13B	32	LL FAIL	NO		
14B	31	UL2 FAIL	NO		

### 3.19 Battery Discharge

When LS-R902 has been used for approx. 10 years, a message window saying “The battery has discharged completely. Please replace the battery and set the date again.” is displayed.

When you set the date again, you can use LS-R902. However, since the battery needs to be replaced, contact Cosmo for repair.

## 4 Large Leak List

The probable cause depends on which stage the large leak judgment is made.

Display	Probable Cause	Treatment
CHG Large Leak WORK side CHG Large Leak MASTER side	There is a large leak on the WORK/MASTER side system.	Check the gaskets, part and fittings for possible leaks.
DL2 Large Leak WORK side DL2 Large Leak MASTER side	There is a large leak on the WORK/MASTER side system.	Check the gaskets, part and fittings for possible leaks.
	Pressurization and stabilization time is insufficient.	Extend Precharge (PCHG), Pressurization (CHG) or Equalization (BAL1) timer. <b>Go to:</b> Settings > Advanced Settings > CHG Options > Precharge Timer (PCHG) <b>Go to:</b> Settings > Advanced Settings > Timer > Pressurization (CHG) / Equalization (BAL1)
BAL2 Large Leak WORK side BAL2 Large Leak MASTER side	There is a large leak on the WORK/MASTER side system.	Check the gaskets, part and fittings for possible leaks.
	Pressurization and stabilization time is insufficient.	Extend Pressurization (CHG) timer and/or Equalization (BAL1) timer. <b>Go to:</b> Settings > Advanced Settings > Timer > Pressurization (CHG) / Equalization (BAL1)
DET Large Leak WORK side DET Large Leak MASTER side	There is a large leak on the WORK/MASTER side system.	Check the gaskets, part and fittings for possible leaks.
	Pressurization and stabilization time is insufficient.	Extend Pressurization (CHG) and/or Stabilization (BAL2) timer. <b>Go to:</b> Settings > Advanced Settings > Timer > Pressurization (CHG) / Stabilization (BAL2)

If the problem persists without identifiable causes, please conduct No-Leak Check.

- 1) Close both the WORK and MASTER stop valves on the rear panel of the tester.
- 2) **Go to:** Maint > Inspection > Leak Check > No-Leak Check

Contact Cosmo for repair if internal leak is found.

## 4.1 Output Signal Timing Charts for Large Leak Timing

### NOTE

The heavy line indicates the judgment timing.

### CHG Large Leak WORK side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BLW	EXH	END	WAIT
Standard	D-SUB												
1B	18	STAGE #0	NO										
2B	17	STAGE #1	NO										
3B	16	ERROR	NO										
5B	14	Pass	NO										
6B	13	UL FAIL	NO										
9B	36	BUSY	NO										
10B	35	END	NO										
12B	33	LL2 FAIL	NO										
13B	32	LL FAIL	NO										
14B	31	UL2 FAIL	NO										

### CHG Large Leak MASTER side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BLW	EXH	END	WAIT
Standard	D-SUB												
1B	18	STAGE #0	NO										
2B	17	STAGE #1	NO										
3B	16	ERROR	NO										
5B	14	Pass	NO										
6B	13	UL FAIL	NO										
9B	36	BUSY	NO										
10B	35	END	NO										
12B	33	LL2 FAIL	NO										
13B	32	LL FAIL	NO										
14B	31	UL2 FAIL	NO										

### DL2, BAL2 DET Large Leak WORK/MASTER side

See the tables in the next page for the judgment timing.

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
1B	18	STAGE #0	NO														
2B	17	STAGE #1	NO														
3B	16	ERROR	NO														
5B	14	Pass	NO														
6B	13	UL FAIL	NO		Varies depending on the stage that Large Leak was detected												
9B	36	BUSY	NO														
10B	35	END	NO														
12B	33	LL2 FAIL	NO		Varies depending on the stage that Large Leak was detected												
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

### NOTE

In the detection of DL2 Large leak, where STAGE #0 is output, BLW is operated immediately after DL2.  
In the detection of BAL2 Large leak, where STAGE #0 is output, BLW is operated immediately after BAL2.

### Output Signal Timing Charts for Large Leak (The heavy line indicates the judgment timing)

In Large Leak judgment, UL and UL2 signals are output simultaneously for Fail judgment of WORK side and LL and LL2 signals are output simultaneously for Fail judgment of MASTER side.

#### DL2 Large Leak WORK side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BLW	EXH	END	WAIT
Standard	D-SUB														
6B	13	UL FAIL	NO												
12B	33	LL2 FAIL	NO												
13B	32	LL FAIL	NO												
14B	31	UL2 FAIL	NO												

#### DL2 Large Leak MASTER side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BLW	EXH	END	WAIT
Standard	D-SUB														
6B	13	UL FAIL	NO												
12B	33	LL2 FAIL	NO												
13B	32	LL FAIL	NO												
14B	31	UL2 FAIL	NO												

#### BAL2 Large Leak WORK side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	BLW	EXH	END	WAIT
Standard	D-SUB															
6B	13	UL FAIL	NO													
12B	33	LL2 FAIL	NO													
13B	32	LL FAIL	NO													
14B	31	UL2 FAIL	NO													

#### BAL2 Large Leak MASTER side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	BLW	EXH	END	WAIT
Standard	D-SUB															
6B	13	UL FAIL	NO													
12B	33	LL2 FAIL	NO													
13B	32	LL FAIL	NO													
14B	31	UL2 FAIL	NO													

#### DET Large Leak WORK side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
6B	13	UL FAIL	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

#### DET Large Leak MASTER side

PIN#		Function	TYPE	WAIT	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLW	EXH	END	WAIT
Standard	D-SUB																
6B	13	UL FAIL	NO														
12B	33	LL2 FAIL	NO														
13B	32	LL FAIL	NO														
14B	31	UL2 FAIL	NO														

## 5 Frequent (+) Fails

Follow the procedures below to identify the cause of the frequent fails and remedy the problem.

- 1 Perform a No-Leak Check with the stop valves on the rear panel closed.

If the air leak tester is not leaking, the cause of the frequent fails is something else. Proceed to the next item to check. Contact Cosmo for repair if internal leak is found.

- 2 Check the fixture condition.

Probable Cause	Treatment
Leaks from pipe fittings	Look for leaks in the fittings by performing a bubble test applying soap solution. Redo the piping if needed.
Deformation of pipe	Replace it with pipe that is rigid enough not to deform.
Proceed to the next item to check if the problem persists without identifiable causes.	

- 3 Check the sealing condition.

Probable Cause	Treatment
Sealing material is missing.	Place the sealing material.
Sealing surface is contaminated.	Clean the sealing surface.
Sealing material is damaged or worn-out.	Replace it with a new one.
Sealing deforms when the fixture clamps.	Check the following: <ul style="list-style-type: none"> <li>• Whether there is enough clearance between the sealing material and the groove.</li> <li>• Wear of the stopper</li> <li>• Whether the size and hardness of the sealing material are appropriate.</li> <li>• If the thrust force of the cylinder has lowered.</li> </ul>
Proceed to the next item to check if the problem persists without identifiable causes.	

- 4 Check whether there were environmental changes.

Probable Cause	Treatment
Tested part is exposed to the direct wind from air conditioner or fan.	Move the source of the wind to where the wind dose not hit the tested parts directly.
Some air tools are branched off the pressure source of the air leak tester causing fluctuation in the pressure source.	Avoid using air tools branching off the pressure source of the air leak tester to supply a stable air. Setting up a dedicated pressure source for the air leak tester is recommended.
Air compressor capacity is insufficient.	Use the air compressor whose capacity is large enough.
The current compensation value may not be suitable for the current environmental condition.	Update the compensation value.
Proceed to the next item to check if the problem persists without identifiable causes.	

- 5 Check the condition of the tested parts.

Probable Cause	Treatment
Part temperature is higher or lower than the ambient temperature.	Let the part temperature be ambient by adding a cooling/warming buffer in the production line.
The tested parts are wet.	Improve the drying process. Add drying process if there isn't any.
The tested parts get deformed by pressurization.	Add a stopper to prevent the deformation.
Leak due to the gas porosity or internal leak	Look for leaks by performing a bubble test applying soap solution. If no leak is confirmed, there may be internal leaks. If there is a leak, re-evaluate the production process.

## 6 Frequent (-) Fails

There are two types of the causes for the negative fails.

One is caused by a pressure rise in WORK-side circuit and the other is caused by a pressure reduction in the MASTER-side circuit.

Follow the procedures below to identify the cause of the frequent fails and remedy the problem.

### 1 Perform a No-Leak Check with the stop valves on the rear panel closed.

If the air leak tester is not leaking, the cause of the frequent fails is something else. Proceed to the next item to check. Contact Cosmo for repair if internal leak is found.

### 2 By a pressure rise in WORK-side circuit

Probable Cause	Treatment
Sealing is not stable.	Check the follows: <ul style="list-style-type: none"> <li>Whether there is enough clearance between the sealing material and the groove.</li> <li>Wear of the stopper</li> <li>Whether the size and hardness of the sealing material are appropriate.</li> <li>Whether the thrust force of the cylinder is too high</li> </ul>
A rise in temperature of the air inside the tested part due to the temperature rise of the cold tested part trying to match the ambient temperature. (Air temperature rise inside the tested part)	<ul style="list-style-type: none"> <li>Let the part temperature be ambient by adding a cooling/warming buffer in the production line.</li> <li>If the part is wet, add or improve the drying process. Add drying process if there isn't any.</li> </ul>
Proceed to the next item to check if the problem persists without identifiable causes.	

### 3 By a pressure reduction in MASTER side circuit

Probable Cause	Treatment
There are leaks from the Master or the fittings on the MASTER side.	Check Master part and the fittings for possible leaks by performing a bubble test applying soap solution. Replace the Master part if leak is found in the Master part. Redo the piping if leak is found in the fittings of the pipe.
Deformation of MASTER side pipe	Replace it with pipe that is rigid enough not to deform.
Adiabatic compression effect of the Master	The size of the Master Chamber may be wrong, or the BAL2 timer may be too short. Replace the master to the one with good temperature stability. Extend BAL2 timer if possible.
Proceed to the next item to check if the problem persists without identifiable causes.	

### 4 By over compensation

Probable Cause	Treatment
The current compensation value may not be suitable for the current environmental condition.	Update the compensation value.



Specifications & References

10 SPECIFICATIONS

1 Primary Specifications..... 136

2 Model Classifications..... 137

# 1 Primary Specifications

Differential Pressure Sensor (Standard)	Resolution: Display Range: Accuracy Guaranteed Range: Sensor Range: Sensor Proof Pressure: Reading Accuracy: *1	0.1 Pa ±2500 Pa ±1000 Pa ±2000 Pa 5 MPa ±2.5 % of rdg ±1 Pa 50 Pa or lower: ±2 Pa
Test Pressure Sensor	Reading Accuracy: Temperature Characteristics:	±1 % of F.S. ±1 digit (Linearity, Hysteresis and Repeatability) ±0.1 % of F.S. / °C
Display Unit *2	Test Pressure Leak *3	kPa, MPa (psi, kg/cm <sup>2</sup> , bar, mbar, mmHg, cmHg, inHg, mmH <sub>2</sub> O) Pa, kPa, mL/s, mL/min, L/min, Pa·m <sup>3</sup> /s, E-3 Pa·m <sup>3</sup> /s, Pa/s, Pa/min, *Pa/s, *Pa/min (mmH <sub>2</sub> O, inH <sub>2</sub> O, mmHg, in <sup>3</sup> /min, in <sup>3</sup> /d, ft <sup>3</sup> /h)
Leak Display	3 to 5 digits (Floating point) Sampling Rate: 10 times/s	
Leak Limit Range (Standard)	Up to ±999.9 Pa	
Number of Channels	32 channels (#0 to #31), 100 channels (available as option)	
Timers	Up to 999.9 s (Resolution: 0.1 s)	
Power Source	100 to 240 VAC ±10 % at 50/60 Hz, 80 VA max Fuse: T2.5 A 250 V Dielectric strength voltage and resistance: 1400 VAC 10 sec, 500 VDC 50 MΩ Internal Solenoid Power Source: 24 VDC	
Test Pressure source	Clean air regulated to the test pressure. The source pressure must be sufficiently higher than the test pressure.	
Pilot Pressure	Clean air regulated between 400 and 700 kPa	
Port Size	Rc(PT) 1/4 (Test pressure, Pilot pressure, WORK and MASTER ports)	
LCD/TP	5.7 inch color LCD 640 x 480 dots (VGA)	
Ambient Temperature	Operation Temperature: 5 to 45 °C Storage Temperature: -20 to 60 °C	
Humidity	80 %RH or less / no dew condensation	
Weight	Approx. 10 kg (Standard model)	
Control I/O Port	Input Signal: Start, Stop, etc. Output Signal: Pass, UL Fail, LL Fail, etc.	
RS232C Serial Communication (D-sub 9 pins) 2 ports	I/F fixed length ID/F fixed length T/F fixed length Others	Test parameters as well as test results are transmitted. Only test results are transmitted.
USB Port	Test Data Exporting test parameters	Judgment, Leak, Compensation value, Test pressure, Channel#, Timers, etc. csv file
LAN Port	FTP server (Plan)	
Calibration / Maintenance Ports	M10 x 1.5 (O ring seal)	
E/P Regulator	Repeatability: ±0.5% of F.S. or less Temperature Characteristics: ±0.16% of F.S. / °C	
Standard Accessories	Power cord Control I/O connector, RS-232 caps (2), USB port cover, Inspection record, Traceability documents, Operation manual CD	· 125 VAC/7 A Length: 3 m · Rating: 250 VAC/10 A Length: 2 m (CE conformed)
Environmental Conditions (IEC 61010-1)	Over voltage category II Pollution degree 2 Altitude 2000 m or lower	Protection class I Place to use: Indoor

\*1 For the option D4: DPS 10kPa, the reading accuracy is ± 5% of rdg ±0.01 kPa. However, ±0.02 for 0.2 kPa or lower.

\*2 The units in ( ) are not available for SI unit restriction models.

\*3 Refer to "11 REFERENCE" for the details. 

## NOTE

Use a power cord that complies with the local standard and regulations.

## 2 Model Classifications

### LS-R902-**A****B** Option

A	Pneumatic Circuit		Intelligent 1 Pneumatic Circuit	A1	Large flow circuit with great sensor protection features		
			Intelligent 2 Pneumatic Circuit	A2	Equipped with an equalization valve and additional self-check features to A1 circuit.		
			Micro Volume Circuit	AS01	For the parts whose volume is approx. 10 mL or smaller and the leak specifications are quite small.		
			Small Volume A1 Circuit	AS1	For the parts whose volume is approx. 100 mL or smaller and high detection performance is required.		
			Secondary Pressure Circuit	C	For external pressure (secondary pressure) test		
B	Test Pressure Range and Regulator Specifications	Precision Regulator Model	Micro Low	L02	Test pressure range: 5 to 20 kPa (PS 20 kPa, Regulator: 200 kPa)		
			Low	L	Test pressure range:10 to 100 kPa (PS 100 kPa, Regulator: 200 kPa)		
			Medium	M	Test pressure range: 50 to 800 kPa (PS 1 MPa, Regulator: 0.8 MPa)		
			High	H20	Test pressure range: 2.0 MPa or lower (PS 2 MPa, without regulator)		
			Extremely High	H49	Test pressure range: 4.9 MPa or lower (PS 5 MPa, without regulator)		
			Vacuum	V	Test pressure range: -5 to -100 kPa (PS -100 kPa, Regulator: -100 kPa)		
		EP Regulator Model	Low	LR	Test pressure range: 10 to 95 kPa (PS 100 kPa, Regulator: 100 kPa)		
			Medium	MR	Test pressure range: 50 to 800 kPa (PS 1 MPa, Regulator: 0.9 MPa)		
			Vacuum	VR	Test pressure range: -5 to -75 kPa (PS -100 kPa, Regulator: -80 kPa)		
Options	Calibrator			J	Come with CAL driving valve for Leak Master	The valve opens/closes automatically during K(Ve) calibration and K(Ve) check. Not available for H20 and H49 models Leak Master is sold separately.	
				K05	Come with ALC *1	Max. Volume Change: 0.5 mL	For Low, Medium and High press. with small volume part
				K1		Max. Volume Change: 1 mL	For Low, Medium and High press with small to medium volume part
				K4		Max. Volume Change: 4 mL	For Low, Medium and Vacuum press with medium to large volume part
				K10		Max. Volume Change: 10 mL	For Low, Medium and Vacuum press with large volume part
	Bypass Circuit Ready without Precision Regulator/Filter			B	Come with a valve to control the separately sold Bypass Circuit Unit. The Bypass Circuit Unit is equipped with a precision regulator. Bypass Circuit Unit is sold separately.		
	Nylon Filter Housing			RX02	Filter housing for the pilot pressure port is nylon.		
				RX03	Filter housings for the pilot pressure and test pressure ports are nylon.		
	Optional Number of Channels			RX11	100 channels		
	DPS 10 kPa			D4	Sensor range: ±10 kPa Display range: ±10 kPa Resolution: 1 Pa		
	Pressure/Vacuum Pressure Sensor			PV1	Equipped with a Pressure/Vacuum pressure sensor There are 2 sensor ranges: For Low press: ± 100 kPa For Medium press: -100 to 1000 kPa		
	Port Size			PX1	NPT used		
	Units and Others			UX1	SI units		
				UX2	All units (For overseas only)		
				UX3	UL certified		

\*1 ALC = Auto Leak Calibrator



# 11

## REFERENCES

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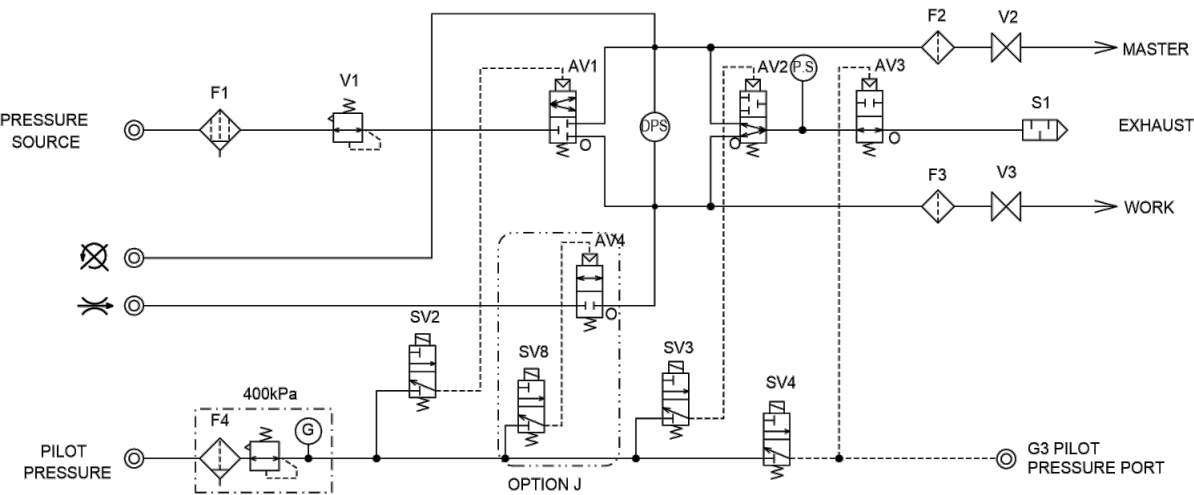
# 1 Leak Testing Overview

After a non-leaking reference part (MASTER) and a tested part (WORK) are pressurized simultaneously, isolating the MASTER and WORK from the pressure source, the differential pressure sensor (DPS) measures the pressure drop resulting by leaks.

## 1.1 Stage Summary

Stages	
Start	After clamping and sealing a WORK, initiates a start signal.
Pressurization (CHG)	Pressurizes or evacuates the WORK and the MASTER for testing.
Equalization (BAL1)	Stops supply of test pressure. Waits for decrease in pressure changes caused by valve operation.
Stabilization (BAL2)	Isolates the WORK and the MASTER from each other to measure the pressure difference between them. Detects medium leaks.
Detection (DET)	Detects small leaks. Drift compensation will be performed.
Air-blow, Exhaust and End (BLW, EXH, END)	Transmits judgment signal, and exhausts air from inside the WORK and MASTER from the exhaust port. Simultaneously, air-blow is performed to clean inside the tester.

Basic Type Pneumatic Circuit (A2 Medium pressure)



Timing Chart

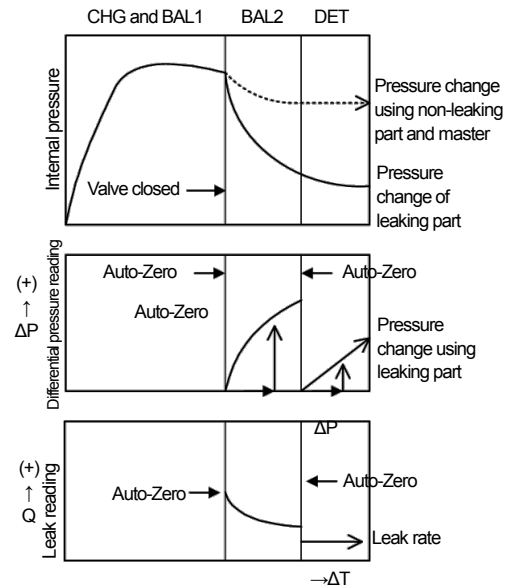
Solenoid Valve	DL1		CHG	BAL1	BAL2	DET	BLW	END
SV2								
SV3								
SV4								

PCHK

## 1.2 Internal Pressure Changes of the WORK And MASTER

- The figure on the right shows the pressure changes inside the WORK and the MASTER.
- In the BAL2 and the DET stages, the differential pressure resulting from leaks rises at a constant rate with time. In the DET stage, the differential pressure sensor (DPS) output is zeroed through an automatic zero operation before a differential pressure reading is produced.
- Leak rate is calculated using the following equation:  

$$Q = K(Ve) \cdot \Delta P / \Delta T$$
 Where:  
 Q: Leak rate (mL/min)  
 K(Ve): Leak coefficient (equivalent internal volume)  
 ΔP: Differential pressure  
 ΔT: Time



## 1.3 Leak Rate Conversion

Detected differential pressure can be converted into leak rate (mL/min) using a conversion equation derived from Boyle's Law. Using the unit's leak calibration facility makes calculations based on the conversion equation unnecessary.

### Pressure and Volume Relationship

The relationship between pressure and volume is stated in Boyle's law, which establishes that, for an ideal gas, pressure multiplied by volume is constant at a constant temperature. Boyle's law can be represented by the following equation:

$PV = \text{constant}$  (where P is absolute pressure)

The amount of leakage to atmosphere is calculated and expressed by the following equation derived from Boyle's law.

$$\text{Leak } (\Delta V_L) = V_e \times \frac{\Delta P}{P_{\text{atm}}}$$

Where:

ΔV<sub>L</sub>: Leak [mL]

V<sub>e</sub>: Equivalent Internal Volume [mL]

ΔP: Pressure drop due to a leak [Pa]

P<sub>atm</sub>: Atmospheric pressure [Pa]

### NOTE

The definition of internal equivalent volume, V<sub>e</sub>, is the volume of air of the entire WORK-side pneumatic circuit at a particular test pressure. V<sub>e</sub> is used as the leak coefficient K(V<sub>e</sub>) in the leak rate calculation.

### Equivalent Internal Volume

- 1) Equation for calculating equivalent internal volume  
Equivalent internal volume can be calculated with the following equation:

$$V_e = V_w + V_t + \{K_s \times (1 + (V_w + V_t) / (V_m + V_t)) + K_w\} \times (101.3 + P) \dots\dots\dots \mathbf{A}$$

Ve: Equivalent internal volume [mL]  
Vw: Internal volume of the Work and the piping [mL]  
Vm: Internal volume of the MASTER and the piping [mL]  
Vt: Tester internal volume [mL] Vt = 13 mL  
Ks: Change in internal volume of the sensor per unit pressure change [mL/kPa] Ks = 0.005 mL/kPa  
Kw: Change in internal volume of the WORK per unit pressure change [mL/kPa]  
P: Test pressure [kPa]

#### Tester internal volume, Vt, of each pneumatic circuit (including CAL port)

Intelligent 1 pneumatic circuit, A1: 11 mL  
Intelligent 2 pneumatic circuit, A2: 13 mL  
A1 pneumatic circuit for small volume, AS1: 11mL  
Small volume pneumatic circuit, A01, with stop valves: 6 mL  
Secondary pressure detection method C: 7 mL

- 2) Equivalent internal volume when the internal volume of the MASTER is almost equal to that of the WORK (Tested part) ( $V_w = V_m$ )  
(In other words, the MASTER-side circuit is the same in volume as the WORK-side, and both are rigid enough that the test pressure does not physically change their dimensions.)  
If the internal volume of the WORK remains unchanged ( $K_w = 0$ ) during detection even though charged with pressure, **Equation A** can be simplified to **Equation B**:  
 $K_s(1 + V_w / V_m) + K_w = 2K_s = 0.01$  [mL/kPa]

$$V_e = V_w + V_t + 0.01 \times (101.3 + P) \dots\dots\dots \mathbf{B}$$

- 3) Equivalent internal volume when a Master Chamber (i.g. MC-F02A, whose internal volume is 109 mL) is used as a MASTER  
If the internal volume of the WORK remains unchanged ( $K_w = 0$ ) during detection even though charged with pressure, **Equation A** can be simplified to **Equation C**:

$$V_e = V_w + V_t + 0.005 \times (1 + V_w/109) \times (101.3 + P) \dots\dots\dots \mathbf{C}$$

#### NOTE

When the volume of the MASTER is smaller than that of the WORK, Ve becomes larger, which lowers DPS sensitivity.

### Calculation of Leak Rate

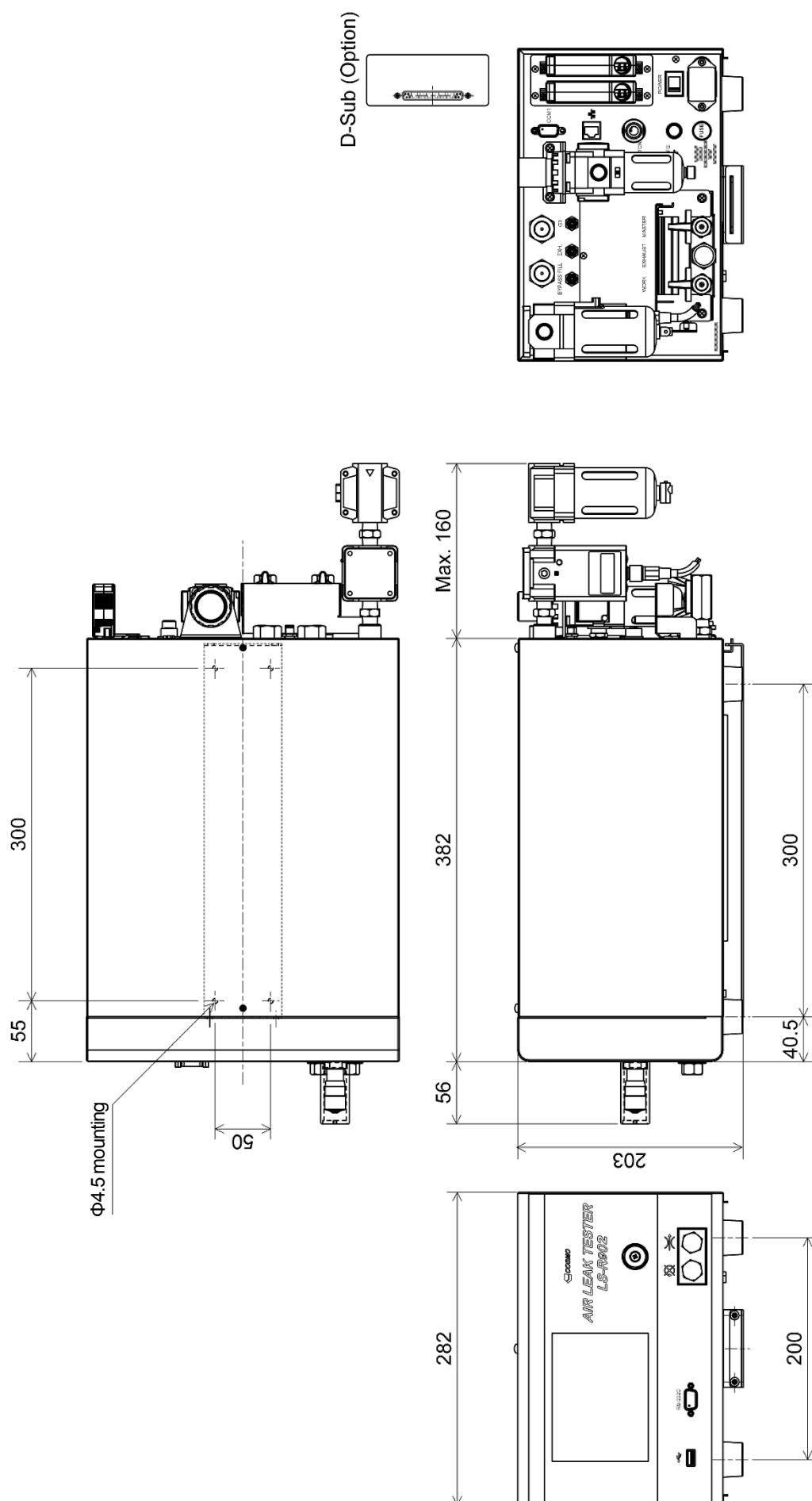
The relationship between differential pressure and leak rate per unit time is given by the following equation:

$$Q = V_e \times \frac{\Delta P}{1.013 \times 10^5} \times \frac{60}{T} \dots\dots\dots \mathbf{D}$$

Q: Volumetric leak rate [mL/min]  
 $\Delta P$ : Pressure drop due to leaks [Pa]  
Ve: Equivalent internal volume [mL]  
T: Detection time(s)



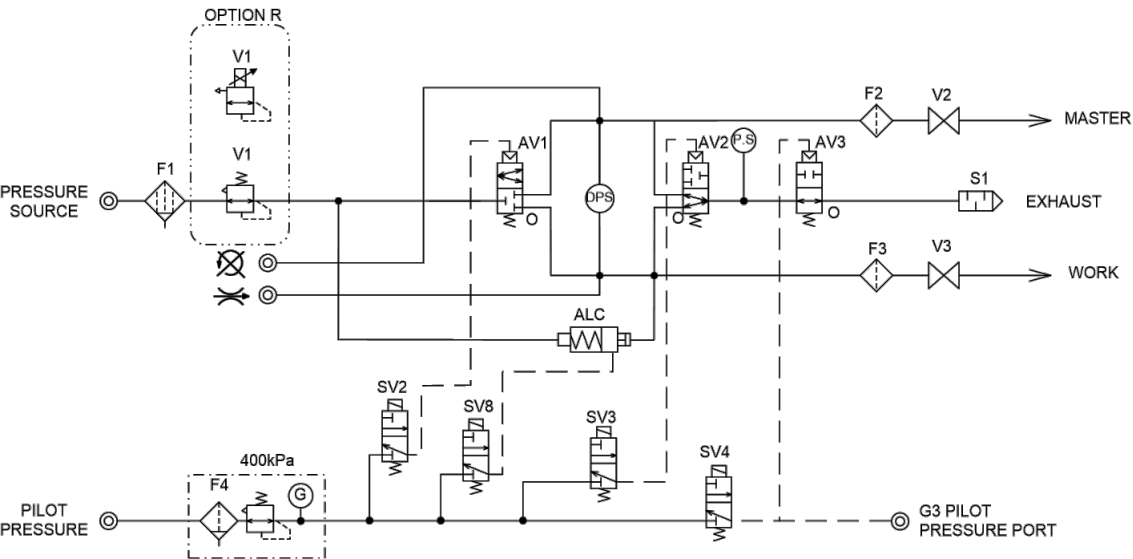
## 2 External Appearance



# 3 Pneumatic Circuit

**NOTE**  
The actual circuit may not be the same as the drawing.

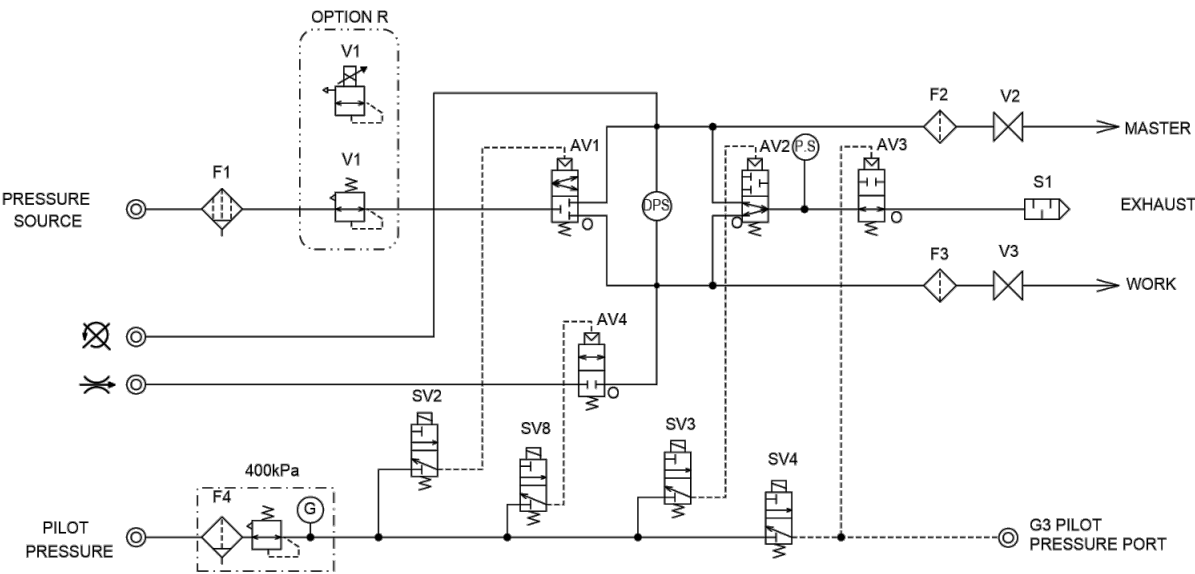
**A2 Type K (Medium Pressure: M / Low Pressure: L)**



	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLOW	EXH	END
SV2												
SV3												
SV4												
SV8												

\*SV8 is for K(Ve) Automatic Setup and K(Ve) Check.

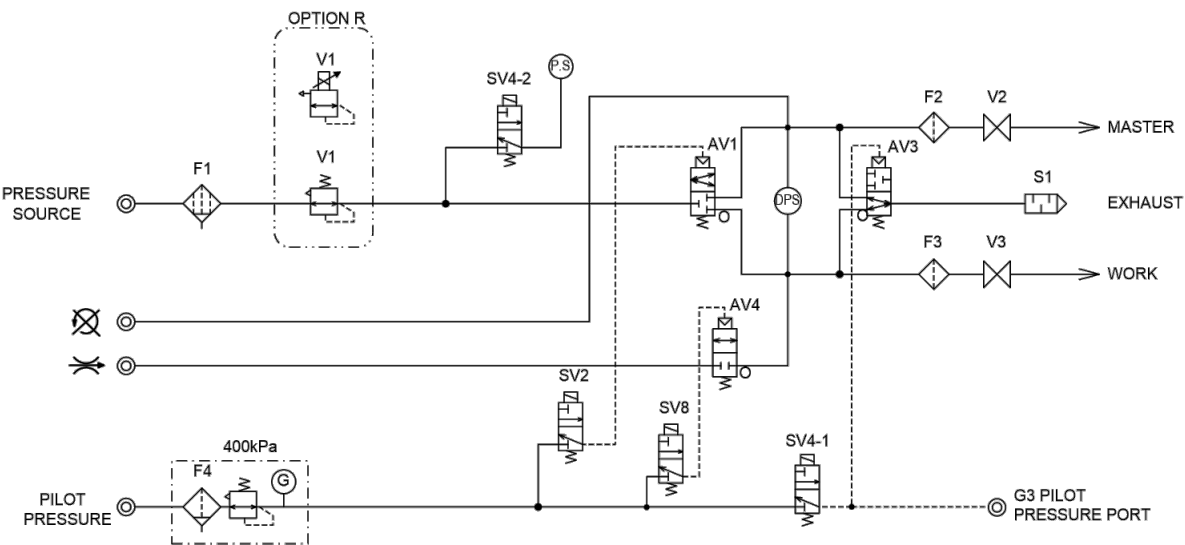
A2 Type J (Medium Pressure: M / Low Pressure: L)



	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLOW	EXH	END
SV2												
SV3												
SV4												
SV8												

\*SV8 is for K(Ve) Automatic Setup and K(Ve) Check.

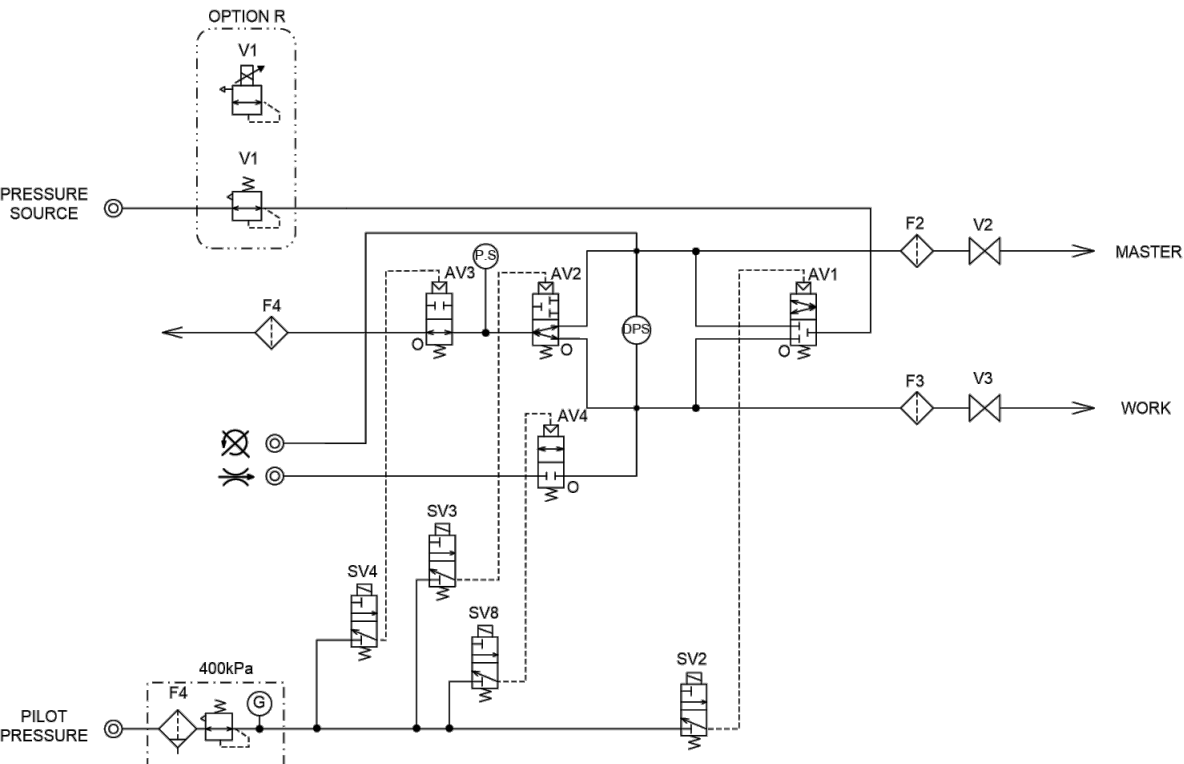
A1 Type J (Medium Pressure: M / Low Pressure: L)



	DL1	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLOW	EXH	END
SV2											
SV4											
SV7											
SV8											

\*SV8 is for K(Ve) Automatic Setup and K(Ve) Check.

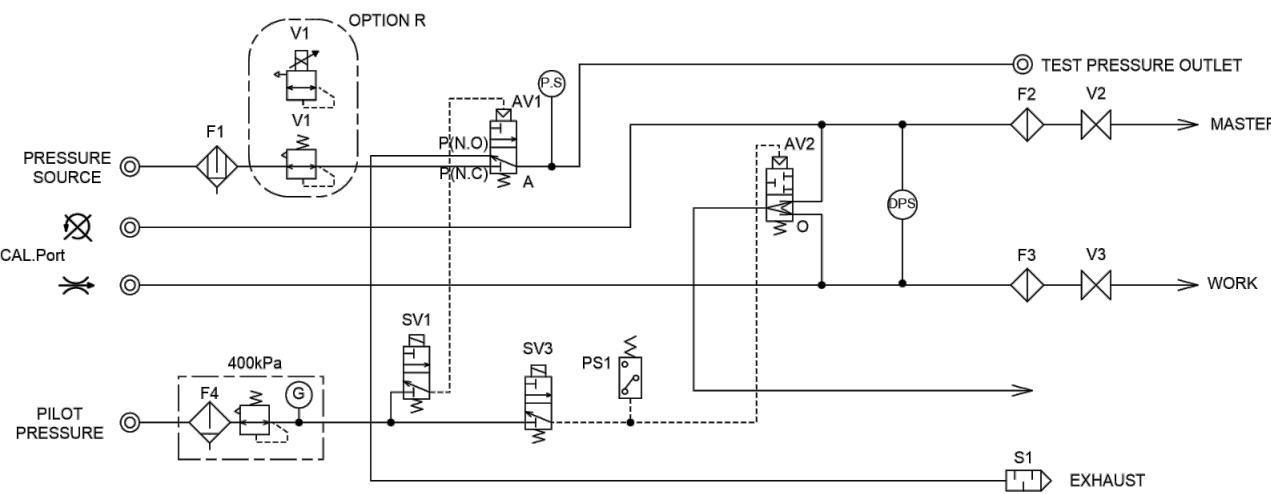
A2 Type V (Vacuum Pressure: V)



	DL1	PCHK	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLOW	EXH	END
SV2												
SV3												
SV4												
SV8												

\*SV8 is for K(Ve) Automatic Setup and K(Ve) Check.

C (Secondary Pressure)



	DL1	PCHG	PEXH	CHG	BAL1	DL2	BAL2	DET	BLOW	EXH	END
SV1											
SV2											
SV3											
SV4											
SV7											
SV8											

## 4 Pressure Unit Conversion Table

1kg/cm <sup>2</sup> →	0.980665	14.2233	735.55914	28.959	393.7	10000	98.0665	0.0980665	980.665	0.96784
1.0197162	←1bar→	14.50373	750.06158	29.529962	401.46227	10197.162	100	0.1	1000	0.9869221
0.0703072	0.0689478	←1psi→	51.715083	2.0360254	27.679934	703.07172	6.8947783	0.0068948	68.947783	0.0680461
0.0013595	0.0013332	0.0193367	←1mmHg→	0.0393701	0.5352391	13.5951	0.1333224	0.0001333	1.3332239	0.0013158
0.0345316	0.0338639	0.491153	25.400018	←1inHg→	13.595083	345.31579	3.3863911	0.0033864	33.863911	0.033421
0.00254	0.0024909	0.0361273	1.8683239	0.073556	←1inH <sub>2</sub> O→	25.400051	0.2490894	0.0002491	2.4908941	0.0024583
0.0001	9.807E-05	0.0014223	0.0735559	0.0028959	0.03937	←1mmH <sub>2</sub> O→	0.0098067	9.807E-06	0.0980665	9.678E-05
0.0101972	0.01	0.1450373	7.5006158	0.2952996	4.0146227	101.97162	←1kPa→	0.001	10	0.0098692
10.197162	10	145.0373	7500.6158	295.29962	4014.6227	101971.62	1000	←1MPa→	10000	9.8692214
0.0010197	0.001	0.0145037	0.7500616	0.02953	0.4014623	10.197162	0.1	0.0001	←1hPa→	0.0009869
1.0332286	1.0132512	14.695921	760.00076	29.921268	406.78211	10332.286	101.32512	0.1013251	1013.2512	←1atm→
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓↓	↓
kg/cm <sup>2</sup>	Bar	Psi	mmHg, Torr	inHg	inH <sub>2</sub> O	mmH <sub>2</sub> O	kPa	MPa	hPa	atm

## 5 Flow Unit Conversion Table

1mL/s	60	0.06	0.00019	101.3	0.1013
0.0167	←1mL/min→	0.001	0.01138	1.689	0.001689
16.667	1000	←1L/min→	11.37990	1689	1.001689
5272.45	87.874	87874.2	←1in <sup>3</sup> /d→	52.035	0.052035
0.009869	0.5921	0.0005921	0.001922	←1PaL/sec→	0.001
9.869	592.1	0.5921	0.000001922	1000	←1Pam <sup>3</sup> /sec
↓	↓	↓	↓	↓	↓
mL/s	mL/min	L/min	In <sup>3</sup> /d	PaL/sec	Pam <sup>3</sup> /sec

## 6 Leak Unit Description

Pa·m <sup>3</sup> /s	SI Leak rate unit
E-3 Pa·m <sup>3</sup> /s	E-3 = $\times 10^{-3} = \times 0.001$ ig: 0.001688 Pa·m <sup>3</sup> /s = 1.688 E-3 Pa·m <sup>3</sup> /s
Pa/s	Differential pressure ( $\Delta P$ ) per second. $\Delta P$ at the end of a stage is divided by the stage timer in second (Time average).
Pa/min	Differential pressure ( $\Delta P$ ) per second. $\Delta P$ at the end of a stage is divided by the stage timer in second and multiplied by 60 (Time average).
*Pa/s	Differential pressure ( $\Delta P$ ) of the last second in a stage. * is prefixed to distinguish from the Pa/s above. Be sure to disable all the compensation features when using this unit.
*Pa/min	Differential pressure ( $\Delta P$ ) of the last second in a stage multiplied by 60. * is prefixed to distinguish from the Pa/min above. Be sure to disable all the compensation features when using this unit.

## 7 CE Marking



CE marking is affixed to the CE conformed model of LS-R902.  
Scope of CE marking conformity is the body of LS-R902.  
Please use a power cord that complies with the local legislation.

### NOTE

Display of the sensor readout may get fluctuated when it gets interfered by jamming. Removing the interference resolves the problem. (IEC-61000-4-3)

"EC Declaration of Conformity" to prove the product complies with the provisions of the European Directive is available upon request.

## 8 Information to Users (FCC Rules)

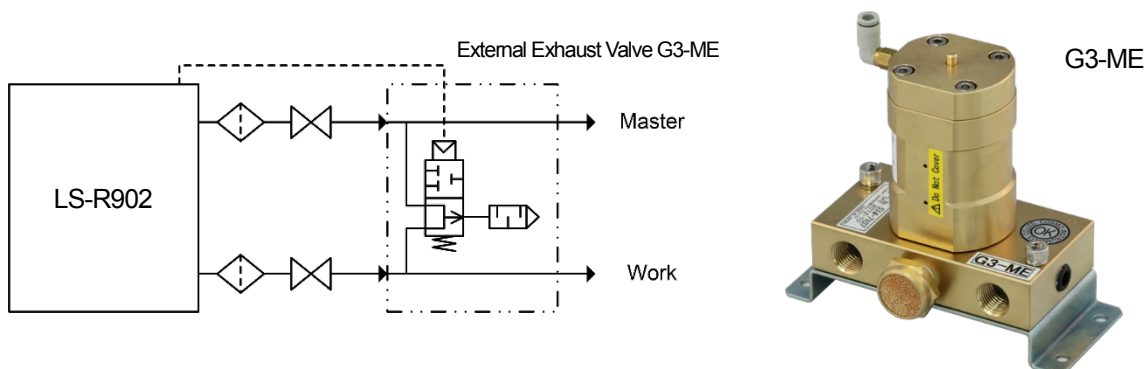
Changes or modifications not expressly approved by Cosmo could void the user's authority to operate the equipment. This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to part 15 of the FCC Rules. Those limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the operation manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own experience.

## 9 Common Peripherals

Refer to “2 INSTALLATION AND SETUP” for the details. 

### 9.1 External Exhaust Valve

Water, oil, or other foreign matters inside the tested parts may get into the air leak tester when it exhausts air, which may damage the tester. Installing an External Exhaust Valve between air leak tester and tested part prevent the contamination.

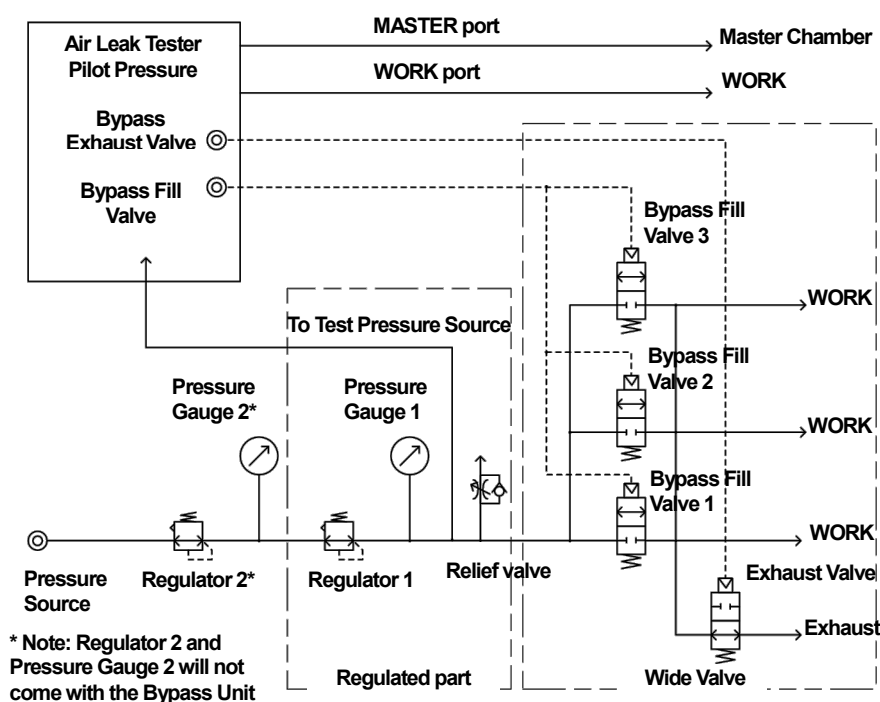


### 9.2 Bypass Circuit Unit

Test time can be reduced by using a Bypass Circuit Unit when testing tested parts with a large internal volume with low test pressure because it fills the parts with air in a short period of time. Models with the option B are equipped with a pilot pressure port for the Bypass Circuit Unit. Air leak tester controls the Bypass Circuit Unit. Enable the Bypass solenoid valve to use it.

**Go to:** Settings > Advanced Settings > CHG Options > Bypass Valve

Pneumatic Circuit Example (BU-100A-3L)







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■ Please note that addresses and numbers mentioned above may change.



\* The specifications are subject to change without notice.

<http://www.cosmo-k.co.jp/>

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