TESCOM

# TC-5972DP Pneumatic Shield Box

## User Manual

R20191111

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# Table of Contents

# Revision History

Revision Record

| Revision | Description | Date |
|---|---|---|
| v1.0 | Initial Draft | 2019-11-06 |
| v1.1 | First Release | 2019-11-12 |
| | | |

# WARRANTY

TESCOM guarantees that this product will be free from defects in materials and workmanship for one year from the date of shipment. During the warranty period, TESCOM will, at its discretion, either repair or replace defective products.

For the warranty service, customer must notify TESCOM of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to TESCOM or to a service center designated by TESCOM. Customer shall pay for shipping charges as well as any other charges incurred outside of Korea. TESCOM shall pay shipping charge to return the product to the customer.

This warranty does not apply to Expendables and Accessories and any failure or damage caused by improper use or unauthorized service. In such cases, TESCOM may refuse to offer any service under the warranty.

## LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulted from software (user interface) supplied by the customer or any third party, unauthorized modification or misuse, accident or abnormal condition of operation. Also, Tescom does NOT warrant certain parts which are considered expendable such as gaskets, gas springs, handle assemblies, accessories, antennas, I/O interfaces, modules and fixtures.

TESCOM's responsibility to repair or replace defective products is the sole and exclusive remedy provided to the customer for breach of this warranty. TESCOM will not be liable for any indirect, extraordinary, incidental, or consequential damages, despite any advance notice of the possibility of such damages.

# Safety Considerations

Review the following safety precautions to avoid personal injury, damage to this product, or damage to any product connected.

### Do not disassemble any part unless listed replaceable in this manual

### Do not operate in wet/damp conditions

To avoid injury or fire hazard, do not operate this product in wet or damp conditions.

### Do not operate in explosive atmosphere

To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

### Provide proper ventilation

To prevent product overheating, provide proper ventilation.

### Do not operate with suspected failures

If there is any damage to this product, have it inspected by qualified service personnel

## Environmental Conditions

Refrain from using this equipment in a place subject to intense vibration, direct sunlight, or uneven ground. Also, use it where the temperature is between 0 °C to 50 °C and relative humidity is less than 85%.

# Safety Symbols and Terms

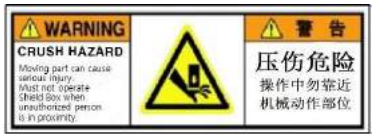
Various symbols are used in this manual and on the product itself to ensure correct usage, to prevent danger to the user and others, and to prevent property damage. The meanings of these symbols are described below. It is important that you read these descriptions thoroughly and fully understand its context.

## Safety Terms

**WARNING:** Identifies conditions or practices that could result in injury or loss of life.

**CAUTION:** Identifies conditions or practices that could result in damage to the product or other property.

**Symbols:** The following symbols may appear in this manual or on the product.

| Symbol | Meaning |
|---|---|
|  | ☒ **Crush hazard**<br>Moving part can cause serious injury. Must not operate Shield Box when unauthorized person is in proximity. |

| Symbol | Meaning |
|---|---|
|  | Indicates a potentially hazardous situation which,if not avoided, could result in serious injury and/or equipment damage. |
|  | Indicates a potentially hazardous situation which, if not avoided, may result in a minor or moderate injury and/or equipment damage. It may also be used to alert against unsafe practices. |
|  | Indicates necessary information or useful information for operation and maintenance. |

# PART 1.

# Getting Started

# 1. Introduction and Specifications

## 1.1 Introduction

Shield Box is an equipment that shields wireless products from RF interference which flows in by radiation or through I/O cables while running tests.
Shield Box is highly effective in shielding as well as being small and sturdy. Therefore, it offers efficient and economical testing solution for mass production, service, and development.

### Key Features

- High RF Shielding
- Pneumatic control of lid open-close and diverse fixture motions
- EMI filters on all Data and DC lines
- Easily customizable to meet various test needs
- Red and Green LED's for Pass/Fail indication
- RS-232C Remote Control
- High performance absorber for radiation testing

## 1.2 Specifications

### Mechanical Specifications

| | | |
|---|---|---|
| RF Connectors without I/O Interface Panel | | Four(4) N(f) outside and SMA(f) inside |
| Input Voltage | | 24 VDC |
| Power Consumption | | Max 1.5 W |
| Remote Control | | RS-232C, 3 wire, DB9(s) |
| Air Connector | Main connector | 6 mm OD hose, one-touch push-on fitting |
| | Fixture control connector | 4 mm OD hose, one-touch push-on fitting |
| | Input air pressure | 5 to 10 bar |

| | | |
|---|---|---|
| Dimensions | Inside | 445(W) x 450(D) x 338(H) mm, 208(D) mm top side |
| | Outside | 582(W) x 661(D) x 451(H) mm, lid closed, 695(H) mm, lid open |
| | Door | 418(W) x 358(D) x 280(H) mm |
| Weight | | Approx. 32 kg |
| *Packing | Size | 850(W) x 720(D) x 590(H) mm |
| | Weight | Approx. 42 kg |
| *The size and/or weight of packing may vary depending on how the product is packed. | | |

### Typical RF Shielding

- The shielding effectiveness below is measured with blank panels; other I/O interface panels may result in different shielding effectiveness of the shield box.

| Frequency | Shielding effectiveness (dB) |
|---|---|
| 100 to 2000 MHz | > 70 dB |
| 2000 to 3000 MHz | > 70 dB |
| 3000 to 6000 MHz | > 60 dB |

### Absorber Reflectivity

- The refelectivity below is verified by measuring signal strength with vector network analyzer after reflecting it on the absorber.

| Frequency | Reflectivity (dB) |
|---|---|
| 500 to 2000 MHz | 15 dB (Typ.) |
| 2000 to 6000 MHz | 20 dB (Typ.) |

## 1.3 Initial Inspection

When Shield Box is delivered, inspect the package and its content as follows:

1. **Check for any damage that could have occurred during the shipment.**
2. **Verify that you have received the accessories supplied with the Shield Box and its options, which are listed in 4.1 Exterior and Accessory Inspection**

③ **In case of any abnormality, do not install or operate the product for your own safety. Please contact TESCOM immediately.**

## 1.4 Operating Environment

Avoid locations with severe vibration, chance of explosion, or direct sunlight. Set Shield Box in a place at 5 °C ~ 40 °C with humidity of less than 85%.

If Shield Box is not supposed to be used for a long time, securely pack it and store in a dry place at room temperature.

## 1.5 Optional Parts Check

Referring to 3. Optional Panels & Fixture , check optional panels and accessories whether they are in place as you ordered.

## 1.6 TESCOM Sales and Service Office

If you have difficulty with the product, call or write to our Technical Support specialists at:

**NOTICE**

TESCOM Company Limited # 927 Unitechvil, 142, Ilsan-ro, Ilsandong-gu, Goyang-si, Gyunggi-do, Korea [ZIP 10442]
TEL.: 82-31-920-6600
FAX: 82-31-920-6607
Email: support@tescom.org
Website: http://www.tescom.co.kr

# PART 2.

# Hardware Description

# 2. Hardware Overview

## 2.1 Front

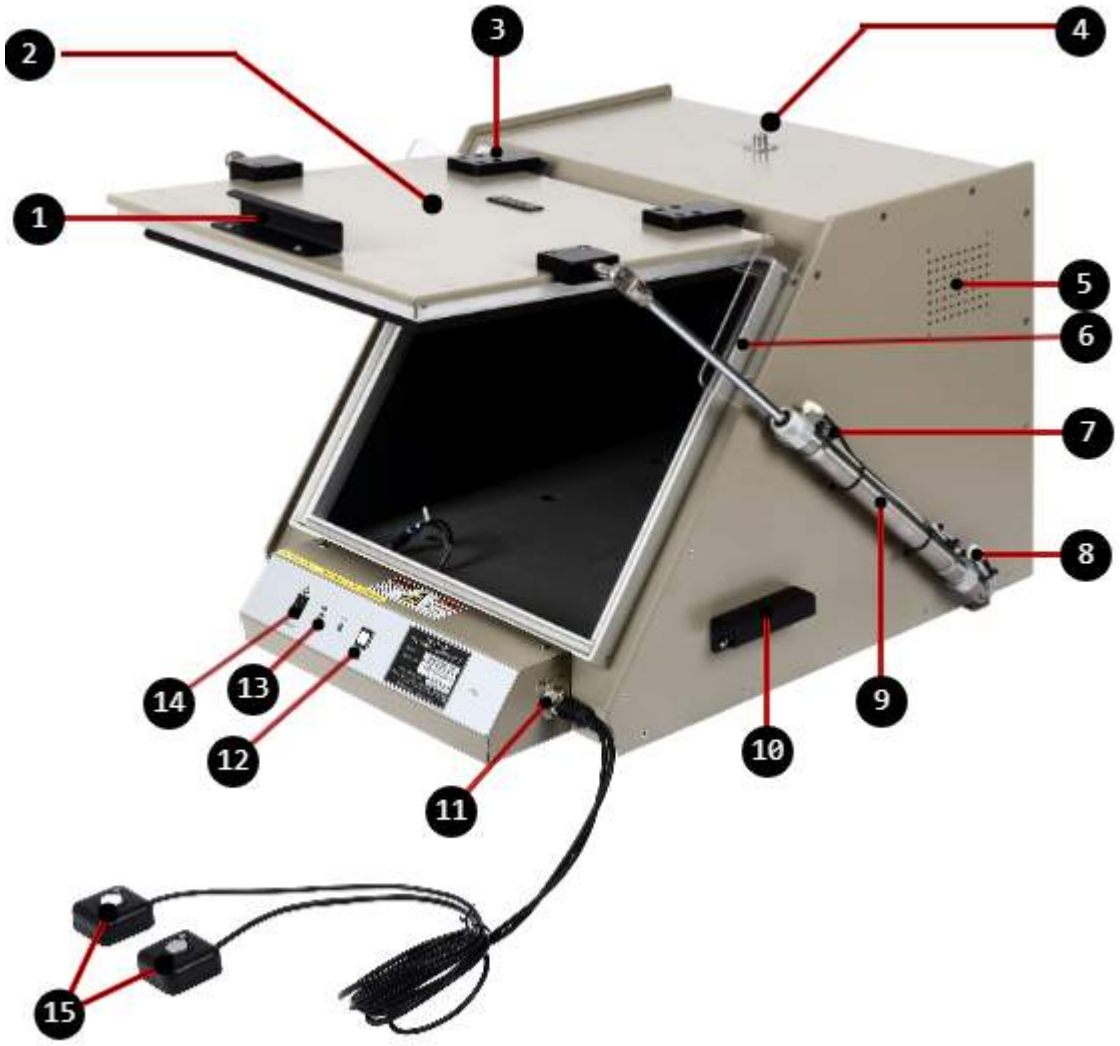



**Figure 2-1** TC-5972DP Front Components

Table 2-1 TC-5972DP Front Components

| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Lid handle | 9 | Air cylinder |
| 2 | Lid | 10 | Body handle |
| 3 | Hinge | 11 | Remote switch connector |
| 4 | RF connector (N(f) outside and SMA(f) inside) | 12 | Fixture operation button |
| 5 | Ventilation holes | 13 | PASS/FAIL LED |
| 6 | Lid safety guide | 14 | Power switch |
| 7 | Lid-open sensor (JP21) | 15 | Remote Switch |
| 8 | Lid-close sensor (JP22) | | |

## 2.2 Rear

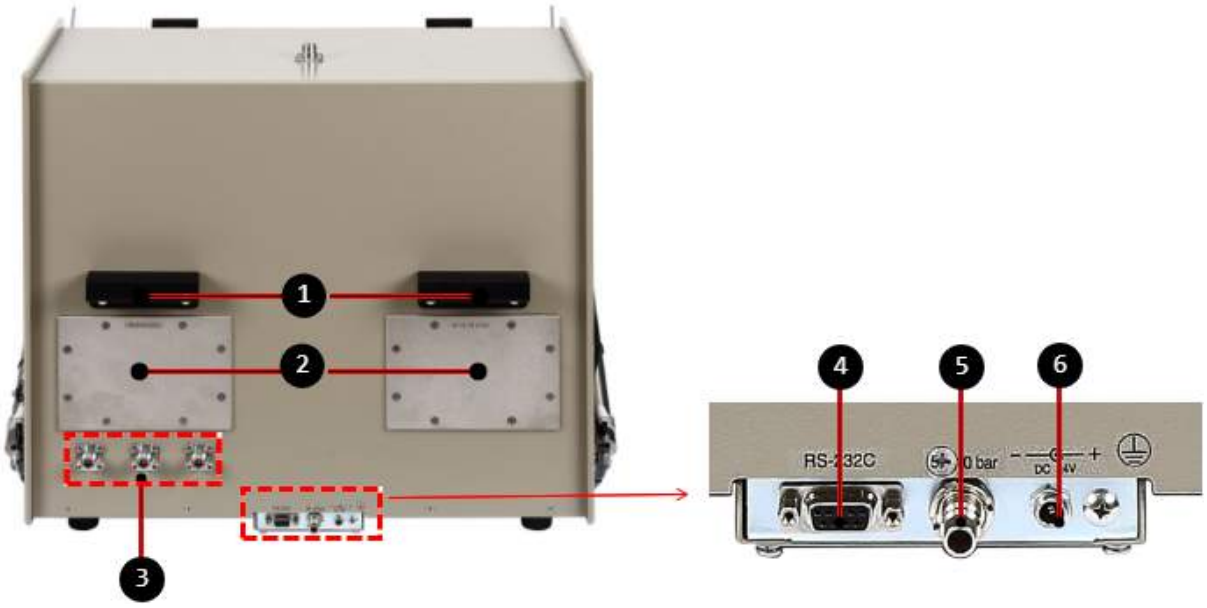



Figure 2-2 TC-5972DP Rear Components

Table 2-2 TC-5972DP Rear Components

| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Rear handle | 4 | RS-232C Connector |
| 2 | I/O interface panel | 5 | Air inlet |
| 3 | RF connector (N(f) outside and SMA(f) inside) | 6 | Power supply |

## 2.3 Inside

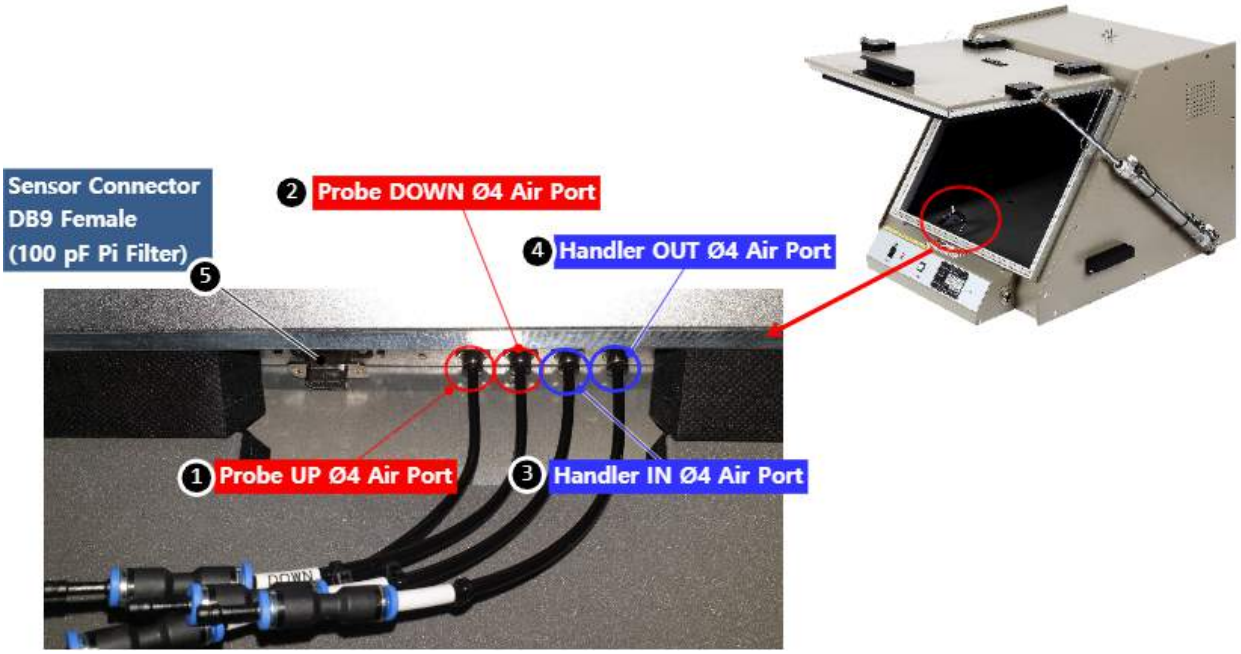



**Figure 2-3** TC-5972DP Control Box Connection

**Table 2-3** TC-5972DP Fixture Air Ports and Sensor Connector

| No. | Description |
|---|---|
| ❶ | Probe UP air port (Ø4) , speed control function excluded |
| ❷ | Probe DOWN air port (Ø4), speed control function excluded |
| ❸ | Handler IN air port (Ø4), speed control function excluded |
| ❹ | Handler OUT air port (Ø4), speed control function excluded |
| ❺ | Sensor connector DB9 100 pF Pi Filter for sensor cable connection |

### Sensor Connector Pin Map

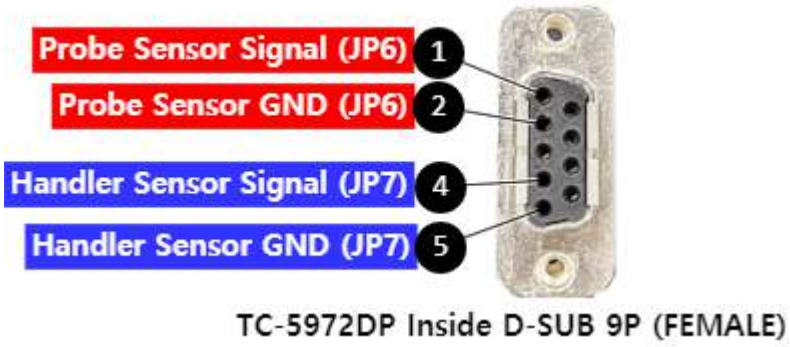
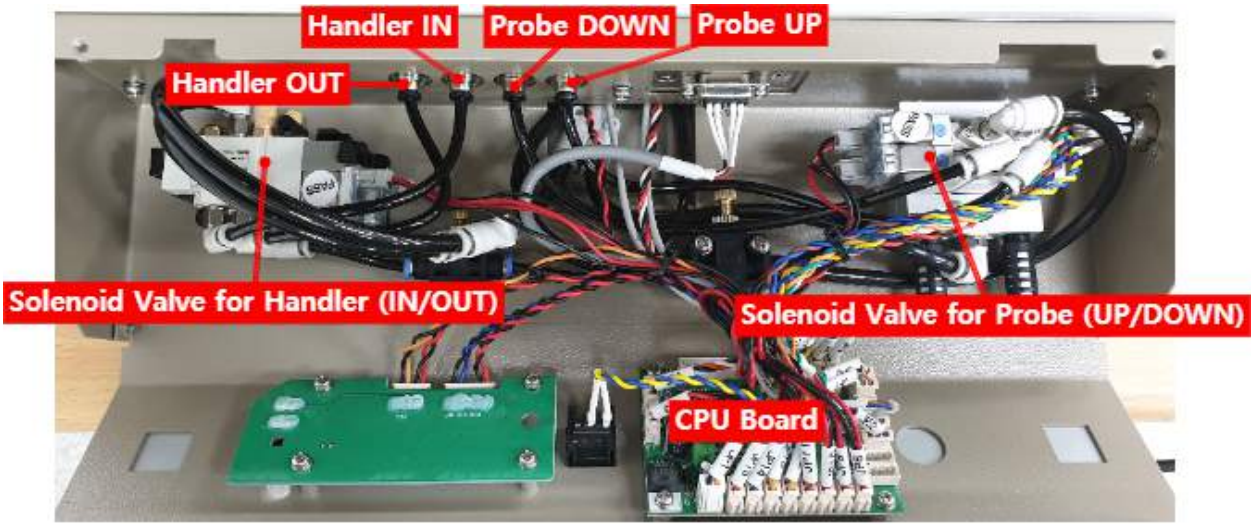



**Figure 2-4** TC-5972DP Inside D-SUB 9P (Female) Connector Pin Map

**Table 2-4** TC-5972DP Inside D-SUB 9P (Female) Connector Pin Map

| Pin Number (Female) | Function |
|---|---|
| ❶ | Probe Sensor Signal |
| ❷ | Probe Sensor GND |
| ❹ | Handler Sensor Signal |
| ❺ | Handler Sensor GND |

## 2.4 Control Box



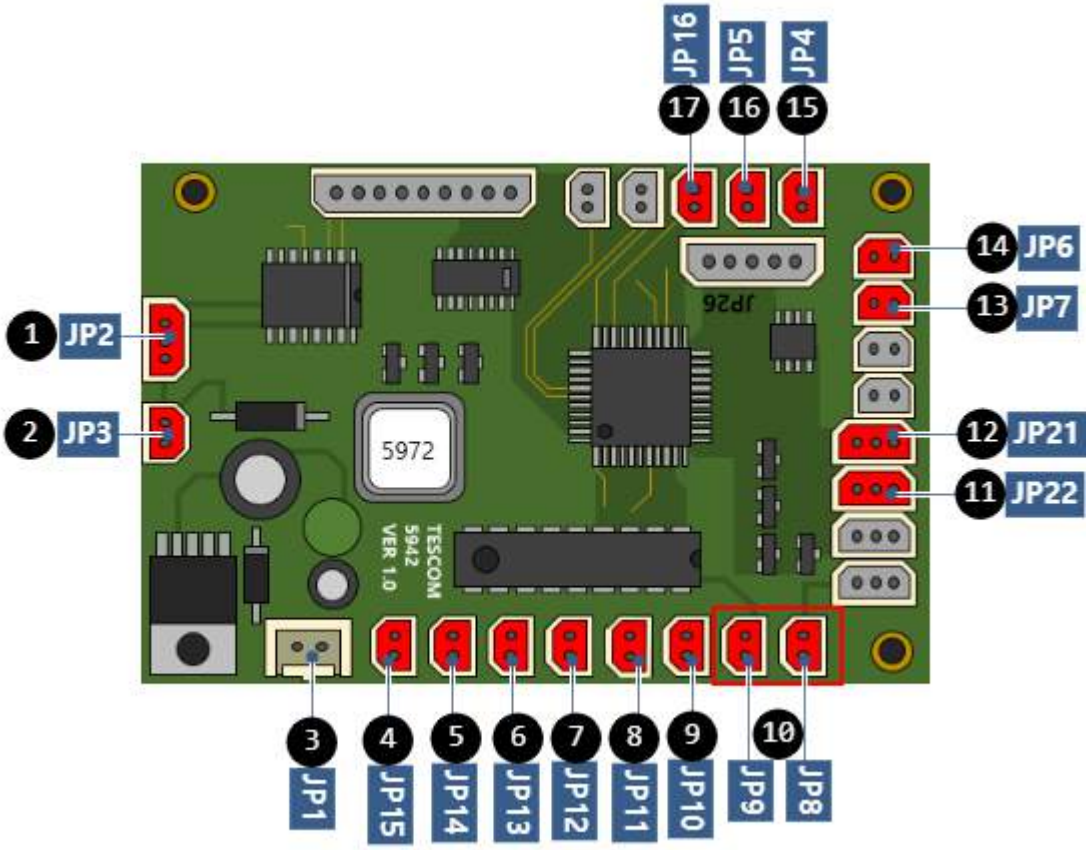



**Figure 2-5** 5972DP CPU Board

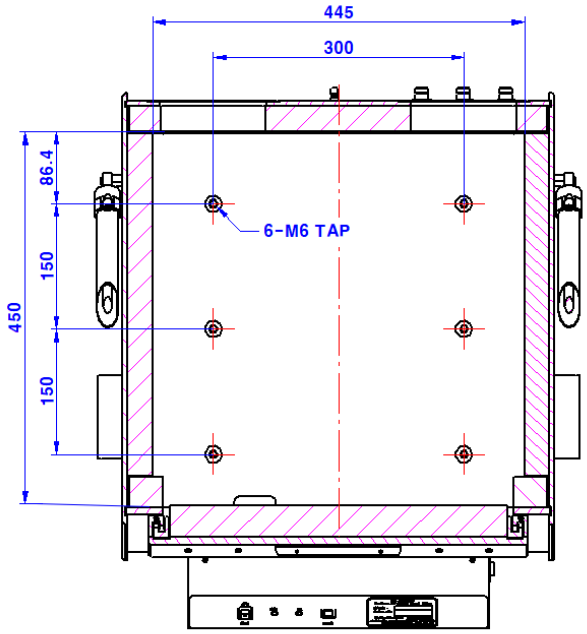
**Table 2-5** TC-5972DP CPU Board Connection

| No. | Function | Connector | Description |
|---|---|---|---|
| ❶ | RS-232C Communication | JP2 | RS-232C connector |
| ❷ | Power LED | JP3 | Power LED connector (remote switch) |
| ❸ | Power Supply | JP1 | +24V DC input connector |
| ❹ | Pass/Fail LED | JP15 | Fail LED connector |
| ❺ | | JP14 | Pass LED connector |
| ❻ | | JP13 | Fail LED connector (remote switch) |
| ❼ | | JP12 | Pass LED connector (remote switch) |
| ❽ | Solenoid Valves | JP11 | Solenoid valve connector for Handler |
| ❾ | | JP10 | Solenoid valve connector for Probe |
| ❿ | | JP9 | Solenoid valve connector for lid |
| | | JP8 | Solenoid valve connector for lid |

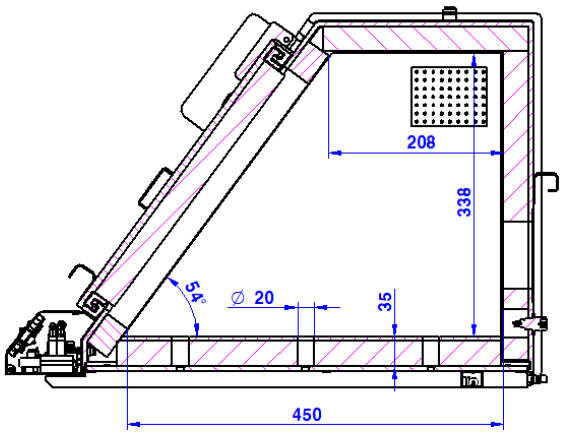
| No. | Function | Connector | Description |
|---|---|---|---|
| ⓫ | Sensors | JP22 | Lid-close detection sensor connector |
| ⓬ | | JP21 | Lid-open detection sensor connector |
| ⓭ | | JP7 | Handler-inward detection sensor connector |
| ⓮ | | JP6 | Probe-downward detection sensor connector |
| ⓯ | Operation Buttons | JP4 | Gray button connector (remote switch) |
| ⓰ | | JP5 | White button connector (remote switch) |
| ⓱ | | JP16 | Fixture operation button connector |

## 2.5 Dimensions

### 2.5.1 Inner Dimensions

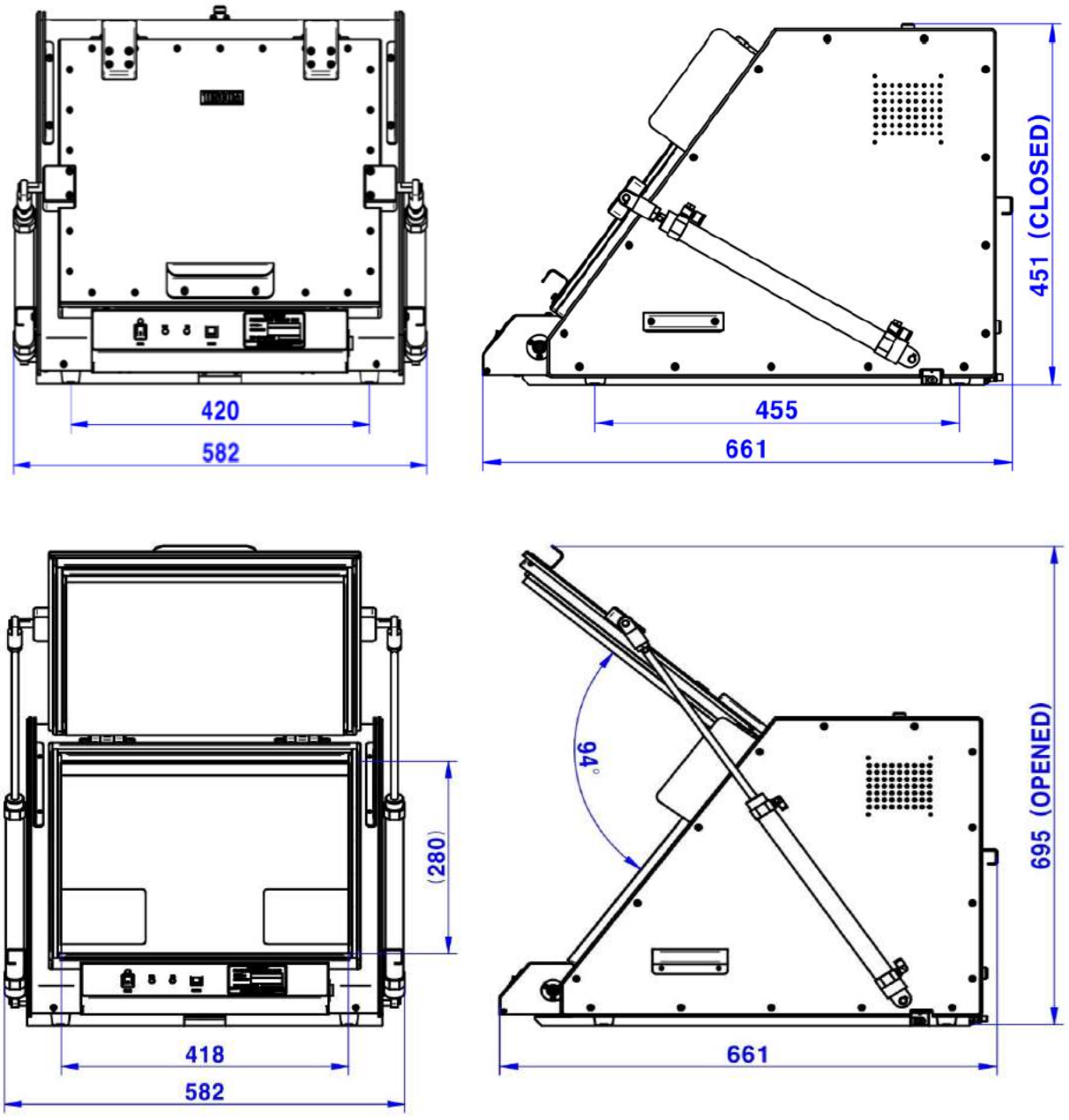



[BOTTOM SECTION VIEW]




[SIDE SECTION VIEW]

## 2.5.2 Outer Dimensions



# 3. Optional Panels & Fixture

## 3.1 I/O Interface Panels

TC-5972DP has several types of panel options for connecting data interface, power, etc.. It can be customized to suit your needs.

### 3.1.1 Pre-configured Panels

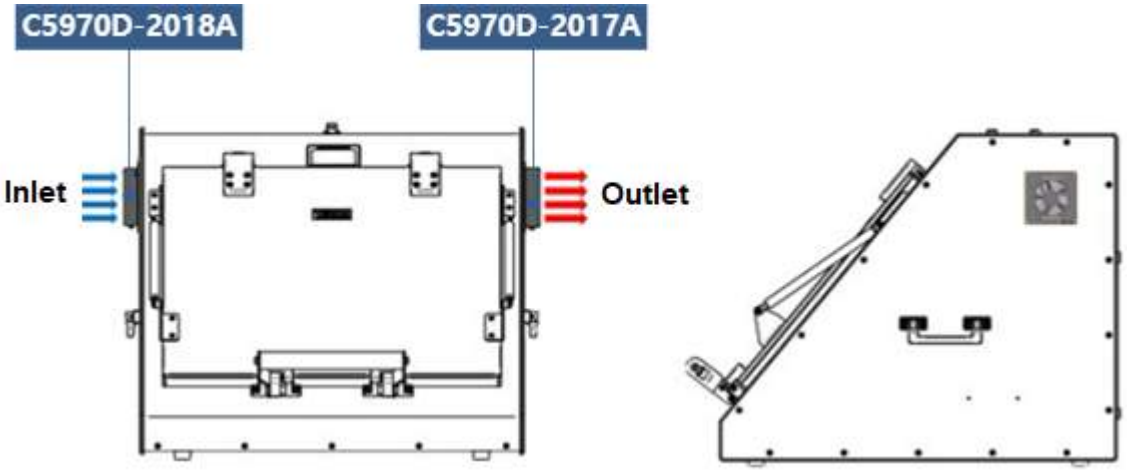
List of I/O interface panels already configured by us

**Table 3-1** Pre-configured I/O Interface Panel for TC-5972DP

| I/O Interface Panel | Order Number | Configuration |
|---|---|---|
|  Blank Panel | M5970D01A | • Blank module (Absorber) |
|  Data Interface Panel | M5970C03A | • One(1) N(f) outside and SMA(f) inside<br>• One(1) RJ-45 outside and inside<br>• One(1) DB25(p) outside and DB25(s) inside, 1000 pF Pi filter |
|  Data Interface Panel | M5970C04A | • One(1) N(f) outside and SMA(f) inside<br>• One(1) USB 2.0 outside and inside<br>• One(1) DB25(p) outside and DB25(s) inside, 1000 pF Pi filter |
|  Data Interface Panel | M5970C04B | • One(1) N(f) outside and SMA(f) inside<br>• One(1) USB 3.0 outside and inside<br>• One(1) DB25(p) outside and DB25(s) inside, 1000 pF Pi filter |

| I/O Interface Panel | Order Number | Configuration |
|---|---|---|
|  Data Interface Panel | M5970C12A | • One(1) USB 2.0 outside and inside<br>• One(1) DB9(p) outside and DB9(s) inside, 100 pF Pi filter<br>• One(1) DB25(p) outside and DB25(s) inside, 100 pF Pi filter |
|  Cooling Fan | C5970D-2017A<br>C5970D-2018A | • One(1) DC Fan Set, DC 24 V (One Pair)<br>◦ C5970D-2017A: 배기<br>◦ C5970D-2018A: 흡기<br>◦ Cooling Fan 사양은 같으며, 조립 방향만 반대입니다. |

## Cooling Fan Locations



## 3.1.2 Custom Panels

By selecting and combining from the list below, you can set your own I/O interface panel

**Table 3-2** Custom I/O Interface

| I/O Interface | Order Number | Transmission Speed / Line Voltage | *Typical Shielding |
|---|---|---|---|
|  DB25, 1000pF pi Filter | 3409-0009-1 | 3 Mbps / 100 VDC, 5 Amps max | >70 dB from 0.5 to 2 GHz<br>>80 dB from 2 to 3 GHz<br>>70 dB from 3 to 6 GHz |
|  DB25, 100pF pi Filter | 3409-0014-1 | 10 Mbps / 100 VDC, 5 Amps max | >50 dB from 0.5 to 2 GHz<br>>60 dB from 2 to 3 GHz<br>>60 dB from 3 to 6 GHz |
|  DB9, 1000pF pi Filter | 3409-0008-1 | 3 Mbps / 100 VDC, 5 Amps max | >70 dB from 0.5 to 2 GHz<br>>80 dB from 2 to 3 GHz<br>>70 dB from 3 to 6 GHz |
|  DB9, 100pF pi Filter | 3409-0010-1 | 10 Mbps / 100 VDC, 5 Amps max | >50 dB from 0.5 to 2 GHz<br>>60 dB from 2 to 3 GHz<br>>60 dB from 3 to 6 GHz |
|  USB 2.0 Filter | 3409-0018A-3 | 480 Mbps / 5 V, 500 mA / Max Current: 5A | >60 dB from 0.5 to 2 GHz<br>>70 dB from 2 to 3 GHz<br>>70 dB from 3 to 6 GHz |
|  USB 3.0 Filter(Active) | 3409-0042A-2 | 5 Gbps / 5 V, 600 mA / Max Current: 1.5 A | >80 dB from 0.5 to 2 GHz<br>>80 dB from 2 to 3 GHz<br>>75 dB from 3 to 6 GHz |
|  RJ-45 Filter | 3409-0022A | 1 Gbps Copper-Line Ethernet (1000 BASE-T) | >60 dB from 0.5 to 2 GHz<br>>70 dB from 2 to 3 GHz<br>>70 dB from 3 to 6 GHz |

| I/O Interface | Oder Number | Transmission Speed / Line Voltage | *Typical Shielding |
|---|---|---|---|
|  DC Power Adaptor, | 3406-0004A | 50 VDC,<br>3 Amps max | 〉70 dB from 0.5 to 2 GHz<br>〉80 dB from 2 to 3 GHz<br>〉80 dB from 3 to 6 GHz |
|  DC Power Adaptor, Banana Jack Type | 3406-0004A<br>3406-0006A | 50 VDC,<br>10 Amps max | 〉70 dB from 0.5 to 2 GHz<br>〉80 dB from 2 to 3 GHz<br>〉80 dB from 3 to 6 GHz |
|  AC Power Adaptor | 3103-0009A | 250 VAC,<br>7 Amps max | 〉70 dB from 0.5 to 2 GHz<br>〉80 dB from 2 to 3 GHz<br>〉80 dB from 3 to 6 GHz |

**NOTICE**

1. Shielding effectiveness is an estimated value with each I/O interface applied.
2. The data above was measured by TESCOM, and they may be different depending on the measuring method and environment.
3. Each shielding effectiveness is measured without according cable. It is likely affected when a cable is connected. Also, it may vary depending on the type of cable.

| I/O Interface | Order Number | Frequency Range / Impedance / V.S.W.R |
|---|---|---|
|  RF, N-SMA Connector | 3408-0038 | From DC to 6 GHz / 50 Ω / 1.15 max |
|  RF, SMA-SMA Connector | 3408-0039 | From DC to 8 GHz / 50 Ω / 1.15 max |

# 3.2 Fixtures

TESCOM offers flexible fixtures that can change the position of the DUT. Depending on the shape of DUT, you can adjust it with fixture blocks instantly. In addition, custom fixtures can be ordered and supplied to suit your needs.

## 3.2.1 Standard Grid Fixture

**Table 3-3** TC-5972DP Standard Grid Fixtures

| Grid Fixture | Order Number | Configuration |
|---|---|---|
|  | F59725B | • Antenna Coupler Fixed Type Fixture<br>• Antenna Coupler(Optional): TC-93026A |
|  | F59724B | • TC-5972DP Top Fixture<br>• Antenna Coupler(Optional): TC-93061A |
|  | F59727A | • 5972DP Side Fixture<br>• Antenna Coupler(Optional): TC-93061A<br>• F59725B Grid Fixture Option Required |

## 3.2.2 Custom Fixtures

TESCOM offers custom fixtures as well as standard fixtures to meet your demand. In addition, there are various Antenna Coupler options to set the best measuring system for your specific device.

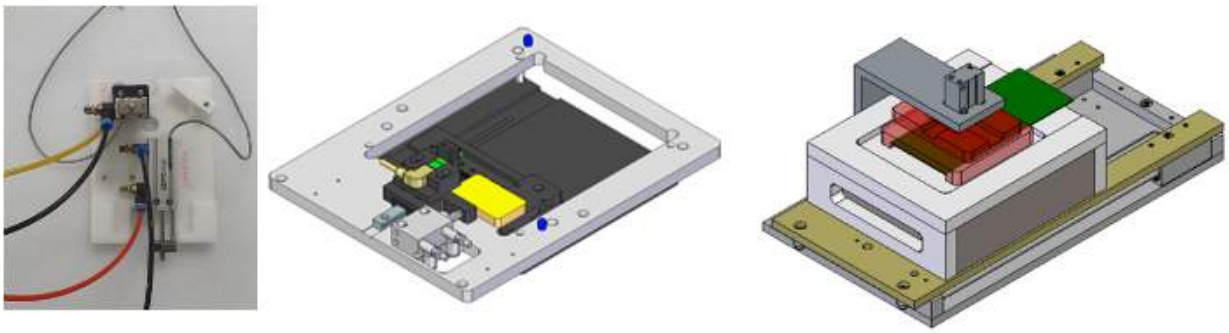


**Figure 3-1** Sample Images of Custom Fixtures

# PART 3.

# Putting into Operation

# 4. Setup and Operation

## 4.1 Exterior and Accessory Inspection

When Shield Box is delivered, inspect the package and check whether the following accessories are included:

### Exterior and Accessory Inspection

1. Upon receiving the TC-5972DP, check for any damage might have occurred during the shipment.
2. Referring to the list below, verify that you have received the accessories supplied with the TC-5972DP and its options.


**Figure 4-1** TC-5972DP Accessories List

Table 4-1 TC-5972DP Accessories List

| No. | Part Number | Name | Spec. | Quantity |
|---|---|---|---|---|
| | | Operating Manual | | 1 |
| | | Test Report | | 1 |
| ❶ | 4003-0025 | Data Cable, DB9(p)-DB9(s) | 2m | 1 |
| ❷ | 4010-0002 | Power Cable, 220V | 1.5m | 1 |
| ❸ | 3001-0039 | Switching Power Supply | 1.5m | 1 |
| ❹ | 4011-0001 | SS-402, N(m) to N(m) | 1m | 1 |
| ❺ | 9703-0074 | Air Coupler (CPS15-6W) | | 1 |
| ❻ | C5972CP-2016-1 | Cylinder Lock | | 1 |
| ❼ | 4601-0018A | Remote Switch Cable | 2m | 1 |

**⚠CAUTION**

In case of any abnormality, do not install or operate Shield Box for your own safety. Please contact TESCOM immediately.

## 4.2 Connecting & Setting Up

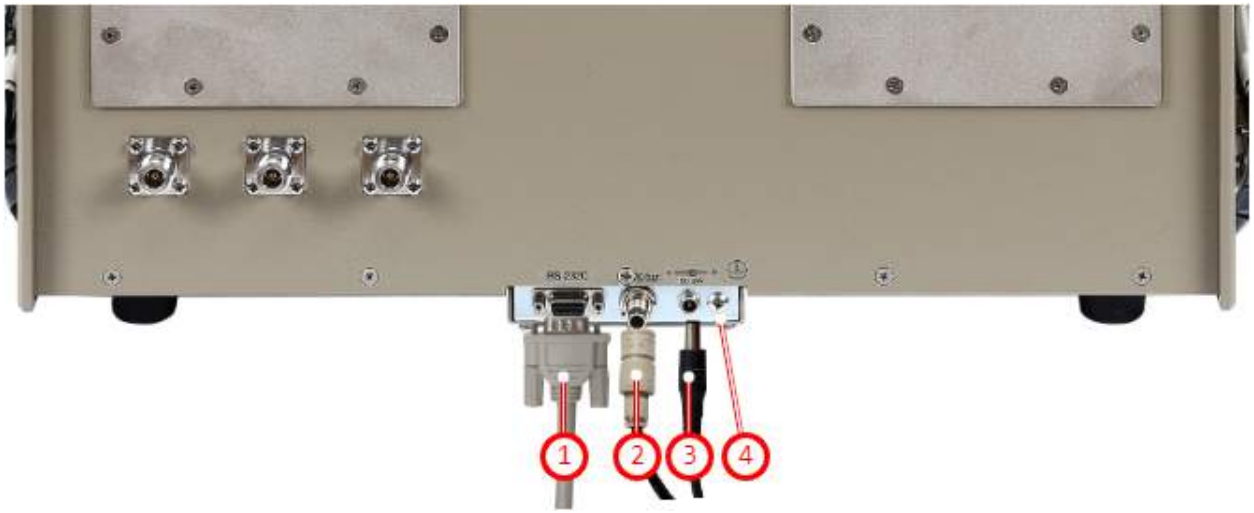



Figure 4-2 Cable Connection

| No | Item | Description | Part Number | Quantity |
|---|---|---|---|---|
| ❶ | Data, DB9(p)-DB9(s) | Connecting Shield Box to PC for control | 4003-0025 | 1EA |
| ❷ | Air Coupler | Main air inlet, 6 mm OD hose, 5 ~ 10 bar | 9703-0074 | 1EA |
| ❸ | DC 24V Power Cable | Supplying power to Shield Box | 3001-0039 | 1EA |
| ❹ | Ground | Ground connection | | |

# 4.2.1 Power Supply

## Connecting Power Supply Cable

In order to set TC-5972DP Shield Box in motion, connect the 24V DC Power Supply Adapter which is included in the package.


**CAUTION**

For your own safety, please use the 24V DC Power Supply Adapter provided by TESCOM.

## Turning Shield Box On

1. Press the power switch on the TC-5972DP control box to the direction of "-" mark.
2. Power LED Indicator will glow white when the power is on.



## 4.2.2 Compressed Air Supply

> **⚠CAUTION**
>
> Please make sure to turn off compressed air supply before connecting or disconnecting air hose.

### Compressed Air Requirement

- **Input air pressure** : 5 ~ 10 bar
- **Main air connector** : 6 mm OD hose, one-touch push-on fitting

> **⚠CAUTION**
>
> It is highly recommended that the compressed air system must be used in conjunction as shown below. Insufficient air quality may cause deterioration of performance.

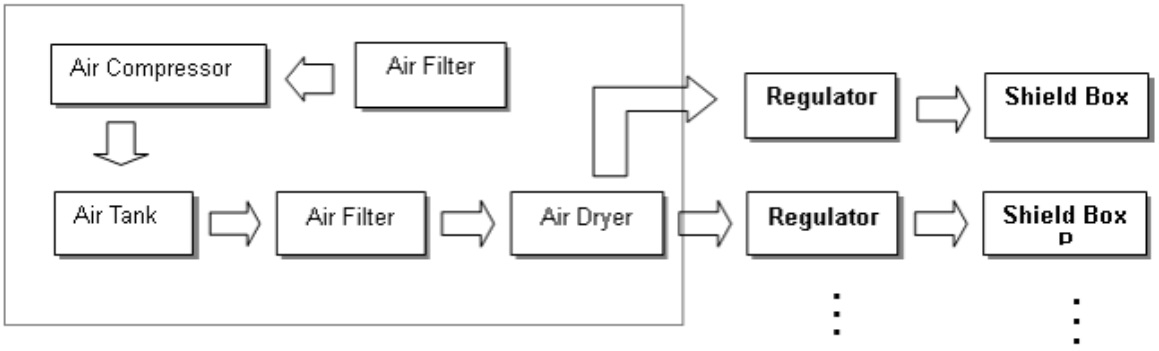



**Figure 4-3** General Compressed Air System

### Connecting Compressed Air Supply


**Figure 4-4** Connecting/Disconnecting compressed air supply

1. The compressed air inlet port is located below TC-5972DP rear panel.
2. Insert the 6 mm Air Hose to the rear point of Air Coupler.
3. Push the front side of Air Coupler on Air Input Connector until you hear a "click" sound.
4. Open the air valve and supply the compressed air.

> **⚠CAUTION**
>
> The lid of Shield Box will pop open if you turn the power on while the compressed air is connected.

## 4.2.3 Remote Switch Connection

**Figure 4-5** TC-5972DP Remote Switch Connector

1. Locate the remote switch connector on the right hand side of control box.
2. Plug in the remote switch cable bundled with Shield Box.

> The TESCOM mark should be facing top to fit in.


**Figure 4-6** TC-5972DP Remote Switch Connection

**⚠CAUTION**

For safety reasons, keep two buttons apart at least 25cm and press them with both hands.


## 4.2.4 Lid Control

### Closing The Lid

- Keep pressing both remote switch buttons (  ) simultaneously until the lid is completely shut.
- A red light will blink at the lid close sensor.

Keep pressing with both hands


**NOTICE**

If you press only one button, both Fail LEDs on the control box and gray switch will glow red. An error data 'ERR40' will return if Shield Box is connected with PC. In this case, take your hand off, and then press both buttons again.

Also, if you let go of a button or two before the lid is completely shut, the lid will open again and Fail LEDs will be on. An error data 'ERR90' will return if it is connected with PC. In the same manner with above, try again.

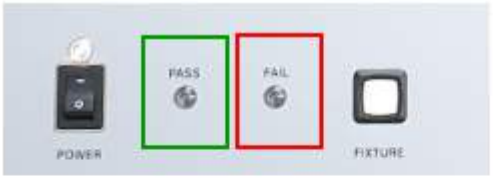

## Opening The Lid

- Press **either one** of the two buttons (  ) to open the lid.
- No need to keep pressing the button.
- A red light will glow at the lid open sensor.


### Counting Function

Shield Box counts the number of lid open/close cycle and saves it on the memory. The cumulative number of open/close motions can be viewed on a PC by sending “COUNT?” query through RS-232C. The box will return the number in 8 digits.

## 4.2.5 Pass/Fail LED Indicator





Green and red LED indicators will be on if the command "PASS" or "FAIL" is sent through RS-232C while the lid is closed. Another LED indicator on the gray switch will glow blue and red accordingly.

This function can be useful to visualize the result when the Shield Box is controlled via RS-232C.

**NOTICE**

The red LEDs glow automatically if there was any problem in previous motion (lid or fixture).

# 4.3 Shield Box Operation with Fixture

**NOTICE**

The fixture operation mode of standard TC-5972DP is set as 'Handler Mode: Off', 'Probe Mode: Timer' at the time of release. (You can check it with the query 'SOLENOID MODE?') You need to configure the fixture operation mode if you are to use it.

## 4.3.1 Fixture Operation Modes

The handler and the probe of fixture can operate in 3 modes each, and the operation is automatic according to the open or close of Shield Box.

The operation of fixture can be controlled with commands via RS-232C. Refer to the list of commands and each command in detail at Handler & Probe Configuration Commands

**Table 4-2** Handler and Probe Operation Modes

| Operation Mode | Description |
|---|---|
| Sensor Mode | The operation of fixture is detected by sensors. This mode can prevent damage from malfunction to either the product or DUT. |
| Timer Mode | The operation runs by timer without using sensors. The waiting time is already fixed upon release and can not be changed. |
| Off Mode | The operation of fixture is off. |

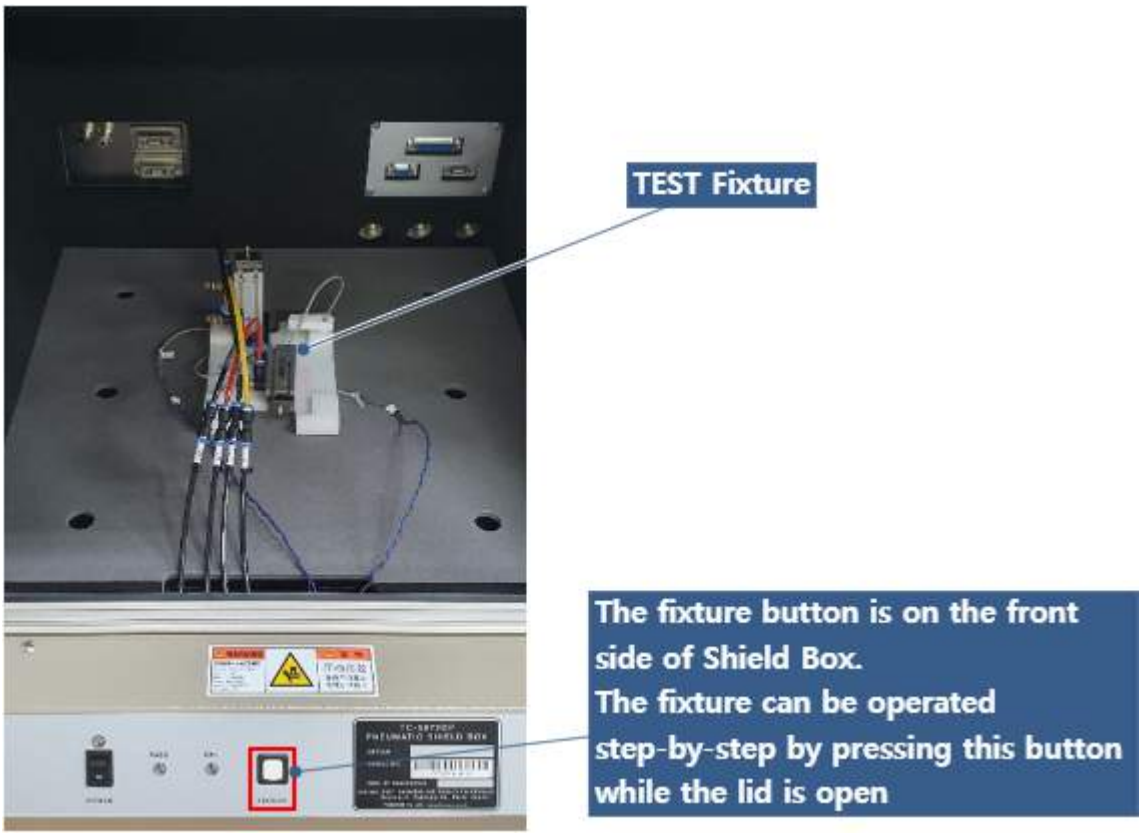
**⚠CAUTION**

It is NOT recommended operating fixture with the Timer Mode.
Without sensors, the lid may close even when the fixture operation is incomplete, thus causing damage to the product or DUT.

## 4.3.2 Fixture Button (  ) Operation

The fixture can be moved step-by-step if you press the fixture button while the lid is open.

Each step can be run under sensor mode or timer mode, and every move can return to the previous step if there is any problem.




**⚠CAUTION**

❶ If the air supply is cut off while the lid is open, the lid will close whether the fixture is in position or not. This may cause damage to the product or the DUT.

❷ If any sensor detects that the operation is incomplete, everything returns to the previous position and the red LED will be turned on.

## 4.3.3 Fixture Connection

### Connecting air hose

**NOTICE**

The air hose for fixture is **4 mm** outside diameter hose.

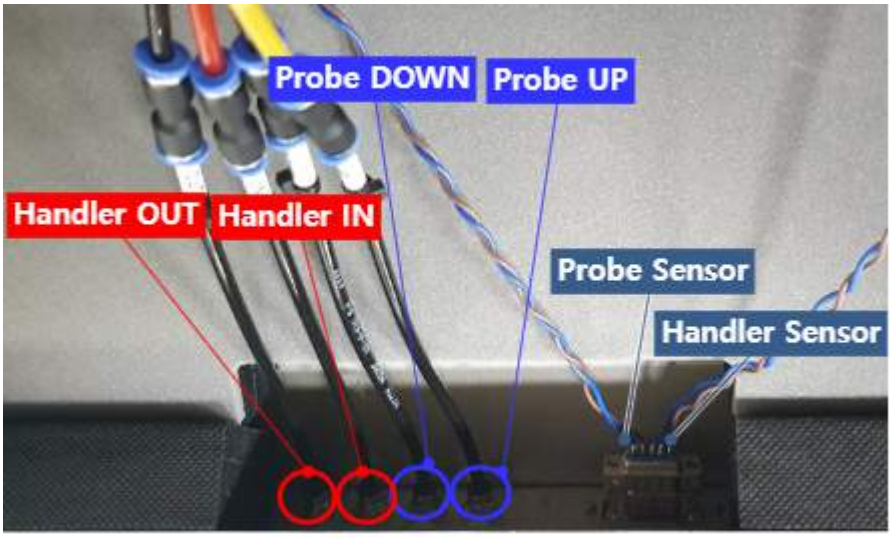



**Figure 4-7** Fixture Connection Guide

① **Remove the fitting plug, and connect 4 mm OD air hose to the fitting.**

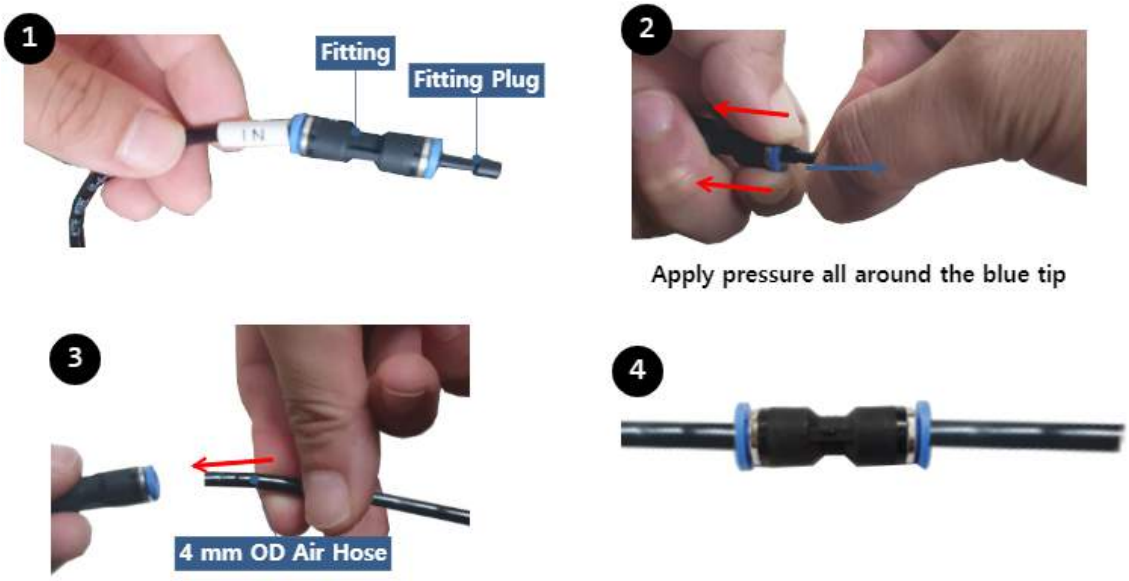



**Figure 4-8** Fitting Plug Removal

② **With all Probe air hoses connected, it will look like below.**

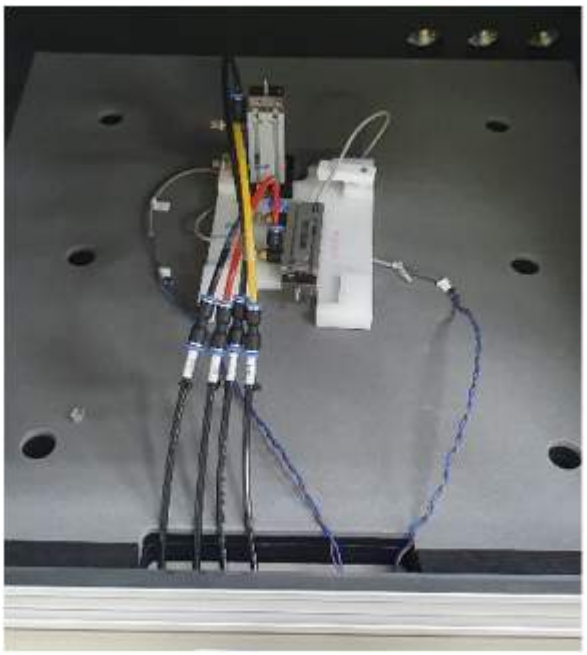


**Figure 4-9** TC-5972DP Fixture Connection

> **NOTICE**
> Figure 4-9 TC-5972DP Fixture Connection above is just a recommendation, so the actual connection may be adjusted for your convenience.

## 4.4 Shield Box Operation without Fixture

In order to work Shield Box without fixture, the fixture mode must be set to 'Off Mode.'

> **NOTICE**
> Refer to 5.6.2.1 Handler & Probe Configuration Commands

If the fixture mode is set to 'Sensor Mode,' the lid will stay open with Fail LED on, as there is no sensor to confirm each motion.

Also, if it is set to 'Timer Mode,' the lid operation will take certain time waiting for each fixture motion, delaying the entire process.

# 5. Remote Operation Using RS-232C

Shield Box can be controlled remotely via RS-232C

## 5.1 RS-232C Cable Connection

Connect RS-232C Cable to RS-232C DB9 Connector on the rear side of Shield Box.

**⚠CAUTION**

RS-232C Port on Shield Box is a DB9 Connector Female, so DB9 Data Cable (DB9(p) to DB9(s) Male to Female) should be used to connect Shield Box and PC.

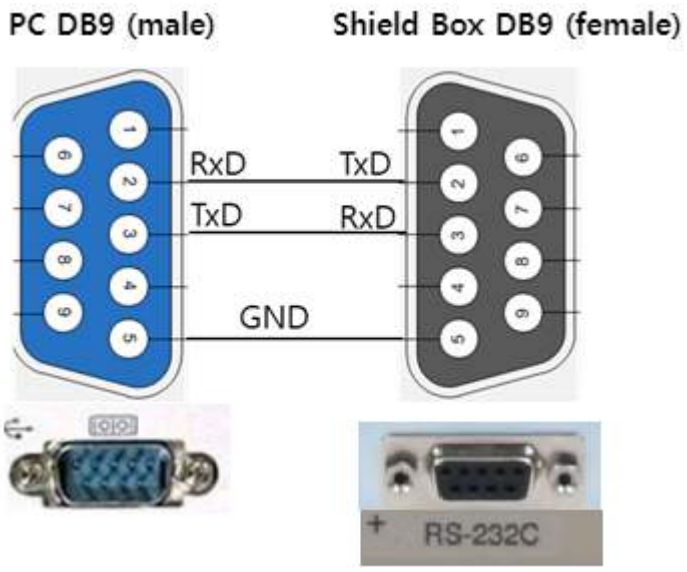



**Figure 5-1** RS-232C Cable Pin Configuration

## 5.2 RS-232C Port Setting

UART port setting is required as follows in order to control the shield box via RS-232C.

**Table 5-1** RS-232C Port Setting

| | |
|---|---|
| **Data rate** | 9600 bps |
| **Data bits** | 8 bit |
| **Parity** | None |
| **Stop bits** | 1 bit |
| **Flow Control** | None |

## 5.3 RS-232C Command Protocol

### 5.3.1 Command and Response Message

❶ Every time a command is sent from PC to Shield Box, a CR(Carriage Return : Wr (0x0D)) is sent at the end of it. (Command+₩r(0x0D))
❷ When a command is sent, a response (Response Data+₩r(0x0D)) comes back after a moment.
❸ If an invalid command is sent, an error (Error Data+₩r(0x0D)) comes back after a moment.
❹ Commands are capitalization-free.

**⚠CAUTION**

**You must wait for a response** whenever you send a command from PC to Shield Box. Otherwise, an error will occur.

# 5.4 Control with Terminal Application on PC

**NOTICE**

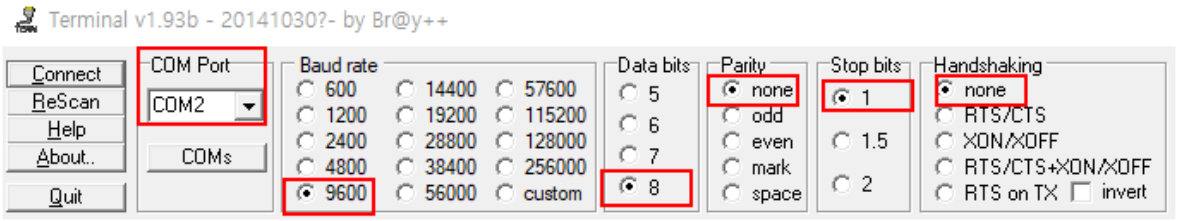
Below you will see how you can control Shield Box using a communication software 'Terminal.'
The application is free to download from here:
https://sites.google.com/site/terminalbpp/

**NOTICE**

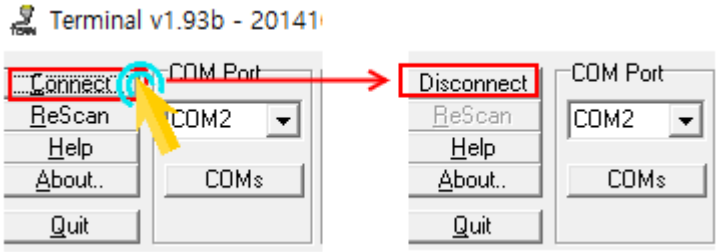
Before beginning, set everything up in Connecting & Setting Up chapter.

1. Execute Terminal .

2. Set COM Port, Baud Rate (9600 bps), Data Bit (8 bit), Parity Bit (None), Stop Bit (1 bit), Handshaking (none).

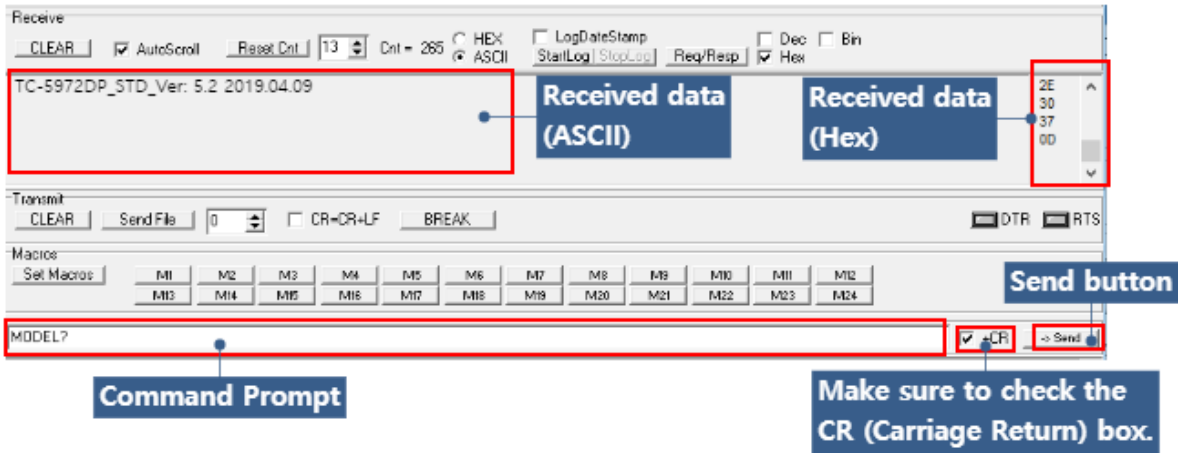



3. Press Connect.



## ④ Send a command and get a response.

1. Enter MODEL? on the command prompt and check +CR ( +CR Send ), then press Send.
2. A response (the model name and the firmware version) will appear on Receive window.
3. Check the Command List and try other commands.



# 5.5 RS-232C Command List

**Table 5-2** List of RS-232C Commands for TC-5972DP

| Category | RS-232C Command | Response | Description |
|---|---|---|---|
| System | MODEL? | Name+Version+Date | Verify model name, firmware version and date. |
| | COUNT? | Numeric 8 digits (ex: 00000001) | Display cumulative number of lid operation. |
| Configuration (Handler & Probe) | SOLENOID MODE? | Handler:xxx, Probe:xxx xxx: {OFF\|TIMER\|SENSOR} | Check Handler and Probe Mode. |
| | HANDLER MODE SENSOR | OK | Set Handler Mode to Sensor Mode. |
| | HANDLER MODE OFF | OK | Set Handler Mode to Off Mode. |
| | PROBE MODE SENSOR | OK | Set Probe Mode to Sensor Mode. |
| | PROBE MODE TIMER | OK | Set Probe Mode to Timer Mode. |
| | PROBE MODE OFF | OK | Set Probe Mode to Off Mode. |
| Lid Operation Commands | LID? | OPEN \| CLOSE | Check the current lid status. |
| | OPEN | OK \| ERR50 | Open the lid. |
| | CLOSE | READY \| ERR20 \| ERR30 \| ERR60 | Close the lid. |
| Handler Operation Commands | HANDLER? | INWARD \| OUTWARD | Check the current Handler status. |
| | INWARD | OK \| ERR20 \| ERR40 | Push the Handler in. |
| | OUTWARD | OK \| ERR40 \| ERR90 | Drag the Handler out. |
| Probe Operation Commands | PROBE? | UPWARD \| DOWNWARD | Check the current Probe status. |
| | UPWARD | OK \| ERR40 \| ERR90 | Lift the Probe up. |
| | DOWNWARD | OK \| ERR30 \| ERR40 \| ERR90 | Lower the Probe down. |
| Pass/Fail (While The Lid is Closed) | PASS | OK \| ERR40 \| ERR50 | Turn the green Pass LED on. Then open the lid. |
| | FAIL | OK \| ERR40 | Turn the red Fail LED on. |

### 5.5.1 Error Data List

**Table 5-3** List of Error Data

| Error Code | Description |
|---|---|
| ERR10 | Syntax error. The command does not exist or is invalid. |
| ERR20 | Handler inward sensor error. It only occurs when the Handler is in Sensor Mode. (The horizontal operation of fixture is incomplete.) |
| ERR30 | Probe downward sensor error. It only occurs when the Probe is in Sensor Mode. (The vertical operation of fixture is incomplete.) |
| ERR40 | Status error, It occurs when an invalid command is sent. For example, a Handler OUTWARD or Probe UPWARD while the lid is closed. It is returned if the command is sent when the motion can not be done in conjunction with the current status. |
| ERR50 | Lid open sensor error. It occurs only to certain products which should always detect whether the lid is open. The response comes when the lid open sensor does not detect the cylinder in open position. |
| ERR60 | Safety error. The Lid Close Sensor does not detect the cylinder in close position. |
| ERR90 | It occurs when the command is sent while the Handler or the Probe is in Off Mode. |

# 5.6 RS-232C Commands in Detail

## 5.6.1 System Queries

> MODEL?
> COUNT?

### MODEL?

A query to see the model name, firmware version, and the date of manufacture.

| | |
|---|---|
| **Type** | Query |
| **Input** | MODEL? |
| **Response** | <Name>_<Version> <Date> |
| **Example** | MODEL?<br>TC-5972DP_STD_Ver: 5.2 2019.04.09 |

### COUNT?

A query to check how many times the lid has opened.

| | |
|---|---|
| **Type** | Query |
| **Input** | COUNT? |
| **Response** | Numeric 8 digits (ex, 00000029) |

## 5.6.2 Configuration Commands

> 5.6.2.1 Handler & Probe Configuration Commands

**NOTICE**

Shield Box will reboot whenever the lid or fixture operation mode is changed, resulting in opening the lid. If the lid is already open, it will close and then open amid the motion.

### 5.6.2.1 Handler & Probe Configuration Commands

```
SOLENOID MODE?
HANDLER MODE SENSOR
HANDLER MODE OFF
PROBE MODE SENSOR
PROBE MODE TIMER
PROBE MODE OFF
```

#### SOLENOID MODE?

A query to check the operating mode of Handler & Probe.

| | |
|---|---|
| **Type** | Query |
| **Input** | SOLENOID MODE? |
| **Response** | Handler:<handler_mode>, Probe:<probe_mode><br>• <handler_mode>: {OFF \| SENSOR }<br>• <probe_mode>: {OFF \| TIMER \| SENSOR } |
| **Example** | // Below is how to change the Probe Mode from Off to Timer.<br>SOLENOID MODE?<br>Handler:OFF, Probe:OFF<br>PROBE MODE TIMER<br>OK |

**⚠CAUTION**

It is NOT recommended operating fixture in Timer Mode.
Without sensors, the lid may close even when the fixture motion is incomplete, thus causing damage to the product or DUT.
**TC-5972DP does NOT support Timer Mode of Handler. Only Probe can operate in Timer Mode.**

#### HANDLER MODE SENSOR

A command to set the Handler in Sensor Mode.

| | |
|---|---|
| **Type** | Command |
| **Input** | HANDLER MODE SENSOR |
| **Response** | OK |

## HANDLER MODE OFF

A command to set the Handler in Off Mode.

| | |
|---|---|
| **Type** | Command |
| **Input** | HANDLER MODE OFF |
| **Response** | OK |

## PROBE MODE SENSOR

A command to set the Probe in Sensor Mode.

| | |
|---|---|
| **Type** | Command |
| **Input** | PROBE MODE SENSOR |
| **Response** | OK |

## PROBE MODE TIMER

A command to set the Probe in Timer Mode.

| | |
|---|---|
| **Type** | Command |
| **Input** | PROBE MODE TIMER |
| **Response** | OK |

## PROBE MODE OFF

A command to set the Probe in Off Mode.

| | |
|---|---|
| **Type** | Command |
| **Input** | PROBE MODE OFF |
| **Response** | OK |

## 5.6.3 Lid Operation Commands

```
OPEN
CLOSE
LID?
```

### OPEN

A command to open the lid.

| | |
|---|---|
| **Type** | Command |
| **Input** | OPEN |
| **Response** | { OK \| ERR50 }<br>• OK : The lid opens (or is already open)<br>• ERR50: Lid-open sensor error. The lid-open sensor does not detect the cylinder in open position. |

**NOTICE**

**In case of ERR50, the response will return only once at first, and the Fail LED will be on. After that, the box does not react to any control. Make sure your air supply has sufficient pressure (5~10 bar) for the lid to open all the way up. If it does not solve the problem, please contact us.**

### CLOSE

A command to close the lid.
The lid-close sensor on a cylinder will blink red if the lid is closed regularly.

| | |
|---|---|
| **Type** | Command |
| **Input** | CLOSE |
| **Response** | { READY \| ERR20 \| ERR30 \| ERR60 }<br>• READY : Lid closed. Ready to test.<br>• ERR20 : Only occurs when the Handler is in Sensor Mode. Inward Handler Sensor detection error. (The horizontal operation of the fixture is incomplete.)<br>• ERR30 : Only occurs when the Probe is in Sensor Mode. Downward Probe Sensor detection error. (The vertical operation of the fixture is incomplete.)<br>• ERR60 : Safety error. The lid-close sensor does not detect the cylinder in close position. |

### LID?

A query to check the current status of the lid.

| | |
|---|---|
| **Type** | Query |
| **Input** | LID? |
| **Response** | { OPEN \| CLOSE }<br>• OPEN : Lid opened<br>• CLOSE : Lid closed |

## 5.6.4 Handler Operation Commands

```
HANDLER?
INWARD
OUTWARD
```

### HANDLER?

A query to check the current status of the Handler.

| | |
|---|---|
| **Type** | Query |
| **Input** | HANDLER? |
| **Response** | { INWARD \| OUTWARD }<br>• INWARD: The Handler is at inward position.<br>• OUTWARD: The Handler is at outward position. |

### INWARD

A command to put the Handler in.
When the lid is closed, only the INWARD command works.
The OUTWARD command will not work, returning 'ERR40.'

| | |
|---|---|
| **Type** | Command |
| **Input** | INWARD |
| **Response** | { OK \| ERR20 \| ERR40 }<br>• OK: The Handler is at inward position.<br>• ERR20: Handler-inward sensor error. It occurs only when the Handler is in Sensor Mode. (The horizontal operation of fixture is incomplete.) |

- ERR40: Status error, It occurs when an invalid command is sent. For example:
  - Handler OUTWARD or Probe UPWARD command is sent while the lid is closed.
  - Probe DOWNWARD or UPWARD command is sent while the Handler is at outward position.
  - Handler OUTWARD command is sent while the Probe is at downward position.

### OUTWARD

A command to drag the Handler out.
If the OUTWARD command is sent while the lid is closed or the Probe operation commands (DOWNWARD/UPWARD) are sent while the Handler is at outward position, it will only return 'ERR40.'

| | |
|---|---|
| **Type** | Command |
| **Input** | OUTWARD |
| **Response** | { OK \| ERR40 \| ERR90 }<br>• OK: The Handler is at outward position.<br>• ERR40: Status error, It occurs when an invalid command is sent. For Example:<br>  ◦ Handler OUTWARD or Probe UPWARD command is sent while the lid is closed.<br>  ◦ Probe DOWNWARD or UPWARD command is sent while the Handler is at outward position.<br>  ◦ Handler OUTWARD command is sent while the Probe is at downward position.<br>• ERR90: The command is sent while the Handler is in Off Mode. |

## 5.6.5 Probe Operation Commands

```
PROBE?
UPWARD
DOWNWARD
```

### PROBE?

A query to check the current status of the Probe.

| | |
|---|---|
| **Type** | Query |
| **Input** | PROBE? |
| **Response** | { UPWARD \| DOWNWARD }<br>• UPWARD: The Probe is at upward position.<br>• DOWNWARD: The Probe is at downward position. |

## UPWARD

A command to lift the Probe up.

| | |
|---|---|
| **Type** | Command |
| **Input** | UPWARD |
| **Response** | { OK \| ERR40 \| ERR90 }<br>• OK: The Probe is at upward position.<br>• ERR40: Status error, It occurs when an invalid command is sent. For example:<br>  ○ Handler OUTWARD or Probe UPWARD command is sent while the lid is closed.<br>  ○ Probe DOWNWARD or UPWARD command is sent while the Handler is at outward position.<br>  ○ Handler OUTWARD command is sent while the Probe is at downward position.<br>• ERR90: The command is sent while the Probe is in Off Mode. |

## DOWNWARD

A command to lower the Probe down.

| | |
|---|---|
| **Type** | Command |
| **Input** | DOWNWARD |
| **Response** | { OK \| ERR30 \| ERR40 \| ERR90 }<br>• OK: The Probe is at downward position.<br>• ERR30: Probe-downward sensor error. It occurs only when the Probe is in Sensor Mode. (The vertical operation of fixture is incomplete.)<br>• ERR40: Status error, It occurs when an invalid command is sent. For example:<br>  ○ Handler OUTWARD or Probe UPWARD command is sent while the lid is closed.<br>  ○ Probe DOWNWARD or UPWARD command is sent while the Handler is at outward position.<br>  ○ Handler OUTWARD command is sent while the Probe is at downward position.<br>• ERR90: The command is sent while the Probe is in Off Mode. |

# 5.6.6 PASS/FAIL Commands (While The Lid is Closed)

## PASS

A command that decides PASS after a test.

If the PASS command is sent, the Pass LED on the control box will glow green ( 

), the LED on gray switch will glow blue (  ), and the lid will open automatically.

| | |
|---|---|
| **Type** | Command |
| **Input** | PASS |
| **Response** | { OK \| ERR40 \| ERR50 }<br>• OK : turns the green PASS LED on, and the lid opens.<br>• ERR40: Status error, The command is sent while the lid is open.<br>• ERR50: Lid-open sensor error. The lid-open sensor does not detect the cylinder in open position. |

## FAIL

A command that decides FAIL after a test.

The FAIL LED on the control box will glow red ( 

), the LED on gray switch will glow red (  ), and the lid will **NOT** open.

| | |
|---|---|
| **Type** | Command |
| **Input** | FAIL |
| **Response** | { OK \| ERR40 }<br>• OK : turns the red FAIL LED on.<br>• ERR40: Status error. The command is sent while the lid is open. |

# PART 4.

# Maintenance

# 6. Maintenance

## 6.1 Maintenance

TC-5972DP Pneumatic Shield Box is designed and built for long life and easy maintenance.

Optimal RF shielding is obtained by using gaskets between the body and the lid. Clean them at least once a month as directed below to maintain Shield Box in good condition. They must be checked periodically for wear and tear which would compromise the performance.

### Check List for Maintenance

- Check for loose screws and tighten with proper tools, if necessary.
- Check for a loose connection. If a loose connector is found, tighten the connector with proper tools.
- Check for a damaged cable, especially near the connector-cable neck. Replace any damaged cables found.
- Visually inspect the RF seal (gasket) between the Shield Box body and lid for wear and tear.
- If there is excessive amount of dust or foreign substance on the aluminum surface (especially parts contact with gaskets), wipe it out with dry cloth.

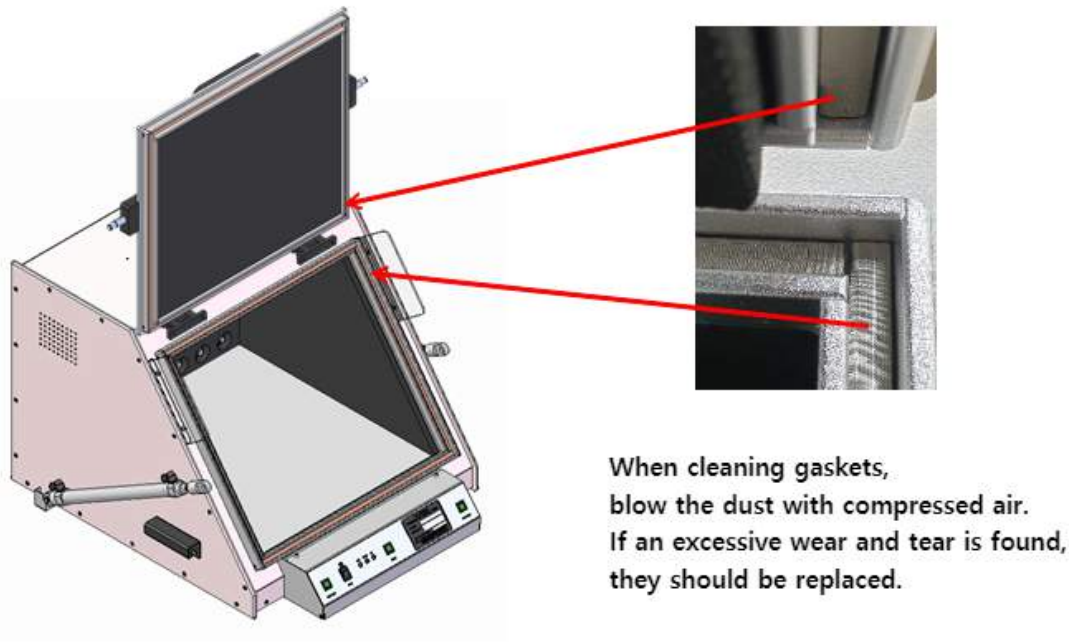



**Figure 6-1** TC-5972DP Gasket Locations

**⚠CAUTION**

Do not clean this equipment with organic solvents such as benzene, toluene or acetone as they will damage gaskets.

## 6.2 Performance Test

TESCOM Shield Boxes are precision RF devices built very sturdily. Their electrical performance can, however, deteriorate with mechanical damages.

Worn out shielding gaskets, as well as metal corrosion or oxidation on the surface of lid-contacting area, can significantly reduce the effectiveness of the Shield Box. This section describes the test and calibration procedure for the Pneumatic Shield Box.

**⚠CAUTION**

Performance test should be carried whenever there is a maintenance or repair work.

### 6.2.1 Calibration Period

- Recommended calibration period : less than 6 months

**NOTICE**

The calibration period can vary depending on the number of operations and the equipment management method.

### 6.2.2 Required Equipment

- Spectrum Analyzer : < 6 GHz
- Signal Generator : < 6 GHz
- Dipole Antenna : TESCOM 900 MHz, 1.8 GHz, 2.4 GHz, 5.8 GHz

## 6.2.3 Performance Test Set Up

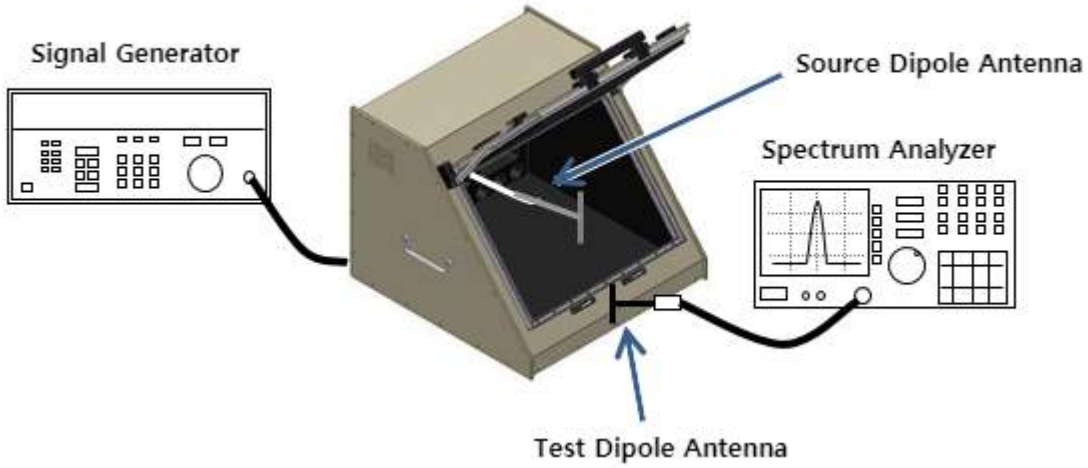



**Figure 6-2** Performance Test Set Up (ex: TC-5970D)

## 6.2.4 Specification Standards

| Frequency | Shielding effectiveness (dB) |
|---|---|
| 100 to 2000 MHz | > 70 dB |
| 2000 to 3000 MHz | > 70 dB |
| 3000 to 6000 MHz | > 60 dB |

**NOTICE**

The shielding effectiveness above is measured with blank panels; other I/O interface panels may result in different shielding effectiveness of the shield box. Please refer to Pre-configured Panelsand 3.1.2 Custom Panels.

## 6.2.5 Test Procedure

**NOTICE**

Before measuring, check the shielding gasket around the lid. If there is a damaged part, replace the gasket and wipe the contact area, which is between the lid and the body except the gasket, with alcohol.

1. **Turn the spectrum analyzer and signal generator on.**
2. **Using an RF cable, connect the RF Connector(N Type) on the rear side of Shield Box to the RF output port(N Type) of signal generator.**
3. **Open the Shield Box lid and connect the 900 MHz Source Dipole Antenna to RF Port(SMA Type) inside the Shield Box. (Place the antenna at the center of the Shield Box.)**
4. **Set the output of signal generator to CW900 MHz, 10 dBm.**
5. **Connect the test antenna to the spectrum analyzer.**

6. **Set the spectrum analyzer as follows:**

   - Center Frequency : 900 MHz
   - Span : 1 MHz
   - Amplitude: +10 dB

7. **Circle the test antenna around the Shield Box lid, and check the maximum reception. (Make sure the lid is OPEN.)**

   - Press Peak Search button on the spectrum analyzer to set the maximum value of measurement standard.

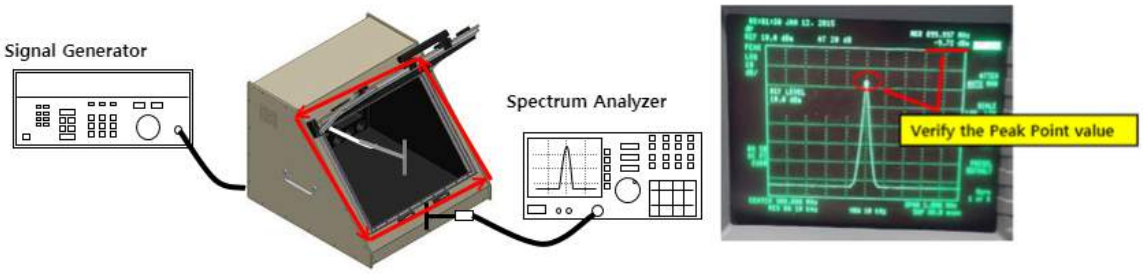



**Figure 6-3** Searching for Maximum Reception

8 **Close the lid.**

9 **Set the input range of the spectrum analyzer as follows:**

- Center Frequency : 900 MHz
- Span : 1 MHz
- Amplitude: -30 dB

10 **Circle the test antenna around the entire Shield Box, particularly around the lid and modules on the rear panel. Check the maximum leakage.**

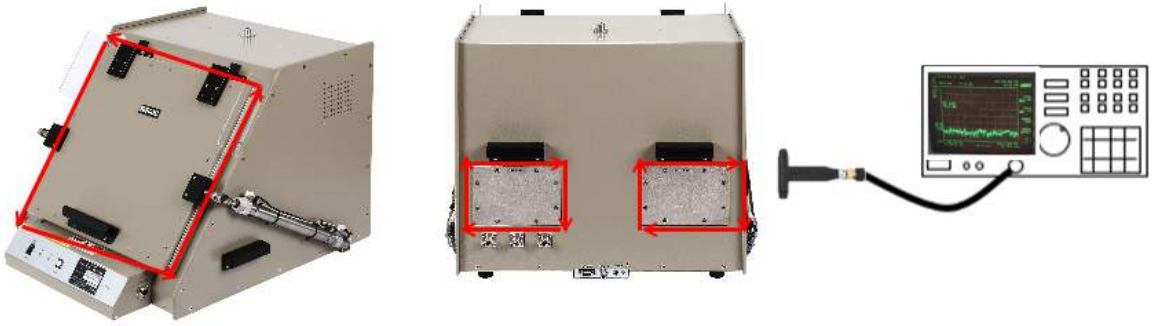


**Figure 6-4** Measuring Maximum Leakage (ex. value: -90 dBm)

> **⚠CAUTION**
> Make sure the test antenna does not contact the surface of the Shield Box or the lid.

11 **See if the difference between the measurement standard (a) and the maximum leakage (b) is within the specification (Shielding Effectiveness) of the product.**

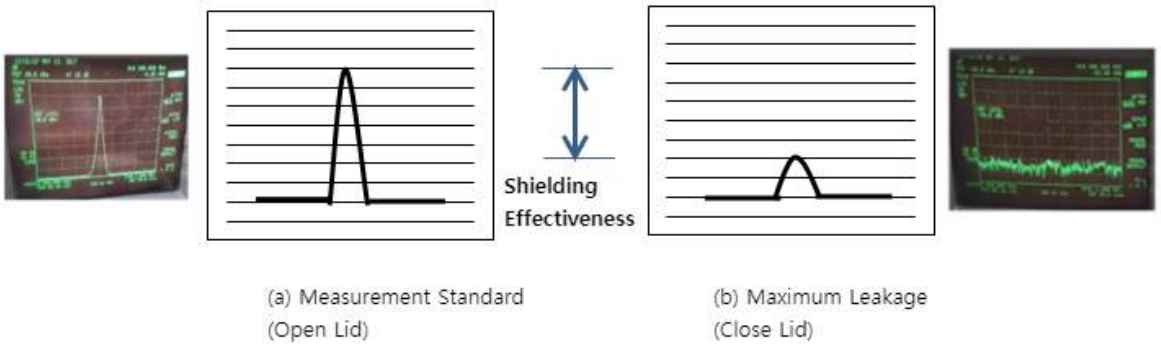



**Figure 6-5** Spectrum Analyzer Display

12 **Repeat the procedure with the frequency set to 1.8 GHz, 2.4 GHz, 5.8GHz.**

# 7. Expendables and Accessories

Below is the list of expendables and accessories of TC-5972DP Pneumatic Shield Box. Please contact TESCOM headquarters or your local distributor to order.

## 7.1 Expendables and Accessories

**NOTICE**

The items below are NOT under warranty.

**Table 7-1** List of Expendables & Accessories

| No. | View | Part designation | Order number | Qty | Remarks |
|---|---|---|---|---|---|
| ❶ |  | Foam Gasket Set | R5972C-80 | 1 Set | 4 kinds, 2 pcs each. 8 pcs total. |
| |  | SS-402, N(m) to N(m) 1m | 4011-0001 | 1 ea | |
| |  | Data, DB9(p)-DB9(s) 2M | 4003-0025 | 1 ea | See Cable Connection |

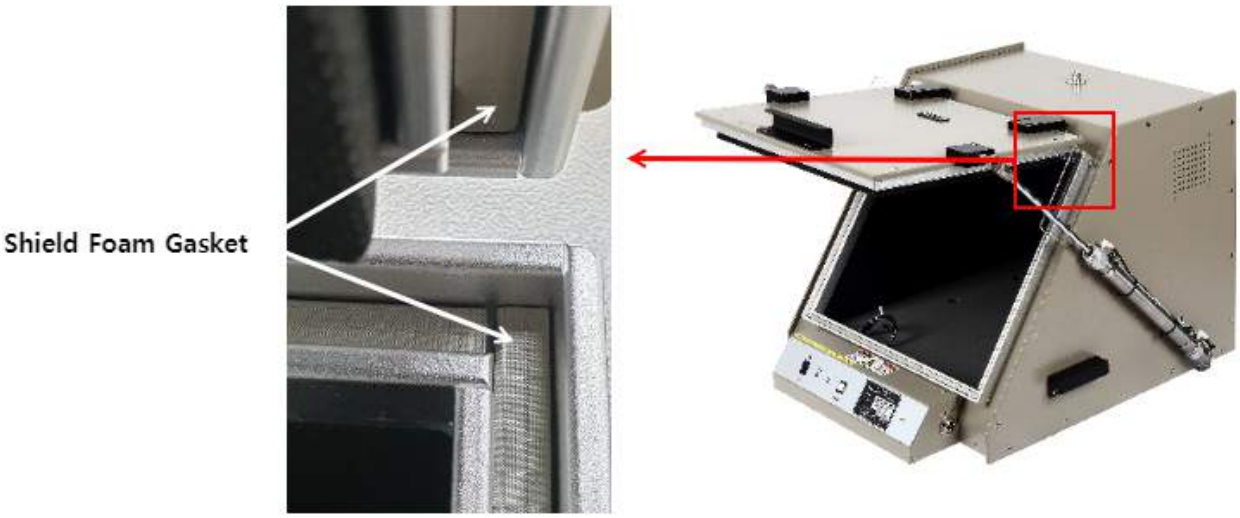



**Figure 7-1** TC-5972DP Gasket Locations

# 8. Check List for Common Problems

Below is the check list for common mistakes. Before calling for help, make sure the problem is NOT one of following issues nor a malfunction of any OTHER connected equipment.

## Power Supply Check

- Verify that the power cord is connected to the product and the switch is on.
- Verify that the power supply is not short or out.
- Verify that the line voltage is within range of 100 ~ 240 VAC.

## Compressed Air Check

- Check the connection of compressed air supply.
- Check the pressure. It should be within range of 5 ~ 10 bar.

## Data Cable Connection Check

- If you are using PC to control the product, check the connection of RS-232C cable and the software settings.