



KS A 9001/ISO 9001
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CAPACITANCE AUTO LEVEL SWITCH

Manual

MODEL SCAP SERIES



株式會社 瑞進인스텍

SEOJIN INSTECH CO.,LTD.

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1. 개요

Tank내의 측정물(분체, 액체, 고체)에 의해 발생하는 정전용량 변화를 측정하여 측정물의 유무를 검출하는 정전용량식 Auto Level Switch이다.

2. 특징

- Setting을 Auto로 설정한다.
- H/L Alarm 설정이 가능하다.
- 출력에 대한 Delay Time 설정이 가능하다.
- 출력에 대한 표시기능(Relay 출력, Error Code 출력)
- 미소한 정전용량 측정 가능(1 pF 변화에도 감지)
- Flow Switch 용도로 사용 가능함(SCAP-6)
- 현장에서 Probe 길이 조성이 가능함.
(SCAP-4A1B, 4A2B에 한함)
- 각종 액체, 분체, 입체, 고체, 서로 다른 두 액체의 계면, 철강, 석탄, 식품, 의약품, 석유화학, 화학, 액체중의 침전물의 측정에 사용된다.
- Probe는 기계적인 가동 부분이 없고 단순한 구조로서 설치, 보수가 쉬울뿐만 아니라 수명이 길다.
- 용도에 따라서 다양한 Probe가 준비되어 있고, 고온, 저온, 고압, 저압, 진공, 부식성이 있는 물질등 특수 조건의 Level 측정에도 완벽하게 동작한다.

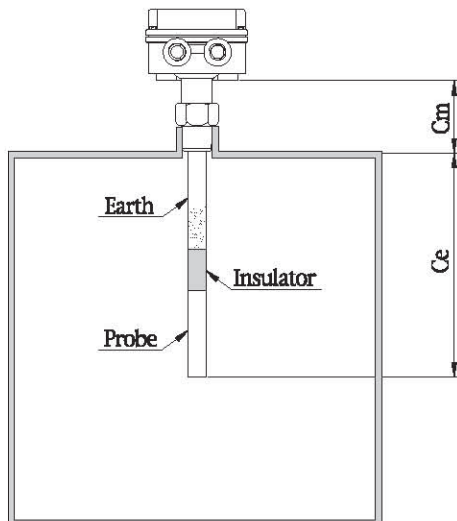
3. 원리

도체 사이에는 정전용량이 발생되는데 Probe 길이(L)와 ϵ_r 인 비유전율에 의해 정전용량 C 값이 변하게 된다. 정전용량식 Level Switch는 이러한 정전용량의 변화를 감지하여 짐점을 출력해준다.

정전용량은 원통형의 Tank의 경우

$$C = \frac{\epsilon_r \cdot 24 \cdot L}{\log \frac{D}{d}} \text{ 로 구할 수 있다}$$

- C : 정전용량[pF] (C=Ce + Cm)
- ϵ_r : 비유전율
- L : Probe 길이
- D : 내부 Tank 직경
- d : Probe 직경



1. Introduction

This level switch uses capacitance to detect the level of liquid, powder or other solids.

2. Features

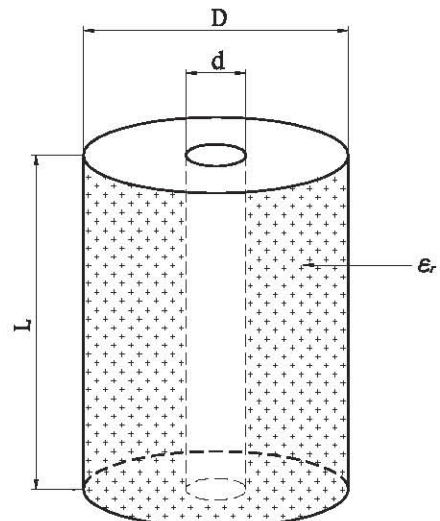
- Automatic setting.
- High/Low Alarm setting.
- Delay time adjustment.
- Displays output(including relay and error code).
- Capable of detecting very small changes in level.
- Can be used as a flow switch.
- The probe length can be adjusted in the field.
- Can be used to detect the levels of various liquids, powder, granular materials and lumpy solid. Can also be used for detection of the boundary between two dissimilar liquids or the level of precipitates in a liquid tank.
- No moving part, simple installation and long life.
- A variety of probes are available for applications in : high and low pressures, vacuum and corrosive materials.

3. Principle

Capacitance is induced between two conductors as a function of the dielectric coefficient of the material and the geometry of the container. For the case of a cylindrical tank shown below, the following equation expresses the capacitance as a function of the geometry formed by the probe and the tank

$$\text{Formula : } C = \frac{\epsilon_r \cdot 24 \cdot L}{\log \frac{D}{d}}$$

- C : Capacitance [pF] (C=Ce + Cm)
- ϵ_r : Dielectric Coefficient
- L : Probe Length
- D : Inside Tank Diameter
- d : Probe Diameter



4. 사양 (Specification)

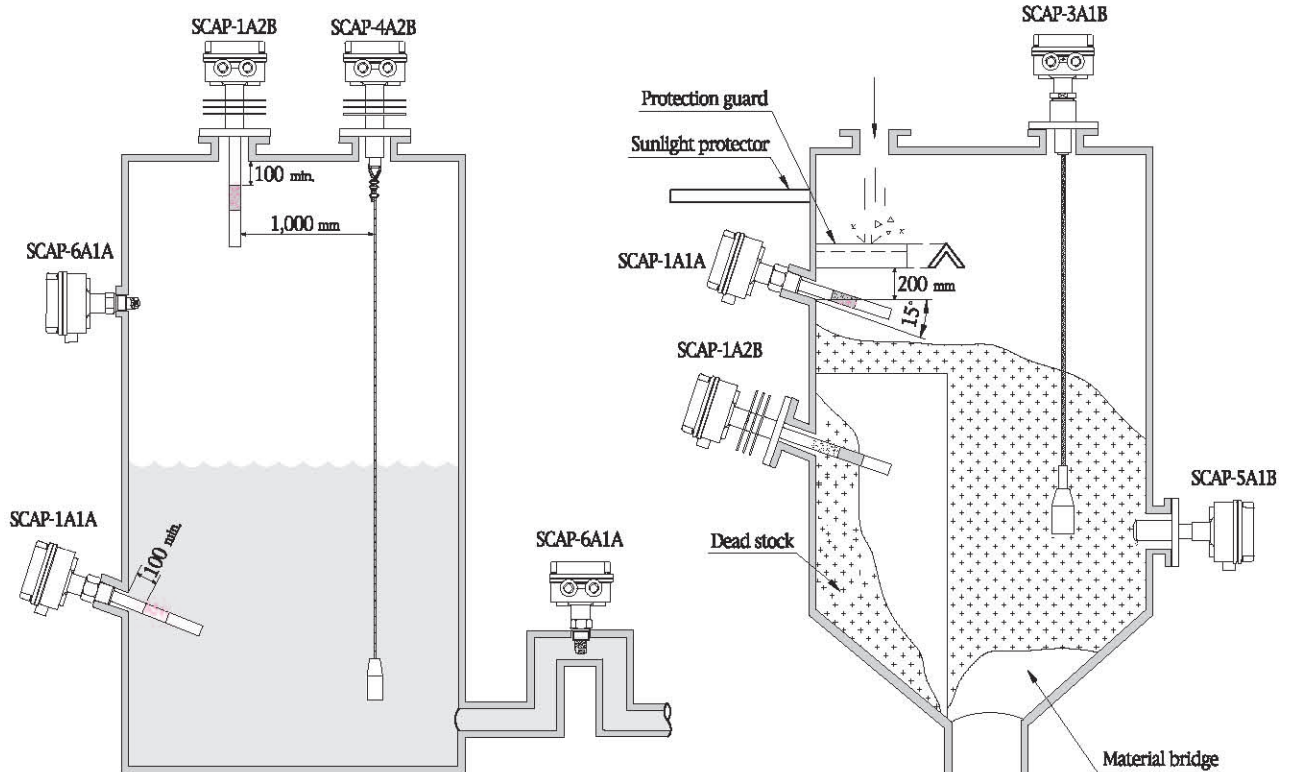
구분(Description)	형식(Type)	SCAP - 1	SCAP - 2	SCAP - 3	SCAP - 4	SCAP - 5	SCAP - 6	
측정 대상 Application		분체, 액체, 고체 Powder, Liquid, Solid	분체, 액체 Powder, Liquid	분체 Powder	액체 Liquid	분체, 액체 Powder, Liquid	액체 Liquid	
측정 길이 Measuring Length		250 ~ 500mm	300 ~ 4,000mm	300 ~ 4,000mm	300 ~ 5,000mm	63mm	20 ~ 100mm	
감출 감도 Sensitivity		1 ~ 1,000pF						
출력 신호 Output Contact		5A, 250V AC (2 SPST)						
진동수 Frequency		35 ~ 40KHz						
기능 Function		Auto Calibration (H/L Setting, Data Backup), H/L Alarm Set, Delay Time (0.5 ~ 10 Sec.)						
표시 Display		Relay 출력표시용 적색LED, Calibration or Error 표시용 녹색 LED Red LED displaying relay contact, Green LED displaying Calibration or Error						
온도 Temp.	본체부 Electronics	0 ~ +60°C						
	검출부 Probe	-40 ~ +150°C					-40 ~ +150°C	-40 ~ +80°C
허용 압력 Operating Pressure		10kgf/cm ² Max.						
검출부 하중 Lateral Load		20kg	40kg	60kg	30kg	60kg	20kg	
전원 Power Supply		110/220V AC ± 10%, 50/60Hz						
재질 Material	본체부 Electronics	ADC 12						
	검출부 Probe	SUS 304, SUS 316, PTFE(UHMW - PE)						
구조 Enclosure		본체부 : 방적구조(IP54), 검출부 : 방수구조(IP67) Electronics : Dust Proof(IP54), Probe : Weather Proof(IP67)						
취부 방법 Mounting		PT 1" Nipple, JIS 5K 65A Flange	JIS 5K 65A Flange(Option for Other)				PT 1" Nipple	
전선구 Cable Gland		PF 1/2" & PF 3/4" (std.), PT 1/2" & PT 3/4"						

5. 설 치 방 법

- 1) 측면 설치시 대관을 이용하여 설치하는 경우에는 Insulator가 Tank의 내부로 100mm 이상 노출되어야 하며, Probe를 수평면에 대해 15° 정도 기울여 설치할 것(대관과 Probe 사이에 이물질 고임에 의한 오동작을 일으킬 수 있음).
- 2) Wire Type의 경우 측정물이 빠질 때 Wire 전체에 큰 장력이 걸리기 때문에 비중이 무거운 경우 견딜 수 있는지 하중계산 및 당사와 상담.
- 3) High Level에 설치할 경우 안식가를 고려해서 설치할 것.
- 4) Low Level에 설치 할 경우 Dead Stock, Material Bridge에 주의하여 설치할 것.
- 5) Probe가 Tank의 내관이나 벽에 접촉하지 않게 설치할 것.
- 6) 화학 Tank, 부식성이 강한 측정물에서는 Probe를 PTFE Tubing을 할 것(Wire Type 또는 Nipple Type은 Tubing 불가능함).
- 7) 측면 설치시 Probe에 가해지는 하중이 제품시양보다 무거운 경우 보호 Guard를 설치할 것.
- 8) 과체의 낙하장소에는 설치하지 말 것 (Probe 파손우려가 있으므로 필요에 따라 Guard를 설치할 것).
- 9) 옥외 사용시에는 온도 상승에 의한 영향을 피하기 위하여 직사광선에 직접적인 영향을 받지 않도록 Cover를 설치할 것.
- 10) 비유전율이 작을 때는 Probe 지름을 크게 하거나, 표면적을 넓게 할 것(Maker 상담).
- 11) Tank내부에서 발생하는 온도 및 압력이 제품시양에 맞는지 확인할 것.
- 12) 2개 이상의 Sensor를 설치 할 때는 Sensor의 설치 간격을 1m 이내에 접근시켜 사용하지 않도록 하고, 긴 Wire Type은 1/10 만큼 간격을 둘 것.

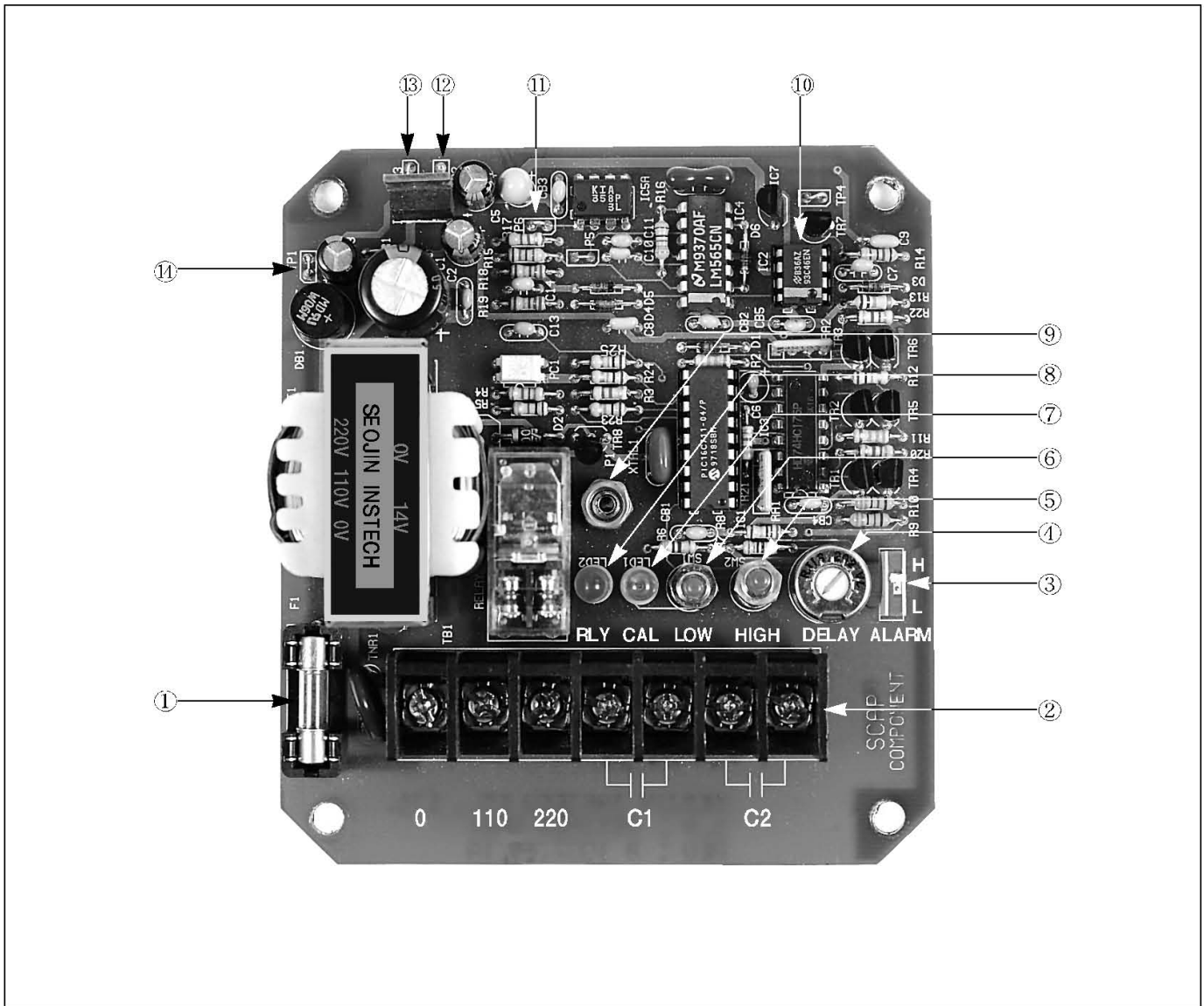
5. Installation

- 1) When a switch is mounted horizontally on a tank wall through a nozzle, the probe should be tilted down by about 15 degrees and the insulated part of the sensor inserted at least 100mm from the wall in order to prevent malfunctions due to the material that can be trapped between the probe and the nozzle.
- 2) When a wire probe is used inside a high density material, tension load on the wire induced during the down flow must be checked in order to prevent probe breakage due to overloading.
- 3) When the probe is to be used for High Level indication of a powder or granular material, the repose angle of the material must be taken into account for proper operation of the probe.
- 4) When the probe is to be used for Low Level indication of a powder or granular material, take steps to properly handle dead stock and material bridging.
- 5) Mount the probe in such a way that it does not touch the tank wall or the nozzle.
- 6) Use PTFE tubing probes in tanks of chemicals and corrosive materials(PTFE tubing is not available for Wire and Nipple type probes).
- 7) For side mounting, use a Protection Guard to prevent overloading of the probe.
- 8) Do not mount the probe within the region of lumpy solid materials to avoid probe damage(A Protection Guard may be used if necessary).
- 9) For outdoor installation, mount the unit away from direct sunlight or use a sun shade.
- 10) In materials of low dielectric coefficients, use a larger diameter probe or increase the surface area(Consult the manufacturer).
- 11) Confirm that the operating temperature and pressure inside the tank are within the specified range of the probe.
- 12) When more than two probes are used in a tank, the probes should be separated by more than 1 m, and the long wire probes should be separated by more than 1/10 of its length.



6. 조 정 방 법 (Setup Procedure)

6-1. Board 내부의 명칭 (Part Names Circuit Board)



- | | |
|---------------------------------|--|
| ① 퓨즈 : AC 250V, 50mA | ① Fuse : 50mA, 250V AC |
| ② 단자대 : 전원, 점점출력 | ② Terminal : For power supply and relay contact |
| ③ H/L 설정 Switch : High/Low 선택 | ③ H/L adjustment Switch : Fail Safe |
| ④ Delay Time 조정 : 0.5 ~ 10초 | ④ Delay Time adjustment : 0.5 ~ 10 Seconds |
| ⑤ High Setting Key : 측정물이 있는 상태 | ⑤ High Setting Key : With measuring material |
| ⑥ Low Setting Key : 측정물이 없는 상태 | ⑥ Low Setting Key : Without measuring material |
| ⑦ Setting 또는 고장 표시 녹색 LED | ⑦ Green LED displaying set or error code |
| ⑧ 점점출력 표시 적색 LED | ⑧ Red LED displaying output contact |
| ⑨ 비나나 플러그 : Probe 연결부 측정물 감지 | ⑨ Plug : Connecting to probe and sensing material. |
| ⑩ EEPROM : Data Back-up | ⑩ EEPROM : Data Back-up |
| ⑪ TP6 : A/D 입력 전압 | ⑪ TP6 : A/D input voltage |
| ⑫ TP2 : DC +5V | ⑫ TP2 : +5V DC |
| ⑬ TP3 : DC +14V | ⑬ TP3 : +14V DC |
| ⑭ TP1 : GND | ⑭ TP1 : GND |

6-2. Setting Low Level

- 1) 측정물이 Probe에 닿지 않은 상태에서 Low Key(⑥)를 눌렀다 놓으면 녹색 LED가 켜지며, Setting이 끝나면 녹색 LED는 꺼진다.
- 2) Error가 발생되는지 확인한다(Error 1,2 번이 발생되면 High Setting을 다시 한다).

6-3. Setting High level

- 1) 측정물이 Probe에 닿게 한 상태에서 High Key(⑤)를 눌렀다 놓으면 녹색 LED가 켜지며, Setting이 끝나면 녹색 LED는 꺼진다.
- 2) Error가 발생되는지 확인한다(Error 1,2 번이 발생되면 Low Setting을 다시 한다).

6-4. High/Low Alarm Setting(③)

- 1) Low Alarm의 선택 : H/L Alarm 선택 Switch를 아래로 (↓) 내려 "L" 위치에 놓는다.
- 2) High Alarm의 선택 : H/L Alarm 선택 Switch를 위로 (↑) 올리 "H" 위치에 놓는다.
- 3) 제품 출고시 High Alarm으로 설정되어 공급된다.

구 분	측 정 물	Relay	적색LED
High Alarm	접촉 됨	Close	On
	접촉되지 않음	Open	Off
Low Alarm	접촉 됨	Open	Off
	접촉되지 않음	Close	On

H/L Alarm의 설정과 출력표

6-5. Delay Time 조정(④)

- 1) 가변저항을 반시계 방향으로 돌릴 경우 지연 시간이 감소하고 시계 방향으로 돌릴 경우 지연 시간이 증가된다 (최소 0.5초, 최대 10초).
- 2) 지연 시간에 대한 확인은 측정물을 변화시키면서 확인할 것(제품 출고시 3초로 설정하여 공급 됨).

7. 결 선 방 법

7-1. 전원 결선

- 1) 0, 110 단자 이용(AC 110V 사용시)
- 2) 0, 220 단자 이용(AC 220V 사용시)

7-2. Relay 출력 연결

Relay C1, C2의 접점 용량은 AC 250V, 5A이며 이 용량 값보다 큰 용량을 사용하고자 할 경우에는 용량이 큰 외부 Relay를 연결해서 사용할 것.

6-2. Setting Low Level

- 1) The Low Level is set by pushing and releasing the LOW key while the probe is not in contact with the material. The green LED light will come on and turn itself off when the setting is completed.
- 2) If an error is indicated by blinking green light, repeat the High Level setup.

6-3. Setting High level

- 1) Bring the material level up so that the probe is in contact with the material. The High Level is set by pushing and releasing the HIGH key. The green LED Light will come on and turn itself off when the setting is completed.
- 2) If an error is indicated by blinking green light, repeat the High Level setup.

6-4. High/Low Alarm Setting

- 1) To set Low Level Alarm : Set the Alarm Switch to [L] position.
- 2) To set High Level Alarm : Set the Alarm Switch to [H] position.
(The switch is set in [H] position at the factory.)

Description	Material	Relay	Red LED
High Alarm	in Contact	Closed	On
	Not in Contact	Open	Off
Low Alarm	in Contact	Open	Off
	Not in Contact	Closed	On

Replay and LED output for Alarms.

6-5. Delay Time Adjustment

- 1) Delay time can be adjusted between 0.5 and 10 seconds by turning the variable resistor with a screw driver. Clockwise turn increases the delay time.
- 2) Delay time setting should be checked against the varying levels of the material(The timer is set for 3 seconds at the factory).

7. Wiring

7-1. Wiring for Power Supply

- 1) For 110V AC, use terminals 0 and 110.
- 2) For 220V AC, use terminals 0 and 220.

7-2. Relay contact Rating

Relay contacts C1 and C2 are rated for 5A at 250V AC. For larger loads, a larger external relay should be used.

8. A/S전 점검사항

8-1. Switch가 항상 동작해 있을 경우

- 1) 측정물에 의한 영향(환경변화, 부식, 점착, 단락등)
Build-up, Probe기 대관 또는 Tank에 점착, Dead Stock, Material Bridge등에 영향을 받고 있을 때는 장소나 설치 위치를 옮긴다.
- 2) Setting값이 잘못 입력 되었을 경우 Error가 발생된다 (Low/High Setting을 다시 한다).

8-2. Switch가 동작하지 않을 경우

- 1) Material Bridge, 안식 각 등의 영향 확인 (설치 위치 옮김).
- 2) Power AC 110/220V, 50/60Hz 공급 여부 확인 할 것 (Fuse 정상 유무 확인).
- 3) Relay 점접 출력 확인 (점접 출력 표시 적색LED ON, OFF 확인).
- 4) Low 설정 Key를 누른 후 TP6 Test Pin에 DC 0.7~4V로 단계적인 전압 변화가 발생되지 않으면 Board 불량.
- 5) 전원 공급이 되고 있는지 확인 (TP2 : DC +5V, TP3 : DC +14V).
- 6) High/Low Setting을 다시 한번 실시하여 동작 유무 확인 할 것.

8-3. Error Code 발생시

- Error 1 a) 녹색 LED가 깜박거림이 1번 반복됨
b) Low 측정값이 High 측정값 보다 클때 발생
c) Low/High Setting을 다시 한다.
- Error 2 a) 녹색 LED가 깜박거림이 2번 반복됨
b) Low 측정값과 High 측정값이 같을때 발생
c) Probe가 Tank 또는 대관에 점착 확인.
d) Probe에 Build-up 상태 확인.
e) Low/High Setting을 다시 한다.
- Error 3 a) 녹색 LED가 깜박거림이 3번 반복됨
b) CPU에 입력되는 A/D 전압이 DC 0.5V 이하로 입력될 때 발생(TP6 Test Pin 확인).
c) Hardware적인 Error이므로 본사로 제품을 이송 할 것.
- Error 4 a) 녹색 LED가 깜박거림이 4번 반복됨
b) CPU에 입력되는 A/D 전압이 DC 4.1V 이상 입력될 때 발생(TP6 Test Pin 확인).
c) Hardware적인 Error이므로 본사로 제품을 이송 할 것.
- Error 5 a) 녹색 LED가 깜박거림이 5번 반복됨
b) EEPROM IC 불량.
c) EEPROM 교체한 후 다시 High/Low Setting을 한다.

9. 취급시 주의사항

- 1) 전원 연결시 정확히 단자대에 연결 할 것.
- 2) 제품 운반시 Sensor 및 내부회로가 파손되는 경우가 있으므로 주의 할 것.
- 3) 임의로 내부 Switch나 가변저항을 조작하지 말 것.
- 4) Sensor부를 분해하지 말 것.
- 5) 진자 회로가 있는 Head 내부에 먼지나 습기가 유입되면 오동작을 할 수 있으므로 주의 할 것.

8. Check Before Servicing

8-1. If the switch is always engaged

- 1) If there is a material buildup between the probe and the tank or nozzle due a change in the environment, corrosion, stickiness, dead stock or material bridging, the problem can be corrected by cleaning the affected area or relocating the probe.
- 2) It may be due to improperly set High or Low Level Alarm. Reset the alarm levels.

8-2. If the switch does not operate

- 1) If material bridging or the repose angle is causing the problem, the probe should be relocated.
- 2) Check to make sure that the power is on.
- 3) Check the output of relay contacts. The output can be confirmed by the red LED lamp.
- 4) If there is no stepwise increase between 0.7~4V DC at TP6 Test Pin when Low Level Setting Key is depressed, the circuit board may be faulty.
- 5) Check DC power supply : +5V DC @TP2 ; +14V DC @TP3.
- 6) Check again to confirm that the Low and High levels are set properly.

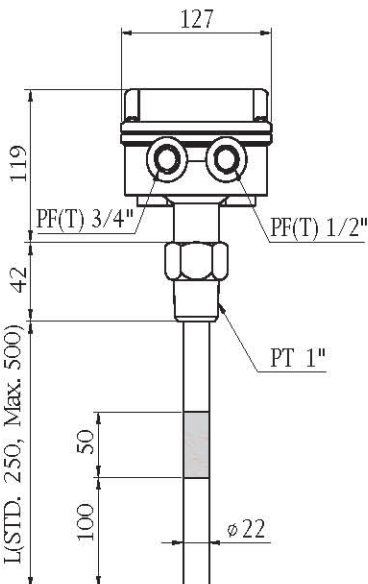
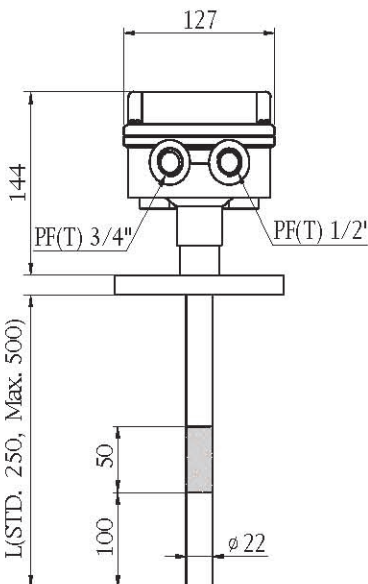
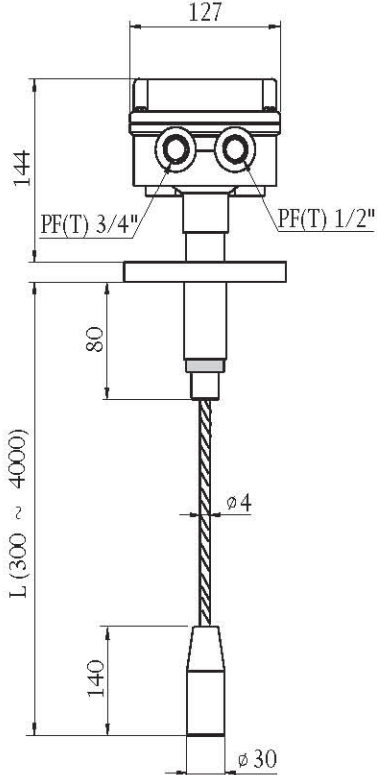
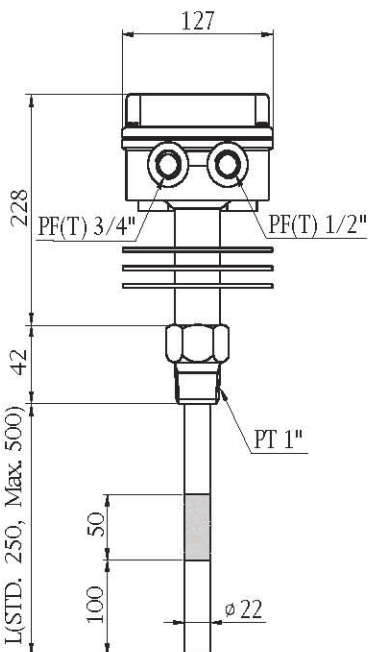
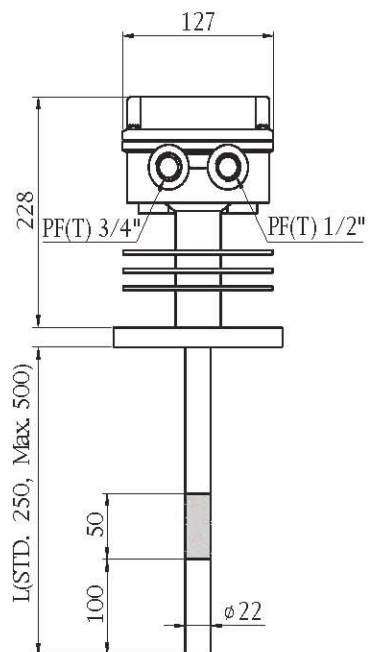
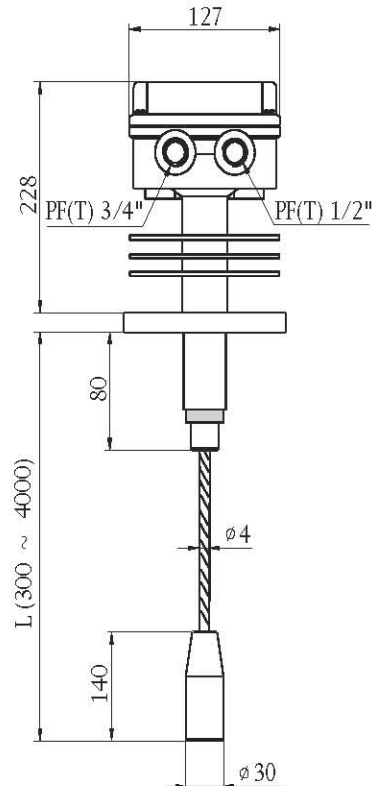
8-3. Explanation of Error Code, Cause and Corrective Action

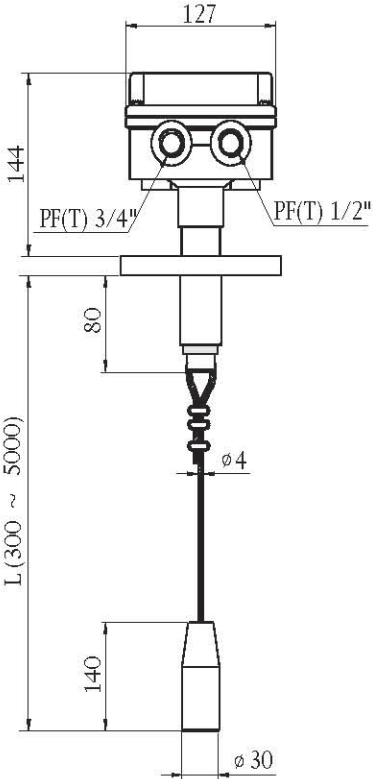
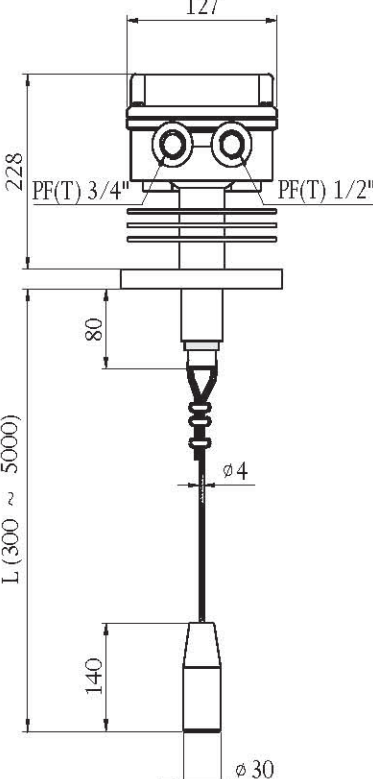
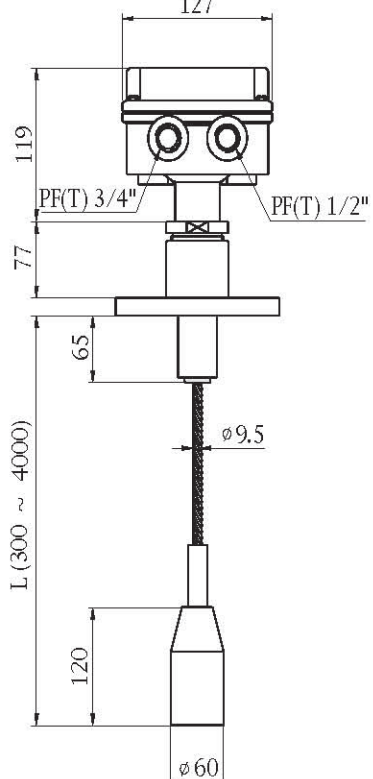
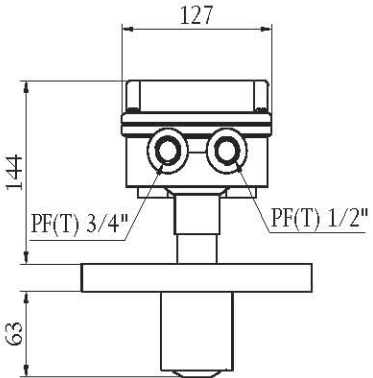
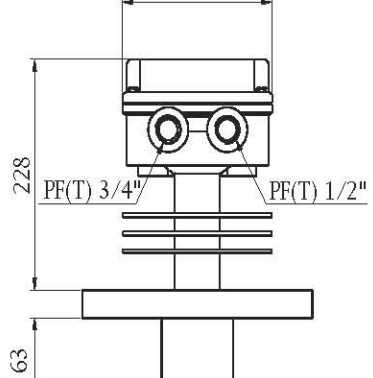
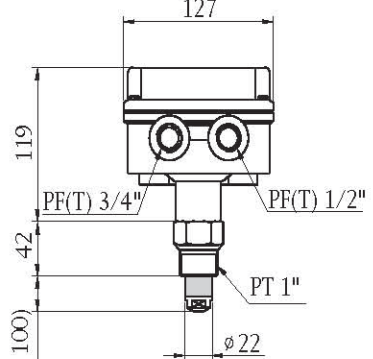
Error Indicated by Green LED Lamp	Cause	Corrective Action
Blinks once and repeats.	Low level is set higher than High level	Reset High and Low levels
Blinks twice and repeats.	Low level may be set as high as High level	Check to see that the probe is not in contact with the tank or the nozzle
Blinks 3 times and repeats.	This condition occurs when the power to CPU falls below 0.5V DC @TP6 Test Pin.	Send the unit back to the manufacturer.
Blinks 4 times and repeats.	This condition occurs when the power to CPU is greater than 4.1 V DC @TP6 Test Pin.	Send the unit back to the manufacturer.
Blinks 5 times and repeats.	This is caused by a faulty EEPROM IC.	Replace EEPROM, and reset High/Low alarms.

9. Precaution

- 1) Make certain that the power is connected to the proper terminals.
- 2) Avoid shock and vibration of the sensor and the circuit board during transport to prevent damages to the hardware.
- 3) Do not arbitrarily change switch positions or reset the variable resistor.
- 4) Do not disassemble the sensor.
- 5) Protect the instrument head to prevent malfunction due to dust and moisture.

10. 외 형 치 수 (Overall Dimensions)

SCAP - 1A1A	SCAP - 1A1B	SCAP - 2A1B
 <p>127</p> <p>119</p> <p>PF(T) 3/4"</p> <p>PF(T) 1/2"</p> <p>PT 1"</p> <p>L (STD. 250, Max. 500)</p> <p>50</p> <p>100</p> <p>$\phi 22$</p>	 <p>127</p> <p>144</p> <p>PF(T) 3/4"</p> <p>PF(T) 1/2"</p> <p>L (STD. 250, Max. 500)</p> <p>50</p> <p>100</p> <p>$\phi 22$</p>	 <p>127</p> <p>144</p> <p>PF(T) 3/4"</p> <p>PF(T) 1/2"</p> <p>80</p> <p>L (300 ~ 4000)</p> <p>$\phi 4$</p> <p>140</p> <p>$\phi 30$</p>
SCAP - 1A2A	SCAP - 1A2B	SCAP - 2A2B
 <p>127</p> <p>228</p> <p>PF(T) 3/4"</p> <p>PF(T) 1/2"</p> <p>PT 1"</p> <p>L (STD. 250, Max. 500)</p> <p>50</p> <p>100</p> <p>$\phi 22$</p>	 <p>127</p> <p>228</p> <p>PF(T) 3/4"</p> <p>PF(T) 1/2"</p> <p>L (STD. 250, Max. 500)</p> <p>50</p> <p>100</p> <p>$\phi 22$</p>	 <p>127</p> <p>228</p> <p>PF(T) 3/4"</p> <p>PF(T) 1/2"</p> <p>80</p> <p>L (300 ~ 4000)</p> <p>$\phi 4$</p> <p>140</p> <p>$\phi 30$</p>

SCAP - 4A1B	SCAP - 4A2B	SCAP - 3A1B
 <p>Technical drawing of SCAP - 4A1B level switch. Dimensions include: top width 127, total height 144, distance from top to mounting flange 80, cable diameter $\phi 4$, and bottom diameter $\phi 30$. Ports are labeled PF(T) 3/4" and PF(T) 1/2". Total length is L (300 ~ 5000).</p>	 <p>Technical drawing of SCAP - 4A2B level switch. Dimensions include: top width 127, total height 228, distance from top to mounting flange 80, cable diameter $\phi 4$, and bottom diameter $\phi 30$. Ports are labeled PF(T) 3/4" and PF(T) 1/2". Total length is L (300 ~ 5000).</p>	 <p>Technical drawing of SCAP - 3A1B level switch. Dimensions include: top width 127, total height 119, distance from top to mounting flange 77, distance from mounting flange to cable start 65, cable diameter $\phi 9.5$, and bottom diameter $\phi 60$. Ports are labeled PF(T) 3/4" and PF(T) 1/2". Total length is L (300 ~ 4000).</p>
SCAP - 5A1B	SCAP - 5A2B	SCAP - 6A1A
 <p>Technical drawing of SCAP - 5A1B level switch. Dimensions include: top width 127, total height 144, and distance from top to mounting flange 63. Ports are labeled PF(T) 3/4" and PF(T) 1/2".</p>	 <p>Technical drawing of SCAP - 5A2B level switch. Dimensions include: top width 127, total height 228, and distance from top to mounting flange 63. Ports are labeled PF(T) 3/4" and PF(T) 1/2".</p>	 <p>Technical drawing of SCAP - 6A1A level switch. Dimensions include: top width 127, total height 119, distance from top to mounting flange 42, and bottom diameter $\phi 22$. Ports are labeled PF(T) 3/4", PF(T) 1/2", and PT 1". Total length is (STD. 20, MAX. 100).</p>