Smart Fault Indicator System

Specification & User Manual

(TYPE : FI-2001-VI, SFI (12) MODEL)

EMT CO., LTD.

TEL +82 31 491 8488 **FAX** +82 31 491 8428

emthan@hanmail.net //emt.co.kr@gmail.com

1. Introduction
- EMT Smart Fault Indicator (12)

EMT's Smart Fault Indicator system (SFI-12 model) is a useful and reliable electrical equipment to find out fault location on the overhead distribution lines. SFI (12) System is the intelligent system for the user to manage the power distribution network efficiently, and to detect, indicate any faults (**Transient fault**, **Permanent fault / Phase to Phase**, **Ground Fault**) on the distribution network and report it to the user swiftly.

Furthermore, SFI(12) can be monitored **Load Current** in SCADA system, and **monitored / controlled / programed by mobile phone**
(※ SFI(12) system is fully functional when SFI(12) indicators and RSUⅡ are installed together.)

Fault Trigger, Load Current Monitoring by SCADA system

Phase ,Ground Fault detection

Fault Trigger monitoring By mobile phone

< EMT SFI (1+2) MODEL with RSU Ⅱ >

2. Specification

2.1. General Specification
- Rating voltage : 3 ~ 76 kV
- Rating current : up to 1000 A
- Rating frequency : 50 / 60 Hz
- Fault detection : Phase to phase / phase to ground fault indication
- Effective communication range with RSUⅡ : ≤ 100m
- ❖ *Inrush restraint / Automatic Fault triggering current pick up Automatic algorithm integrated (di/dt, Io, restrained)*

2.2. LED Indication
- Different flashing indication for Transient / Permanent fault / Reclosing Progressing / Ready / Sleep Mode / Wake-up Mode
  - **White LED flashing (Transient Fault)**
  - **Red LED flashing (Permanent Fault)**
  - **White / Red LED alternate flashing (Reclosing Progressing)**
  - **White LED 3 Times Flashing (Reset, or Ready)**
  - **Red LED 3 times short interval flashing (Sleep mode)**
  - **White LED 3 times short interval flashing (Wake-Up mode)**
- Low battery indication
- Fault Trigger Flashing indication time : ½, 1, 2, 3, 4, 5, 8, 24hrs(Settable)
  * Default : 1/2 hours for SFI(12) Model Operation

2.3. Remote Monitoring and Control function
- Remote monitoring of fault trigger signal and Remotely Reset Control with RSUⅡ in SCADA System.
  - *Load Current Monitoring (Display values on RSUⅡ LCD)*
- Remote monitoring of fault trigger signal and Remotely Reset Control with RSUⅡ by Mobile phone

2.4. Other Function
- Manual Indication test function by Manual Probe
  - Transient / Permanent / Ready / Sleep Mode / Wake-up mode
- Reset function
  - Automatic reset function
  - Manual reset function
  - Remote reset function

2.5. Battery Information
- Battery type : Rechargeable 3.7V 4200mAh Li-Ion
- *Self power charging device integrated : DC 3.7 V*
- Battery life : up to 10 years

3. Indicator Operation Ready

3.1. Indicator Sleep / Wake-Up Mode
Attach and hold the *Manual Test Probe for* 3 Seconds on the name plate and confirm the following LED flashing indicator signal.
  ➢ Sleep Mode
   : 3 times short interval **Red LED flashing**
      (Battery life saving)
  ➢ Wake-Up Mode
   : 3 times short interval **White LED flashing**
      (Ready to fault detecting on line)

❖   **Note** : **Before installation, all SFIs MUST be on Wake-Up Mode.**

3.2. SFI Manual Test Procedure
Check LED flashing or trigger fault manually with Manual Test Probe.
Touch the name plate with the Manual Test Probe and clear it quickly, then check the following LED flashing as touching sequentially.

1st Touch : White LED Signal (Transient fault)
2nd Touch : Red LED Signal (Permanent fault)
3rd Touch : Three times White LED (Ready for operation)
  ➢ Test mode is always working regardless of Sleep/Wake-up Mode.
  ➢ Test mode reset is actually resetting indicator to the default status.

3.3. Manual Trigger / Communication Test with RSUⅡ
  1) Turn on RSUⅡ and make sure RSUⅡ is at default status.
  2) Try to trigger registered indicator(s) as described in 3.2.
     (No matter transient fault/permanent fault)
  3) Check LCD Display and LED lamp flashing on RSUⅡ.
     ➢ If only one indicator is triggered, there must be a Gnd fault indication.
     ➢ If more than 2 indicators are triggered, there must be Gnd fault and Phase fault indication.

4. SFI (12) MODEL with RSUⅡ

4.1. Key functions of SFI (12) System
- ➢ **Applicable to SCADA system**
- ➢ **Applicable to GSM Mobile phone system**
  - ▪ Different Flashing Indication Transient / Permanent faults
  - ▪ Detect & Indicate LED for Phase to Phase / Ground faults
  - ▪ Detect & Indicate Power failure / Line Charged
  - ▪ **Load Current Monitoring**
  - ▪ Adjustable flashing time
  - ▪ SFI battery Low Indication
  - ▪ Easy installation

4.2. SFI (12) MODEL Component
1) RSUⅡ (Receiving & Sending Unit) : 1 unit
2) SFI (12) Indicator : 3 ea / group, can be occupied 9 ea / 3 group
3) Manual Test Probe : 1 ea / 50 ea indicators (or, 20 set **RSUⅡ)**
4) GSM module ; 1 ea
5) Solar Charging Device : Optional
4) RF/ Ethernet Modem : Optional

4.3. RSUⅡ Specification
- ➢ Charger : AC220V/DC24V(12V), Max150mA,or Solar charging(optional)
- ➢ Rechargeable battery : DC24V, or DC12V, 2AH x 2 ea
- ➢ External modem interface : RS232 Port
- ➢ Settable flashing time (½, 1, 2, 3, 4, 5, 6, 8 hrs)
- ➢ Communication Protocol : DNP 3.0, or IEC 60870-5-101,104 in optional
- ➢ RF Module : 315MHz, 433 MHz
- ➢ **GSM module ; 1 ea**
- ➢ Poly Box Enclosure
- ➢ Load current / Event display

[LCD Display]
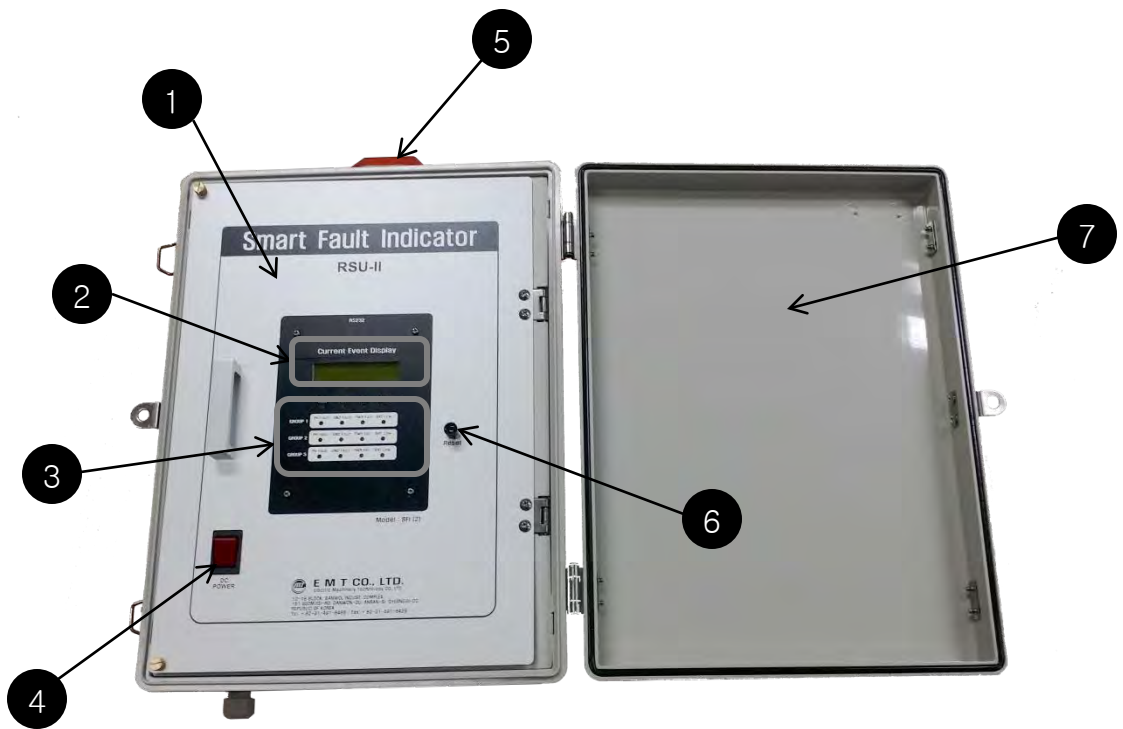
- ● **A, B, C Phase Load Current Monitoring for 3 Groups**
- ● **Event Display (T, L, F) for 3 Groups**
  [**T** : Fault Trigger, **L** : SFI Battery Low, **F** : Power Failure]

[LED Indication]

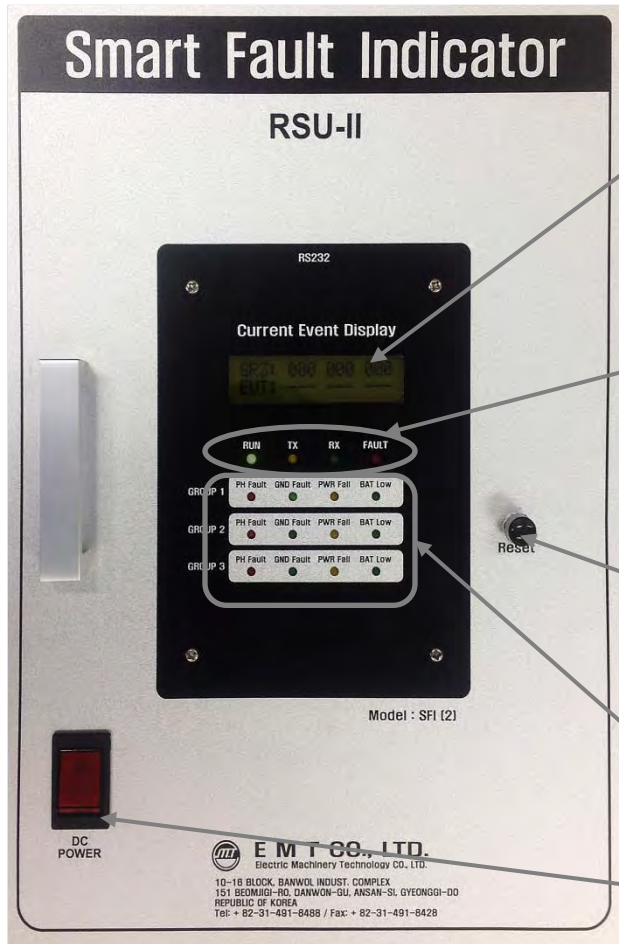- ● **Phase Fault, Ground Fault, Power Failure, Battery Low**
  for Group 1,2,3

4.4. RSU Ⅱ Controller Configuration

No.	Description	Remark
1	RSU Ⅱ	
2	LCD Display（A,B,C, Phase Current, Event）	For 3 Groups
3	SFI status LED （Phase, Ground Fault, Power Failure, Battery Low）	For 3 Groups
4	DC Power Switch	DC12, or 24 V
5	External Flashing Indicator	
6	Local Reset Button	
7	RSU Ⅱ Enclosure	Poly Box

4.5 Quick guide for RSU Ⅱ controller

1) Configuration

Current & Event Display LCD
• Show Current value / Events of Group 1,2 and 3 alternately every 1 sec
• Show type of events occurred
  (T: Trip, L: Battery Low, F: Power failure)

RSU status LED

RUN	TX	RX	FAULT
Normal	Transmit	Receive	Fault Trigger

Reset button
• When no events
  : Alternate group display lock & unlock
• When event occurs
  : Reset to default status

Event status LEDs
Phase fault, Ground fault, Power failure, Battery low

DC Power Switch

2) Strobe Lamp Flashing Time Setting

RSU Ⅱ's strobe lamp flashing time is adjustable by left 3 pins of a DIP-switch. This DIP-switch can be found on the back side of control panel near Reset switch.

* Default setting : 1 hour

DS(6)	DS(7)	DS(8)	Time (hours)
OFF	OFF	OFF	0.5
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	8

4.6 GSM controller in RSU II

NO.	Description	Remark
❶	**GSM Central Unit**	GSM SIMCARD Not included
❷	**Rechargeable Battery**	DC12V (2VA) x 2 EA
❸	**External Fault Signal Flashing lamp**	
❹	**Battery Charger (Under GSM Central Unit)**	AC 220V / DC12V
❺	**External power supply input**	AC 220V, or other
❻	**Panel box**	Poly box, or Metal box

4.7 GSM controller operation manual

4.7.1 Installation & Programming Guide

1) **Get in GSM network (Insert SIM card in GSM Central Unit)**
Press the yellow tip on the right side of the GSM Central Unit with a pin, then SIM tray comes out. Put the SIM card carefully on to the tray concerning the metal contacts of the SIM is downward.

❖ **Note : Before inserting SIM card into GSM Central Unit,**
● **Set SIM card in Power off**
● Write SIM number on Right inside of Panel Box

➢ RF code mode : The signal status LED on the GSM Central unit will turn to **Red** and last for 20 seconds.
 - System is waiting for wireless signal detectors to be coded into the GSM Central Unit. **(Refer to the clause 3) Register indicator in RSU)**
➢ After 20 seconds, the signal status LED will turn to **Orange**, and begin to flash, indicating system is checking SIM card and search for GSM network.
➢ After GSM Central unit finishes checking, if the signal status LED turns to **Green** and **flashes slowly**, it shows the GSM Central Unit is running.
➢* If the signal status LED keeps on Solid green, it shows SIM is not registered in the GSM Central unit, and the GSM system is not working.
➢* If not correctly set, try again from the first step after power off-on.

2) Command System start working / stop working

To make system start working or stop working, send the following SMS message to GSM central unit number.
➢ 123456#1#1# (Start system working)
➢ 123456#1#0# (Stop system working)
➢ You can send "123456#30##" SMS message to check the status of the Central Unit.

ex) If GSM central unit no. is 21140022, send "123456#1#1" SMS message to 21140022 to make system working.

3) Register Fault indicator in GSM central Unit

To get SMS alarming of line fault detected from indicators, indicators must be registered in RSU. It is possible to register 2 group (One circuit A1,B1,C1 phase ; 3ea indicators, The second circuit group A2,B2,C2 Phase) in one GSM Central Unit.
To register SFI indicator in RSU, follow the below steps.

    1) Power on GSM Central unit and check LED is Red color.
    2) Trigger the indicator by manual probe
    3) Flickering red LED on the Central Unit (Registration on the process)
    4) Return to green LED (Indicator registration completed)
    5) Repeat the above sequences for 2nd and 3rd indicator registration.

4) Register operator's mobile phone number

One Central Unit is able to be registered 5 mobile numbers.
To register the numbers, send SMS command to the Central Unit as follows;

1st Phone registration : 123456#51#1st Phone No.#
2nd Phone registration : 123456#52#2nd Phone No.#
3rd Phone registration : 123456#53#3rd Phone No.#
4th Phone registration : 123456#54#4th Phone No.#
5th Phone registration : 123456#55#5th Phone No.#

❖*Checking all registered numbers in Central Unit : 123456#50##*

ex) If GSM central unit no. is 21140022, 1st Phone no is 21140023, send "123456#51#21140023" SMS message to 21140022. To check whether the registration is successful, send "123456#50##" SMS message to 21140022, then SMS message which summaries registered numbers will be replied.

5) Alarming message

5.1) Phase trip message

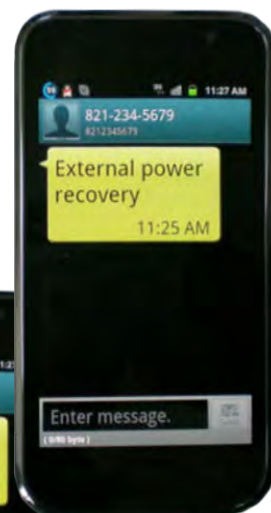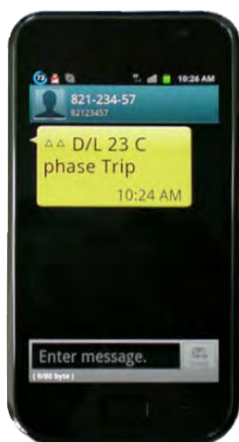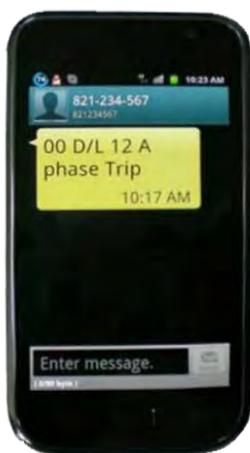When the indicator is triggered by fault, phase trip message will be sent to the registered phones immediately.

This trip message for 1st 3 phase Circuit Group can be programmed as following command
A Phase Indicator message : 123456#81#"Message"#
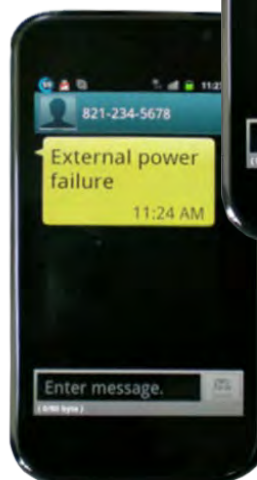B Phase Indicator message : 123456#82#"Message"#
C Phase Indicator message : 123456#83#"Message'#

ex) At the default status, if the user want to receive A phase indicator's fault trigger message as "B DL 100P A phase Trip", send"123456#81#B DL 100P A phase Trip" SMS message to the Central Unit.

5.2) RSU power alarming message

➢ When RSU's external power supply is failed or internal battery power is low, the user will receive "External Power Failure" SMS message.
➢ When the external power supply or battery power is recovered, the user will receive " External power recovery" SMS message

6) Test RSU external fault signal lamp flashing

It is possible to reset RSU external lamp flashing by following SMS message.
123456#3#1# : Trigger RSU external lamp flashing
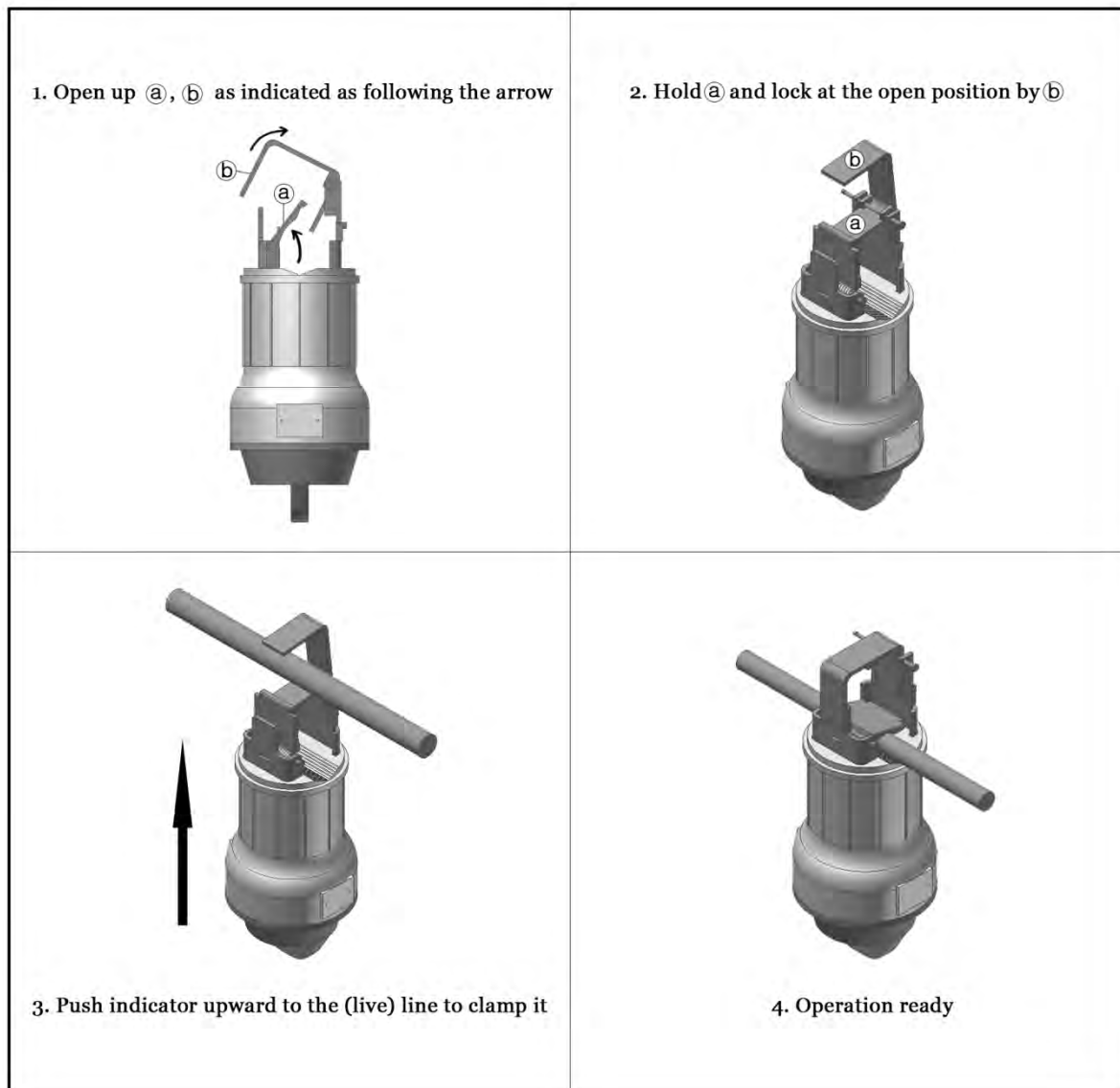123456#3#0# : Stop RSU external lamp flashing
❖ RSU external lamp is flashing automatically when fault or RSU power failure is detected

ex) If GSM central unit no is 21140022 and the user want to trigger the RSU external lamp flashing, please send "123456#3#1#" SMS message to 21140022 . On the other hand, if the user want to stop the lamp flashing, please send "123456#3#0" SMS message to 2140022.

5. Summary of SMS program command

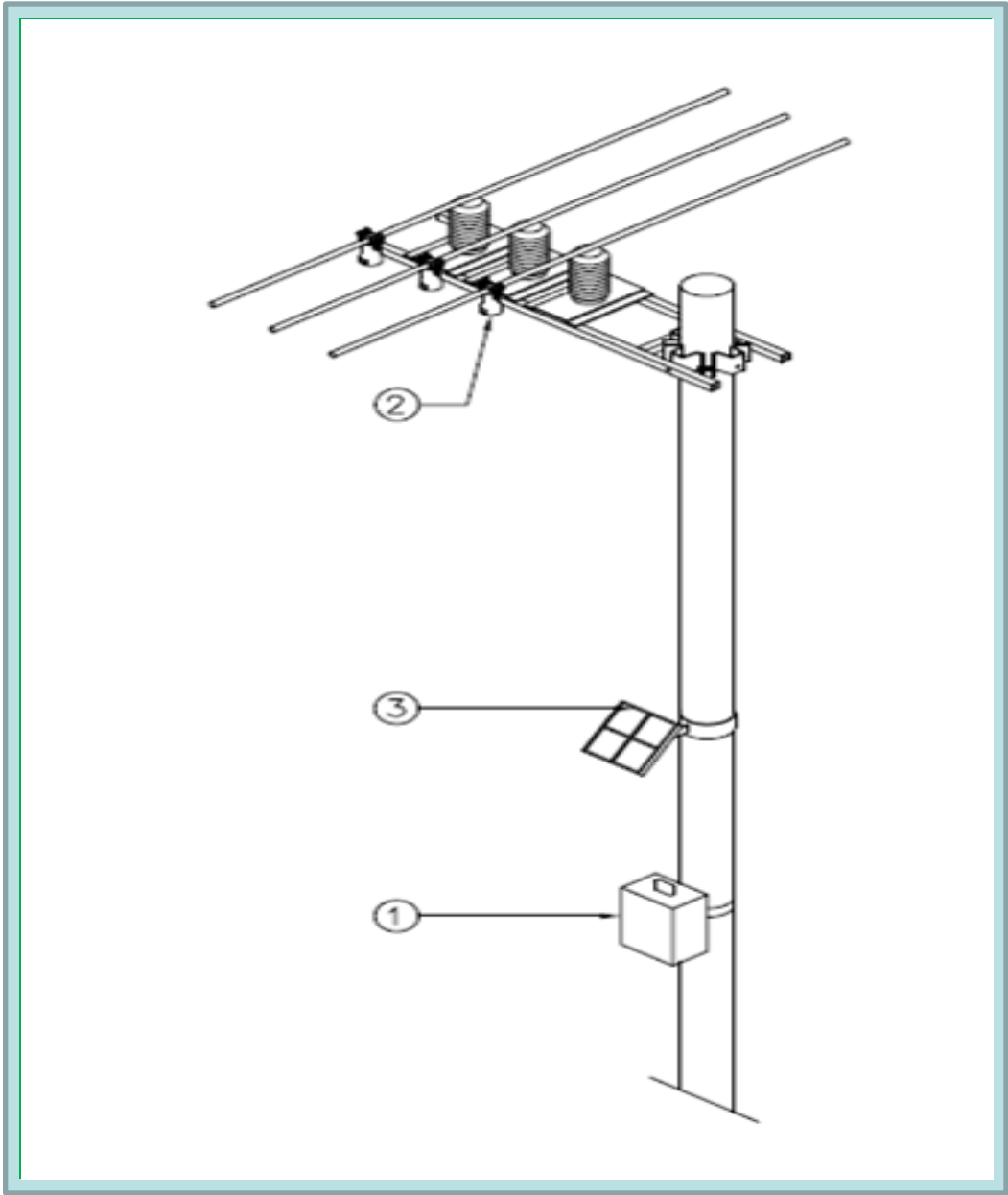| Function	SMS Program command
System start working	123456#1#1#
System stop working	123456#1#0#
Start RSU external lamp flashing	123456#3#1#
Stop RSU external lamp flashing	123456#3#0#
Check working status	123456#30##
Change password	123456#31#newpassword#
Check all the registered phone nos. in Central Unit	123456#50##
1st Phone registration	123456#51#1st phone no.#
2nd phone registration	123456#52#2nd phone no.#
3rd phone registration	123456#53#3rd phone no.#
4th phone registration	123456#54#4rd phone no.#
5th phone registration	123456#55#5th phone no.#
Program A Phase indicator message	123456#81#message A Phase Trip#
Program B Phase indicator message	123456#82#message B Phase Trip#
Program C Phase indicator message	123456#83#message C Phase Trip#
* If password is changed, you have to use a new password instead of 123456	

6. SFI Installation Layout on Distribution Line

1. Open up ⓐ, ⓑ as indicated as following the arrow

2. Hold ⓐ and lock at the open position by ⓑ

3. Push indicator upward to the (live) line to clamp it

4. Operation ready

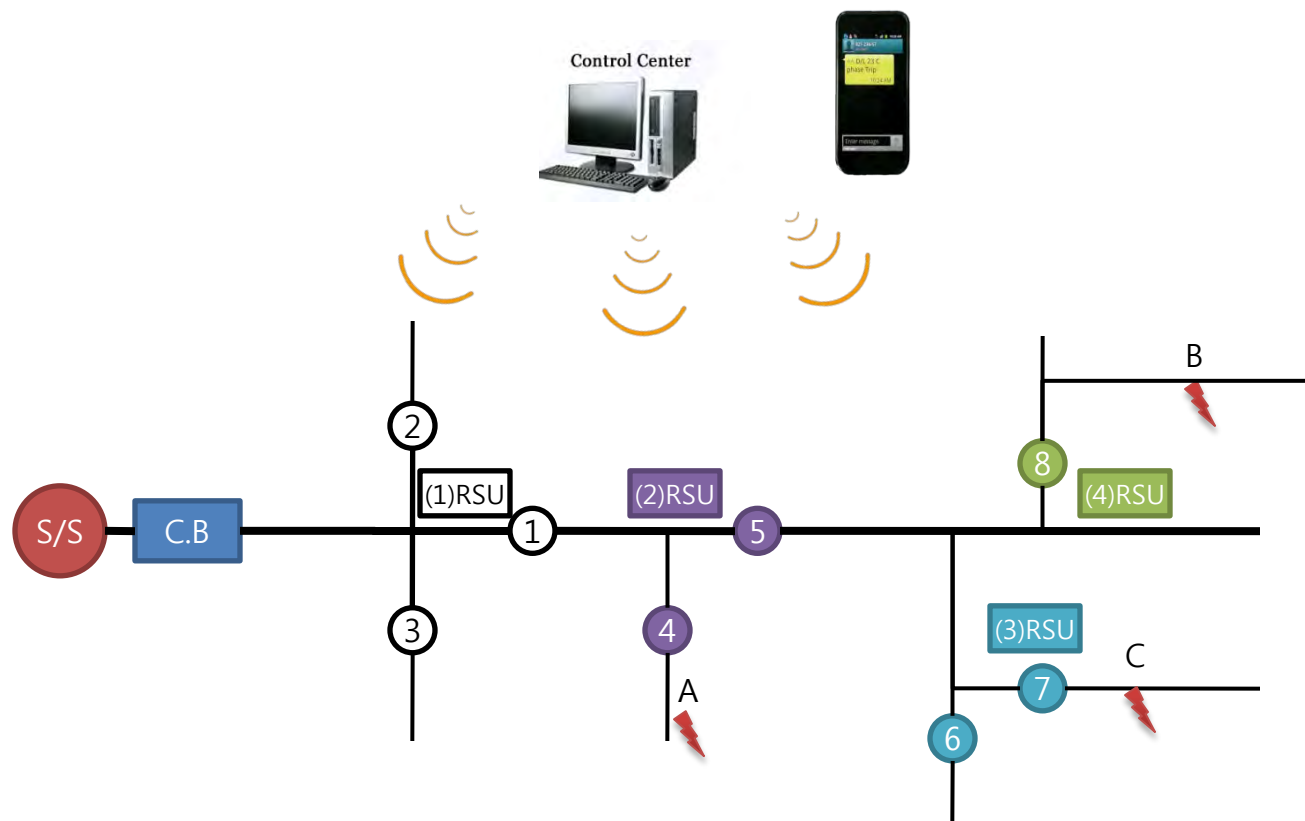❖ **Note** : **Before installation, all SFIs MUST be on Wake-Up Mode.**
(All indicators will be delivered in sleep mode. Therefore, attach Manual Test Probe for 3 sec. on the name plate, and check White LED short interval flashing 3 times, then ready to operate for installation)

7. SFI Pole Mounting Installation Layout

NO	Description	Q'ty	Remark
①	RSUⅡ	1	
②	Smart Fault Indicator	3	Use to 9 ea SFI
③	Solar Charging System	1	Optional

8. Example of SFI(12) System Operation Scheme

The above figure is the example of SFI(12) system installation on the distribution line. Each RSU occupies different group of SFIs as shown in the below table. SFIs and RSU should be installed within the effective communication range.

RSU No.	(1)RSU	(2)RSU	(3)RSU	(4)RSU
SFI Group No.	① ② ③	④ ⑤	⑥ ⑦	⑧

According to the fault location, SFIs shall be triggered as follows ;

(1) In case of fault at "A" point : ① and ④ SFI triggered
(2) In case of fault at "B" point : ① , ⑤ and ⑧ SFI triggered
(3) In case of fault at "C" point : ① , ⑤ and ⑦ SFI triggered

Fault Indicator Trigger shall be monitored and controle by SCADA system and Mobile phone ;
(1) Mobile phone : A,B,C phase FI trip
(2) SCADA sytem ; A,B,C Phase FI trip / Phase & Ground Fault
                Line Live, Dead / FI Battery Low
                Line Current Monitoring