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IMP SERIES

Intelligent Motor Protection Relays

LS ELECTRIC

Perfect Selection of Motor Protection & Monitoring Device!

With the compact system structure and advanced protection functions, the device provides new standards of next-generation motor protection relay.

IMP Series

Intelligent Motor Protection Relays

- Ground fault protection for both zero current/residual current
- Support rated current 0.12~100A without external current transformer
- Definite/inverse time selection and diverse protection factors
- Basic application of ground fault/instance protection
- Separation of the display part with the use of Cable
- MODBUS communication and 4~20mA DC output

Contents

Product characteristics

Convenience

Comprehensive Digital Motor Protection Relay with the MCU (Microprocessor Control Unit)
Real-time processing and high precision

Applicable to Inverter Circuits
Thanks to its characteristics to harmonic noise, it can be applied to the inverter control circuits. The available frequency range is 20~200Hz. When the relative harmonic factor is over 30%, a harmonic filter should be installed (However, the ground fault function should be off).

Storage of Fault Events
Up to 5 fault events can be stored for easy fault history management.

One-Body Type and Separate Body Type
The display can be attached to the panel front so that current, operation time and settings can be checked without fetching the unit. With the display separated, the motor protection is available.

Communication support type
RS-485 MODBUS communication with various systems.The model with analogue signals (4~20mA) is compatible with transducer systems.

Various Reset Functions
Manual, automatic and electric reset functions are provided for customer convenience.

Date and Total Operating Time Setup
When a fault occurs, its date and time are stored for easy checkup. When the total operation time is over, it is displayed for changing motor bearings or supplying oil.

Password
Settings are protected with a password.

Total operating time and operating time setting
When the predefined operating time has elapsed, related information is displayed so that operators may replace the motor bearing and check the refueling cycle.

Quick Setup
All settings can be decided quickly on the display.

Wide Setting of Ground Fault Current Sensitivity 30mA~25A
Zero current sensing by zero sequence CT. zero current sensing by Residual circuit.

Reliability

Thermal Inverse Time, Inverse Time and Definite Time Modes
According to user's needs, the motor can be protected in the inverse time mode or definite time mode.

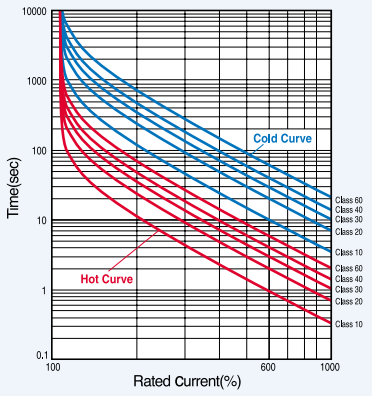
3-Phase Digital Ampere-Meter
3-phase current is displayed every two seconds for motor monitoring.

Wide Current Setting Range: 0.125~100A for One Model
With the slide S/W, the current setting range can be decided 0.5~10A or 5~100A. Depending on the number of CT penetration, even 0.125A current can be protected. (Wire penetration hole is required).

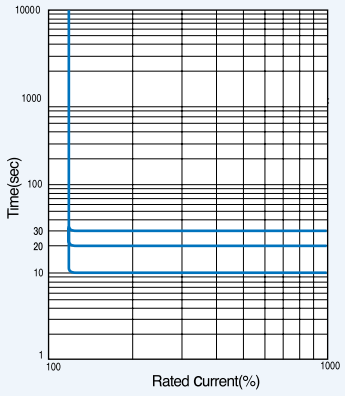
Overcurrent-51

By setting up an operating time in the 1-60 seconds unit on the basis of 6005 of rated current in consideration of a motor's starting time, it is possible to configure the overload characteristic curve of Class 1-60.

If Definite Time Characteristic is selected, the equipment starts to detect overcurrent after the set operating delay time (D-Time) regardless of a motor's generated heat. If overcurrent continues to be supplied after an operating time (O-Time), Trip occurs.



<Inverse Time Characteristic>



<Definite Time Characteristic>

Stall/Locked Rotor-48/51LR

This function is used to prevent the loss and damage made by a motor's rotor stall, starting failure, and staring delay, and to detect an increased load current by overheat overload in operation or the case that load torque exceeds motor torque in order to block a circuit. Overcurrent function by starting current works after a set delay time

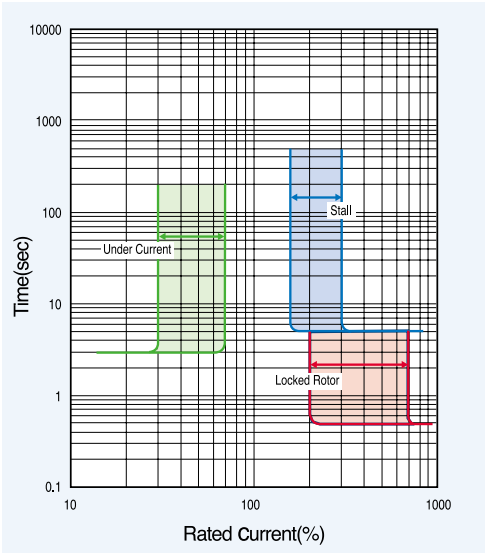
Under current-37

This function is used to monitor the no-load caused by the separation or damage of a motor's drive shaft, or to prevent a pump's idle rotation (no-load). It is possible to set up to 30~70% of rated current. It works within three seconds.

Phase fail/Phase unbalance-47P

If phase failure occurs, a motor fails to start. A motor in operation stops due to shortage of torque or has overheat due to continuous reverse phase current.
IMP calculates phase unbalance of three-phase current. It is possible to select one of the two cases: if the calculated result is 70% or more, this function is executed within 1.5 seconds; if phase unbalance factor is 10-70%, trip occurs within three seconds.

* In a single-phase motor, turn OFF phase fail and phase unbalance protection function.



Reverse phase

This function is used to prevent a motor's reverse rotation. After the phase difference of three-phase current inputs is compared, this function is executed within 0.1 second if the phase sequence changes. Reverse phase is checked only if a motor starts up.
In a single-phase motor, turn OFF this function.

Ground fault-51G

This function is used to detect ground fault leakage current. In other words, it aims to prevent leakage-induced ground fault and secondary accidents (short circuit and electric shock).
It is possible to set up a current sensitivity and an operating time differently depending on grounding system or protection purpose.
It is possible to set a current sensitivity to 30mA~25A and an operating time to 0.05~1.0 second.

Rated specifications & model numbering system

Integral type

Extention type

Rated specifications

Protection		Over current, Lock/Stall, Phase failure, Phase unbalance, Reverse phase, Under current, Ground fault, Short circuit
Connection method		Extention type
Operating Time Characteristics		Heat accumulation inverse time / inverse time / definite time
Rated current		0.5~10A/5~100A (Separate)
Display		4digit, 7-Segment
Operating power		AC/DC 85~245V (50Hz/60Hz)
Return method	Auto	1~20min
	Manual / Electrical	On/Off Selectable
Installation / installation method		Display can be installed separately, 35mm DIN rail / Screw installation
Tolerance	Current	±5%
	Time	±5%
	4~20mA Output	±5%
Time setting	Startup delay	1~200sec
	Operation delay	1~60sec
Aux. contact	Configuration	3-SPST(Power supply 1a1b, instantaneous operation 1a) Note1)
	Capacity	3A/250VAC Resistive Load
	Contact minimum load	10mA / 5VDC
ZCT Input		200mA/100mV (Exclusive ZCT) Note2)
Environment	Operation	-10~55°C
	Storage	-20~70°C
	Relative humidity	within 80% RH, no condensation
Insulation Resistance		100Mohm/500VDC
Power consumption		1.2X50us 5kV Prototype waveform supply
Fast Transient		2kV/1Min
Power consumption		Below 3W

Note) 1. See No. 17-19 of A-Group in Setting menu.
2. It is used if zero current detection type is selected.
3. This product is designed for protecting a low-voltage motor with 1,000V or less. Therefore, it should not be used in high voltage lines.

Model numbering system

IMP — C — A420 — 10A — 110/220

Factors Protected	
C	Current

Communication	
NO	None
A420	4~20mA Output
M485	Modbus/RS-485

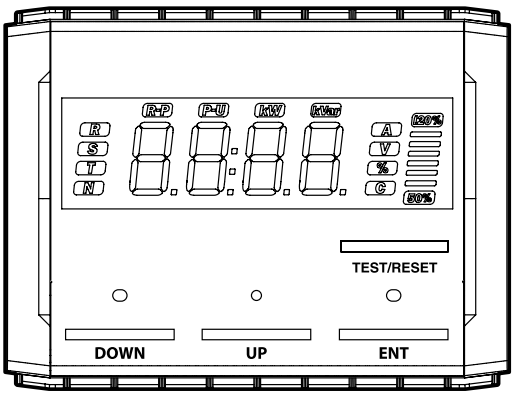
Current adjustment range	
10	0.5~10A
100	5~100A

Control Voltage	
110/220	AC/DC85~245V
24/36	AC/DC24~36V

*When using Display separately, please purchase a dedicated cable as well. (See Other Options)

Operation & setting method

1. Check the Test/Reset button



1) Check wires.
2) Note) While the motor is running, the Test/Reset key does not work.
3) Press again the Test/Reset key to reset the EMPR.

Note) While the motor is running, the Test/Reset key does not work.

2. Setting

1)Press the Test/Reset key once. Then“ TEST” is displayed and the EMPR is tripped.

2) Press the Enter key. Then “P-99” is displayed.
Use the Up/Down keys to change the password(P-00).

3) Press the Enter key to enter A-gr setup mode.
Use the Up/Down keys to select a group and Press the Enter key to enter the selected group. Press the Test/Reset key to move back to the previous mode.

4) In the A-Grp mode, Press the Enter key. Then “1.CHA” is displayed.
Use the Up/Down keys to select an item and Press the Enter key to enter the selected item.
Press the Test/Reset key to move back to the previous mode.

5) Use the Up/Down keys to set up the value and Press the Enter key to save it.

Note) When the power is supplied first or is resupplied after a power failure, must set up the date in b-gr, 5.S-d.
Set up the rated current S/W while the power is off.

3. Quick setup

1) Press the “Up and Enter” keys at the same time. “UPLD” is displayed and settings are uploaded to the display.
2) Insert the display to the body without settings, and then press the Test key to enter the test mode.
3) Press the “Down and Enter” keys at the same time. “TEST” is displayed and downloading is completed.
4) Press the Test key to return to the normal mode.

Note) Communication settings cannot be uploaded or downloaded.

4. Setting checkup

1) Press the Enter key.
2) Use the Up/Down keys to select a group and Press the Enter key to enter the selected group.
Press the Test/Reset key to move back to the previous mode.
3) Use the Up/Down keys to select an item and Press the Enter key to enter the selected item.
4) Press the Enter key again to check settings.

5. Failure event checkup

1) Press the Up and Down keys at the same time to display “1.O-C” (recent failure events).
Note) When no failure events are stored, “1.non” is displayed.
2) Use the Up/Down keys to select an event and press the Enter key to go to the selected event.
3) The R-phased failure current is displayed. Every time the Down key is pressed, S-phased failure current, Tphased failure current, overload rate and date are displayed one after the other.
4) Press the Test/Reset key to move back to the previous mode.
5) Press the Up and Down keys at the same time to get out of the failure event checkup mode.

6. Forced thermal reset

When the system is tripped while it is in the thermal inverse time mode, if you want to turn the EMPR into the cold mode by resetting the motor’s heat amount, Press the Enter and Test/Rest keys at the same time.

* When a trip occurs due to the thermal excess current, if the motor is started right after it is reset, as the motor is hot, it is highly likely that the motor is tripped again.

Operation & setting method

Setting menu (A Group)

Group	Menu	Setting Value	Description	Default Value
A	1.CHA	dEF/th/n-th	Operation Characteristics (Definite/Thermal Inverse/Inverse)	n-th
	2.0-t	1~60s	Operation Time (sec)	60
	3.d-t	1~200s	Delay Time (sec)	If dEF
	4.r-C	0.5~10A/5~100A	Rated Current	Max. value
	5.Ctr	0.25, 0.5, 1~200 note 1)	CT Ratio (4 times, twice, once)	1
	6.Loc	Off, 200~800%	Lock Protection (sec)	Off
	7.StL	Off, 150~500%	Stall Protection (sec)	Off
	8.P-F	Off/On	Open Phase	Off
	9.P-U	Off, 10~70%	Unbalance Protection (%)	Off
	10.rP	Off/On	Reverse Phase	Off
	11.UC	Off, 30~90%	Under Current Protection (%)	Off
	12.gF	0ff, 0.03, 0.05/0.1~3A	Ground Fault Operation Current (Zero sequence CT) (A)	Off
	13.gn	Off, 20~500% (FLCmin) note 2)	Ground Fault Operation Current (Residual circuit) (FLCmin)	Off
	14.gt	0.05, 0.1~1.0s	Ground Fault Operation Time(sec)	-
	15.gd	On/Off	Ground Fault Delay During Start	On
	16.IC	Off, 500~1000%	Instantaneous Protection (%)	Off
	17.AL	I-tp, I-AL, ALo, U-C, OrH	07-08 Output setting (see the output information described below.)	I-tp
	18.Ar	On, 60~110/10% note 3)	07-08 Output setting (current or no current, and alarm)	On
	19.cS	1A1b, 2A, 2b	Contact (95-96, 97-98) Setting	1A1b

Note) 1. In case of CT ratio, rated current setting S/W is not displayed; in case of 100A product, 5.Ctr(CT) item is not displayed.
2. In case of 10A rating, it is possible to set to 0.1~2.5A; in case of 100A rating, it is possible to set to 1~25A.
3. No. 18 menu appears only if "ALo" is enabled in No. 17 menu.
(On: if a current is recognized, 07-08 contacts are displayed. 60~110%: if an on-load current value is higher than a set load factor, 07-08 contacts are displayed.)
4. No. 17 menu operation

17.AL Setting		Output conditions	Alarm display type	
			Motor operation	07-08
	I-tp	Detect instantaneous current	Motor stop	NC
	I-AL	Detect instantaneous current	Keep status	NC
	U-C	Detect on-load less than low current set value	Keep status	NC
	OrH	Set and display operating time	Keep status	NC
	ALo	Select 18.Ar setting	Comply with the set value of the No. 18 item	
18.Ar Setting		If ALo is set in the No. 17 menu	Motor operation	07-08
	On	Display on-load status(I > 0A)	Keep status	NC
	60~110%	On-load of current higher than a set value	Keep status	NC

19.cS Setting	Output conditions	Contact display type	
		95-96	97-98
1A1b	Normal operation status	NC	NO
	Ground fault/leakage accident	NO	NC
	Failures including overcurrent, phase failure, reverse phase, and ground fault	NO	NC
2A	Normal operation status	NO	NO
	Ground fault/leakage accident	NO	NC
	Failures including overcurrent, phase failure, reverse phase, and ground fault	NC	NO
2b	Normal operation status	NC	NC
	Ground fault/leakage accident	NC	NO
	Failures including overcurrent, phase failure, reverse phase, and ground fault	NO	NC

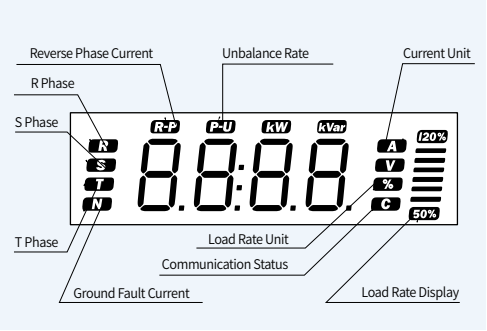
Setting menu (B Group)

Group	Menu	Setting Value	Description	Default Value
B	1E-r	On/Off	Electric Reset	On
	2A-r	Off, 1~20min	Automatic Reset (min)	Off
	3r-t	Hour/Minute	Run Time	Time Check
	4Srt	Off, 1~8760 time	Run Time Setup (Hour)	-
	5.5-d	2009/01.01/00:00	YY/MM/DD/ HH:MM (View/Setup)	-
	6.trt	Day/time : min	Total Run Time	Time Check
	At-d	0.5~10/5~100A	20mA Output settings	A420 model
	A.Adr	1~247	Communication address	M485 model
	b.bPS	96/192/384	Communication speed	
	c.S-P	On/Off	SWAP	

Note) 1. If power is first supplied or power is recovered after outage, make sure to enter date information (5.-sd).
2. Auto reset is applied only to overcurrent Trip.

Operation display

display	Description	Remark
0-C	Over current Trip	Operate within predefined time.
U-C	Under current Trip	Operate within 3 seconds
P-F	Open Phase Trip	Operate within 1.5 seconds when the unbalance rate is over 70%.
P-U	Unbalance Trip	Operate within 3 seconds. note 4)
Loc	Lock Trip	Operate within 0.5 seconds. note 4)
StL	stall Trip	Operate within 3 seconds.
r-P	Reverse Phase Trip	Operate within 0.1 second.
G-F	Ground Fault Trip	Operate within predefined time.
Sho	Instantaneous Trip	Operate within 0.05 seconds.
OrH	Elapsed Time (No Trip)	The operation time is reset when the Reset key is pressed.
CErr	Communication Fault between Body and Display (Press the ENTER/RESET key to return to the normal mode)	
uErr	Different program version between main body and display part (if this message appears, contact our company.)	



Note) kW, kVar, and V indicate the specification of the voltage models (under development).

Note) 1. The maximum allowable operating time of Loc function and reverse phase function is +50mSec.
2. Reverse phase function is detected for one second at the time of startup.
3. The allowable operating time of the instant function is +20mSec.
4. Inverse time: detect after O.t, Definite time: detect after D-t

7. IMP Specifications for low voltage 3-Phase induction motors (Reference)

Full Load Current for the Motor	IMP Settings			External CT	Motor Output (Less than kW)		
	Current Selection S/W	Wire Tunnel	CT ratio		220V	380V	440V
0.7A or less	0.5~10A	4 times	0.25	-	0.1	0.18	0.2
0.7~1.6A		Twice	0.5	-	0.25	0.55	0.6
1.6~8A		Once	1	-	1.5	3	3.7
7~100A	5~100A	Once	1	-	25	45	55
90~120A	0.5~10A	Once	30	SCT-150	30	55	55
120A~160A		Once	40	SCT-200	45	75	90
160~240A		Once	60	SCT-300	55	110	132
240~320A		Once	80	SCT-400	90	160	160
320~400A		Once	100	500 : 5	110	200	200
400~480A		Once	120	600 : 5	132	250	250
480~640A		Once	160	800 : 5	160	320	320

Note) 1. This table is written based on the full load current.
2. The CT is selected as a reference for the EMPR's current setting range.

Operation & setting method

8. Analog (DC 4~20mA) output

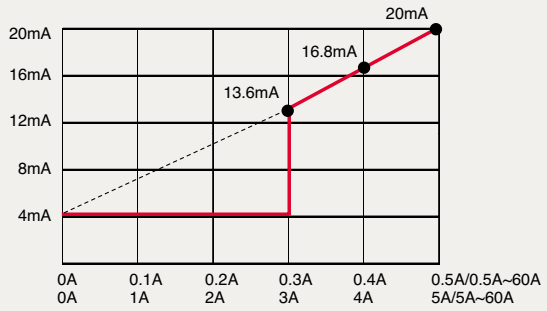
1) The biggest current out of measured 3-phase currents is converted into DC 4mA~20mA and the current measured remotely by digital meter can be displayed.
2) When there is no current, 4mA is sent. If the current goes beyond the predefined value, 20mA is sent.

• Output Current = $\frac{16\text{mA}}{\text{Setting}} \times$ Load Current + 4mA (Settings are changed in A.t-d of b-gr)

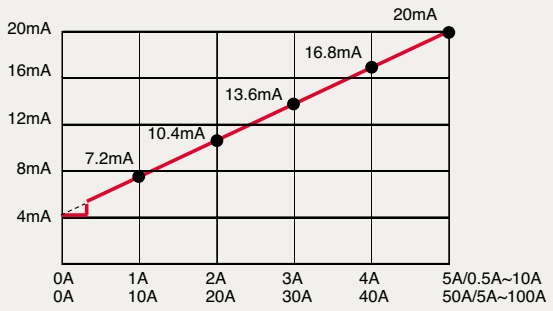
3) When the system is the 0.5A~10A setting mode, measurement starts from 0.3A. When the system is the 5A~100A setting mode, measurement starts from 3A. Thus, when the current is under 0.3A (3A), 0A is measured and output is 4mA. (To measure the load current correctly, an appropriate CT should be used).

Note) The allowable burden is less than 500Ω. Considering the receiver resistance (usually 250Ω) and track resistance), the shielding cable should be used.

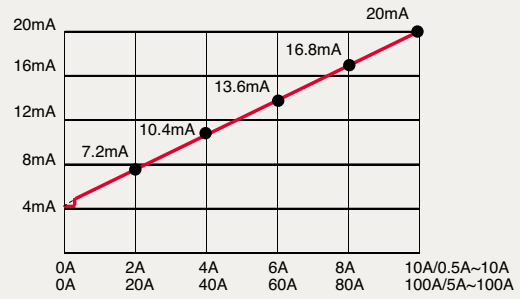
Analogue output when the output is set to be 0.5A (5A)



Analogue output when the output is set to be 5A (50A)

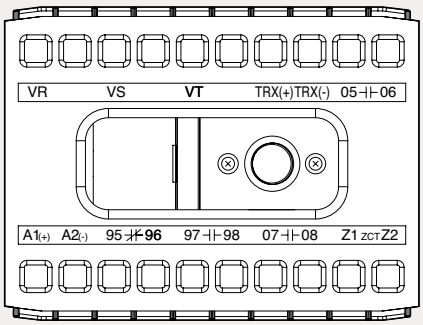


Analogue output when the output is set to be 10A (100A)



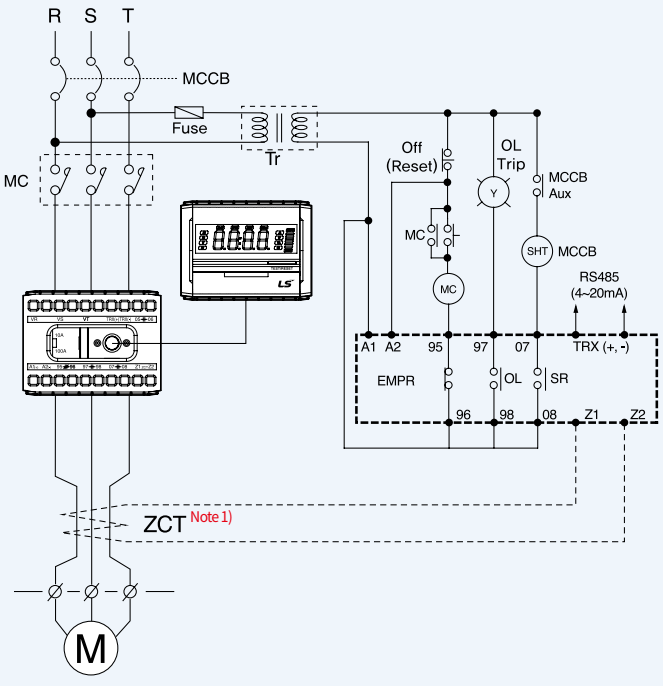
Terminal configuration / Wiring & cable connection

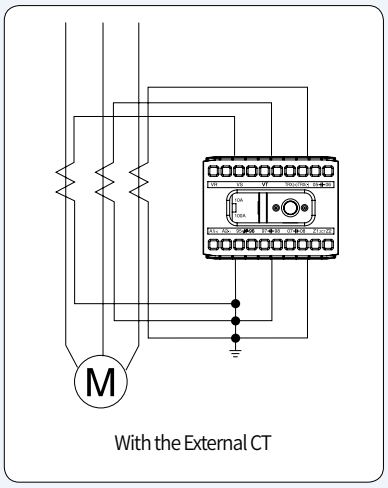
Terminal configuration

Terminal layout	Communication specification
	• Operation mode: Differential • Distance: Max. 1.2km • General RS-485 shielded twist 2-pair cable • Baud rate: 9600/19200/38400bps • Transmission Method : Half-Duplex • Max. In/Output Voltage : -7V~+12V

Engrave	Description	Remark
A1(+), A2(-)	Input terminal for operation power	AC/DC85~245V
95-96	When the power is ON (NC contact output)	Settings Menu Reference
97-98	When the power is ON (NO contact output)	
07-08	Converted to the NC mode only when an instantaneous trip occurs.	
Z1, Z2	Output terminal for the zero-phase sequence current transformer	Specific ZCT (for the EMPR)
TRX(+)	RS485 terminal (TRX+) Or 4~20mA (+) output	M485, A420 Type
TRX(-)	RS485 terminal (TRX-) Or 4~20mA (-) output	
VR/VS/VT	3-phase voltage input terminal	Specifications not available for IMP-C models
05-06	Output terminal for voltage protection	

Note) 1. The 3-phase voltage input terminal and 05-06 output terminal should be connected only for voltage protection models, which will be released in the future.
2. For RS485 connection, the terminal resistance should be 120Ω.
3. For 4~20mA current, the maximum burden should be less than 500Ω.



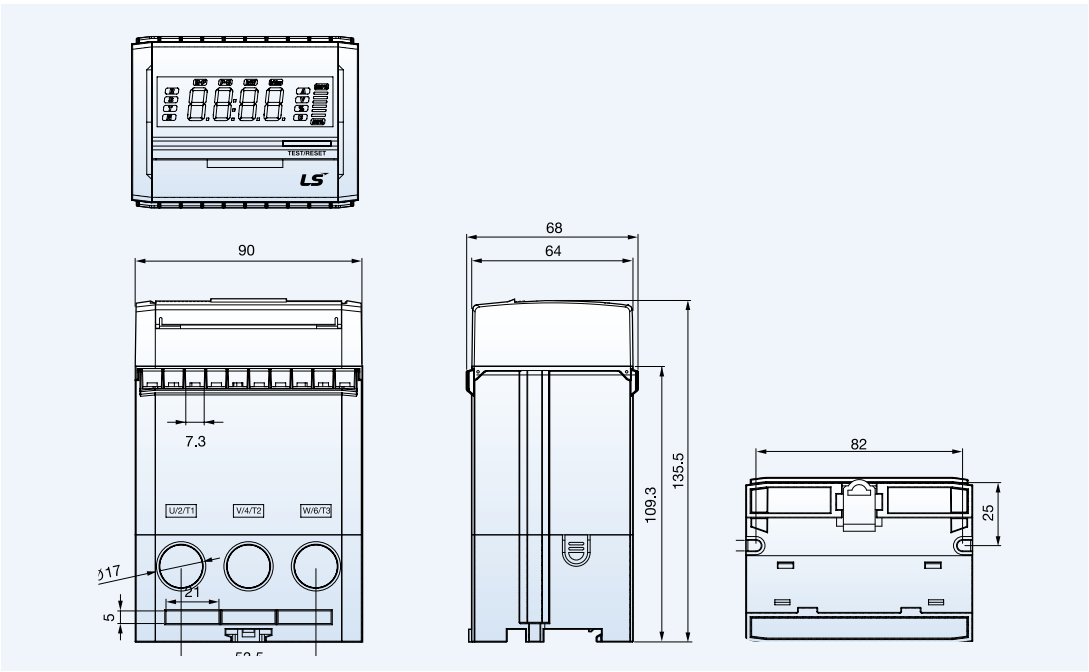


Note) 1. When the zero-phase-sequence current transformer is used to detect ground faults, connect the ZCT.
2. When the single-phase motor is used, all phases are connected except the S phase, and open-phase, unbalance and ground fault should be set OFF.
3. It is possible to change settings of output contact(95-96, 97-98, 07-08) at your discretion.

Dimensions

One-body type

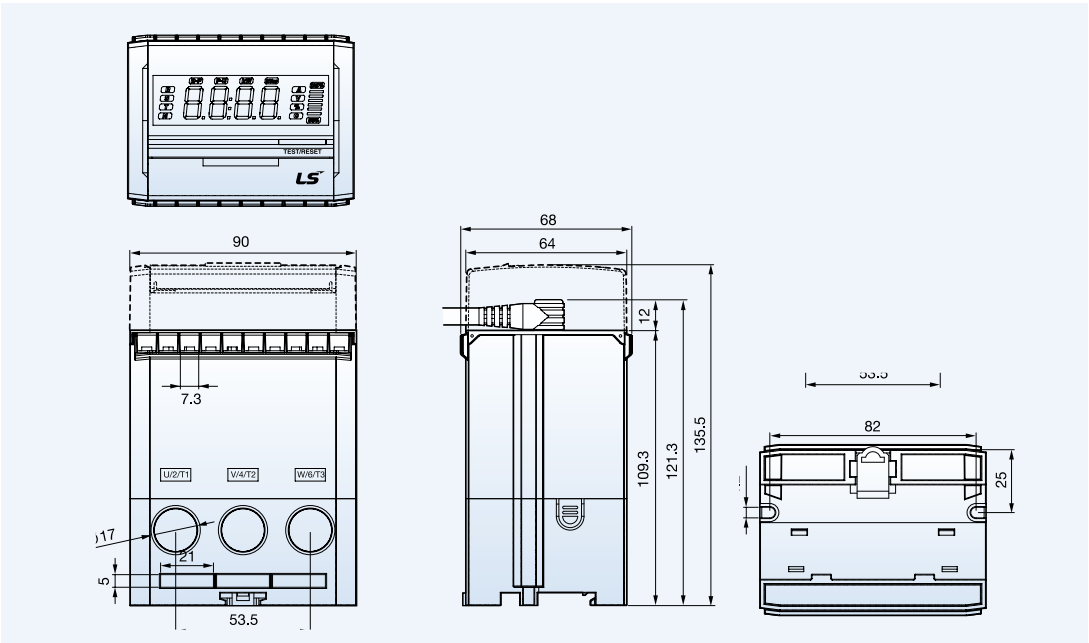
Unit : mm

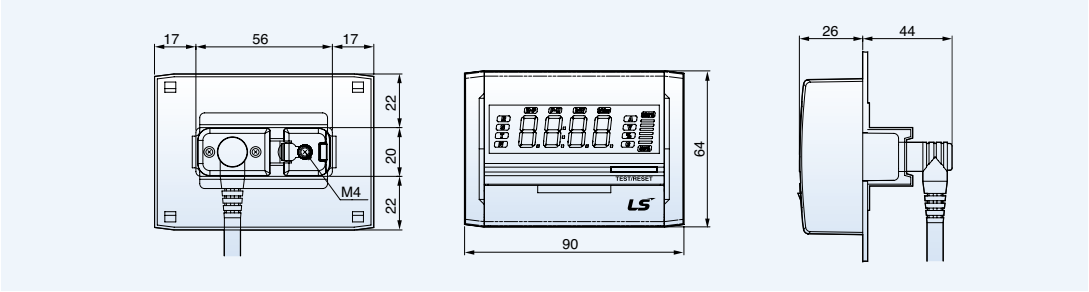


Note) The cable should be purchased separately (1m/1.5m/2m/3m).

Separate body type

Unit : mm





Memo

FUTURING SMART ENERGY

We open up a brighter future through
efficient and convenient energy solutions.

Safety Instructions

- For your safety, please read user's manual thoroughly before operating.
- Contact the nearest authorized service facility for examination, repair, or adjustment.
- Please contact qualified service technician when you need maintenance.
  Do not disassemble or repair by yourself!
- Any maintenance and inspection shall be performed by the personnel having expertise concerned.

- According to The WEEE Directive, please do not discard the device with your household waste.

LS ELECTRIC

www.ls-electric.com

■ Headquaters

127, LS-ro(hogye-dong) Dongan-gu, Anyang-si, Gyeonggi-Do, 14119, Korea

■ Seoul Office

LS Yongsan Tower, 92, Hangang-daero, Yongsan-gu, Seoul, 04386, Korea
Tel: 82-2-2034-4916, 4684, 4429

■ Overseas Subsidiaries

- **LS ELECTRIC Japan Co., Ltd. (Tokyo, Japan)**
  Tel: 81-3-6268-8241 E-Mail: japan@ls-electric.com
- **LS ELECTRIC (Dalian) Co., Ltd. (Dalian, China)**
  Tel: 86-411-8730-5872 E-Mail: china.dalian@lselectric.com.cn
- **LS ELECTRIC (Wuxi) Co., Ltd. (Wuxi, China)**
  Tel: 86-510-6851-6666 E-Mail: china.wuxi@lselectric.com.cn
- **LS ELECTRIC Vietnam Co., Ltd. (Hanoi, Vietnam)**
  Tel: 84-222-2221-110 E-Mail: vietnam@ls-electric.com
- **LS ELECTRIC Middle East FZE (Dubai, U.A.E.)**
  Tel: 971-4-886-5360 E-Mail: middleeast@ls-electric.com
- **LS ELECTRIC Europe B.V. (Hoofddorp, Netherlands)**
  Tel: 31-20-654-1424 E-Mail: europartner@ls-electric.com
- **LS ELECTRIC America Inc. (Chicago, USA)**
  Tel: 1-800-891-2941 E-Mail: sales.us@lselectricamerica.com
- **LS ENERGY SOLUTIONS LLC (Charlotte, USA)**
  Tel: 1-704-587-4051 E-Mail: cmfeldman@ls-es.com
- **LS ELECTRIC Türkiye Co., Ltd. (Istanbul, Türkiye)**
  Tel: 90-212-806-1252 E-Mail: turkiye@ls-electric.com
- **LS ELECTRIC IBERIA S.L.U. (Madrid, Spain)**
  Tel: 34-910-28-02-74 E-Mail: iberia@ls-electric.com

■ Overseas Branches

- **LS ELECTRIC Tokyo Office (Japan)**
  Tel: 81-3-6268-8241 E-Mail: tokyo@ls-electric.com
- **LS ELECTRIC Beijing Office (China)**
  Tel: 86-10-5095-1631 E-Mail: china@lselectric.com.cn
- **LS ELECTRIC Shanghai Office (China)**
  Tel: 86-21-5237-9977 E-Mail: china@lselectric.com.cn
- **LS ELECTRIC Guangzhou Office (China)**
  Tel: 86-20-3818-2883 E-Mail: china@lselectric.com.cn
- **LS ELECTRIC Chengdu Office (China)**
  Tel: 86-28-8670-3201 E-Mail: china@lselectric.com.cn
- **LS ELECTRIC Qingdao Office (China)**
  Tel: 86-532-8501-2065 E-Mail: china@lselectric.com.cn
- **LS ELECTRIC Nanjing Office (China)**
  Tel: 86-25-8467-0005 E-Mail: china@lselectric.com.cn
- **LS ELECTRIC Bangkok Office (Thailand)**
  Tel: 66-90-950-9683 E-Mail: thailand@ls-electric.com
- **LS ELECTRIC Jakarta Office (Indonesia)**
  Tel: 62-21-2933-7614 E-Mail: indonesia@ls-electric.com
- **LS ELECTRIC Moscow Office (Russia)**
  Tel: 7-499-682-6130 E-Mail: info@lselectric-ru.com
- **LS ELECTRIC America Western Office (Santa Fe Springs, USA)**
  Tel: 1-562-903-5527 E-Mail: america@ls-electric.com
- **LS ELECTRIC India Office (India)**
  Tel: 91-80-6142-9108 E-Mail: Info_india@ls-electric.com
- **LS ELECTRIC Singapore Office (Singapore)**
  Tel: 65-6958-8162 E-Mail: singapore@ls-electric.com
- **LS ELECTRIC Italy Office (Italy)**
  Tel: 39-030-8081-833 E-Mail: italia@ls-electric.com

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