CITEL

LSCM-D

User Manual

Smart SPD Monitoring Device
Surge Current Counter

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SAFETY INSTRUCTIONS

- Installation must be performed only by electrically skilled operator.
- National electrical installation rules must be followed.
- The unit must be used only as surge current counter & SPD monitoring, according the conditions described in this document.

P1/6 Introduction

P7/10 Installation

P11/17 OLED Instructions

P18/20 Modbus Protocol

1 - Introduction

1-1 Overview: LSCM-D

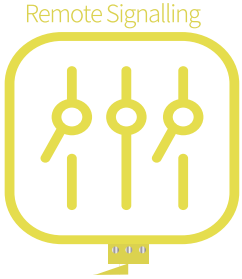
LSCM-D, mainly used for monitoring and measuring the lightning current which flow through PE conductor, it will enhence the protective efficiency if we don't know clearly about surge characteristics, by this means more suitable lightning protection measures for direct and indirect surge impulses can be realized as below

LSCM-D for lightning monitoring

- More precise lifetime prediction to ensure timely maintenance for surge protection devices (SPDs)
- More reasonable type selection for SPDs
- Know clearly surge current distribution can also contribute to better layout position for sensitive equipment
- Design more resonable grounding system to discharge lightning current.

LSCM-D also can be used for monitoring SPD/MCBs/Fuses remote signalling state

Output alarm for monitoring input switching and lightning are both applicable.



LSCM-D is composed of one sensor and one monitoring unit, detailed combinations described as follwing table.

Type	Description	Version
LSCM-D/24	Monitoring unit	12-24 Vdc/ac Power Supply
LSCM-D/230AC	Monitoring unit	120-230 Vac Power Supply
LSCM-P300	Surge sensor	300 A minimum surge detection
LSCM-P1000	Surge sensor	1000 A minimum surge detection
LSCM-D/24/P300	Complete set: 1 monitoring unit+1 sensor	12-24 Vdc/ac Power Supply + 300 A minimum detection
LSCM-D/230AC/P300	Complete set: 1 monitoring unit+1 sensor	120-230 Vac Power Supply + 300 A minimum detection
LSCM-D/24/P1000	Complete set: 1 monitoring unit+1 sensor	12-24 Vdc/ac Power Supply + 1000 A minimum detection
LSCM-D/230AC/P1000	Complete set: 1 monitoring unit+1 sensor	120-230 Vac Power Supply + 1000 A minimum detection

1-2 Main functions

The main funcitons for LSCM-D described as below :

▪ Lightning and surge current detection for wide detection range :

- 0.3/25kA@10/350μs or 0.3/50kA @ 8/20μs(LSCM-P300)
- 1.0/50kA@10/350μs or 1.0/100kA @ 8/20μs(LSCM-P1000)

▪ Front OLED display can read recorded events and device parameters

▪ Peak current and time stamping recording of the surge events

▪ RS485 communication interface/MODBUS protocol

▪ Two inputs and one output terminal can realize to monitor remote/switching signalling from SPDs and its associated disconnectors (operating/disconnected).

▪ Benefit from Equipped rechargeable 3 V battery, the clock can keep running in case of power loss, to ensure the accuracy of recording time.

▪ Equipped with an LED indicator light can indicate the working status of the equipment.

1-3 Technology and features

1-3-1 Technology

This measuring system, utilizes Faraday effects, to analyze surge currents which pass through conductors when discharge happens. The measured electric signals, caused by electromagnetic effects, transfer to differential voltage signal to monitoring unit through sensor's connection wire, then the controlling unit will proceed back calculation through microprocessor.

The data acquisition system for incoming surges consists of signal conditioning circuit, DSK interfacing circuit, RS-485 communication interfacing circuit, system clock circuit, power supply circuit and so on. System schematic diagram Fig 1.

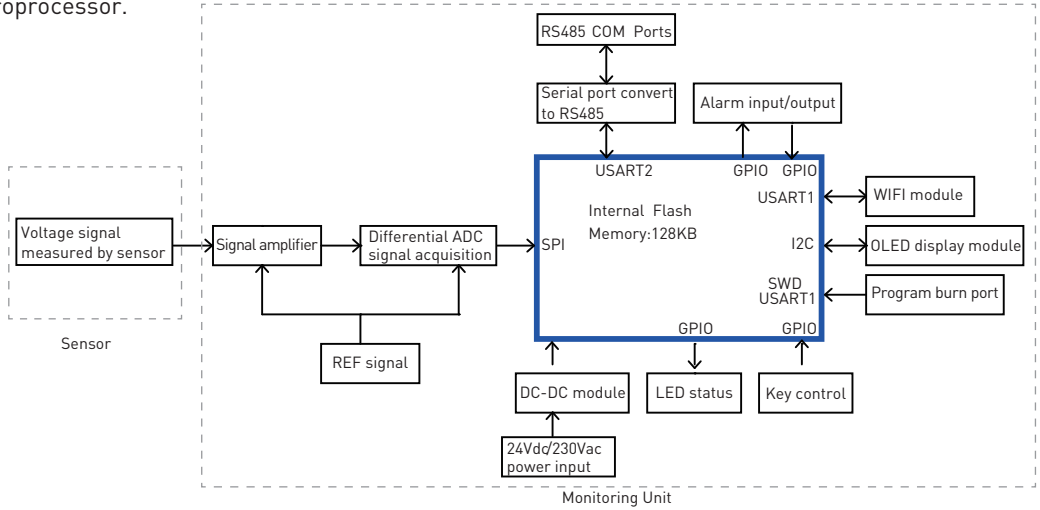


Fig1. LSCM-D system schematic diagram

1-3-2 Main features

▪ **Surge current monitoring**

The peak value and polarity of surge currents flowing conductors, including PE wires or down conductor, as well as the time stamping for the event can be recorded. Long (10/350μs) and shorter (8/20μs) duration impulse currents can be monitored with wide range (range described as 1 -2).

▪ **Monitor the state of the SPD and its associated disconnectors (operating/disconnected)**

This information will send through the communication line or will operate a contact (output port) to activate a LED indicator, or a buzzer, or a contactor to cut down the main circuit (Fig4).

▪ **With high precision**

The precision rate for LSCM-D within +/-5%. The precision could reach better performance in certain electromagnetic interference conditions.

▪ **Wide operating voltage range**

The power supply is equipped with rectifying bridge, which can support DC and AC wide voltage range input, and applicable for reverse wiring, two versions optional:

- DC power supply: 12-24Vdc/ac (DC:9Vdc min/36Vdc max; AC:6Vac min/30Vac max)
- AC power supply: 120-230Vac (90Vac min/264Vac max)

▪ **Information display and communication**

• Local information: the front OLED display gives access the recorded information (surge parameters, devices status)

• Remote signal communication: remote computer can access to the full recorded data of LSCM-D through RS485 communication/Modbuis protocol.

▪ **Higher immunity level on interference**

LSCM-D have passed strict tests on EMC and EMI, comply with the standard requirements on IEC 61000 and CISPR.

▪ **Built-in battery for timer**

To ensure the accuracy of recording timethe monitoring device equipped with rechargeable 3V battery which can keep the timer running in case of power loss the battery life could reach 3-6 months.

▪ **Wide applicability**

Based on compact design and wide surge detection range for 10/350μs and 8/20μs currents, LSCM-D typically used for:

• Detect the surge current via SPD PE wire which always mounting inside an electrical cabinet

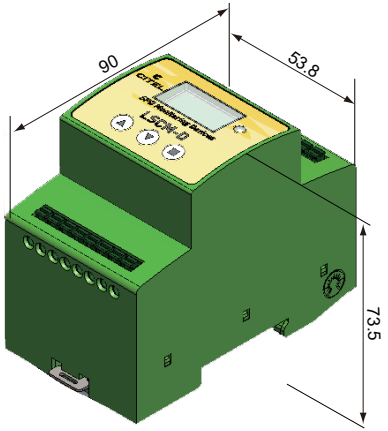
• Monitor the state of SPD and/or of its associated disconnector (fuse/MCB)

• Detect the lightning current flowing grounding wire from blades to the hub in wind turbine.

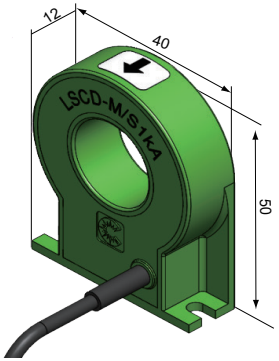
• Detect the direct lightning strike from LPS through down conductor or grounding wire.

2- Installation

2-1 Main view and mechanical Scheme



Monitoring unit LSCM-D



Sensor LSCM-P1000

Fig2. Mechanical Scheme for LSCM-D

2-2 Interface introduction

2-2-1 Power supply

The applicable voltage for power supply is 12-24 Vdc/ac or 120-230Vac (two different versions) (please refer to 1-3-2).

2-2-2 RS485

RS485 ports is designed for communicating with remote computer to transmit the detecting data and monitoring instructions : this system uses half-duplex communication by the way of Modbus transmission protocol. RS485 communication cable in general is using twisted pair, but under the high requirement of environment suggest to use shielded twisted pair cables, to achieve perfect performance of anti-interference.

2-2-3 PE shield connection

The monitoring device should connect to the earthing system. By this way, the system immunity for LSCM-D can be increased and the common interference through RS485 can be reduced, so higher measurement accuracy can be ensured.

2-2-4 Switching signal-Alarm inputs

The device is equipped with two alarm input ports for monitoring the switching state from SPD and/or disconnectors. The received switching state information will transfer to the alarm output port and remote computer through RS485 in real time. Tthe “alarm” process can be triggered by setting the fault state for each input ports.

2-2-5 Alarm output

Output port is designed for trigger the "alarm" process like LED/buzzer/contactor. The output signal status totally depends on the input switching signal status/detected lightning. The maximum operating voltage and current for output ports is 350Vdc & 120mA.

2-2-6 Sensor

LSCM-D equipped with dedicated coil sensor for surge measuring : two versions ar available for different detection range. The sensor should be mounted around the discharge conductors as fig4 shows. The connection wire (default configuration) should connect to monitoring unit. Sensor cables of different colors should be connected to different terminals as shown in right figure.

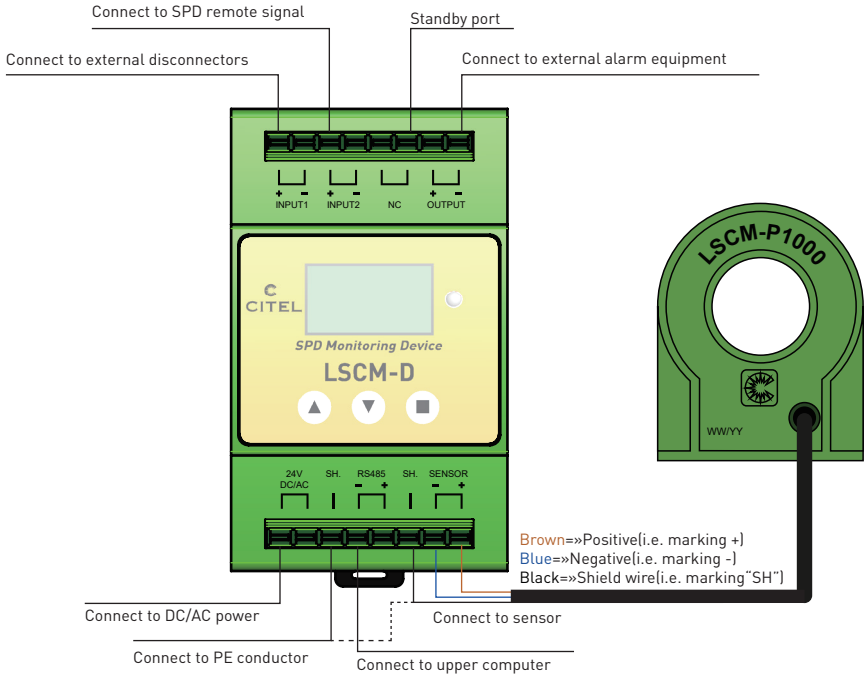


Fig3. Typical LSCM-D wiring connection

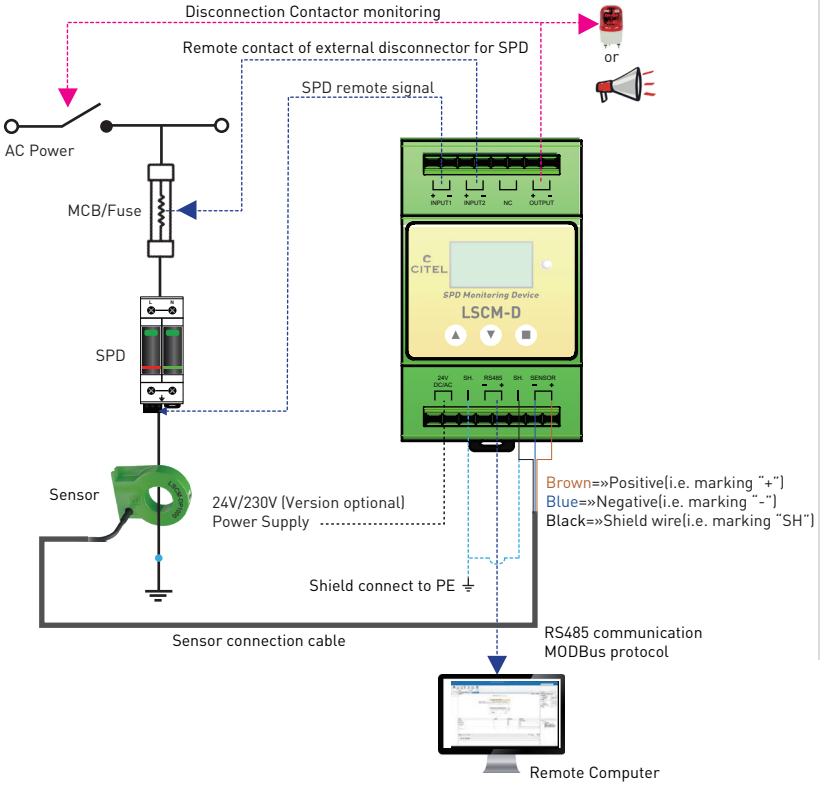


Fig4. Typical wiring diagram for LSCM-D

2-3 Typical wiring diagram for LSCM-D

- Symmetrical DIN rail mounting
- Connection terminal : spring contact -1.5 mm² wire max
- Operating/storage temperature : -25/+70 °C
- Protection rating : IP20
- Weight： 170g
- Maximum acceptable conductor diameter for sensor: 19mm

*Note: 1) Two input ports for the wiring of SPD remotes and associated switching is optional, details pls refer to 3-3-2.

2) Please keep power off when wiring sensor connect to monitoring unit, to avoid some malfunction triggered by signalling interference.

3-OLED Instructions

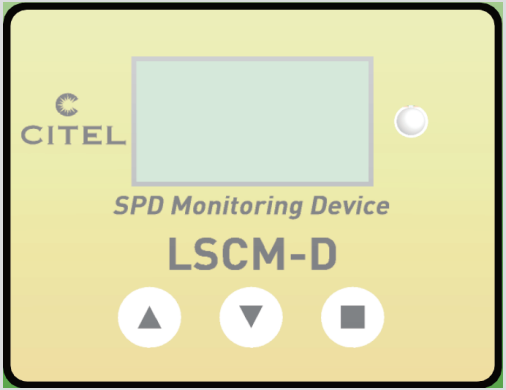
3-1 Main operator panel

Monitoring unit equipped with one 128×64 OLED display screen and three operating buttons like below, buttons from left to right are defined as"▲▼■"respectively.

The main interface for OLED can be divided into four main operator interfaces (3-2) and two system setting interface (3-3).

Buttons ▲▼ are used for pages switching between the main interface. Button ■ is used for selection or confirmation .

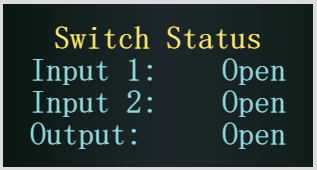
After pressing Button ■ for 5 seconds, the screem can access the system setting interface and proceed to set system parameters.



3-2 Main operator interfaces

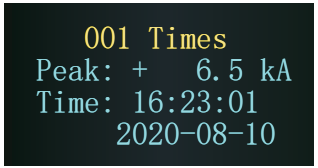
3-2-1 First page : basic information

The first interface displays basic information for LSCM-D, including manufacturer name, device designation, real-time clock time and date.



3-2-2 Second page : switch status

The second page displays disconnectors' state, two input ports can display the real time state for the connecting disconnectors like fuses or MCBs, and the output port state can be set by modbus communication(4-3-1) according to different state of input ports.



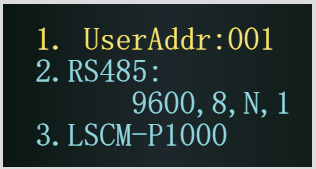
3-2-3 Third page : Surge current information

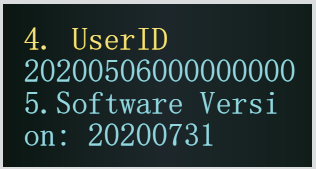
The third page is the interface about surge current information. Press button ■ can access this page and detailled the recorded detected data (the latest 1200 surge events). It contains the polarity and peak value of lightning current, the time and the sequence number. Button ▲▼ can switchover each surge events, press button ■ can exit the query page.

3-2-4 Fourth page : Status information of the system

The fourth page displays the equipment information. Press button■ will display the current user device address(user-defined) and RS485 communication baud rate.

Press ■ again will access next page, the device serial number and software version can be queried in this page.





3-3 System settings

3-3-1 Settings introduction

System setup is mainly used to set up system information, such as RS485 communication baud rate, user device address, languages settings. Press the function button ■ more than 5 seconds can access the first system settings page, press button ▲▼ can move the cursor in this page. There are two pages for system setting.

- The first page as 3-3-2 described, RS485 baud rate (default 9600 baud), user-defined device address and language can be set at this page.

- The second page as 3-3-3 described, the type of sensor can be selected between LSCM-P300 or LSCM-P1000, the real time and clear record can be set too.

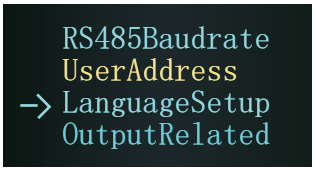
3-3-2 First page : System settings

▪ **RS485 baud rate**

After access to interface of RS485 baud rate selection, move cursor button ▲ and ▼ to choose the appropriate baud rate, then press button ■ to confirm your selection.

▪ **User address**

By using buttons ▲ ▼can modify LSCM-D communication address with upper computer, and use button ■ to confirm code setting.



▪ **Language setup**

Setting language, select buttons ▲ and ▼ can modify the optional language for English and simplified Chinese, and use button ■ to confirm the change.

▪ Press ▼ again, the second page for system settings as 3-2-3 will display.

▪ **Output state related to remote signalling and associated device**

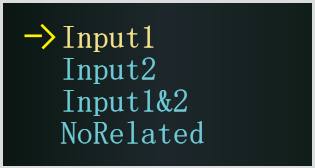
Four states can be defined in sub-option as below:

-Input 1 =>after set and when state for input 1 changes, the state of output will change 1.0 s and then back to normal state.

-Input 2 =>after set and when state for input 2 changes, the state of output will change 1.5 s and then back to normal state.

-Input1&2 =>after set and when state for input 1 changes, the state of output will change 1.0 s and then back to normal state; if state for input 2 changes, the state of output also will change 1.5 s and then back to normal state.

-Not related=> nothing related.



▪ **Output state related to lightning strikes**

Two states can be defined in sub-option as below:

-Open the output related for lightning detection=> when detecting the lightning, the state of output will change 2.0s and then back to normal state.

-Close the output related for lightning detection=> not related with the lightning detection.

3-3-3 Second page : System settings

▪ **Time setup**

After access the second system setting page, press button ■ to enter the year setting, and select buttons▲and▼ to switch the year value. Month, date and time setup take similar way. Above setting also can be set by means of time synchronization with upper computer, more simple and fast than above setting by button.

▪ Sensor setup

After access the sensor setting interface, press button ■ to enter the selection bar, the sensor type LSCM-P300 and LSCM-P1000 can be selected by button ▲ and ▼.

After select the sensor, the lightning detection range also can been set too, take LSCM-D/24/P1000 for example, three option "1kA-100kA", "2kA-100kA" and "4kA-100kA" optional, the range option depend on the application requirements.

Be careful, if choose mismatching sensor type, the measured value is unreliable.

▪ Clear record

If user want to clear all history record, first move the cursor to "clear record" option, then press button ■ to confirm the selection.

Be careful, if the record is cleared, all the data can not recovered.

When all setting finished, move the cursor to "exit setup" option, then press button ■ to exit.

4- Modbus Protocol

4-1 Introduction

4-1-1 About Modbus protocol

Modbus is a very commonly used communication protocol and communication convention in industry. Modbus protocol includes RTU, ASCII and TCP type, and Modbus-RTU is the most commonly used, relatively simple, and can be easily implemented on single chip microcomputer.

Through Modbus protocol, controllers can communicate with each other through network, such as Ethernet, and with other devices. Modbus has become a universal industry standard and with it, control equipment produced by different manufacturers can be connected into an industrial network for centralized monitoring. Controller communication uses master-slave technology, that is, only one device (master device) can initiate the transport (query). Other devices (slave devices) respond accordingly to the data provided by the master device query. The master device can communicate with the slave device alone or broadcast with all slave devices.

4-1-2 How to realize Modbus protocol

Master device communicate with LSCM-D through Modbus-RTU by RS485, the transmission medium use shielded twisted pair. Modbus RTU messages are a simple 16-bit structure with a CRC (Cyclic-Redundant Checksum). This protocol primarily uses an RS-232 or RS-485 serial interfaces for communications and is supported by almost every commercial SCADA, HMI, OPC Server and data acquisition software program in the marketplace. This makes it very easy to integrate Modbus compatible equipment into new or existing monitoring and control applications.

The user should selects the desired RTU mode in the controller for LSCM-D device, including the serial communication parameters (baud rate, calibration mode, etc.).

When configuring each controller, all devices on a Modbus network must select the same transmission mode and serial port parameters.

The Modbus protocol establishes the format of the master device query: device address, functional code, all data to be sent, and an error detection field. The response message from LSCM-D also consists of the Modbus protocol, including the domain to confirm the action, any data to return, and an error detection domain. If an error occurs during message receiving, or if the slave device is unable to execute its command, the slave device creates an error message and sends it back.

Device Adress	Function code	Data field	Data 1	.....	Data n	CRC check high byte	CRC check low byte

CITEL 4-Modbus Protocol

▪ Device address

RTU mode address field of a message frame contains eight bits. The possible address from the device is 0...247 (decimal), and the address range of a single device is 1...247. When a response message is sent from a device, it puts its address into the address field of the response so that the master device knows which device is responding.

▪ Function code

RTU mode functional code field in the message frame contains 8 bits. The possible code range is decimal 1...255. When a message is sent from the master device to the slave device, the functional code field tells the slave device what behavior it needs to perform. For example, to read the switching state of the input, to read the data content of a set of registers, to read the diagnostic status of the slave device, to allow the input, record, verify the program in the slave device, etc.

▪ Data field

Data field is composed of two sets of hexadecimal numbers, with a range of 00...FF. A pair of an RTU character sent from the master to the slave devices contain additional information: the slave devices must be used to perform what is defined by the functional code. This includes things like discontinuous register addresses, the number of items to process, and the actual number of bytes of data in the field.

▪ CRC check

The RTU mode is selected as the character frame, and the error detection field contains a 16 bits value (implemented with two 8-bit characters).The content of the error detection domain is obtained by looping verbose detection of the message content. The CRC is appended to the end of the message and is added first in low bytes and then in high bytes, therefore, the high byte of CRC is the last byte to send a message.

《Modbus protocol》 for LSCM-D to programe please visit CITEL official website and download it.