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INSTRUCTION MANUAL

CAPACITANCE TYPE LEVEL SWITCH

HCC-96RF-C(S) Series

Doc. no. : HCC96RFC(S)_IM_Eng_Rev.1

Issue date: 2021. 01

Table of Contents

You shall be well-informed of the contents where WARNING is marked before carrying out the work.

You shall be careful where CAUTION is marked to carry out the work.

You shall be aware of where NOTICE is marked to carry out the work.

Overview

HCC-96RF-C(S) Series is a Radio Frequency Type Level Switch, and it detects level of a medium by sensing of capacitance value change caused by a dielectric constant of each medium. HCC-96RF-S Series can solve the build-up phenomenon of the detection part due to electro-conducting materials by using "Guard Technology Phase Shifting".

Characteristics

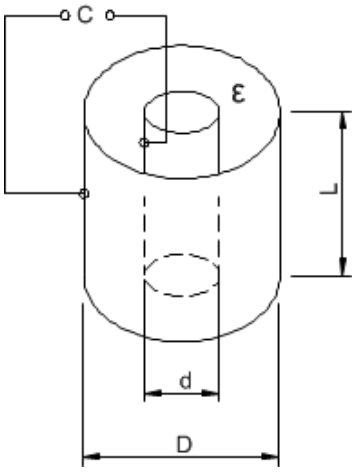
- ■ Compensation electrode type with double structured sensor (Only for HCC-96RF-S)
- ■ Prevention of malfunction caused by material build-up on the sensor
- ■ Solid structure and semi-permanent life cycle due to non-machinery parts
- ■ Easy installation and calibration
- ■ Operating can be checked at the site.

Operating Principle

For HCC-96RF-C Series, if the level of the medium increases and the main probe comes into contact with the medium, the impedance changes depending on the capacitance value. Using phase change of the signal being measured according to change of impedance, measure the presence or absence of the medium and output it to the relay contact.

For HCC-96RF-S Series, compares the signal flowing from active sensing probe towards ground with reference RF signal, when the medium is detecting. Since all material has unique dielectric constant (relative permittivity) and conductance value that are different from air, the impedance of the signal circuit is changed when medium touches the probe. This change causes a shift in phase of the RF Signal. A phase difference between the active signal and reference signal causes the output circuitry to operate. (This type can only be applied to solid/dust.)

For cylindrical tank, the capacitance can be obtained as follow.



$$C = \varepsilon L / \log\left(\frac{D}{d}\right)$$

C : Capacitance of medium (pF)

ε : Relative dielectric constant

L : Length of Probe

D : Outer diameter of tank

d : Outer diameter of sensing probe

Specifications

Product

Model	HCC-96RF-C	HCC-96RF-CH	HCC-96RF-S
Probe Type	Main Probe		Main + Compensation Probe
Mounting	Flange or Screw		
Ambient temperature	-20˚C ~ +60˚C		
Process temperature	Max. 80˚C	Max. 150˚C	Max. 240˚C
Process Pressure	Up to 20kg/cm^2		Up to 10kg/cm^2
Power Source	AC 90~240V, 50Hz/60Hz (Std.) / DC +24V (Opt.)		
Output Signal	DPDT		
Contact Rating	AC 250V, 5A / DC 30V, 5A		
Enclosure	Weather-Proof		
Wetted Parts Material	SUS 316L + Teflon		SUS 316L + PPS
Process Connection	PT 1" Screw		50A JIS 10K RF
Housing ; Cable Entry	PBT ; 2-PF 1/2" (F), IP65 (Std.) AL. ; 2-PF 1/2" (F), IP66 (Opt.)	AL. ; 2-PF 1/2" (F), IP66	AL. ; 2-PF 1/2" (F), IP66

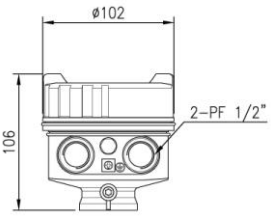
Amplifier Specification

Module	M-96RFC	M-96RFS
Microprocessor	16 Bit Microprocessor	
Oscillation Frequency	420KHz @ ±10KHz	154KHz @ ±10KHz
Dielectric Constant	1.5 @ Min.	
Sensitivity (Adjustment)	1pF ~ 80pF	1pF ~ 20pF
Function (Adjustment)	■ Measurement Range ■ Relay Delay Time ■ Relay Return Time ■ Relay Out Control (Normal/Reverse)	
Relay Delay Time (Adjustment)	0.5Sec. @ Min. / 1 ~ 10Sec. @ 0.1Sec. Resolution	
Relay Return Time (Adjustment)	0.5Sec. @ Min. / 1 ~ 10Sec. @ 0.1Sec. Resolution	
Relay Contact Out Control	Normal Close @ Default.	
Status Indicator	Bi-Color LED [Green / Red / Orange]	
Detection Indicator	Red LED	
Relay Control Indicator	Green LED	
UART	Monitoring	
Ambient Temperature	-20˚C ~ +80˚C	

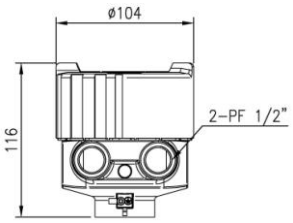
Product Composition

The dimensions on the following pages are indicated in [mm].

[Housing]

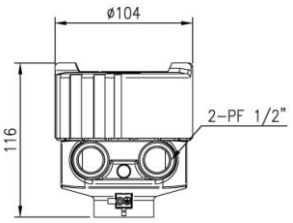


Material: PBT



Material: Aluminum

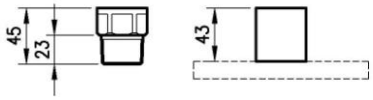
For HCC-96RF-C(H)



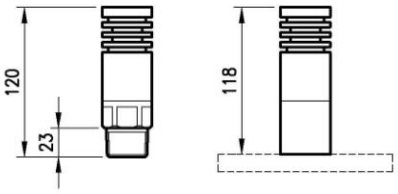
Material: Aluminum

For HCC-96RF-S

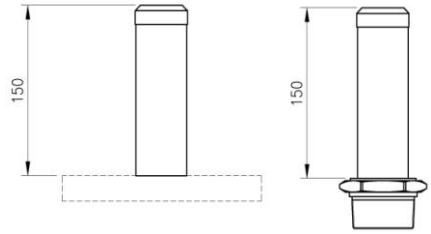
[Connection]



For HCC-96RF-C



For HCC-96RF-CH



For HCC-96RF-S

■ Connection Type

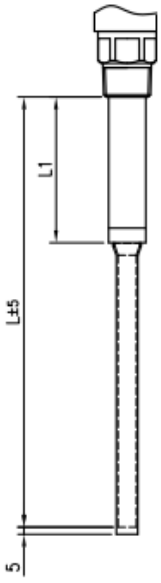
-Screw: PT 1" (Std.), NPT 1", PF 1", Others

-Flange: ANSI, JIS, DIN

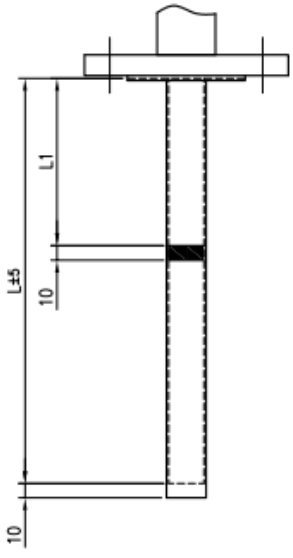
■ Material

-SUS 316L, Others

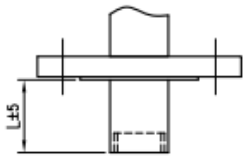
[Probe]



Rod Type

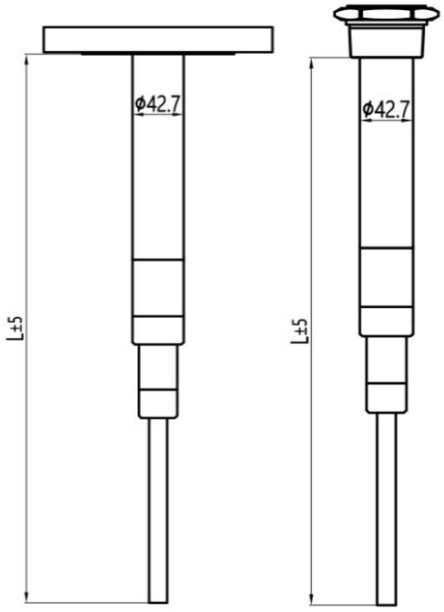


Rod Type
(Fully insulated Teflon)



Flat Type (*)

For HCC-96RF-C(H)



Rod Type

For HCC-96RF-S (Only Solid)

* Flat Type can be used in liquids, but further verification is required at the head office as a sample.

NOTICE **Actual product may have a tolerance slightly.**

Installation

HCC-96RF-C(S) Series is generally used for high or low alarm with an installation on the side or top of the tank and can be also applied to metallic or synthetic resin tank as there are no restrictions on the material of the tank.

■ Side Mounting Installation

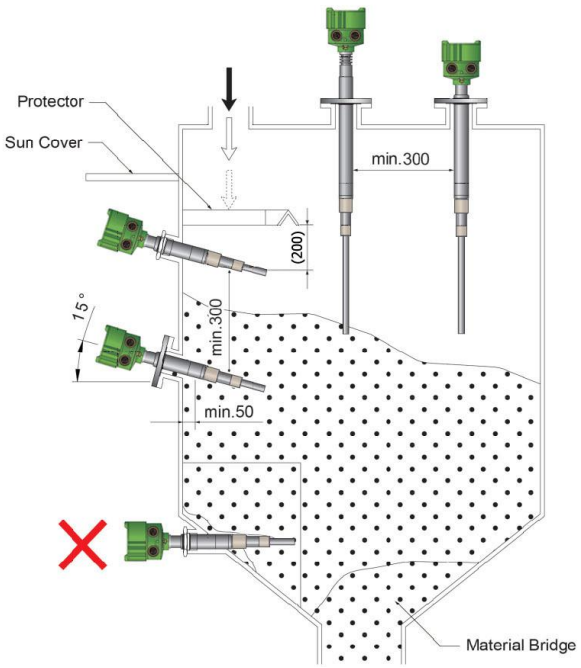
- If the content has the characteristics of creating an excess sediment layer, the product shall be installed at an angle of about 45 degrees.
- If the content has a high density, a protector shall be installed at least 200mm above from the probe in order to protect the probe.

■ Top Mounting Installation

- If the probe length is more than 1000mm, install a fixed bracket insulated at the bottom.
- Sensing probe shall be installed at least 500mm away from the side of the tank.

Precautions for Installation

- If more than one level switch is installed in a tank, the distance between each probe shall be at least 300mm apart. (If the distance between probes is short, it may be affected by the interconnection of the instrument, causing unstable operation.)
- For side mounting installation, an inactive rod shall be located at least 50mm inside of tank, and it is recommended that the probe be tilted by 15 degrees to the horizontal surface. (A foreign object between the nozzle and the probe may cause malfunction.)
- Protector shall have sufficient area to protect the sensor from incoming medium and be installed at a distance that does not affect sensor operation.
- For side mounting installation, the cable entry shall be installed facing the ground to maintain the waterproof function.
- When installing on the low level, carefully install the dead stock and material bridge.
- For outdoor installation, it is recommended to install the sun cover to avoid the effects of temperature increases.
- In case of tank with stirrer, the probe shall be installed at a safe distance from the stirrer.



Precautions for Attachment

- ■ Connect the flanges or bolts with the same specifications.
- ■ Make sure to insert washers between bolts and nuts to prevent loosening.
- ■ Make sure to insert gaskets between flanges. (Select the gaskets in consideration of the temperature of the content and the pressure inside the container.)
- ■ Make sure to install the product and the cover before supplying the power.
- ■ When installing the sensor, avoid shaking or obstacle.
- ■ Condensation may occur if the temperature of the housing differs significantly from the ambient temperature, so dehumidifier shall be filled or ventilated(gortex) before use.

When installing the product, use the tool to tighten it.

Wiring

- ■ Connect correctly AC(90~240V) or DC(+24V) power to the power specification.
- ■ Make sure to connect the DC power with correct polarity(+, -).
- ■ Do not connect the wire with the power connected.
- ■ It provides DPDT output by default, wired COM and N.O terminals when using the high alarm.
- ■ External grounding shall be completed.

Precautions for Use

- ■ Do not bend or extend the sensor randomly.
- ■ Make sure to install the product and the cover first before supplying the power.
- ■ Do not use if the temperature range of the installation exceeds -20℃ to +60 ℃.
- ■ Do not use if the protection grade requires a higher grade than its product. (IP66 for AL. Housing or IP65 for PBT Housing)
- ■ Do not use where vibration is present.

Precautions for Removal

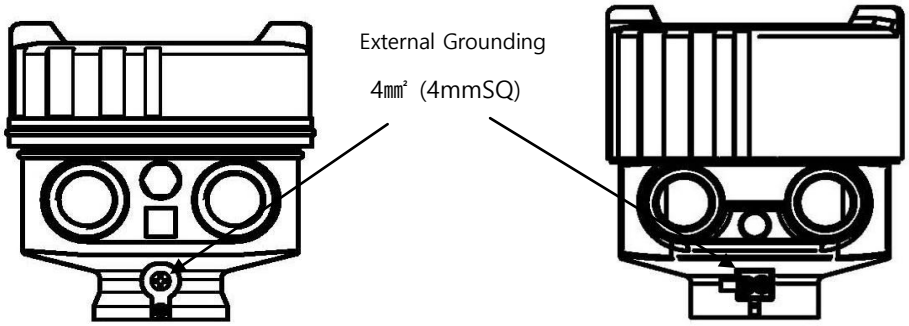
- ■ Check the level and presence of medium in the tank before removing it.
- ■ Wear gloves when removing it, to prevent a burn.
- ■ Disassemble work shall be done with the power off.
- ■ Make sure that any O-ring or gasket is not damaged while opening or closing the cover of product.

Please do not apply high impact to the product.

Precautions for Grounding

- ■ The grounding has an external and an internal grounding. When connecting to an external ground, the ground wire shall be 4㎟ (4mmSQ).
- ■ The internal grounding wire shall be the same size as the power line, and the size of the internal grounding terminal lug shall be 3.1㎟ (3.1mmSQ). If the power line is larger than 3.1㎟, connect the ground wire without terminal lug.

Make sure to insert a washer if the terminal lug is removed from ground terminal and then re- connected. (Loosening prevention)



HEAD External Grounding (PBT)　　HEAD External Grounding (AL.C)

Maintenance

The life span of key parts depends on user's environment and can be used optimally through periodic check. Therefore, regular inspection ensures optimal performance of product, so take regular inspection and maintenance at least every year. Inspection of the appearance of the product shall be visually checked to see if there is any damage, and the attachment of the medium or foreign substances to the sensor will make it worse, so they shall be removed regularly.

WARNING **Turn off the power of the product for maintenance.**

Failure Check

If there is a problem with operation, check the following first.

■ Is power voltage connected correct?

■ Is power voltage supplied according to specifications correct?

■ Is cable wiring correct?

■ Is the Fail-Safe Mode setting correct?

■ Does the green LED turn on?

Safety and Environment

■ Precautions for Use

- Make sure to connect the product and vessel using required tools for sure.
- Keep the lock key safe and make sure that it is locked.
- Do not apply high impact to the product.

■ Precautions for Wiring

- Make sure to wire contacts correctly.
- Wire and supply the power to the product after checking the specifications.
- Incorrect power voltage may cause damage to the product.
- Pay attention to prevent electric shock.

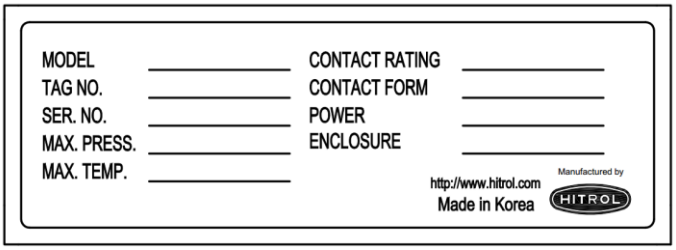
■ Disposal of Product

- Make sure to separate the amplifier and main unit from housing before disposing the products. Also, the amplifier shall be detached and discard the metal and non-metallic materials. No part (ex. Mercury switch) has influence on the environment, so no special attention is required.

Marking

■ Product Identification

- The product identification mark is attached onto the housing and shows the model name, serial number, working temperature, working pressure, and matters regarding output. The serial number is a unique manufacturing number for the identification of products.



Warranty and Contact

■ Warranty and Service

This product is subject to the warranty for 2 years of shipment and unpaid service will be provided for any damage found under normal operating conditions. If it is not about the failure of product, the service charge will be payable.

You can request A/S at our website or by contacting our headquarters.

■ Headquarters . Factory . Laboratory Contact Number

ADDRESS: HITROL CO., LTD 141, Palhakgol-gil, Jori-eup, Paju-si, Gyeonggi-do, Korea

T E L : 031-950-9700 (Headquarters & A/S)

F A X : 031-943-5600 (Headquarters & A/S)

APPENDIX Q

HCC-96RF-C

Setting Guide

RF Admittance Type Level Switch

Doc. no. : Rev0.0

Issued Date : 2020.11.18

Always The Best Solution

HITROL CO., LTD.

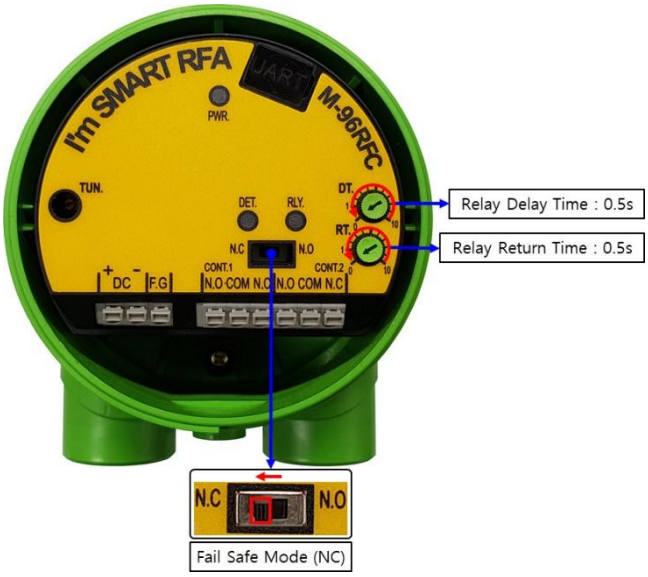
1. M-96RFC Configuration and Function

No	Configuration	Function
1	**TUN.**	■ Tuning Capacitance in the tank ■ Sensitivity Adjustment
2	**DT.**	■ Relay Delay Time Adjustment ○ Time Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s
3	**RT.**	■ Relay Return Time Adjustment ○ Time Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s
4	**Fail Safe Mode**	■ Relay Transformation Adjustment ○ N.C ↔ N.O
5	**DET.**	■ Measurement Status LED ○ OFF → Red
6	**RLY.**	■ Relay Status LED ○ N.C: OFF → Green ○ N.O: Green → OFF
7	**PWR.**	■ Power & Status Display
8	**UART**	■ M-96RFS Status Setting and Status Communication Port
9	**Power**	■ Power Connector (AC / DC)
10	**Relay Out**	■ Relay Contact Out (DPDT)

2. M-96RFC Setting and Adjustment

■ Initialization Setting Method

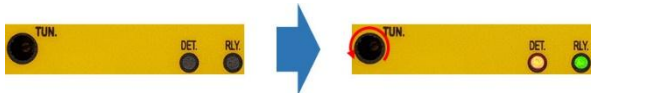
☐ After installing it on the tank, set it to the initial state for quick response.



■ Tuning Setting 1

☐ When the capacitance value in the tank is lower than the reference value,

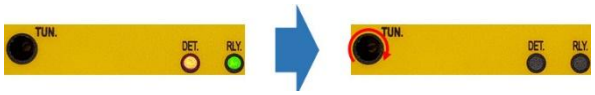
[Before Adjusting *TUN.* VR] [Adjusting *TUN.* VR] [After Adjusting *TUN.* VR]

No	Function	Method
1	Frequency Tuning	■ To set the reference value while the *DET.* LED is off, adjust the *TUN.* VR counter-clockwise until the *DET.* LED is on.  [Before Adjusting *TUN.* VR] [Adjusting counter-clockwise *TUN.* VR] ■ Fine-tune *TUN.* VR clockwise until the *DET.* LED turns off.  [Adjusting clockwise *TUN.* VR] [After Adjusting *TUN.* VR]

■ Tuning Setting 2

□ When the capacitance value in the tank is higher than the reference value,

[Before Adjusting *TUN.* VR] [After Adjusting *TUN.* VR]

No	Function	Method
1	Frequency Tuning	■ To set the reference value while the *DET.* LED is on, adjust the *TUN.* VR clockwise until the *DET.* LED is off.  [Before Adjusting *TUN.* VR] [After Adjusting *TUN.* VR]

■ Sensitivity Adjustment Method

□ You can adjust measurement sensitivity for each environment.

[Before Adjusting Sensitivity by *TUN.* VR] [After Adjusting Sensitivity by *TUN.* VR]

No	Function	Method
1	Tuning Setting Status	■ The *TUN.* VR state according to the "Tuning Setting" is the most sensitive state. ■ Keep this status for sensitive use.
2	Sensitivity Adjustment	■ You can adjust the sensitivity by adjusting *TUN.* VR. ■ Sensitivity Adjustment Method [SENSITIVE]  [INSENSITIVE]

■ Relay Time Adjustment Method

☐ You can adjust the relay operation time after detecting the measurement.

[Operating Status According to Relay Delay Time]

No	Function	Method
1	DT.	■ Relay Delay Time ■ Time Adjustment Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s

☐ You can adjust the relay return time after undetecting the measurement.

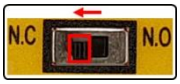
[Operating Status According to Relay Return Time]

No	Function	Method
1	RT.	■ Relay Return Time ■ Time Adjustment Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s

■ Fail Safe Mode Adjustment Method

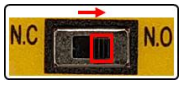
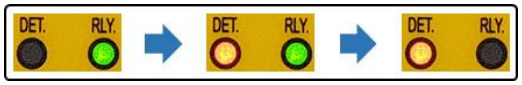
☐ You can adjust the contact status to Relay Contact N.C.

[Operating Status According to Relay Contact [N.C]]

No	Function	Method
1	N.C	■ Relay Contact Out Default Status  ■ After detecting the measurement, the contact point changes from N.C to N.O. ■ LED Status 

☐ You can adjust the contact status to Relay Contact N.O.

[Operating Status According to Relay Contact [N.O]]

No	Function	Method
1	N.O	■ Relay Contact Out Opposite Status.  ■ After detecting the measurement, the contact point changes from N.O to N.C. ■ LED Status 

3. M-96RFC UART Monitoring

■ Monitoring Method

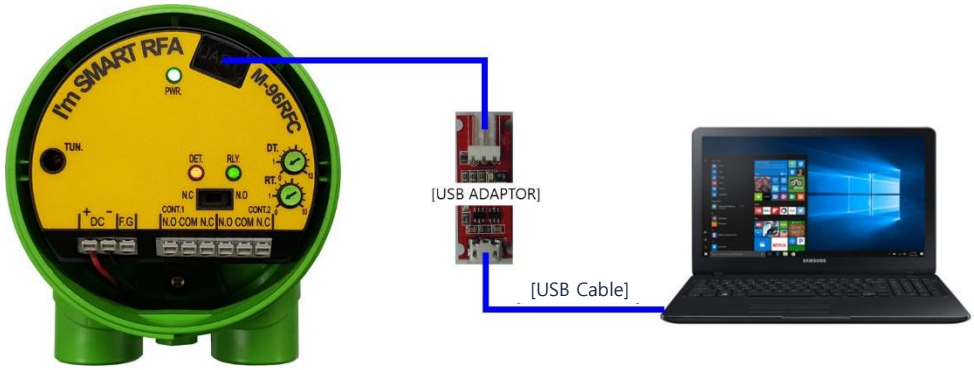
☐ You can only check the state of the adjusted setting values using PC or Smartphone.

☐ The execution method is the same using PC or Smartphone. (Password: 1975)

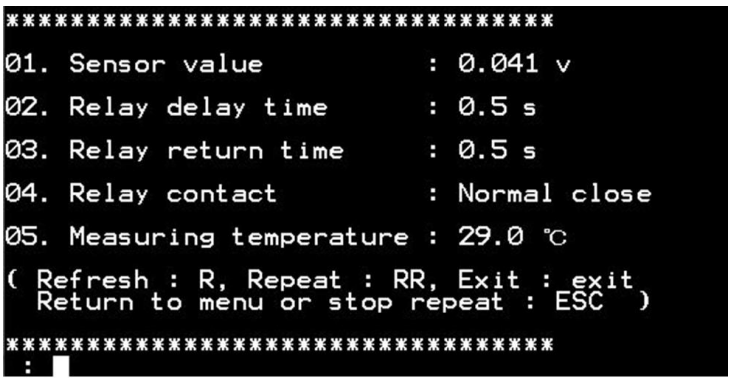
☐ Run Screen Component: You can check the sensor measurement status, sensitivity setting value, relay setting, etc.

■ Monitoring Method Using PC

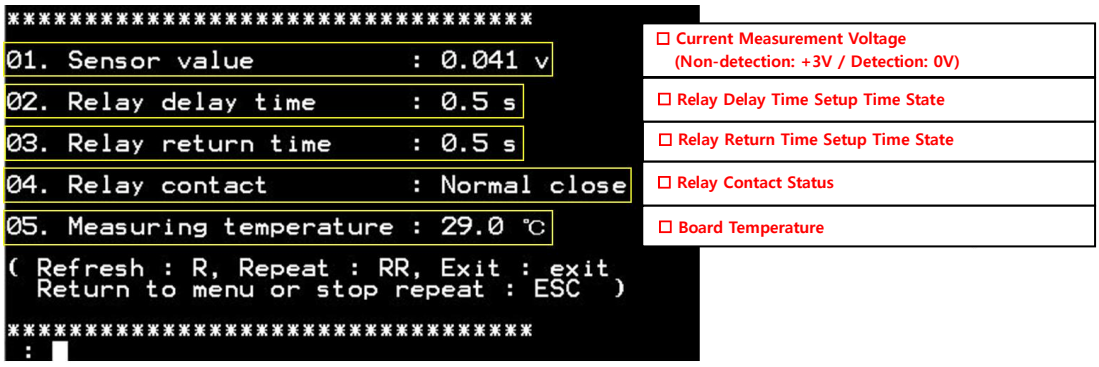
☐ Component: PC, USB Cable(typical USB to Micro USB B), UART Adaptor.



[M-96RFC PC UART Component]



[M-96RFC PC UART Run Screen]

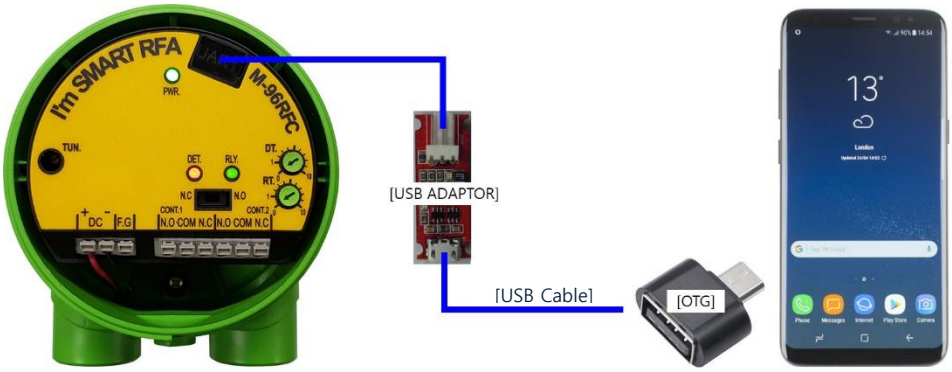


[M-96RFC PC UART Run Screen Component Function]

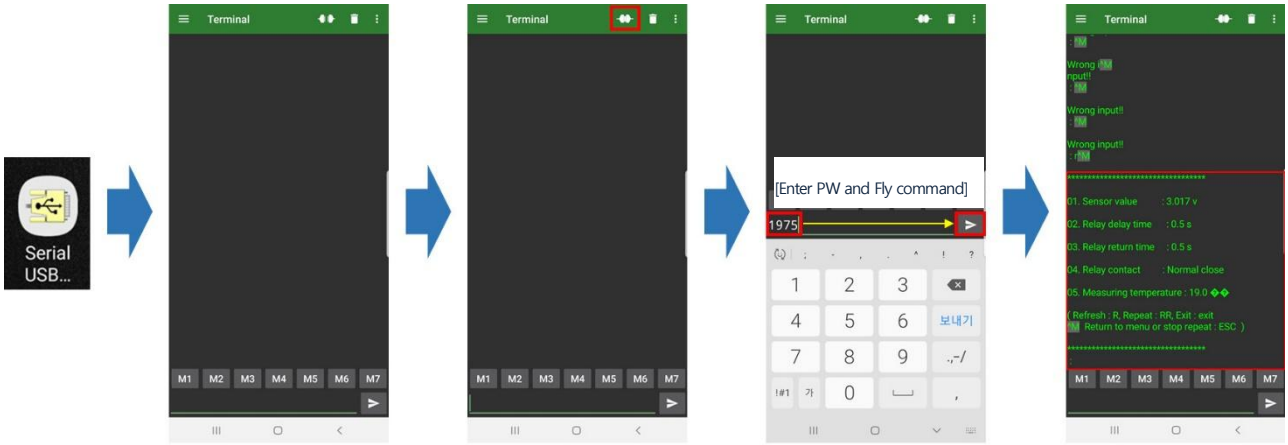
■ Monitoring Method Using Smartphone

☐ Component: Smartphone(Android OS), OTG, USB Cable(typical USB to Micro USB B), UART Adaptor..

☐ App: Refer to “Serial USB Terminal Install Guide”.

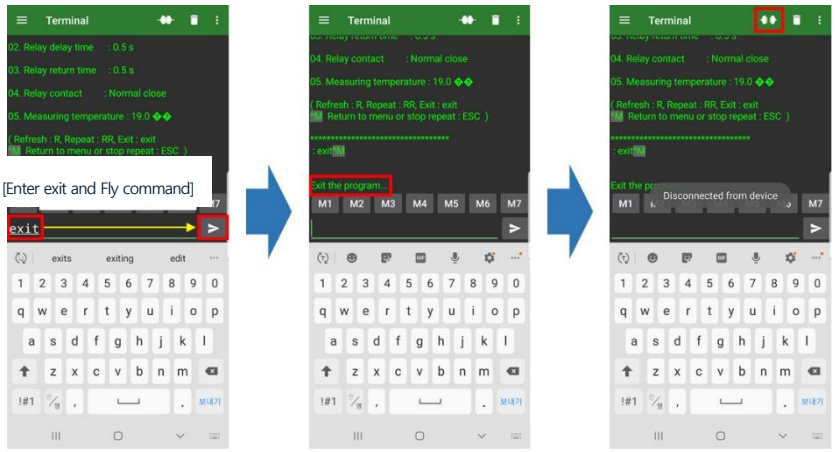


[M-96RFC Smartphone UART Component]



[Open App] [Home Screen] [Select UART Connection] [Enter Password] [Run Screen]

[M-96RFC Smartphone UART Execution]



[Enter exit command] [Exit Program] [Select UART Disconnection]

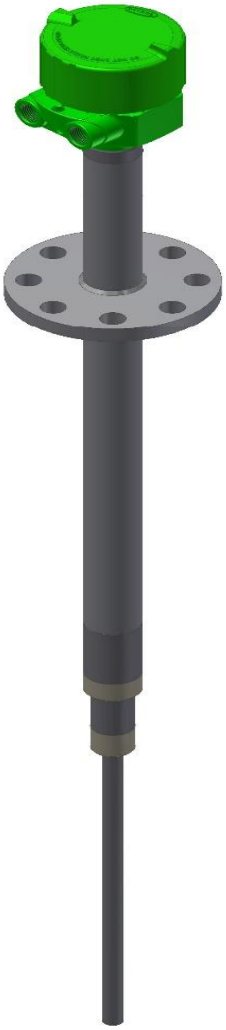
[M-96RFC Smartphone UART Exit]

APPENDIX S

HCC-96RF-S

Setting Guide

RF Admittance Type Level Switch



Doc. no. : Rev0.0

Issued Date : 2020.11.18

Always The Best Solution
HITROL CO., LTD.

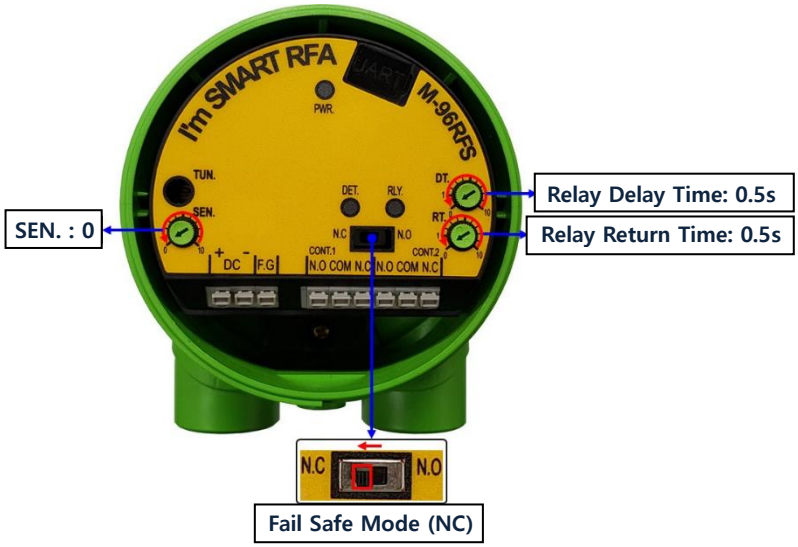
1. M-96RFS Configuration and Function

No	Configuration	Function
1	**TUN.**	■ Tuning Capacitance in the tank
2	**SEN.**	■ Sensitivity Adjustment
3	**DT.**	■ Relay Delay Time Adjustment ○ Time Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s
4	**RT.**	■ Relay Return Time Adjustment ○ Time Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s
5	**Fail Safe Mode**	■ Relay Transformation Adjustment ○ N.C ↔ N.O
6	**DET.**	■ Measurement Status LED ○ OFF → Red
7	**RLY.**	■ Relay Status LED ○ N.C: OFF → Green ○ N.O: Green → OFF
8	**PWR.**	■ Power & Status Display
9	**UART**	■ M-96RFS Status Setting and Status Communication Port
10	**Power**	■ Power Connector (AC / DC)
11	**Relay Out**	■ Relay Contact Out (DPDT)

2. M-96RFS Setting and Adjustment

■ Initialization Setting Method

☐ After installing it on the tank, set it to the initial state for quick response.



■ Tuning Setting

☐ Set the default capacitance value in the tank.

[Before tuning the cap trimmer] [After tuning the cap trimmer]

No	Function	Method
1	Frequency Tuning	■ Tune the cap trimmer for setting the default value.  ■ Adjust clockwise until *DET.* LED turns off.
2	If the sensing LED does not turn off (High capacitance in the tank)	■ Adjust SEN. VR slightly clockwise and then readjust the cap trimmer. 

■ Sensitivity Adjustment Method

☐ You can adjust measurement sensitivity for each environment.

[Before Adjusting *SEN.* VR] [After Adjusting *SEN.* VR (Insensitive)]

No	Function	Method
1	Tuning Setting Status	■ The *SEN.* VR state according to the "Tuning Setting" is the most sensitive state. ■ Keep this status for sensitive use.
2	Sensitivity Adjustment	■ You can adjust the sensitivity by adjusting *SEN.* VR. ■ Sensitivity Adjustment Method [SENSITIVE]  [INSENSITIVE]

■ Relay Time Adjustment Method

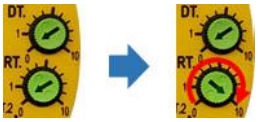
☐ You can adjust the relay operation time after detecting the measurement.

[Operating Status According to Relay Delay Time]

No	Function	Method
1	DT.	■ Relay Delay Time ■ Time Adjustment Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s 

☐ You can adjust the relay return time after undetecting the measurement.

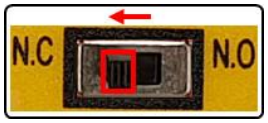
[Operating Status According to Relay Return Time]

No	Function	Method
1	RT.	■ Relay Return Time ■ Time Adjustment Range: 0.5s, 1s ~ 10s @ Adjustment 0.1s 

■ Fail Safe Mode Adjustment Method

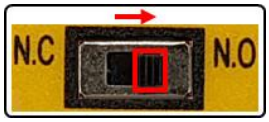
☐ You can adjust the contact status to Relay Contact N.C.

[Operating Status According to Relay Contact [N.C]]

No	Function	Method
1	N.C	■ Relay Contact Out Default Status  ■ After detecting the measurement, the contact point changes from N.C to N.O. ■ LED Status 

☐ You can adjust the contact status to Relay Contact N.O.

[Operating Status According to Relay Contact [N.O]]

No	Function	Method
1	N.O	■ Relay Contact Out Opposite Status.  ■ After detecting the measurement, the contact point changes from N.O to N.C. ■ LED Status 

3. M-96RFS UART Monitoring

■ Monitoring Method

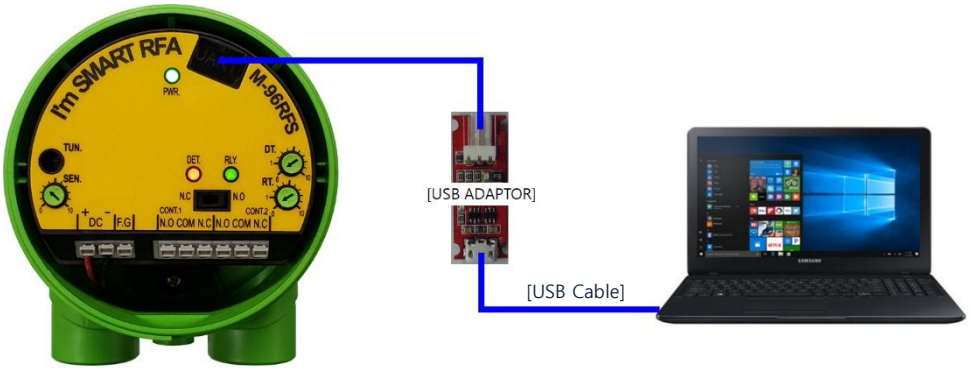
☐ You can only check the state of the adjusted setting values using PC or Smartphone.

☐ The execution method is the same using PC or Smartphone. (Password: 1975)

☐ Run Screen Component: You can check the sensor measurement status, sensitivity setting value, relay setting, etc.

■ Monitoring Method Using PC

☐ Component: PC, USB Cable(typical USB to Micro USB B), UART Adaptor..



[M-96RFS PC UART Component]

```
**********************************
01. Sensor value           : 3.300 v
02. Sensor adjust          : 1.280 v
03. Relay delay time       : 0.5 s
04. Relay return time      : 0.5 s
05. Relay contact          : Normal close
06. Measuring temperature  : 29.0 ℃
( Refresh : R, Repeat : RR, Exit : exit
  Return to menu or stop repeat : ESC  )
**********************************
 : 
```

[M-96RFS PC UART Run Screen]

```
**********************************
01. Sensor value           : 3.300 v
02. Sensor adjust          : 1.280 v
03. Relay delay time       : 0.5 s
04. Relay return time      : 0.5 s
05. Relay contact          : Normal close
06. Measuring temperature  : 29.0 ℃
( Refresh : R, Repeat : RR, Exit : exit
  Return to menu or stop repeat : ESC  )
**********************************
 : 
```

☐ Current Measurement Voltage

☐ Sensitivity Threshold Voltage

☐ Relay Delay Time Setup Time State

☐ Relay Return Time Setup Time State

☐ Relay Contact Status

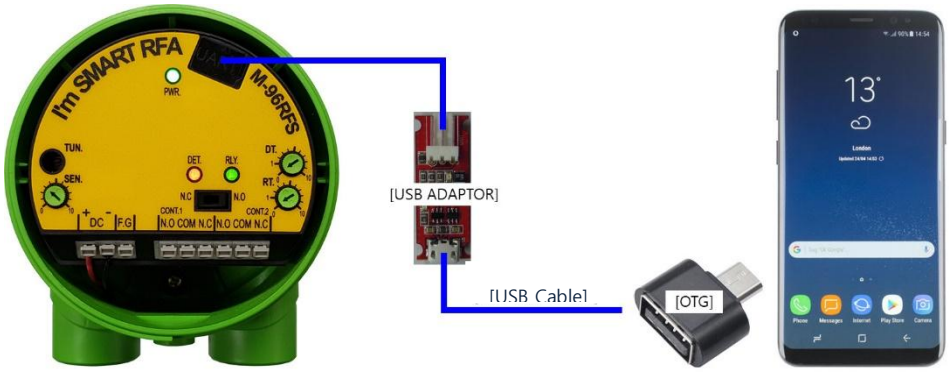
☐ Board Temperature

[M-96RFS PC UART Run Screen Component Function]

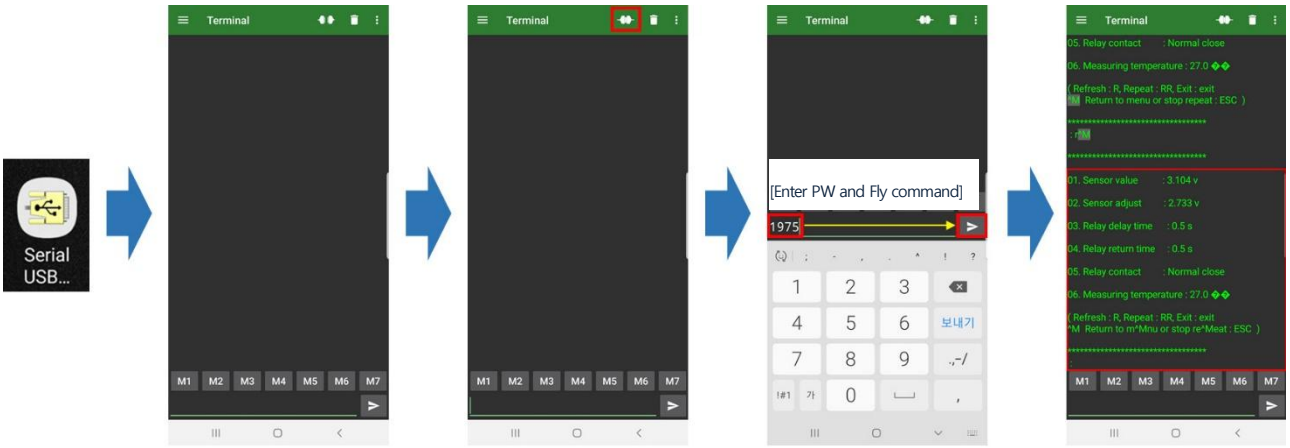
■ Monitoring Method Using Smartphone

☐ Component: Smartphone(Android OS), OTG, USB Cable(typical USB to Micro USB B), UART Adaptor.

☐ App: Refer to “Serial USB Terminal Install Guide”.

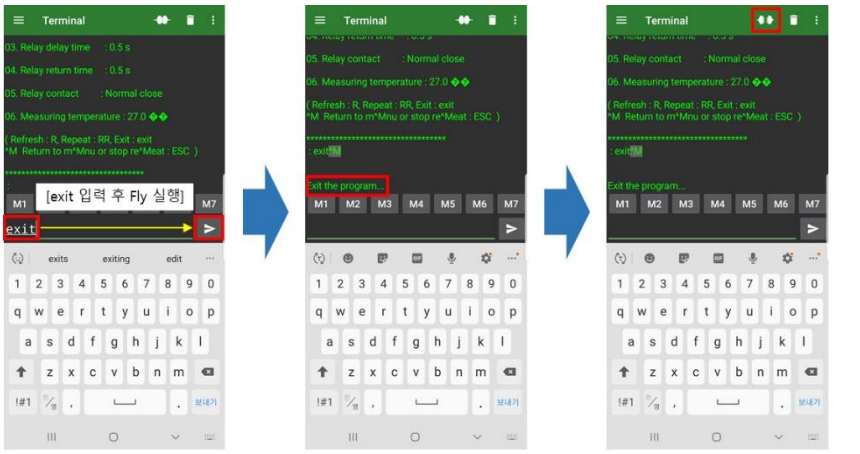


[M-96RFS Smartphone UART Component]



[Open App] [Home Screen] [Select UART Connection] [Enter Password] [Run Screen]

[M-96RFS Smartphone UART Execution]



[Enter exit command] [Exit Program] [Select UART Disconnection]

[M-96RFS Smartphone UART Exit]

APPENDIX H

Serial USB Terminal

Serial USB Terminal Install & Setting Guide

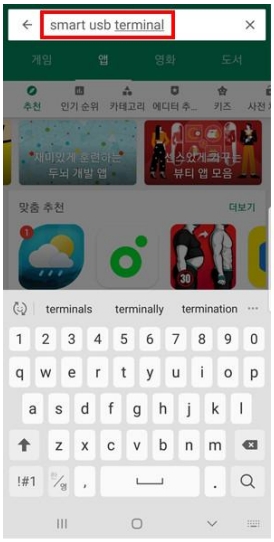
Application : Level Switch / Level Transmitter

Always The Best Solution
HITROL CO., LTD.

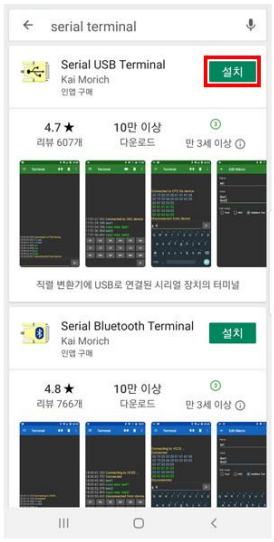
Doc. no. : Rev0.0
Issued Date : 2020.04.29

■ Installing Serial USB Terminal App

☐ Search and Install a App that "Serial USB terminal" in the App Store.



[Search]



[Install]

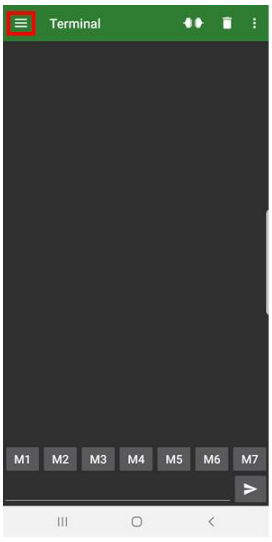
[Icon]

■ Serial USB Terminal Setting

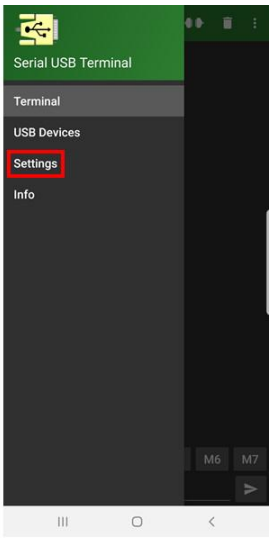
☐ Run The Serial USB Terminal Icon

☐ Four types of environments must be set up for normal operation of Serial USB Terminal.

- ▶ Serial
- ▶ Terminal
- ▶ Receive
- ▶ Send



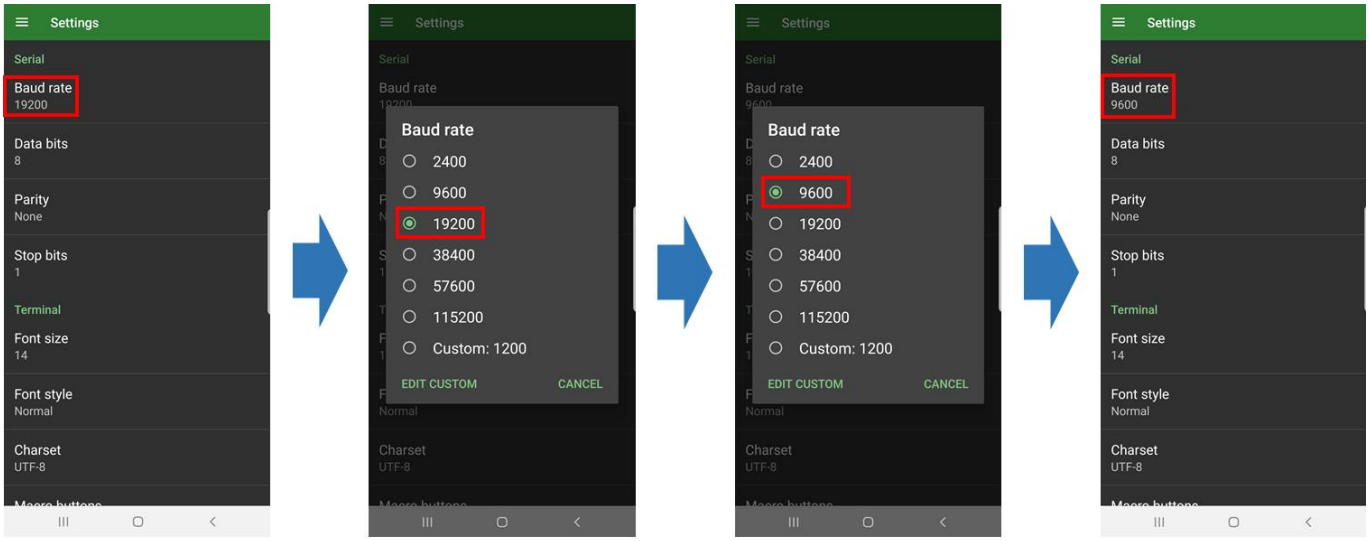
[Configuration]



[Setting]

■ Serial – Baud rate Setting

☐ **Baud rate : 19200 -> 9600**



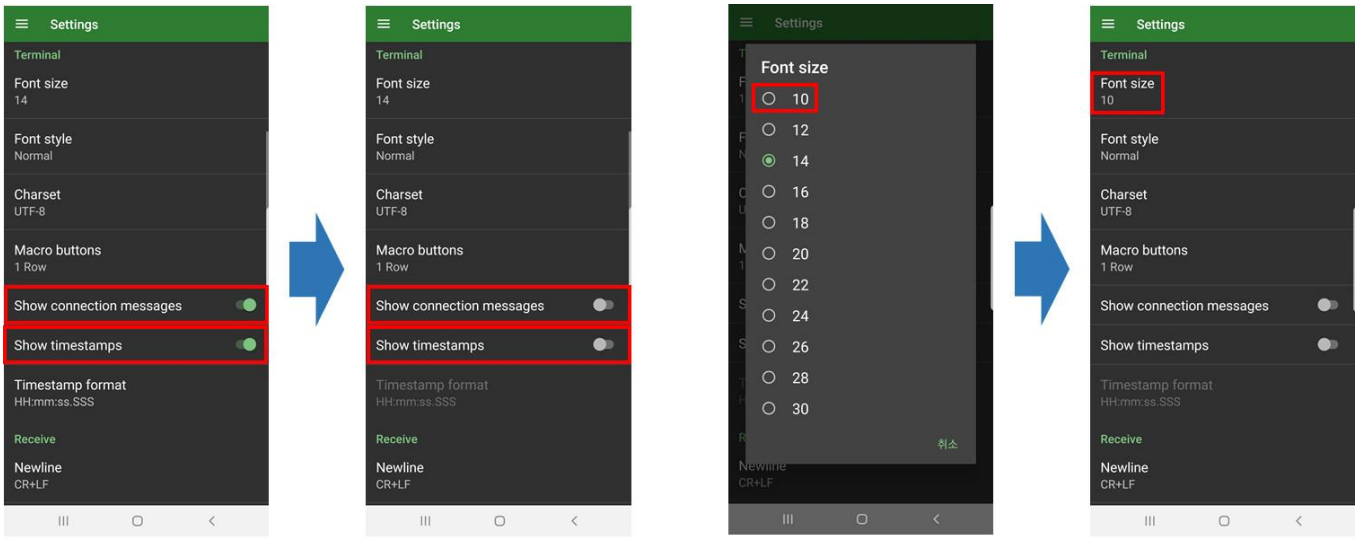
[Select Baud rate] [Default] [Setting] [Complete]

■ Terminal - Show connection message / Show timestamps Setting

☐ **Show connection message : ON -> OFF**

☐ **Show timestamps : ON -> OFF**

☐ **The size of the Terminal Font is the size set in the Smartphone.**

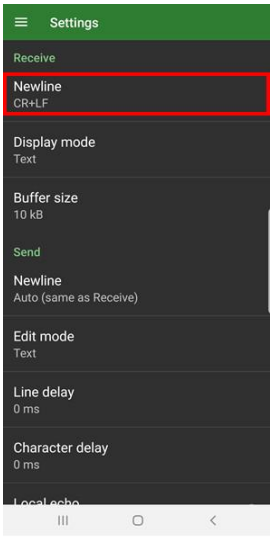


[Default] [Complete] [Terminal Setting]

[Default] [Complete] [Terminal Font Setting]

■ Receive – Newline Setting

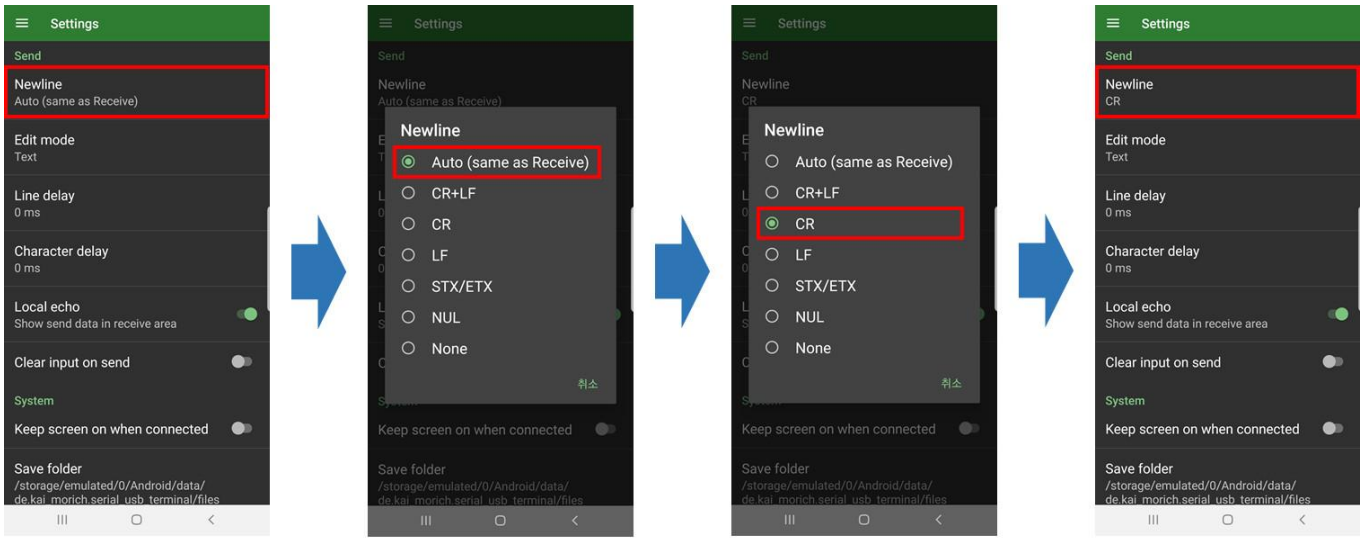
☐ Newline : CR+LF (Carriage Return + Line Feed) Check



[Default]

■ Send - Newline Setting

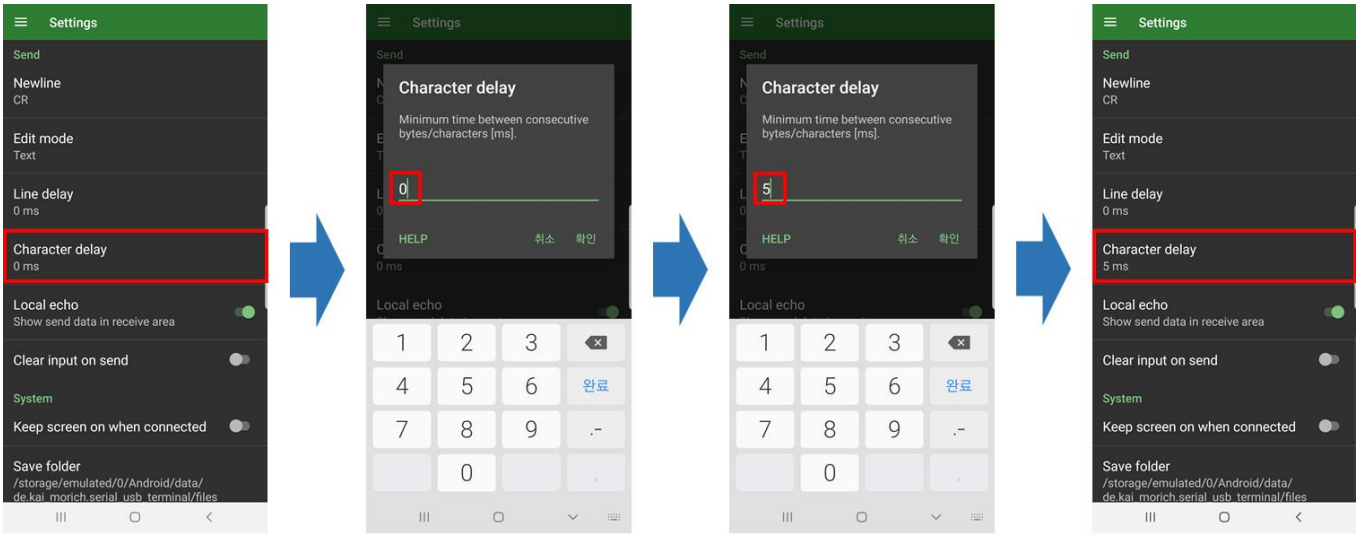
☐ Newline : Auto(same as Receive) -> CR



[Select Newline] [Default] [Setting] [Complete]

■ Send - Character delay Setting

☐ Character delay : 0ms -> 5ms

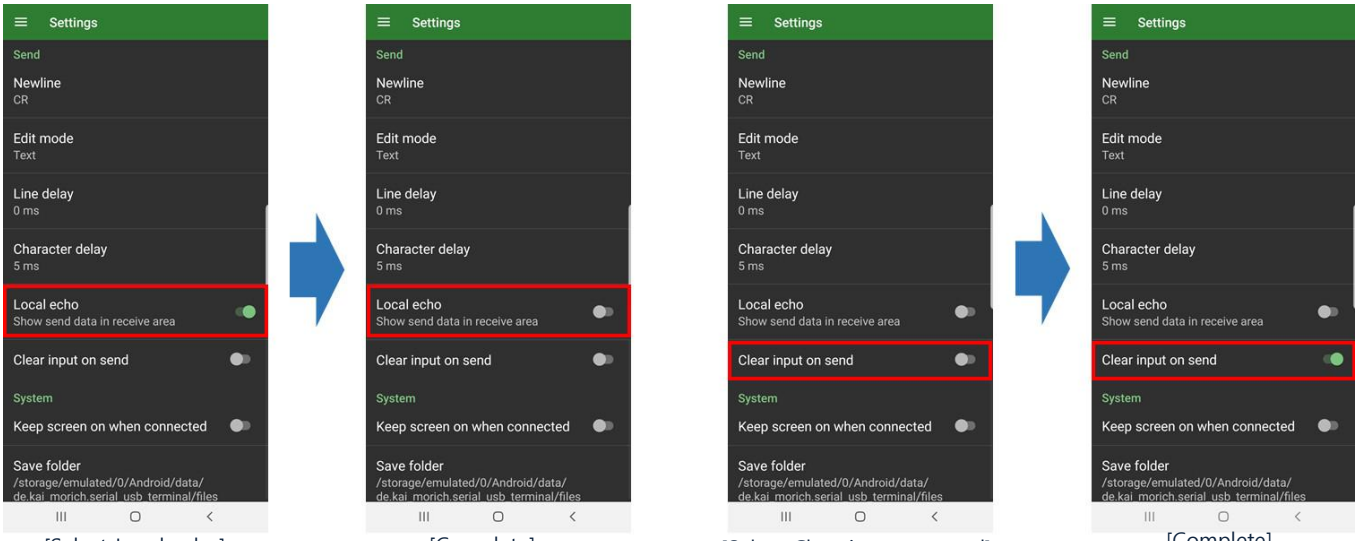


[Select Character delay] [Default] [Setting] [Complete]

■ Send – Local echo / Clear input on send Setting

☐ Local echo : ON -> OFF

☐ Clear input on send : OFF -> ON



[Select Local echo] [Complete] [Select Clear input on send] [Complete]

[Local echo Setting] [Clear input on send Setting]

※ For detailed instructions, refer to the manual of each product.