

A Solution beyond the electricity.

Be the Best No.1 choice

Electric Equipment Proposal



OUR VISION

To continue playing a leading role in all of our customers' innovation, we stay one step ahead of the rest of the world.



The heart of LSIS vision lies in Innovation, while also transforming itself into not just Korea's leader, but a world leader as well. The company is realizing its new vision through globally acknowledged products, abundant human resources, and a strong corporate culture. Each employee at LSIS will be an Innovator of Innovation as the company grows into a leading business that can guide customers across the world to innovation.

Solution provider

New Face & New Resolution To become a global leader that gives top priority to customer values

We promise you that LSIS will be reborn as a corporation that returns the best values to its customers. We are committed to global product development, driving future growth, and expanding the overseas market share, as well as consolidating existing business. Join us in a future where LSIS will become a genuine global leader.



Customer Satisfaction through Quality & Service

The best products come from LSIS



Cheongju Plant (Korea)



Busan Plant (Korea)



Dalian Plant (China)



Wuxi Plant (China)



Hanoi Plant (Vietnam)



Chonan Plant (Korea)



Wuxi Plant (China)

Electric Power Industry | Electric Equipment & Systems

The electric equipment and systems of LSIS, ranging from low to high voltage products, have not only acquired ISO 9001 and 14001 certification for their efficient design and excellent quality, but many other certificates, including KEMA, TÜV, CESI, ASTA, and KERI. The outstanding quality of the products that we are manufacturing conforms to international standards such as IEC, UL, ANSI, CCC, JIS, and KS.

We also provide Total Solutions that encompass customized designs and more advanced technology, as well as efficient production and installation, and highly accurate testing and analysis of power equipment.

Automation Industry | Automation Equipment, Industrial IT & RFID

LSIS, a leading pioneer of the domestic automation business, developed the first ever PLC, Inverter (AC Drive), and DCS in Korean automation history. We now provide Total Solutions through the diverse application of our own products, ranging from controllers to control systems that are based on sophisticated technology and proven experience, to bring innovative change to distribution systems and logistics.

Research & Development

The world-class Power Testing & Technology Institute guarantees certified products and global brands.

The PT&TI is an accredited testing laboratory that provides a worldwide testing service with a 1500MVA-capacity High Power Laboratory, a High Voltage Laboratory, and a Reliability Testing Laboratory. Its testing has been fully acknowledged and recognized by overseas testing certification bodies, such as KEMA of Netherlands, UL of America, and CE of the EU for its low voltage testing.



Global technology and R&D are behind the best industrial Electric power and automation products from LSIS

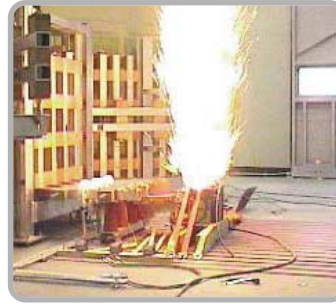
PT&T Quality Test at PT&T



High Voltage Test / Impulse Test



Characteristics Test / VCB Characteristics Test



Short-Circuit Test / ACB Breaker Test



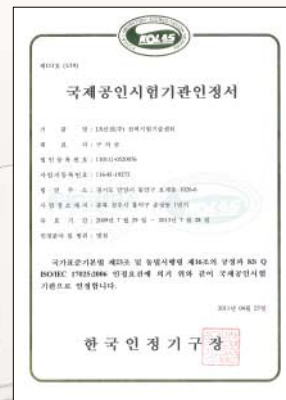
Environmental Test /
Non-stop High Temperature Test



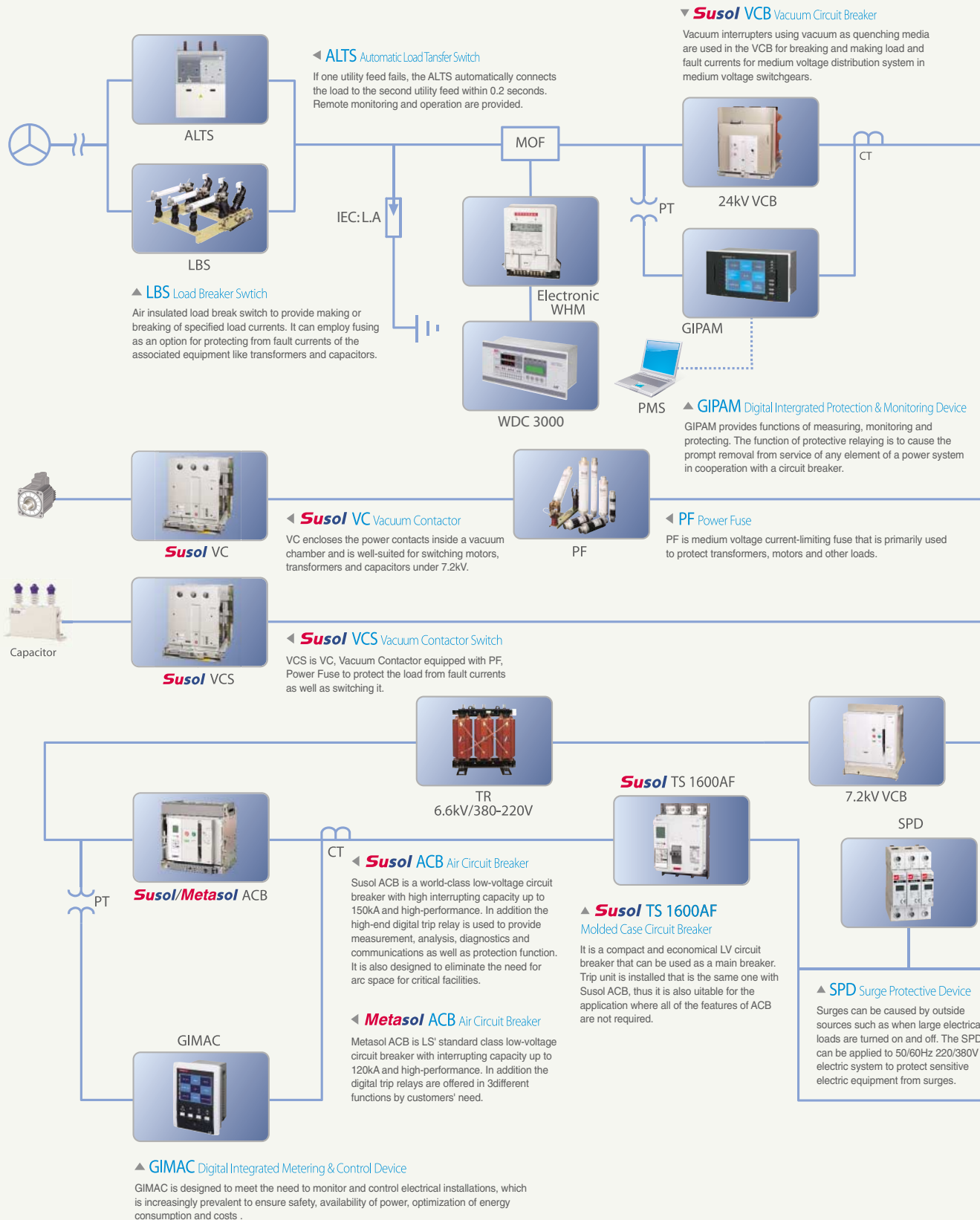
KOLAS | Korea Laboratory Accreditation Scheme

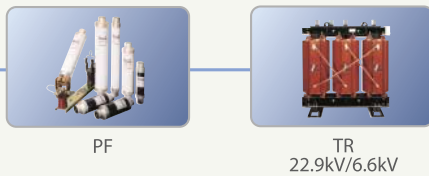
KOLAS evaluates the technical competence of testing and calibration laboratories based on the general requirements of ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories and specific technical requirements of each field. Laboratories that demonstrate competence and meet the requirements of KOLAS are granted accreditation.

Laboratories accredited by KOLAS are allowed to use the accreditation logo on their test reports for those tests in its scope of accreditation. And they are publicly listed in the KOLAS Directory and web site to allow customers to readily identify and access reliable testing and calibration services



System Configuration



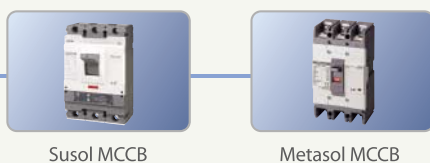


▼ **Susol MCCB** Molded Case Circuit Breaker

Susol MCCB is a world-class circuit breaker with high interrupting capacity up to 150kA and high-performance. 5 frame sizes cover the rated current upto 1600A and high-end digital trip units are also provided as well as broad range of accessories.

▼ **Metasol MCCB** Molded Case Circuit Breaker

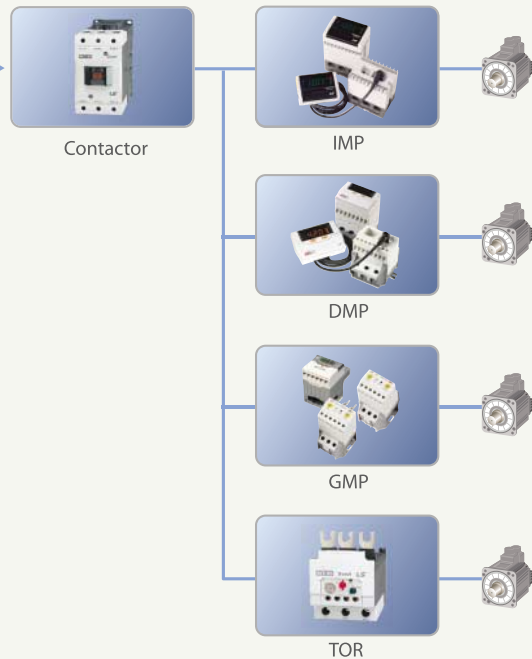
Metasol MCCB is LS' standard class circuit breaker for use in a wide variety of applications. Compact and various frames by interrupting rating are prepared for customer's need. ELCB that is 100% compatible with MCCB is provided.



Distribution Boards

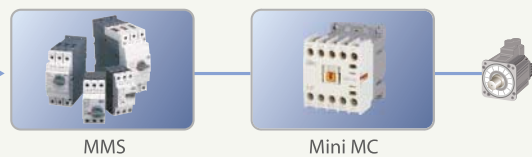
▼ **Susol/Metasol MS** Contactor & Overload Relay

A contactor is usually used to switch current to an electric motor or other high-power load. Large electric motors can be protected from overcurrent damage through the use of Overload Relays. LS provide Susol and Metasol series by the need of installation.



▲ **IMP,DMP,GMP** Electronic Motor Protection Relay

EMPR is electronic type protection relay in which the MCU, Microprocessor Control Unit is embedded. DMP and GMP series provide high-precision through real-time data processing, and IMP can check the current of each phase for ease to use and quick response if a fault occurs.



▲ **MMS** Manual Motor Starters

MMS is very compact and cost saving device equipped with the main functions that start and stop pushbuttons, an overload relay and a circuit breaker can provide. Frame sizes of 32, 63 and 100A are provided with many other accessories.

▼ **Mini MC** Mini-Contactor

LS' Mini MC series are provided as contactor, motor starter and control relay with compact size requires less panel space. Various terminal configurations and wide variety of accessories are main features.



◀ **MCB** Miniature Circuit Breaker

MCB, ELCB and RCD are provided in different design-mounting, characteristics, dimensions-according to IEC and other standards for consumer units and industrial boards for up to 10kA fault capabilities.



◀ **LCP** LS Circuit Protector

It is a circuit protector to protect the control circuits of the equipments like Semiconductor, LCD and machinery. It can replace the fuse of the equipment or be used with the fuse in combination.

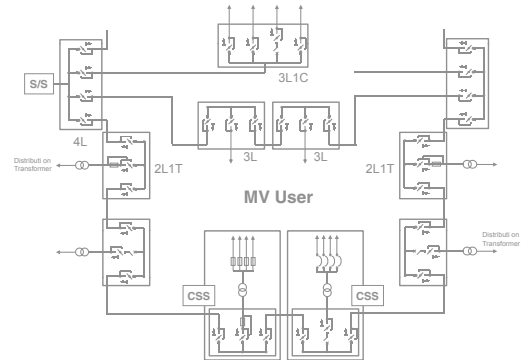
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Product Overview

Susol RMU

Susol RMU is a SF₆ gas insulated Ring Main Unit. It is a compact and comprehensive solution for secondary distribution networks up to 24kV and is mainly used for protection of transformers in compact substations.



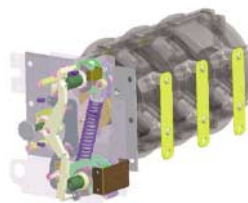
Proposed specification

- Rated Voltage[kV] 12, 17.5, 24
- Rated impulse withstand voltage[kV] 75, 95, 125
- Short-time withstand current 21kA/3s
- Internal arc fault current(1s, AFAL) 21kA
- Applied an automatic interlocking system
- Insulated by SF₆ gas
- Compact size (2L1C, 2L1F, 3L basis)
 - W×D×H: 1030×752×1400 (mm)
- Offering a choice between 2 types of RMU
 - Non-extensible (L: LBS, C: VCB, F: Switch-fuse combination): 1L1C, 2L1C, 2L2C.../1L1F, 2L1F, 2L2F, 3L1F.../1L, 2L, 3L...
 - Extensible (R: Bus riser, L: LBS, C: VCB, F: Switch-fuse combination): R/L/C/F
- Application (Mainly used in compact secondary substation)
 - Small industries
 - Buildings
 - Wind power plants
 - Airports
 - Under ground installations
 - Mining

Reason for proposal

- Enhanced safety
 - Impulse withstand voltage and short-time current
 - Internal arc withstand is tested for the operator safety. (21kA/1s, without SF₆ gas)
 - Cable compartment front cover interlocked with earthing switch
- Ease of arc suppression
- Saving cost
 - Compact design that requires minimum space to install and operates locally
- Supplied in various configuration
 - LCL type: Feeder protection by VCB
 - LFL type: Protection by LBS-Fuse combination
 - Extensible: Modular assemble switchgear
- Applied where compact, flexible and economic solutions are required

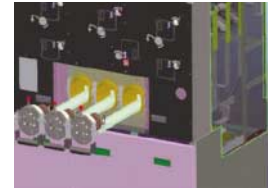
• Load Break Switch



• Circuit Breaker



• Switch-fuse combination



Load Break Switch

- Three position load break switch with disconnecter and earthing switch.
- Operating mechanism with two separate shafts for load & earth function.
- Earthing operation is available only through the "OFF" position (Not available through the "ON" position directly)
- Optional features
 - Motor operation for load break switch
 - Auxiliary contacts (LBS position: 2NO+2NC / Earthing switch position: 2NO+2NC)
 - Voltage indicating system
 - Short circuit and earth fault indicator

Circuit Breaker

- 200A vacuum circuit-breaker for transformer protection or 630A for feeder protection
- Three position with disconnecting & earthing switch
- Switch position indicator for CB and DS/ES
- Interlocking between CB and DS/ES
- Optional features
 - Motor operation for circuit breaker
 - Auxiliary contacts (CB position: 2NO+2NC / Disconnector position: 2NO+2NC / Earthing switch position: 2NO+2NC)
 - Voltage indicating system
 - Trip coil and closing coil

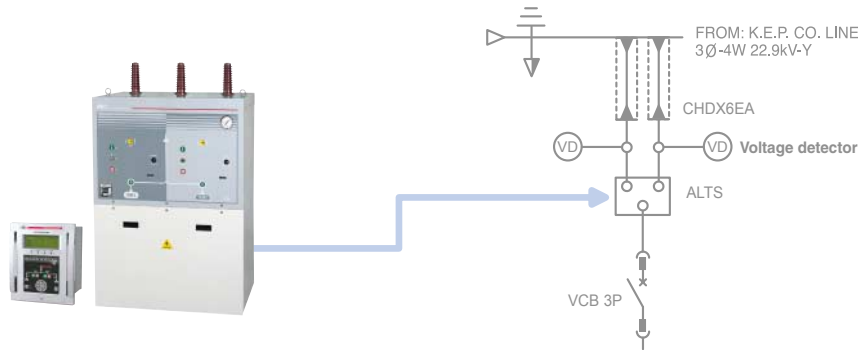
Switch-fuse combination

- The combination of load break switch and HRC power fuse
- Automatically tripped to protect transformers from fault current when a fuse is blown.
- The Fuse holder for DIN type fuse-links
- Fuse-link rating
 - 12kV: max. 100A, LSIS DIN type fuse-link
 - 24kV: max. 75A, LSIS DIN type fuse-link
- Optional features
 - Motor operation for switchfuse fuse combination
 - Auxiliary contacts (LBS position: 2NO+2NC / Earthing switch position: 2NO+2NC / Fuse blown status: 1C)
 - Voltage indicating system
 - Trip coil

Product Overview

Tri-MEC ALTS

LS Tri-NEC Automatic Load Transfer Switch is a customer oriented product that has maximized the ease of installation and use by adopting Air Insulation for the first time in domestic market as well as subminiature digital control box.



Proposed specification

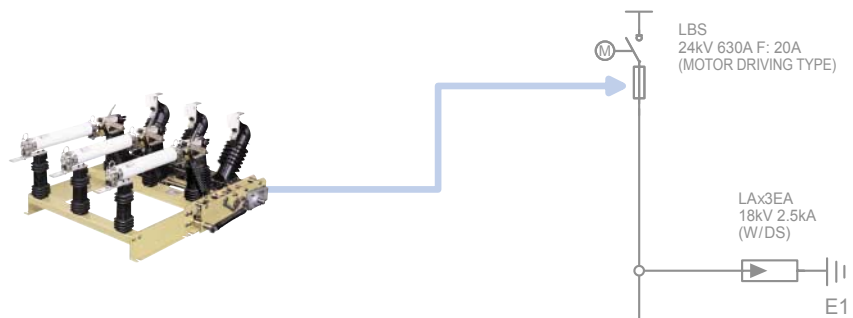
- Rated voltage / current - 25.8kV / 630A
- Load breaking current - 630A
- Rated making current - 630A
- Lightning impulse withstand voltage - 125kV BIL
- SF₆ gas minimum movement pressure - 0.14 (2)[psi.G/20°C]
 - stable load switching and excellent insulation recovery by using the high-speed Rotary Puffer Arc Suppression
- Operation mechanism - motor spring charge
- Number of circuits and switches - 3 circuits - 2 switches
- Anti-pressure panel : to prevent the explosion of a tank due to the expansion of SF₆ gas in case of an unexpected short-circuit inside a tank.
- Bushing (power supply module) : The potential for a gas leak of bushing itself is eliminated by using the O-Ring type bushing, which can be easily connected to the Dead Break type fittings.
- Air Insulation bushing (load side) : To facilitate the connection on the load module, the Air Insulation epoxy mold has been used so that you can get a connection to the Busbar or Cable without using fittings.

Reason for proposal

- Heightened ease of installation by reducing the size and weight
 - Adoption of Air Insulation for the first time in domestic market (Bus-bar or Cable connection on the connection)
 - Dramatic reduction in width of the distributing board (product width : 1470mm→806mm)
 - Attachment of a panel door on the control box
- Performance Enhancement
 - Rapid transfer time (10cycle, less than 167ms)
 - Increase of the rated short-circuit withstand current (12kA/1s→16kA/1s)
 - Function of monitoring open-phase of main power supply
- Performance Enhancement with the adoption of the digital control box
 - Status indicator function (Live wire status, Switch status, voltage, current, threshold and event)
 - Prevention of transfer act incurred due to occasional power outage with the function of transfer time
 - Function of selecting the main power supply (Power supply1, Power supply2, No selection)
 - Function of checking a phase (Power supply1 vs Power supply2)

Tri-MEC LBS

Adapting bendable type blade structure Tri-MEC LBS and ASS provide stable switching operation and require less panel depth than conventional linear type.



Proposed specification

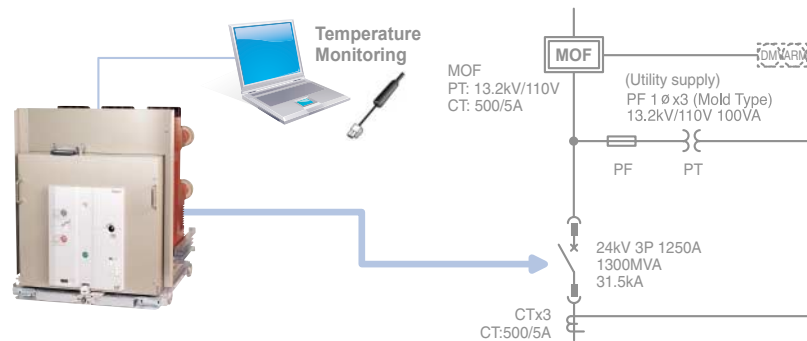
- Rating: 24kV 630A
- Short time withstand current: 20kA/1s (52kA peak)
- Up-graded performance
 - Conforming to IEC 60265-1 E2 grade
 - On-load switching 100 operations
 - No-load switching 1,000 operations
- Metal screen tested
 - Distance of metal to metal between phases acquired more than 215mm.
 - Enhanced safety through the angle of the arc eruption under 50°
- Space saving design
 - Three phase batch operation and fusing type available
 - Adapting bendable type blade structure

Reason for proposal

- Mechanical and thermal short-time capacity ensured
- Obtaining a reliable international standard
 - Certification according to the latest standard
 - Assured switching durability
- Perfect insulation stability and arc space secured even through minimum distance between phases
 - Minimized arc eruption to prevent ground fault
 - Operator's safety first design
- Space flexibility
 - Either vertical or horizontal installation
 - Simplification of maintenance

Susol VCB

Vacuum interrupters using vacuum as quenching media are used in the Vacuum Circuit Breaker for breaking and making load and fault currents in cooperation with a separately mounted protection relay in medium voltage switchgears for medium voltage distribution system.



Proposed specification

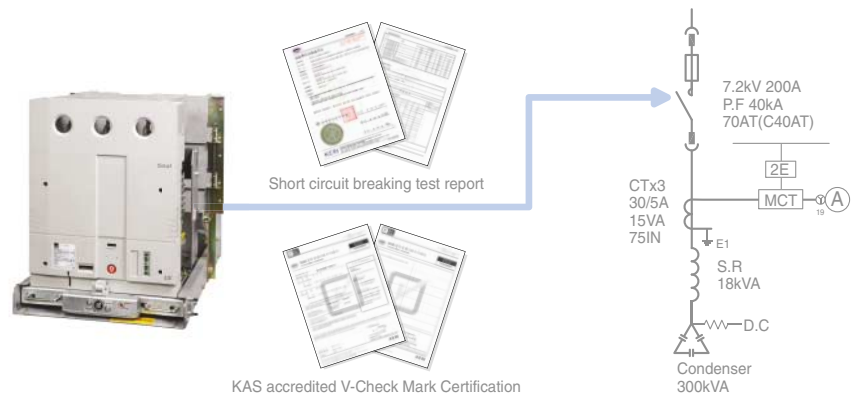
- Rated short time: 3 Sec
- Rated breaking time: 3 Cycles (50ms @60Hz)
- The latest standard IEC62271-100 (2008)
 - [M2, E2 (List1 or 3), C2]
- Temperature Sensor (Temperature Monitoring)
 - Modbus/RS-485/Profibus-DP
- High-speed reclosing feature
 - O-0.3s-CO-3min-CO
- Large VCB with Free Cooling System
 - High-Current temperature rise suppression
- Metal isolated CB Compartment
 - Apply to Metal Clad Switchgear

Reason for proposal

- Ensured mechanical and thermal strength in the event of short-circuit
- Fast separation of the system from the fault line
- Can deliver optimal interrupting ability against the repeated short-circuit
 - VI with excellency in the electrical and mechanical strength and charging current switching capacity
- Monitoring temperature rise of VCB terminals in the switchgear
 - On-site and remote monitoring
- Fast closing when reclosed to optimize the system recovery
 - Immediate control requirement for opening and closing
- Temperature rise suppression through natural cooling
 - Adoption of non-powered cooling system
- Proper for building independent compartment to minimize the spreading of accident.

Susol VCS

LS Vacuum Contactor with enhanced short circuit strength encloses the power contacts inside a vacuum chamber and is well-suited for switching motors, transformers and capacitors.



Proposed specification

- 3.6/7.2kV 200/400A
- Short time withstand current 6.3kA (16.4kA peak)
 - Top performance in its class
- Complete compatibility with existing products
- Various customer-oriented safety devices
- Equipped with an external withdrawable and metal shutter
 - Provide the safety of customers first
- Type tested by accredited lab according to IEC 60470
- VC + Fuse (VCS): 40kA type tested
- Standards: IEC 62271-106, V-Check

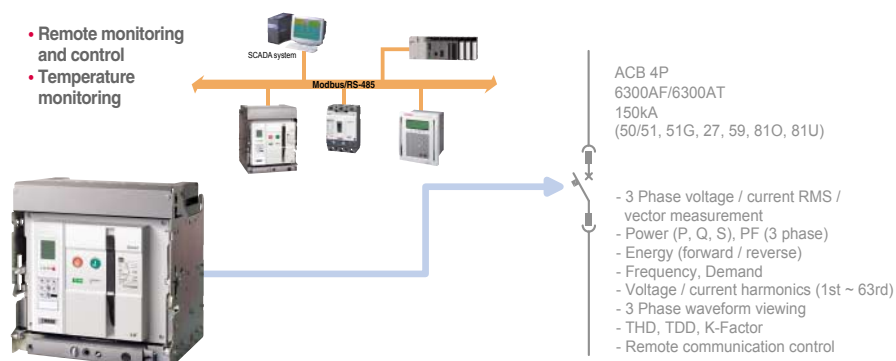
Reason for proposal

- Rated short-time capability ensured
- Flexible in replacing existing products
- Diversity in add-on additional functions
- Safe and ease of maintenance
 - Minimizing impacts of electrical accidents
- Reliability verification by an accredited agency
 - Standard specification requirements
- VCS performance verification through the short-circuit test (safety verified at under 40kA system)
- Ensured interrupting performance of Power Fuse combination type
 - VI performance ensured

Product Overview

Susol ACB

Susol ACB is a world-class low-voltage circuit breaker with high interrupting capacity up to 150kA and high-performance. In addition the high-end digital trip relay is used to provide measurement, analysis, diagnostics and communications as well as protection function. It is also designed to eliminate the need for arc space for critical facilities.



Proposed specification

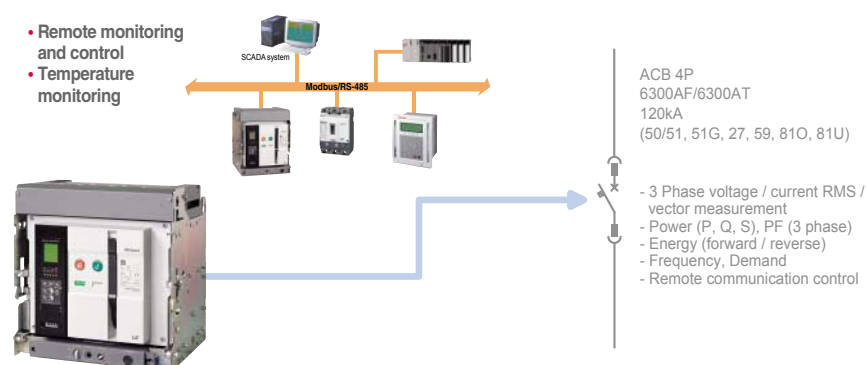
- KS (KS C 4620) approval
- Temperature Sensor (Temperature Monitoring)
 - Modbus/RS-485/Profibus-DP
- Direct remote control
 - Modbus/RS-485/Profibus-DP
- Earth leakage / ground fault protection by combination with outside CT and ZCT
 - 500mA and over can be detected
- Measurement and selective relaying protection
 - Voltage and current harmonic analysis / overvoltage / undervoltage / reverse power / frequency
- Fault / event record (256)
- Ics = 100% Icu
- 100% full rated for all N-phase
- UL model available

Reason for proposal

- KS approved as "low-pressure air circuit breaker"
- Temperature-rise monitoring on the energized parts of ACB terminals inside the panel
 - On-site and remote monitoring
- Remote control by ACB itself
 - Additional RTU, PLC, etc. not required
- Protecting life and equipment from earth leakage / ground fault
- Power quality analysis and voltage / frequency / power protection relaying by ACB
 - Power measurement analysis and complex protective relay elements
- Fault records management system
- Increased thermal and mechanical strength
- Increased nonlinear load disconnecting capability of N-phase
- UL Certified

Metasol ACB

Metasol ACB is LS' standard class low-voltage circuit breaker with interrupting capacity up to 120kA and high-performance. In addition the digital trip relays are offered in 3 different functions by customers' need.



Proposed specification

- KS (KS C 4620) approval
- Temperature Sensor (Temperature Monitoring)
 - Modbus / RS-485 / Profibus-DP
- Direct remote control
 - Modbus / RS-485 / Profibus-DP
- Earth leakage / ground fault protection by combination with outside CT and ZCT
 - 500mA and over can be detected
- Measurement and selective relaying protection
 - Overvoltage / undervoltage / reverse power / frequency
- Fault / event record (256)
- Ics = 100% Icu
- 100% full rated for all N-phase

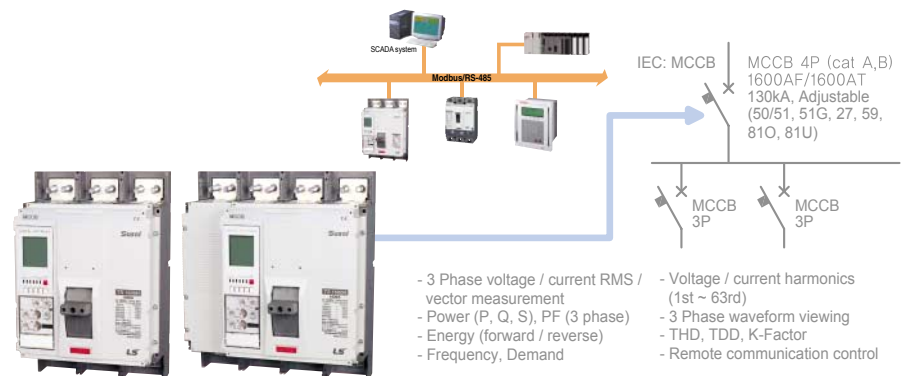
Reason for proposal

- KS approved as "low-pressure air circuit breaker"
- Temperature-rise monitoring on the energized parts of ACB terminals inside the panel
 - On-site and remote monitoring
- Remote control by ACB itself
 - Additional RTU, PLC, etc. not required
- Protecting life and equipment from earth leakage / ground fault
- Voltage / frequency / power protection relaying by ACB
 - Complex protective relay elements
- Fault records management system
- Increased thermal and mechanical strength
- Increased nonlinear load disconnecting capability of N-phase

Susol TS 1600AF

1600AF large MCCB

- 1000/1250/1600AF
- 50, 65kA @ 460V, Cat B
- 130kA @ 460V, Cat A
- Implementation of various protection
- Trip relay for ACB is used
- Diversification in connection



Proposed specification

- Rated insulation voltage (Ui) AC 1000V
- Rated impulse voltage (Uimp) 8kV
- Remote monitoring
 - Modbus / RS-485 / Profibus-DP
- Earth leakage / ground fault protection by combination with outside CT and ZCT
 - 500mA and over can be detected
- Measurement and selective relaying protection
 - Voltage and current harmonic analysis / overvoltage / undervoltage / reverse power / frequency
- Fault / event record (256)
- Ics = 75/100% Icu
- Icw = 1000ms 25kA (Category B)

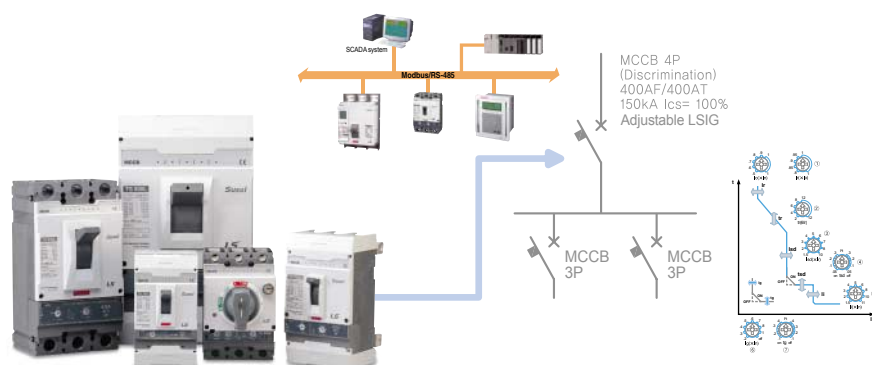
Reason for proposal

- Enhanced safety of switchgear system
 - Insulation and impulse voltage
- Remote monitoring by MCCB itself
 - Fault current, power, energy, etc
- Protecting life and equipment from earth leakage / ground fault
 - Setting values adjustable
- Power quality analysis and voltage / frequency / power protection relaying by ACB
 - Power measurement analysis and complex protective relay elements
- Fault records management system
- Increased thermal and mechanical strength
- Short-time withstand capacity

Susol MCCB

Susol MCCB is a world-class circuit breaker with high interrupting capacity up to 150kA and high-performance. 5 frame sizes cover the rated current upto 1600A and high-end digital trip units are also provided as well as broad range of accessories.

- 160/250/630/800/1600AF
- Super Performance
- 150kA (Ics = Icu)



Proposed specification

- Rated insulation voltage (Ui) AC 750V
- Rated impulse voltage (Uimp) 8kV
- Rated currents adjustable
 - LSIS configuration
 - Modbus communication monitoring
- Rated breaking current up to 150kA @ AC 415V
 - Discrimination supported
- Common accessory (AX, FAL, AL, SHT, UVT)
- Wide variety of accessories including electric operator
- Ics = 100% Icu (all products)
- Type II protection cooperation
 - With Susol / Metasol series contactors
- DC breaker available (maximum operating voltage DC 1000V)
- UL Model available

Reason for proposal

- Enhanced safety of switchgear system
 - Insulation and impulse voltage
- The flexibility of the rated current
 - Adjustable according to the increase or decrease of load
- Protection cooperation in accordance with the use of large transformer
 - Requires breakers with higher interrupting capacity
 - Minimizing power system outage
- Ease of using and management of internal accessories
 - Common use for all frames
 - The flexibility of replacement parts
- ON-OFF control remotely
- Ensured thermal and mechanical strength
- Protection coordination with contactors and overload relays
 - Continuity of operation required
- DC-only circuit breaker (German VDE test passed)
- UL certified series provided

Product Overview

Metasol MCCB

Metasol MCCB is LS' standard class circuit breaker for use in a wide variety of applications. Compact and various frames by interrupting rating are prepared for customer's need. ELCB that is 100% compatible with MCCB is provided.

- $I_{cs} = 100\% \phi I_{cu}$
- $U_i = 750V$
- $U_{imp} = 8kV$



Proposed specification

- Rated insulation voltage (U_i) AC 750V
- Rated impulse voltage (U_{imp}) 8kV
- Various frame sizes by interrupting rating
 - 30, 50, 60, 100, 125, 250, 400, 800AF
- Increased breaking capacity (vs. Meta-MEC series)
 - 10 $\Rightarrow$ 18kA, 25 $\Rightarrow$ 37kA, 35 $\Rightarrow$ 50kA, 50 $\Rightarrow$ 65kA
- Common accessory (AX, AL, SHT, UVT)
 - 30-250AF, 400-800AF
- $I_{cs} = 100\% I_{cu}$
- ELCB compatible with MCCB
- Discrimination supported
- Physically compatible with Meta-MEC series MCCB

Reason for proposal

- Enhanced safety of switchgear system
 - Insulation and impulse voltage
- The flexibility of the rated current
 - Adjustable according to the increase or decrease of load
- Protection cooperation in accordance with the use of large transformer
 - Requires breakers with higher interrupting capacity
- Ease of using and management of internal accessories
 - Common use between frames
- Ensured thermal and mechanical strength
- Flexible and rapid replacement
- Protection coordination when fault happens
- Existing products can be replaced without any change

Susol/Metasol MS

Contactor, Overload Relay & Starter

A contactor is usually used to switch current to an electric motor or other high-power load. Large electric motors can be protected from overcurrent damage through the use of Overload Relays. LS provide Susol and Metasol series by the need of installation.



Proposed specification

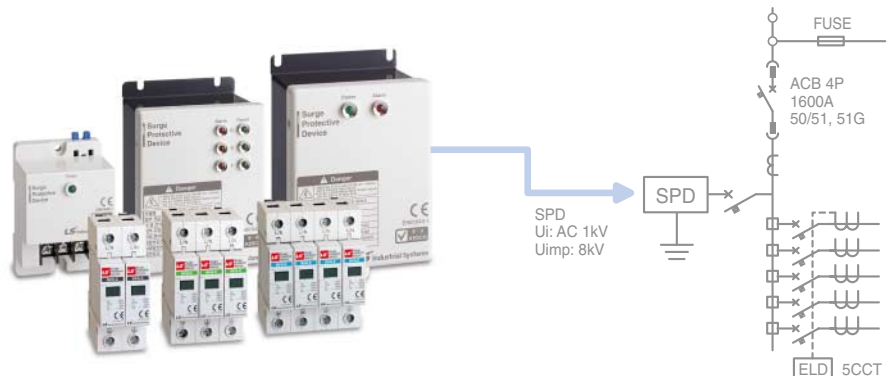
- Rated insulation voltage (U_i) AC 1000V
- Rated impulse voltage (U_{imp}) 8kV
- Longer electrical lifetime
 - 18/22AF: 2.5 mil. - 40/65/100AF: 2 mil.
 - 150/225/400AF: 1 mil. operations
- Increased rated current (Metasol MC)
 - 125 $\rightarrow$ 130A, 180 $\rightarrow$ 185A, 220 $\rightarrow$ 225A
 - 300 $\rightarrow$ 330A, 600 $\rightarrow$ 630A
- Improved current capacity (Susol MC)
 - 32AF (45%), 63AF (58%), 95AF (12%)
 - Electrical lifetime 1 $\rightarrow$ 2 mil. operations
- Four coil-terminal structure (~ 150AF)
 - Double arrangement for both line and load sides
- Sealing structure without arc leakage
 - Finger proof structure
 - Requirement of temperature-rise suppression
- Type II Coordination (with Susol MCCB)

Reason for proposal

- Enhanced safety of switchgear system
 - Insulation and impulse voltage
- Cost saving through longer life
 - Less inventory burden
- Easy to select the standard contactors by motors
 - Product configuration based on motor rating
 - Selection conforming to the standard
- Longer life and higher current capacity required
 - Electrical switching durability assurance
- Control power wiring flexibility
- Operation with minimizing arc when switching
 - Operator safety required
- Reliability assurance by system protection
 - Continuity of service after removal of short-circuit

SPD

Surges can be caused by outside sources such as when large electrical loads are turned on and off. The SPD can be applied to 50/60Hz 220/380V electric system to protect sensitive electric equipment from surges.



Proposed specification

[BKS Series]

- Poles : 1, 2, 3, 4-pole
- Mounting : on DIN-Rail
- Indication by mechanism

[SP Series (Box Type)]

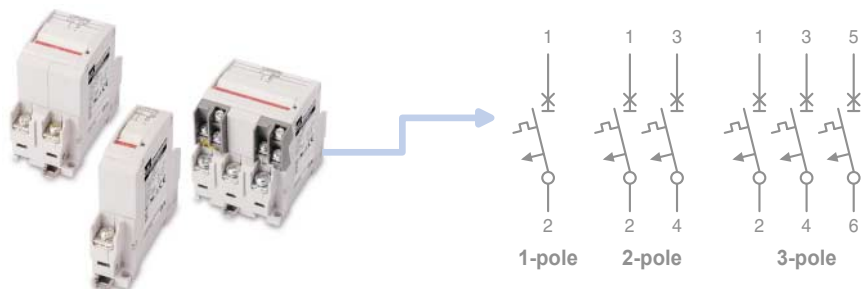
- poles : single phase 2W + G, three phase 3W + G, three phase 4W + G,
- Mounting : by screw
- Protection against lightning and surge overvoltage in the AC power system
- Related standard (KS C IEC 61643-1, 61643-12)

Reason for proposal

- To protect and reduce damages of sensitive electric equipment from lightning surge entering directly or indirectly into power system and transient
- Easy for replacement of the protection-element, and provides the basic specifications
- Connected to the power input terminal of precise control equipment
- Indicator to check the operation status of SPD
- Protection element, surge fuses, enclosures and accessory in one unit
- Can be used at the load side of ACB in LV
- Indicator to check the operation status of SPD
- Where the lightning shock current may be partially propagated
- LV switchboards and industrial lighting board where less lightning damage is expected
- Indoor outlet and consumer unit where less lightning damage is expected

LCP Circuit Protector

It is a circuit protector to protect the control circuits of the equipments like Semiconductor, LCD and machinery. It can replace the fuse of the equipment or be used with the fuse in combination.



Proposed specification

- Rate insulation voltage - 1-pole: AC250V / DC65V
- 2-pole: AC250V / DC 125V - 3-pole: AC 250V
- Rated interrupting current - 2.5kA at AC240V, DC 60V(1-p), DC120V(2-p)
- Rated current [A]
- 0.1, 0.3, 0.5, 1, 2, 3, 5, 7, 10, 15, 20, 25, 30
- Mounting - M4 screw or IEC35mm rail
- Type of trip - Hydraulic-Magnetic
- Withstand voltage - AC2000V, 1min.
- Endurance - Over 10,000 operations at rated current
- Featuring - AC / DC common use
- Slim size with 17.5mm width (1 pole) for compact panels
- Accessories - Auxiliary S/W, Alarm S/W, Terminal cover
- On / Off Status visible through window
- UL, CSA, TUV, CCC certification
- Conforming to UL1077, CSA, C22.2, NO.235, EN60934, IEC60934, CCC

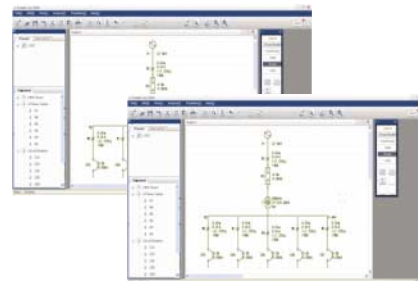
Reason for proposal

- LCP is used for overload protection
- Equipments can be protected fully if used in combination with a fuse
- Suitable for the equipments that small rated current (0.1 ~ 30A) and breaking capacity (3kA and less) are required
- Operating characteristic with middle speed
- Trip mechanism - Hydraulic Magnetic (Oil Dash Pot) system
- To protect semiconductor devices such as SCR with small overcurrent strength from over 10 times of the rated current
- Applications
- Telecommunications equipments: electronic exchanger, broadcast equipment, large computer
- Transportation equipments: elevator, conveyor, crane, train
- Others: air conditioner, rectifier, UPS, capacitors, battery, entertainment equipment, vending machines, medical equipment, control panel

Product Overview

LSPS

LS Power Solution supports the selection and design review of power distribution equipments. It provides a solution for the integrated protection cooperation of the low and medium voltage system.



• Functions

- Selection and design review of the equipments for distribution facilities
- Breaking capacity of circuitbreakers (Coordination Simulation)
- Report on model selection through the power system analysis

Susol Design

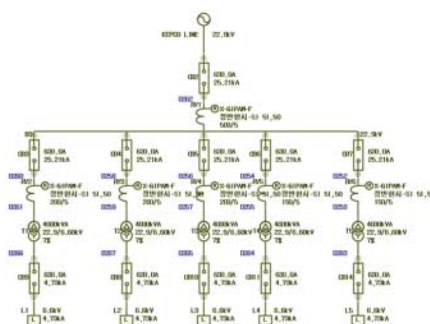
1. Fault calculation (IEC 60909)
 - Balanced and unbalanced, single-phase branch circuits
2. Automatic selection
 - Low and medium voltage circuit breakers & switches
3. De-rating
4. Low voltage protection cooperation
 - Discrimination and cascading
5. Type II Coordination
6. Correction of Relays
 - User input, and automatic correction
7. Drawing
 - Equipment rotation, multi-project
8. Report

Susol T-C Curve

1. Output and adjustment of the characteristic curve
 - Low voltage breakers, fuses
 - Motors and transformers
 - Relays
2. Protection coordination review
3. Current / voltage range conversion
4. Summary of a single line diagram
5. Marking of failure
6. Changing of axis setting
7. Report

Susol Coordination

1. Breaker search
 - Low voltage breakers
 - Medium voltage breakers
2. Protection coordination search
 - Discrimination
 - Cascading
3. Characteristic curve
4. Catalogue output
5. Report



• Susol Design Screen



• Selection of electric equipments from LS catalog

• HMI

- Provides User - friendly HMI
- Main screen, Drawing parts
- User-friendly function (copy, delete)
- Implementation of a number of the project windows
- Equipment rotation - Error message display

• T-C Curve

- T-C Curve output
- Protection coordination review function without fault calculating
- Single line diagram (full view of TC curve / up and down stream equipments)
- TC curve X/Y- axis scale change function - Fault Location mark

• CAD linked

- Single line diagram linked with CAD

• Report

• Provides detailed information

- Links to the website for catalogue when selecting a product

• Optional feature

- Messaging in case of violation in reviewing downstream breaker capacity

• Multilingual support

- Language packs (Korean and English as standard / Optional Russian, Chinese and Vietnamese)

• Search

- Circuit breaker selection and protection coordination review function without fault calculating
- Low and medium voltage circuit breakers search
- Low voltage breaker protection coordination review function.

X GIPAM

X GIPAM is the Digital Integrated Protection & Monitoring Device solution for more convenient and reliable power protection and monitoring system through the Easy Interface, User Friendly, High Accuracy and High Reliability.



Proposed specification

- Protection function - 50/51, 50/51N, 67G, 67N, 59, 27, 64, 47, 46, 49, 48/51LR, 79, 87T, 37, 66
- 8.4 inch large touch screen Color TFT LCD
- System MIMIC diagram
- Korean / English support, and user-selectable screen setting
- Modular design of H/W and S/W with flexibility
 - DI/DO board expandable up to 4 : Total DI 40 points, DO 32 points
 - AI/AO board expandable up to 2: Total AI 12 channels, AO 8 channels
- HMI detachable / integral
- Setting for the secondary rating of PT: 110 or 110 / 3
- Wave Capture available
- Waveform recording for the state changes of equipment
- Dedicated PC Manager Program Supported
 - Analysis of fault waveform and PQ, and checking protection coordination curves
- Supporting dual independent systems through two built-in communication ports
- 0.2% of the voltage and current measurement accuracy

Reason for proposal

- More convenient to operate via large screen
- Easier for monitoring and control by intuitive display of power system
- Improving the operator's convenience through language support and selection of the user screen
- Providing reliability by implementation of mutually independent functions of modules
 - RTU and PLC functionality built-in results cost savings in communication equipments
- Flexibility in mounting position and operator's convenience
- Detection of the fault voltage of the phase when ground fault happens (backup protection for voltage relay)
- A variety change of device status can be stored as a waveform
- Exact analysis on the fault thanks to the storing of various waveforms
- Convenience in setting for Protection element and control system
 - Accidents waveform (COMTRADE format support) and characteristic curve PLOT
- Establishing a Fail Safe communication system by preliminary communication line
- A variety of measurement items and monitoring

X GIPAM is the next generation of digital power monitoring & protection products with artificial intelligence which enables the establishing of power protection and monitoring system as it provides the functions like IEC 61850, Setting Group, Power PQ, and other control / monitoring.



Proposed specification

- Harmonic analysis spectrum 63rd support (THD, TDD, k-factor)
 - Analysis and measurement of Sag, Swell and Interruption
- IEC 61850 communication support
- Setting Group setting (up to 4 Groups)
- CB Capacity Limit (1st monitoring)
- Voice alarm and Mobile phone messaging (SMS)
 - Breaker status, relay operation and other accidents

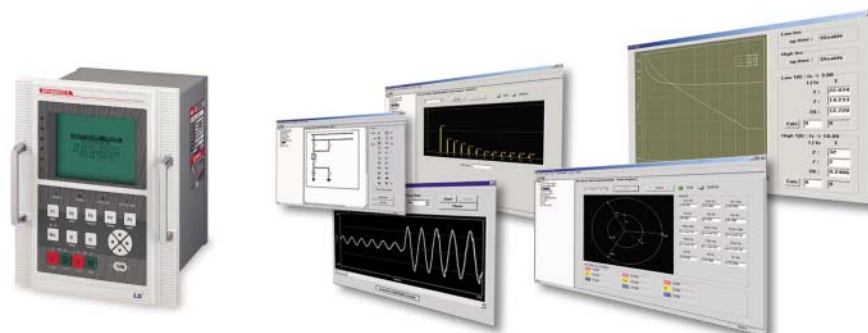
Reason for proposal

- Checking the stability of system through real-time monitoring of power quality
- Switching Device Control applying 4 of CB, DS and ES as standard
- Convenient collection of all data without additional PC or S/W
- Rapid response using the intuitive representation of voice on behalf of Buzzer
- Enable the immediate responding to the emergency situation of a remote user

Product Overview

GIPAM-2000

GIPAM 2000 is a Digital Integrated Protection & Monitoring Device and monitoring device providing various protective elements and measurement elements for fault monitoring and protection and comprehensive monitoring of the distribution equipments.



Proposed specification

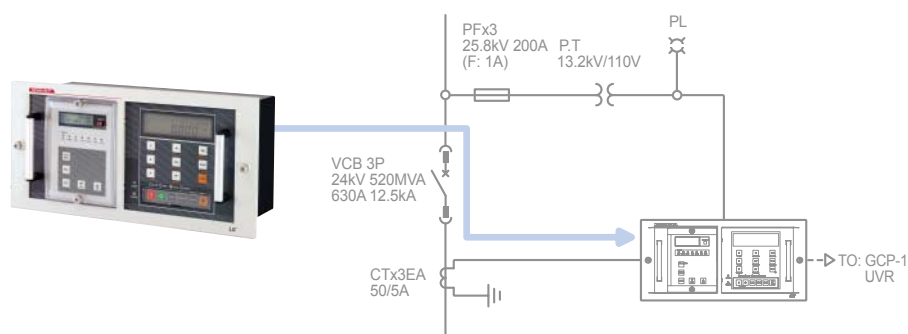
- Protection function - 50/51, 50/51N, 67G, 67N, 59, 27, 64, 47, 46, 49, 48/51LR, 79, 87T
- Covering PLC (Programmable Logic Controller) functions
- 320 x 240 Graphic LCD & MIMIC Diagram
- SOE (Sequence of Event) function
- Recording Event & Fault functions
 - Event up to 800, Fault up to 200
 - voltage and current waveforms with up to 128 cycles recordable over four times
- Displaying Harmonic Spectrum, THD (Total Harmonic Distortion)
- Combination of the two elements of characteristic curve of the relay should be available
 - Low Set / High Set, T / C Curve can be checked
- Power and Current Demand should be measured

Reason for proposal

- Operating signals of all I/O contacts and relay elements including Trip Relay to be operated by the Trip Logic created directly by the user
 - Inter-lock Sequence between relays and between switchgears
- System displayed in the form of One Line Diagram
 - Checking the operations of contacts or circuit breaker by output state
- Ease of inquiry about failure analysis and operation history
 - Saving events such as Relay, Circuit breaker operations and alarm contact output
- Saving cause, voltage, current and waveform of the fault
 - Fault waveform can be saved as Comtrade (IEEE) file formats
- Measurement and verification as for current and voltage up to the 2nd and 13th harmonics
- Setting precise protective cooperation curve taking into account the load characteristics
 - Checking the correction of values for relay via current-time curve
- Decision and prediction of expansion for the distribution system capacity

GIPAM-115FI

GIPAM 115FI is power protection and monitoring device with seven different protective factors and various instrumentation elements for the purpose of comprehensive monitoring and protection of the distribution equipments.



Proposed specification

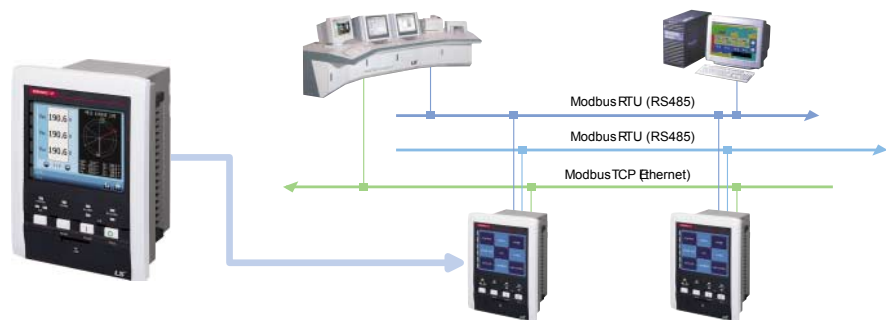
- 7 types of protective factors built-in as Digital arithmetic types
 - OCR, OCGR, OVR, UVR, OVGR, SGR, POR
- Displaying various measurement
 - Electrical measurements : V, A, W, VAR, WH, VARH, PF, F, Vo
 - Breaker operating time, number of operation and On/Off status
- Event & Fault Recording
 - Event : 128EA, Fault: 32EA
- High accuracy measurements
 - Voltage / Current: $\pm 0.5\%$, Power / Energy: $\pm 1.0\%$
- Self diagnostics, and power-outage compensation
- Data Communication
 - Universal RS485 Modbus and LS⁺ I-NET Communications

Reason for proposal

- Selectable configurations of protection functions in needs
 - Exact operating time to improve the reliability of protection and cooperation system
- Digital and Analog Bar Graph displayed on LCD for user convenience
- Saving cause, voltage, current and waveform of the fault
 - For the ease of fault analysis
- Improvement of measurement accuracy
- Providing high reliability through self-diagnostics by μ -Processor
 - NV-RAM adoption for over 10 years Data Back-up
- Establishment of power control and monitoring panel

GIMAC-V

GIMAC-V is of Digital Integrated Metering & Control Device and Automatic Power Factor Controller(APFC). Digital Integrated Metering & Control Device provides various functions including measurement with high-precision, power quality, harmonic analysis, circuit breaker control, DI monitoring and event recording in the distribution system.



Proposed specification

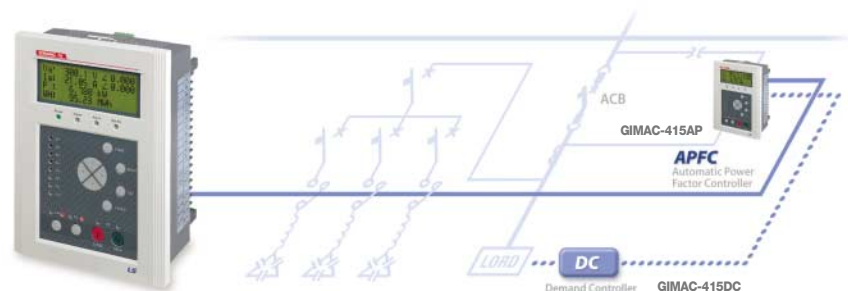
- Language supported on 6.5-inch Touch Graphic LCD
- Measurement of Power quality factors for both short-term and long-term change
 - Sag (voltage drop), Swell (voltage rise), Interruption (power loss)
 - Capture of real-time waveforms and Transient Voltage (1,024 Sampling)
- High accuracy measurements: 0.2% for single and 0.5% for complex
 - Measurement of phase, harmonics (max. 63rd harmonics) and demand
 - Measurement of K-Factor and Crest Factor
- Metering & Measurement: V, VO, V2, I, IO, I2, ϕ , W, WH, VAR, VARH, VA, F, PF DPF, Demand(W, I), THD(V,I), Analog Input
- Event recording
 - Up to 512 events including PQ event
- Dedicated PC Manager Program Support
 - PC connection via USB communication
- Support ing 3-way communication: Mod RTU RS485, Mod TCP Ethernet

Reason for proposal

- More convenient to operate via large screen and language support
- Prevention of equipment problems due to momentary and long-term voltage fluctuations
 - An increase of harmonics due to nonlinear loads sensitive to power quality
 - Oscillograph views, Transient Waveform Analysis
- Various measurement factors and easier power quality analysis
 - Inquiry and analysis of current trend
- Enable the analysis of various events such as breaker operation, contacts change, settings change, etc.
 - Storage of maximum, minimum and average for 110 days, and trend analysis
- For device setting, harmonic analysis graphs, demand trend and event Inquiry
- Two RS485 and one Ethernet communication ports are provided to support independent communication through each port

GIMAC-IV

GIMAC-IV is composed of Digital Integrated Metering & Control Device, Automatic Power Factor Controller(APFC) and Demand Controller. Digital Integrated Metering & Control Device provides various functions including various measurement with high-precision, harmonic analysis, circuit breaker control, and event recording in the distribution system.



Proposed specification

- Certified by KERI as a high-efficiency energy product (APFC)
 - Control for upto 8 capacitor banks or loads
 - Seeking optimal power factor control through automatic / manual, circulation and combination controls
- Peak demand power control (Demand Control)
 - Power management of peak demand through automatic / manual and priority control
- Metering & Measurement: V, VO, V2, I, IO, I2, ϕ , W, WH, VAR, VARH, VA, F, PF, DPF, Demand(W, I), THD(V, I), Analog Input
- Accuracy: $\pm 0.2\% \sim 0.5\%$
- Event recording
 - Storing up to 300 events
- Analog Input contacts can be input
- Support ing DNP 3.0, Modbus/RS-485 communication

Reason for proposal

- Product required in the Hybrid switchgears certified as a high-efficiency energy equipment by Korea Energy Management Corporation
- Provides the maximum demand power management via continual monitoring of the power usage to save the electric costs by disconnecting of the load before exceeding the set peak value
- Various measurement factors and easier power quality analysis
- Enable the analysis of various events such as breaker operation, contacts change, settings change, etc.
- AI of 2 points can be input
 - DC4 ~ 20mA, 0.5% at Full Scale
- Various communication compatibility

Product Overview

GIMAC-PQ

Harmonics and electro-magnetic phenomena may cause unexpected problems such as equipment malfunction, production disruptions and process confusing which result economic loss.

GIMAC-PQ is designed in order to minimize those things by providing of the measurement of the power quality. It does not only measure the voltage and current of each phase, phase, frequency and harmonics, but also store power quality factors in the electric power system.



Proposed specification

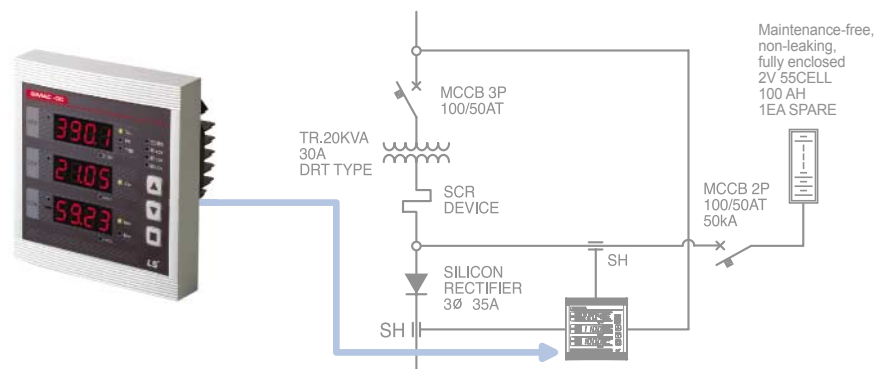
- Measurement of Power quality factors for both short-term and long-term change
 - Sag (voltage drop), Swell (voltage rise), Interruption (power loss)
 - Interruption maintenance, lower voltage, over voltage, voltage unbalance, and frequency fluctuations
- High accuracy measurements : 0.2% for single and 0.5% for complex
 - Measurement of phase, harmonics (max. 63rd harmonics) and demand
 - Transformers heat capacity coefficient k-Factor displayed
- Event recording
 - Storing up to 300 events
- Analog Input contacts can be input
- Support ing Modbus/RS-485 communication

Reason for proposal

- Prevention of equipment problems due to momentary and long-term voltage fluctuations
 - An increase of harmonics due to nonlinear loads sensitive to power quality
- Various measurement factors and easier power quality analysis
- Enable the analysis of various events such as breaker operation, contacts change, settings change, etc.
 - Sag, Swell, Interruption, Under voltage, Over voltage
- Without using TD 2 points AI can be input
 - DC 4 ~ 20mA, $\pm 0.5\%$ at Full Scale
- Under the normal communication state the fault waveform data can be transmitted separately

GIMAC-DC

GIMAC DC is Digital Meter specified to Rectifier Panels. It provides measurement and display such as input AC voltage, output DC voltage, frequency, THD, and the battery charge and discharge current.



Proposed specification

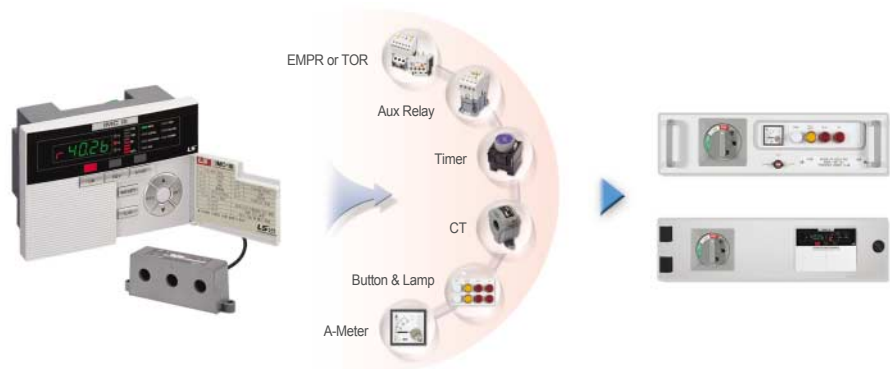
- DC voltage and DC current (measurement of output current and battery current)
 - Max DC voltage / current measurement
- AC/DC voltage $\pm 0.3\%$, DC current $\pm 0.5\%$
- A wide range of PT voltage input
 - AC 20 ~ 452V, DC 20 ~ 264V
- Control power : Free voltage AC / DC 88 ~ 264V
- Communications support Modbus/RS-485

Reason for proposal

- Specialized product for rectifier panel
- Ensured high reliability as maintaining of accuracy even in the field of frequency variation
- Economical and easy wiring as additional PT is not required for voltage input
- Can be used in various power environments
- Power control and monitoring panel configurable

IMC-III

IMC-III is Digital motor protection and control device that is suitable for MCC (Motor Control Center). Its functions comprise of ammeter, motor protection relay, various sequence control, motor On/Off button and indicators.



Proposed specification

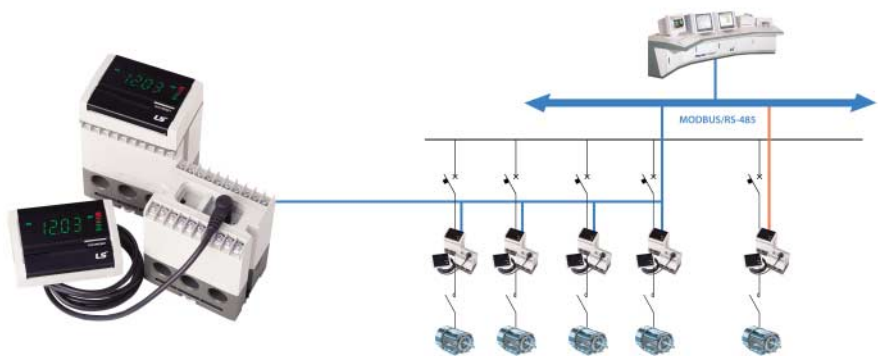
- Various motor start application
 - Direct, Y-Delta, Forward/Reverse, Reactor, Inverter, S/V valve starts
- Protection
 - Overcurrent, undercurrent, phase loss, phase reverse, unbalance, Stall/Locked rotor, ground protection
- Enables MCC to be compact
- Applying 0, 125 to 1000A with one model
 - Can be combined with external CT
- Momentary power failure compensation and restart (Restart)
- Display and storage of failure cause and value (Fault Recording)
- Self-diagnostic and sequence monitoring (Contactor failure)
- Communications support Modbus/RS-485

Reason for proposal

- Applied to various motor starting methods
 - Easy responding to modification of sequence
- Various functions for motor protection
- Small installation space and ease of wiring
 - Ease of maintenance and saving labor costs
- Wide current adjustment range
 - Change of the current adjustment range 0.5 ~ 6 to 5 ~ 60A by Dip S / W
- Maintaining the previous state by restart at momentary power outages less than 20 seconds
 - Sequential restart up to 300sec. to prevent an overload
- Rapid response to accident and maintenance (saved in the event of a power failure)
- Rapid identification of the fault status
 - Monitoring the input and output status of a contactor at the start and stop of a motor
- Suitable for power control and monitoring panels

EMPR IMP

IMP is Electronic Motor Protection Relay to replace the existing thermal overload relays.



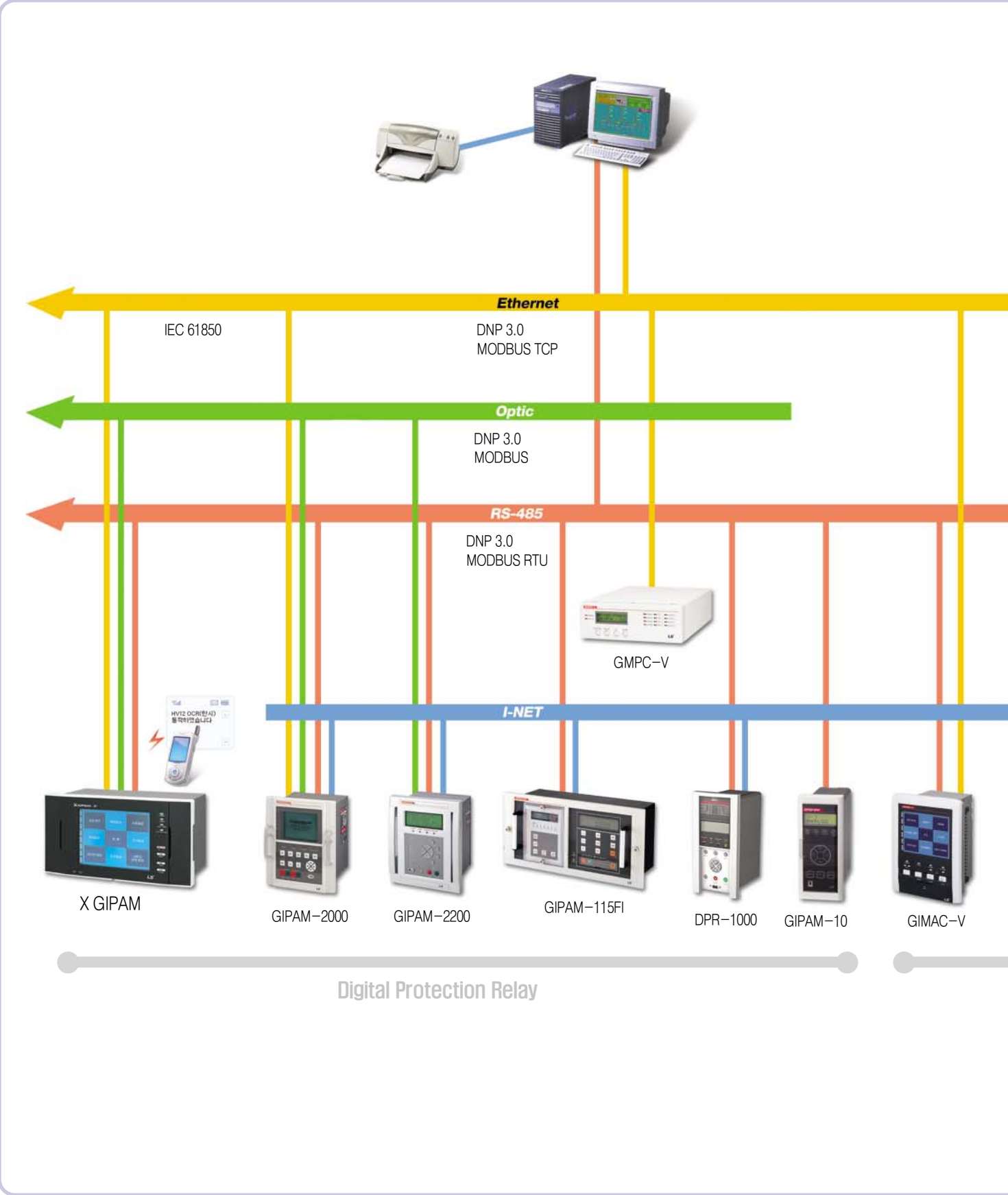
Proposed specification

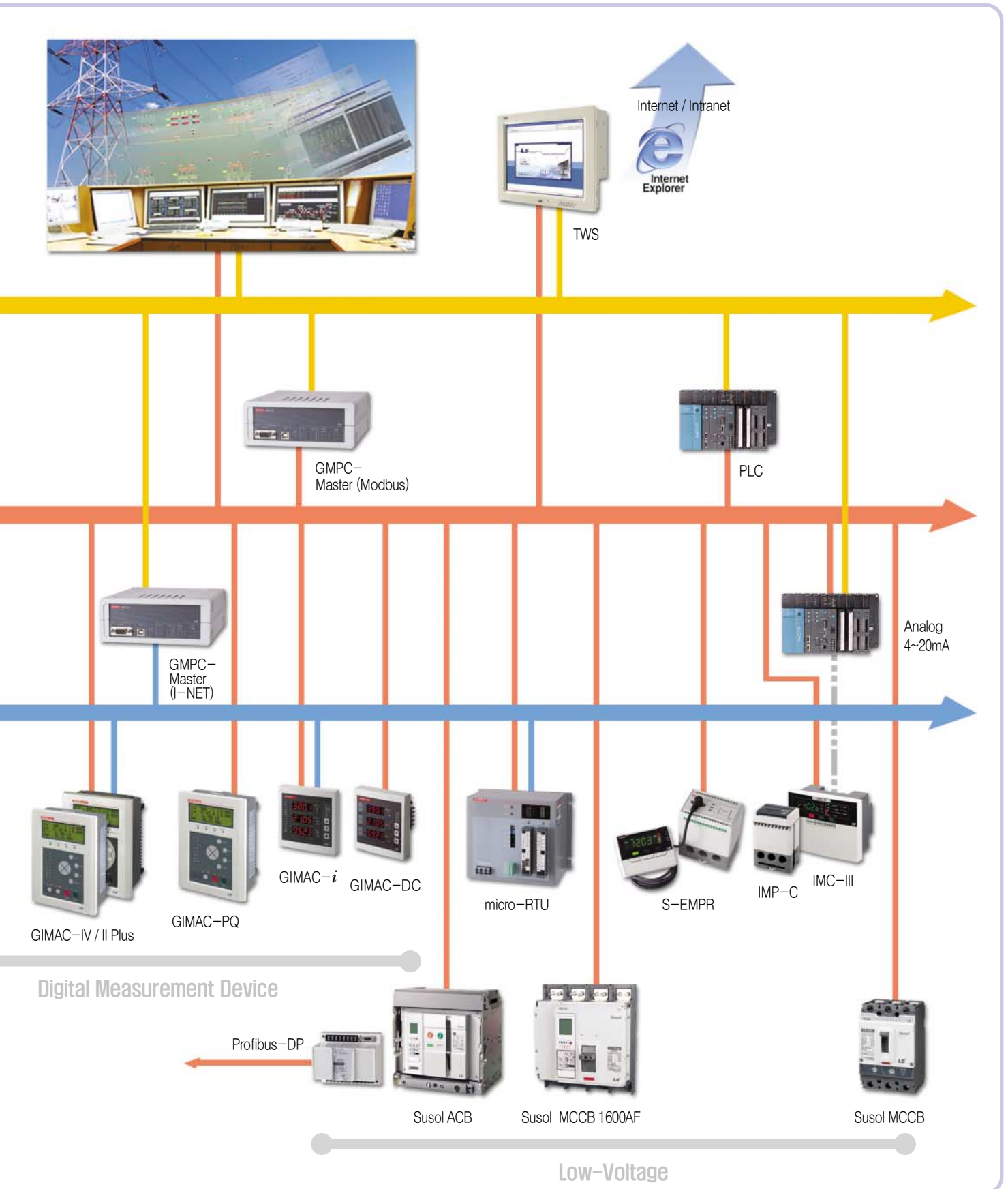
- Protection
 - Overcurrent, undercurrent, phase loss, phase reverse, unbalance, Stall/Locked rotor, ground protection
- Applicable to the motor rated 100A based on inverse time characteristic
 - Internal CT shall not be saturated up to 100A
 - Providing the escape hole for wire penetration two or more times
- Ground fault protection with 2-mode detection
 - Both 'Zero-phase current' and 'residual circuit' detection
 - Wide ground sensitivity current range : 30mA ~ 25A
- Definite / Inverse / Thermal inverse selectable
- Fault cause stored: up to 5 events
 - Date information displayed
- Total operating time and operation time can be set
- Modbus / RS-485 communication support, or 4 ~ 20mA output

Reason for proposal

- Wide range of settings: one model covers 0.125 to 100A
 - External CT not required up to 100A
- Ensured high reliable protection for the earth leakage / ground fault in non-grounding / direct grounding system
- Optimum motor protection considering the operation rating / load characteristics / external environment of the motor
- Easy to identify the fault history
 - Date and time stored in the event of failure
- Information displayed when the set operation time is over
 - For the checking of bearing replacement and lubrication cycles
- Suitable for power control and monitoring panels
 - Compatible with the systems using TD (Transducer)

Power System Monitoring & Control System





Protection coordination among circuit breakers

(Discrimination and Cascading)



1. Protection coordination in the low voltage system

The development of low voltage protection devices seems to be in the trend of steady increase in a quantitative respect, and also in accordance with the enlargement of power plant-capacity the development of technology for high breaking capacity and large current rating is being made. As a result, Current limitable breakers that enable the interruption of very high short circuit current, and vitra-current limitabe breakers. However, in establishing of the power distribution system the safety and continuity of service can not be compromised. To achieve this principle, the need for coordination of protection using the appropriate protective equipments is increasing in the electric power system. Protective devices in the event of system faults such as short circuits need to be coordinated so that the circuit breaker nearest the fault is opened to interrupt the fault with minimum impact to the remainder of the power system. There are commonly used methods that are being used as a short-circuit protection coordination in the low voltage system. They are discrimination, cascading and the fully-rated methods. To build cost-effective and highly reliable low voltage power distribution system, these protection methods need to be applied appropriately depending on the contents and characteristics of the load and the system. The description of protection coordination is followed by an explanation of the characteristic curves of low voltage circuit breakers. Below fig. 1 shows a typical operating characteristic curve of low voltage circuit breaker. The curve can be divided into two parts.

■ Overload protection zone

This section refers to the long time delay. This characteristic is common to the breakers with electronic and thermal-magnetic trip units.

■ Short-circuit protection zone

In case of a breaker with electronic trip unit (ACB included), this zone is composed of short time delay plus instantaneous sections. In the mean time thermal-magnetic type breaker provides only instantaneous section. Doing protection coordination is generally mentioned to make sure for the associated breakers to operate in accordance with its obligations on the zone of the overload and short circuit.

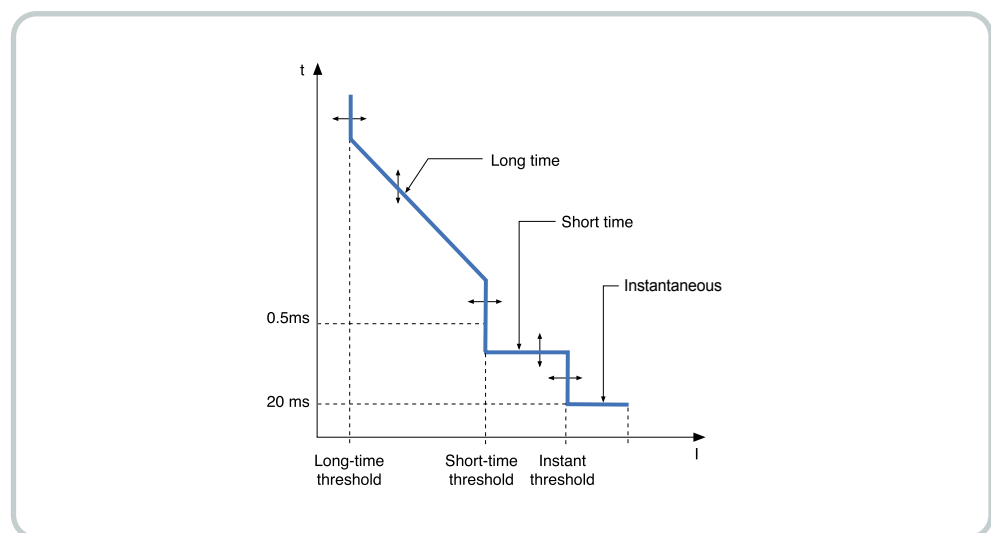


Fig 1. Characteristic curve of low voltage circuit breaker

2. Protection coordination among low voltage circuit breakers

When the power plant protection system is designed, three basic approaches- discrimination, cascading and the fully rated methods-can be considered. The ultimate goal of each of the different approaches is to protect safely the systems and equipments, but the actual installation cost and the sustainability of power supply in the event of fault happening are different.

2. Protection coordination among low voltage circuit breakers

Protection by the fully-rated method

All circuit breakers operate independently according to the each other's rated breaking capacity in the power system. Each circuit-breaker must have higher breaking capacity than the prospective short-circuit current at the point of installation. The system reliability for this method is very high, but the discrimination is limited to a few cases. The disadvantage is in the installation cost which is higher than cascading method for downstream breakers, but cheaper than the discrimination method. Every breaker is required to interrupt and clear the maximum fault current that may happen at the point of the breaker for itself regardless of upstream breakers. It ensures less system service continuity than the discrimination method.

Protection by the discrimination

Discrimination is intended to have only the MCCB2 operated when a fault occurs at the point S1, while other breakers, MCCB3 and upstream MCCB1 continue the service [Figure 2]. It enables disconnecting only the faulty line from the network not to spread to unfaulted equipments for the increase of service reliability. MCCBs must meet the following conditions to be applied for the discrimination.

- The time setting for the upstream breaker is longer than the downstream breaker interrupting time.
- The upstream circuit-breaker must withstand the peak value of let-through current, (I_p) and the let-through energy, I^2t caused by the fault current for a defined period of time without alteration of its characteristics.

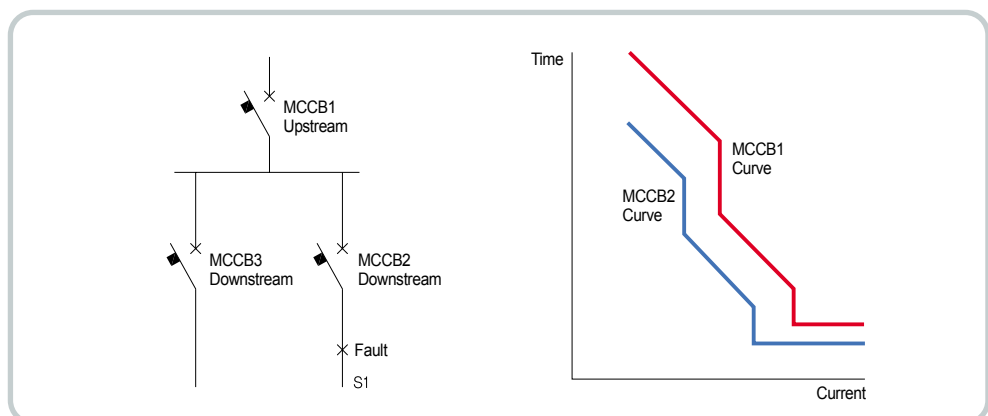


Fig 2. Discrimination

Using discrimination the system can maximize the continuity of service. While the fully rated method requires each circuit-breaker must have higher breaking capacity than the prospective short-circuit current at the point of installation, the discrimination requires that as only the circuit breaker nearest the fault is opened to interrupt the fault, the upstream breaker must have short-time delay characteristic.

The upstream breaker must not be tripped and withstand against the thermal and electro-dynamic stress passed through the breaker nearest the fault until the clearing it. The disadvantage of discrimination compared to the cascading or the fully rated method is in the initial installation costs. The cost for the total discrimination can be reduced to some extent by using partial discrimination. There are different techniques to approach to implement this discrimination. The Current discrimination is the technique using the difference between the trip thresholds of the breakers, the Time discrimination using trip delaying, and the Energy-based discrimination using arc energy.

■ Current discrimination

The Current discrimination is the technique using the difference between the instantaneous or short-time current trip thresholds of the breakers in series. The maximum trip thresholds of the downstream breaker should be less than the minimum thresholds of the upstream breaker. Discrimination is ensured if the difference between the trip thresholds is large. If the current limiting type is used as the downstream breaker, it can limit thermal and electro-dynamic stress considerably as well as ensure the discrimination. Fig.3 shows the concept of the technique.

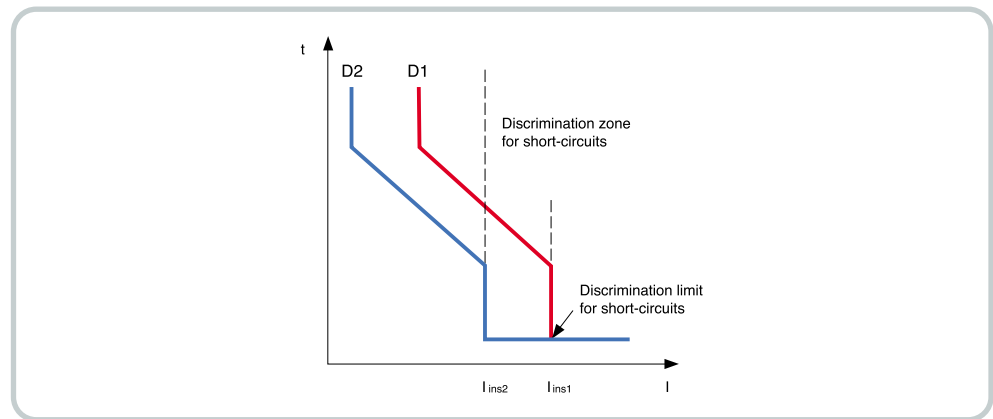


Fig 3. Current discrimination

■ Time discrimination

Time discrimination is the technique using a time delay and is applicable when the short-time threshold of the upstream breaker is longer than that of the downstream breaker. Therefore the breaker with electronic trip unit that provides adjustable time-delay is recommended as a upstream breaker. The delay time of the upstream breaker must be longer than the total clearing time of the fault of the downstream breaker. This technique can be used if the upstream breaker can withstand the thermal and electro-dynamic stress caused by the fault current during this time delay.

Fig.4(a) shows the concept of the technique.

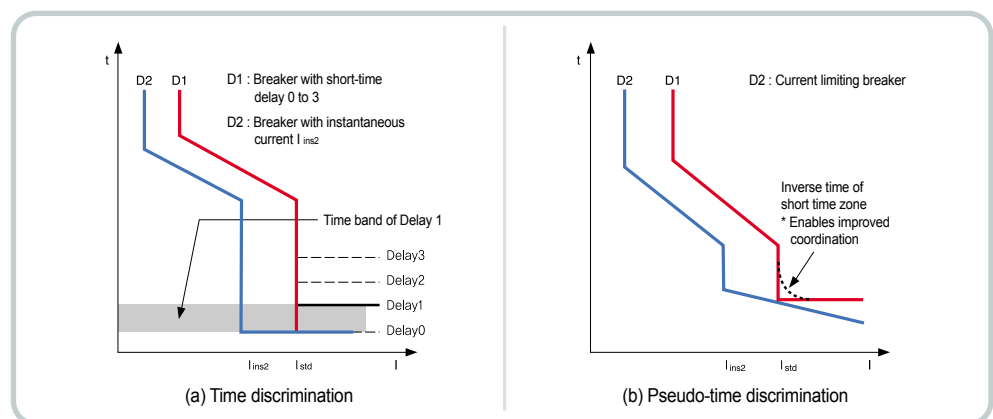


Fig 4. Time discrimination

2. Protection coordination among low voltage circuit breakers

Fig.4(b) shows an improved type of time discrimination. If the upstream breaker trips in proportion to the magnitude of the short-circuit current, the short-time zone of the trip curve D1 will become the dotted line. In addition, if a current limiting breaker is used downstream, the magnitude of the actual short-circuit current is considerably reduced. In this case the discrimination will be much improved. Actually Air Circuit Breaker is designed to have such Pseudo-time characteristic in the trip unit, while MCCB generally provides normal time characteristic. Time discrimination is the technique using a time delay and is applicable when the short-time threshold of the upstream breaker is longer than that of the downstream breaker because circuit breakers commonly operate under similar speed at the instantaneous zone.

■ Energy-based discrimination

This solution provides complete selectivity between two breakers in series concerning short-circuit zone. The trip is implemented by the pressure sensing mechanism in arc chamber of a current limiting breaker. The level of air pressure pressurized in the arc chamber is determined by the arc energy. The starting point of trip varies by the difference of energy levels accumulated in arc chamber when the arc fault current passes. So if upstream and downstream breakers are selected according to the energy level, the discrimination can be achieved, where current limiting is a necessity. Sometimes it is not easy to ensure the discrimination only through previous mentioned time and current discrimination methods specially in the instantaneous zone because of the similar operation speeds on the T-C curve between breakers in series. However, if the characteristics of current limiting of breakers are considered by the energy-current curves as shown in Fig. 5, the discrimination can be ensured.

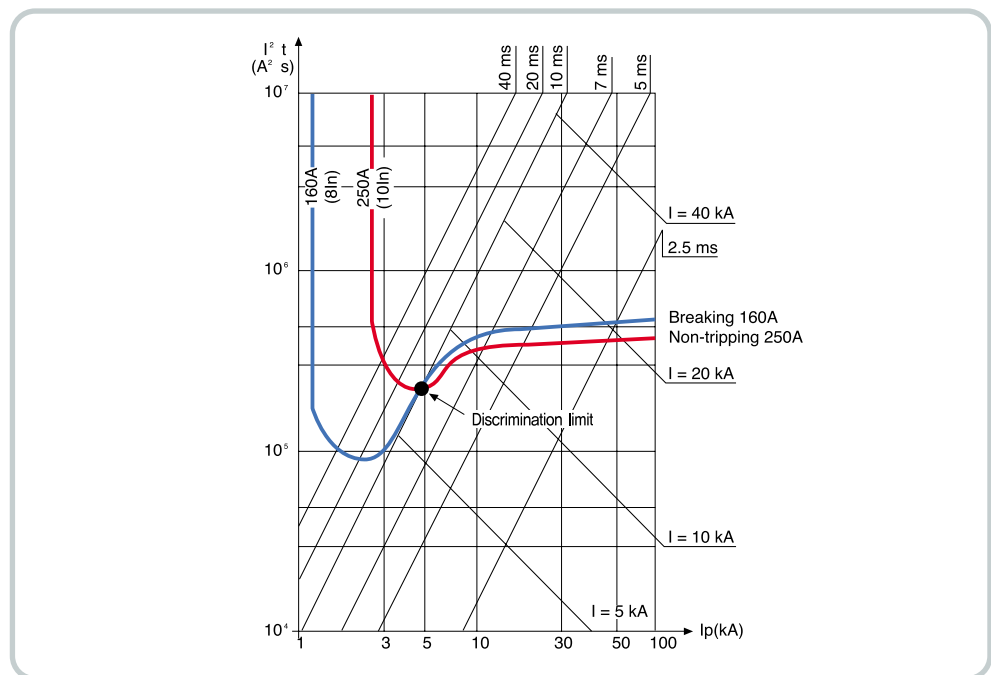


Fig 5. Energy-based discrimination

Cascading

Cascading uses the limiting capacity of the upstream circuit-breaker to increase the actual breaking capacity of the unit downstream and thus enables use of circuit-breakers with a lower breaking capacity than the prospective short-circuit current downstream of a current-limiting circuit-breaker. For the Coordination of cascading between an upstream breaker (MCCB1) and a downstream breaker (MCCB2), the following conditions are required.

- The short-circuit peak current limited by a upstream breaker should be less than the mechanical strength of MCCB2
- When interrupting the let through energy, I_2t should be less than the thermal strength.
- The energy generated by MCCB2 should be less than the strength of each part.

Therefore, the upstream circuit breaker is recommended to be able to interrupt the fault current very fast, to withstand high arc voltage, advantage of current-limiting breakers. Though a downstream circuit-breaker MCCB2 may have a lower breaking capacity than the prospective short-circuit current downstream of a current-limiting circuit-breaker, it is necessary to increase the mechanical strength of cases and covers. The breakers to be used for cascading must be tested by the standard.

Using the cascading in most of the installation enables the saving of the initial cost and space because it allows a downstream breaker with a lower breaking capacity than the prospective short-circuit current, while the upstream circuit breaker must have the capacity at least equal to or greater than the prospective short-circuit current at the installation point. In addition, the circuit breakers in series must be tested to verify the cascading.

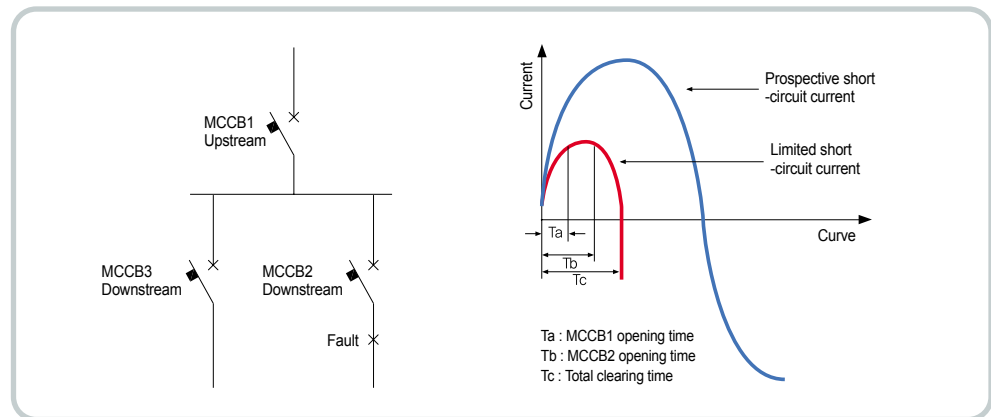


Fig 6. Cascading

The current limiting type breakers generally limit the short-current considerably. Most of the MCCBs, even they are not current limiting breakers, provide the blow-open characteristic which enables some current limiting. Therefore if the breakers in series for the purpose of cascading are opened together in the event of short-circuit they limit the occurred electric energy to protect devices downstream of them. When using this cascading method, considering of the safety is essential. Protection coordination and safety of the cascading is the same as the fully-rated method. However, the continuity of service is not ensured and falls compared to discrimination.

Cascading is the most inexpensive method out of the protection coordination methods. If a cascading is designed, the operating characteristics of downstream/upstream breakers must be always considered must be considered. If the upstream breaker is non-current limiting type and the downstream is current limiting type, cascading does not work. (Opposite case is to work.)

Ics (Rated service short-circuit breaking capacity)

The rated service short-circuit breaking capacity (Ics) of a breaker is given by the manufacturer and is expressed as a percentage of rated ultimate short-circuit breaking capacity (Icu).

$$I_{cs} = 100\% I_{cu}$$

The test sequence

for rated ultimate short-circuit breaking capacity (Icu) ➔ O-3min-CO

for rated service short-circuit breaking capacity (Ics) ➔ O-3min-CO-3min-CO

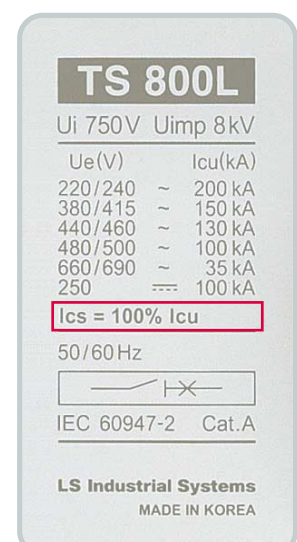


Fig 7. Ics on a name plate

2. Protection coordination
among low voltage
circuit breakers

■ Circuit breaker selection (Discrimination type)

Upstream MCCB: Susol TS 1000/1250/1600

Downstream MCCB: Susol TS 100/160/250

Branch breaker		Main breaker		TS1000L		TS1000N/H		TS1250N/H	TS1600N/H
				Trip units-Electronic(Instant OFF)					
		Rating (A)		800	1000	800	1000	1250	1600
TS100	N	Trip units- Thermal magnetic	40	T	T	T	T	T	T
			50	T	T	T	T	T	T
			63	T	T	T	T	T	T
			80	T	T	T	T	T	T
			100	T	T	T	T	T	T
	H		40	T	T	T	T	T	T
			50	T	T	T	T	T	T
			63	T	T	T	T	T	T
			80	T	T	T	T	T	T
			100	T	T	T	T	T	T
	L		40	T	T	T	T	T	T
			50	T	T	T	T	T	T
			63	T	T	T	T	T	T
			80	T	T	T	T	T	T
			100	T	T	T	T	T	T
TS160	N		100	T	T	T	T	T	T
			125	T	T	T	T	T	T
	H		160	T	T	T	T	T	T
			100	T	T	T	T	T	T
			125	T	T	T	T	T	T
L	160		T	T	T	T	T	T	
	100		T	T	T	T	T	T	
	125		T	T	T	T	T	T	
	160		T	T	T	T	T	T	
	125		T	T	T	T	T	T	
TS250	N		160	T	T	T	T	T	T
			200	T	T	T	T	T	T
			250	T	T	T	T	T	T
			125	T	T	T	T	T	T
	H		160	T	T	T	T	T	T
			200	T	T	T	T	T	T
			250	T	T	T	T	T	T
			125	T	T	T	T	T	T
	L		160	T	T	T	T	T	T
			200	T	T	T	T	T	T
		250	T	T	T	T	T		

Contactors and Overload Relays Coordination

(Type II Coordination)



1. Coordination

Protection Range of Magnetic Switch

Magnetic switch is mainly used for remote control of motor's starting, stopping, etc. and protecting from motor burnout by overload, binding, etc. Also its operational current range is relatively small so during short circuit, it is not capable of opening and closing large current. General magnetic switch on the market mostly has AC3 or AC4 level switching efficiency(8~10 times of rated operational current) which is designated by KSC IEC 60947-4-1 and even with extra about 10~15 times. If there is current over certain amount on TOR, except special case, there is a danger of heater fusion before it operates. To prevent heater fusion, KSC and IEC standards designate overload current flow test as resisting 13 times of current and electric installation technology and wiring regulations also test with 13 times of rated operational current. Our company's MT type satisfies above designated value(over 13 times) of the standards. So more than 13 times of rated operational current is out of magnetic switch's protection range and to protect from short circuit, you need to use short circuit protection breaker such as MCCB and ELCB, or short circuit protection fuse.

Protection Functions

1. Disconnecting functions & short-circuit protection

- Disconnecting function / Disconnecting motor's circuit before maintenance work
- Short circuit protection / Wire and load devices protection from over current ($I > 10I_n$)

2. Control

- On and off operation / Motor's starting and stopping

3. Heat and overload protection

- Overload protection / Load devices protection from over current($I > 10I_n$)
- Additional characteristic protection
 1. Restrictive fault protection (during motor operating)
 2. Preventive fault protection (motor insulation test during motor stopping)

4. Protection range

- Overload($I < 10I_n$) / Overload is occurred under following cases.
 1. Electric problem on main power(phase burnout, voltage difference between phases)
 2. Long start with excessive torque by system or motor damage (during bearing vibrating)
- Impedance short circuit($10 < I < 50I_n$)
Main reason of motor insulation burnout
- Short circuit ($I > 50I_n$)
This fault is barely occurs but the reason could be short circuit fault between phases during maintenance.

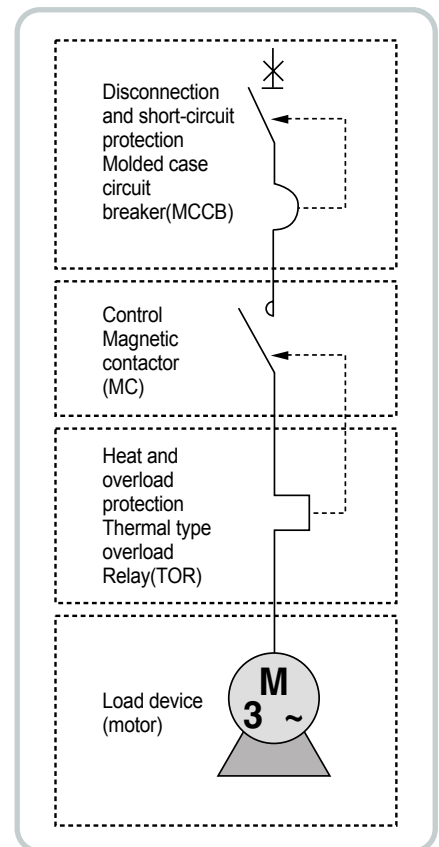


Fig 1. Protection system

Application Standards

Motor circuit should be applied by designated general rules of KSC IEC 60947-4-1 and related contents with motor protection are as follow.

- Protection coordination of motor circuit accessories, etc.
- Thermal type over current relay Trip Class
- Magnetic contactor application range
- Insulation coordination

1. Coordination

■ Various kind of test currents

The standard for propriety of Type-2 coordination requires 3 different faulty current tests to check normal operation of magnetic switch and control devices under overload and short circuit condition.

1. "Ic" current (overload $I < 10 I_n$)

TOR provides protection against Ic value (Im or Isd function) indicated by manufacturer and this type of fault. And KSC 60947-4-1 designates two different tests which have to be operated to ensure protection coordination between TOR and short circuit protection device.

- Apply to TOR in $0.75 I_c$.
- Apply to short circuit protection device in $1.25 I_c$.

TOR's tripping characteristic shouldn't be changed from 0.75 and $1.25 I_c$ tests, and Type2 coordination enhances service continuance. After getting rid of fault, magnetic contactor can be closed automatically.

2. "r" current (impedance short circuit $10 < I < 50 I_n$)

The main cause of this type of fault is insulation destruction. KSC IEC 60947-4-1 describes instant short circuit current "r". This test current is used to check whether the protection device provides protection against impedance short circuit. After this test, there shouldn't be any changes on basic characteristics of the magnetic contactor or TOR. The breaker should trip within 10ms against a faulty current over $15 I_n$.

Table 1. Estimated test current value by rated operating current

Motor operational current I_e (AC3) (A)	Estimated current "r"(kA)
$I_e \leq 16$	1
$16 < I_e \leq 63$	3
$63 < I_e \leq 125$	5
$125 < I_e \leq 315$	10
$315 < I_e \leq 630$	18

3. "Iq" current (short circuit $I > 50 I_n$)

This type of fault is relatively rare. The possible cause of this could be connection fault during maintenance. Short circuit protection is provided by rapid breaking device. KSC IEC 60947-4-1 states "Iq" current as usually over 50kA. "Iq" current is used to check protection coordination of magnetic switch and control device which is installed to motor supply circuit. After this test under extreme conditions, all assembled magnetic switch and control device should be operated continuously.

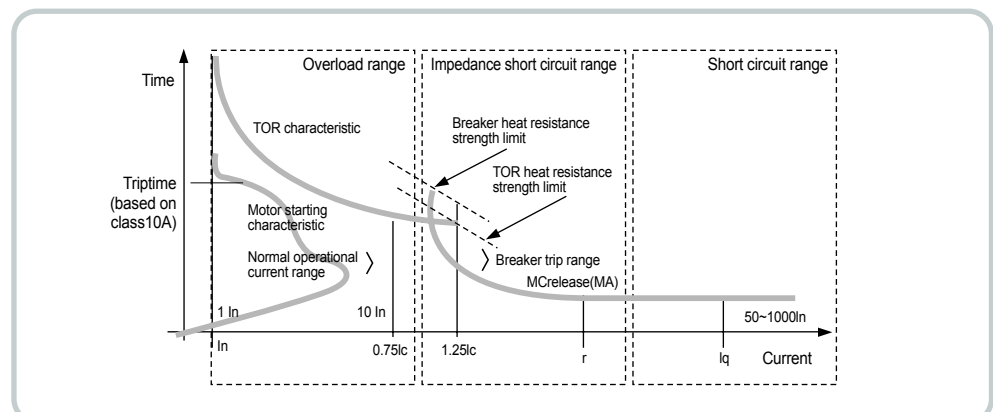


Fig 2. Time-current characteristic curve

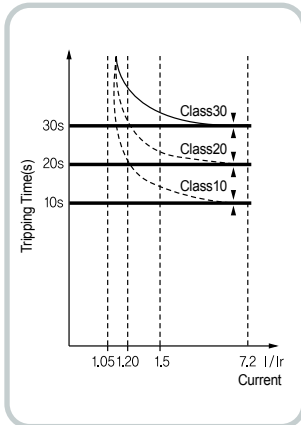


Fig 3. Characteristic curve by trip class

■ TOR Trip Class

Four trip classes of TOR are 10A, 10, 20 and 30(max. tripping time in 7.2Ir). Generally class 10 and 10A are used the most. Class 20 and 30 are needed for motors with long starting time. You can use fig 3 and table 2 to select right TOR suitable for motor starting time.

Table 2. Operating range by trip class

Class	1.05 Ir	1.2 Ir	1.5 Ir	7.2 Ir
10A	$t > 2h$	$t < 2h$	$t < 2 \text{ min.}$	$2 \leq t \leq 10s$
10	$t > 2h$	$t < 2h$	$t < 4 \text{ min.}$	$4 \leq t \leq 10s$
20	$t > 2h$	$t < 2h$	$t < 8 \text{ min.}$	$6 \leq t \leq 20s$
30	$t > 2h$	$t < 2h$	$t < 12 \text{ min.}$	$9 \leq t \leq 30s$

General Consideration of Magnetic Switch and MCCB Protection coordination

■ Protection coordination conditions

When you determine protection coordination for branch circuit with MCCB and magnetic switch which have motor as load, the following details should be considered.

1. Magnetic switch should certainly be able to break the maximum current which could occur under motor's normal condition.
2. TOR should definitely have an operation characteristic to protect during motor's overload and binding.
3. MCCB should have the capacity to adequately break a short circuit current which could flow on each short circuit point.(including cascade interruption)
4. The thickness of the branch circuit wire should be the size which is not to be burnt out by 1 σ that passes through within MCCB interruption time, when short circuit current passes.
5. Branch circuit wire should be protected from over current by TOR or MCCB.
6. MCCB should not operate faultily from motor's starting current or rush current.(Especially, be cautious of rush current of semi-cycle during closing.)
7. Operation characteristics of TOR and MCCB have an intersecting point at overall current range, the protection operating characteristic should not have a gap. Also, for current range below the intersecting point, the TOR's characteristic should be on the low-side.
8. The intersecting point of the operation characteristic should be a current value which is less than the magnetic switch's breaking capacity.
9. when short circuit current flows on the magnetic switch, it should not be damaged until the MCCB breaks.

If the above conditions are satisfied, the protection coordination of branch circuit is able to be completed but completing economical side and all conditions are not always the most advantageous solution. The protection coordination level of a branch circuit means the reliability of a branch circuit system but regarding credibility and economical efficiency, several details need to be added. So from above details, 1~6 are required, and economical efficiency, 7~9 can be considered by their degrees of necessity.

■ The relation between MCCB and magnetic switch operation characteristics

To protect the motor and to prevent faulty operation, a magnetic switch and TOR should be installed on an E type motor and their operation characteristic should meet the following conditions.

1. Inactive operation with 105% of motor's rated current, operating with 120%.
2. Operating within 3~30sec with motor's starting(binding) current

Fig. 4 indicates the TOR's operation characteristic, the motor's heat characteristic and the motor's starting current but if each curve is same as fig. 4(A), the condition can be satisfied. This condition can be satisfied when in a modern (RC scale) TOR's selects the motor rated current is roughly the same as the heater set current.

1. Coordination

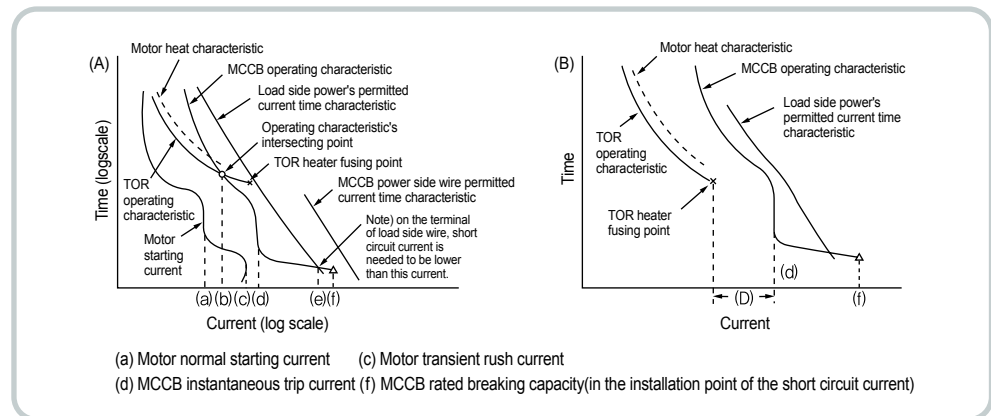


Fig 4. Each characteristic's relation of protection coordination

There is a possibility of faulty operation by rush current during motor's starting. For a squirrelcage motor, approximately 5~7 times the normal starting current flows during starting but because direct current overlaps during early starting (especially very beginning of semi cycle), an even bigger transient rush current flows and the amplification changes by a power factor as in fig. 6. When motor's starting power factor is 0.4 delay, it becomes about 1.3 times of normal starting current. Moreover if there is instant restarting (after power is off, restarting before motor stops spinning), at worst it reaches two times, in other words, 2.6 times of normal starting current from effect of residual current of motor. Fig. 7 shows actual measurement results from a real motor. Instantaneous trip time of MCCB is operated around a semi cycle so it is necessary to be cautious not to be operated with selected rush current.

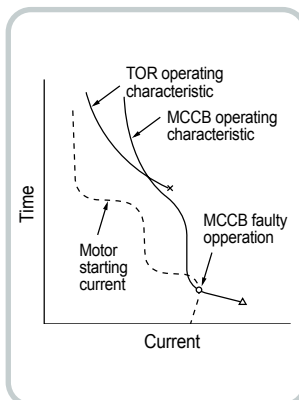


Fig 5. Example of faulty operation by motor rush current of MCCB

To prevent faulty operation from this rush current, check actual measurement result and set breaker's instantaneous trip current as 14 times of rated current. After deciding operation characteristic of magnetic switch and MCCB like this, it is a problem to make each characteristic's intersecting point. Fig. 4(A) indicates when the 7th item (p37) of protection coordination condition is satisfied and fig. 4(B) indicates when it's not satisfied. In the case of fig. 4(B), because there is gap of protection coordination, if the current of this range flows, the TOR's heater will be fused.

TOR operating characteristic MCCB operating characteristic MCCB faulty operation Also on fig. 4(A), when the intersecting point of the operation characteristic exceeds the magnetic switch's breaking capacity, even if TOR is operated, the magnetic switch becomes incapable of breaking and is damaged. So in the case of having an intersecting point of operation characteristic for protection coordination, the 8th item (p37) of protection coordination condition needs to be satisfied. It is desirable to satisfy the condition stated in this paragraph for protection coordination but because this kind of current range is relatively narrow and the possibility of flowing is also very rare (the current of this range is mostly from motor winding ground and layer.), it can be neglected.

General Consideration of Magnetic Switch and MCCB Coordination

■ Magnetic switch when short circuit current flows

If current flows on a magnetic switch, an electron repulsive power occurs between contact points. By this electron repulsive power, the magnetic switch will have contact points' loosening (separation) from 20~40 times current of usual rated operational current. So if more than that amount of short circuit current flows, an arc can occur by contact points' loosening, and there are possibilities of contact points' melting and short circuit between poles. If there is short circuit fault, it can be broken by MCCB but maximum value of the current and I^2t which flows at that point are a function of agreed short circuit current and it tends to increase together with short circuit current increase. So if over certain limit of short circuit current flows, preventing damage of magnetic switch by MCCB prevents to have arc between these contact points (do not let them rise up.) and it is difficult if it's not suppressed with extremely small amount. But when short circuit current is small with short circuit point being load side's front and end, it is possible to avoid magnetic switch's damage as stated on short circuit fault consideration.

■ Protection coordination degree

Now MCCB which satisfies various function and characteristics are being manufactured and also for protection coordination, small changes can be added to magnetic switch. About the details which are considered with relation between MCCB and magnetic switch operation characteristic(p37) and magnetic switch with short circuit current flowing (p38), each step can become feasible by protection coordination degree. Certain requirements on top of this protection coordination degree can be decided by its necessity and economical point of view which was mentioned before. In relation to this fact, KSC and IEC standard [electric machine type contactor and motor starter] indicates following coordination types by the level of magnetic switch's damage during short circuit.

Type "1" is that contactor or starter should not be the main cause of harming human or facilities under short circuit condition and it doesn't have to be suitable to use continuously without repairing or exchanging accessories. Type "2" is that contactor or starter should not be the main cause of harming human or facilities under short circuit condition and it should be used continuously. When manufacturer is instructing steps to take for device repair, it is okay for contact point to be melted and fused. And as stated example of handling method with other various standards, UL standard (American Safety Standard) No. 508 and CSA standard(Canadian Safety Standard) C22-2 No. 14 designate that when 5000A short circuit current which is combined by 3~4 times of rated operational current's rated fuse or breaker, flows on magnetic switch, magnetic switch would not have any abnormality(just, contact point's melting and fusion permitted).

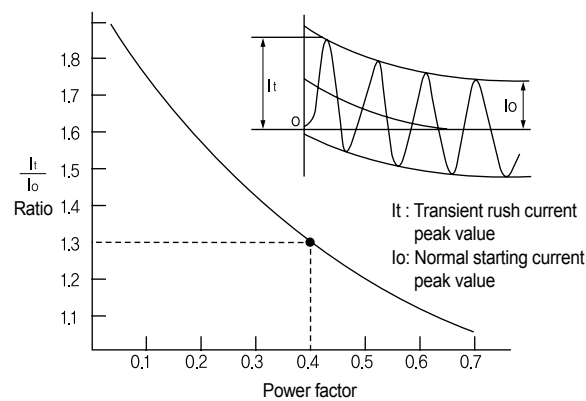
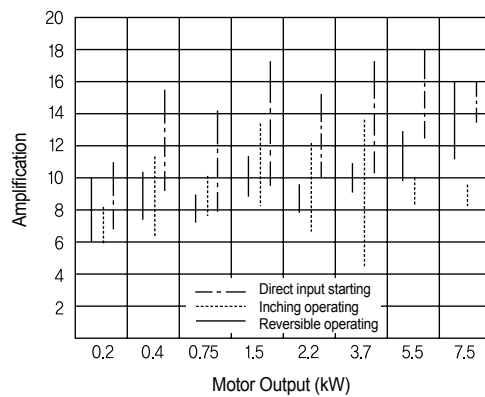


Fig 6. Inrush current during motor's starting



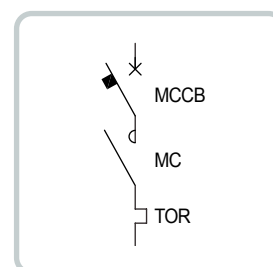
Note) amplification = $\frac{\text{transient inrush current peak value}}{\text{rated current (effective value)}}$

Fig 7. Amplification of motor's rated current and transient inrush current

2. Machinery Selection Table for Type II Coordination

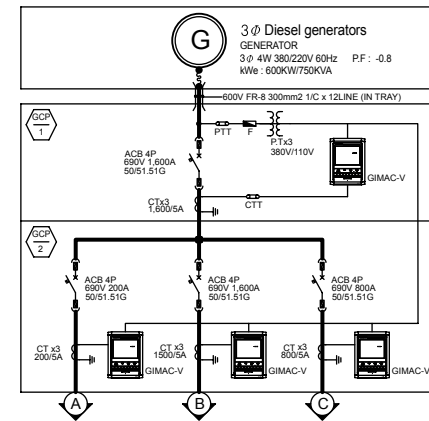
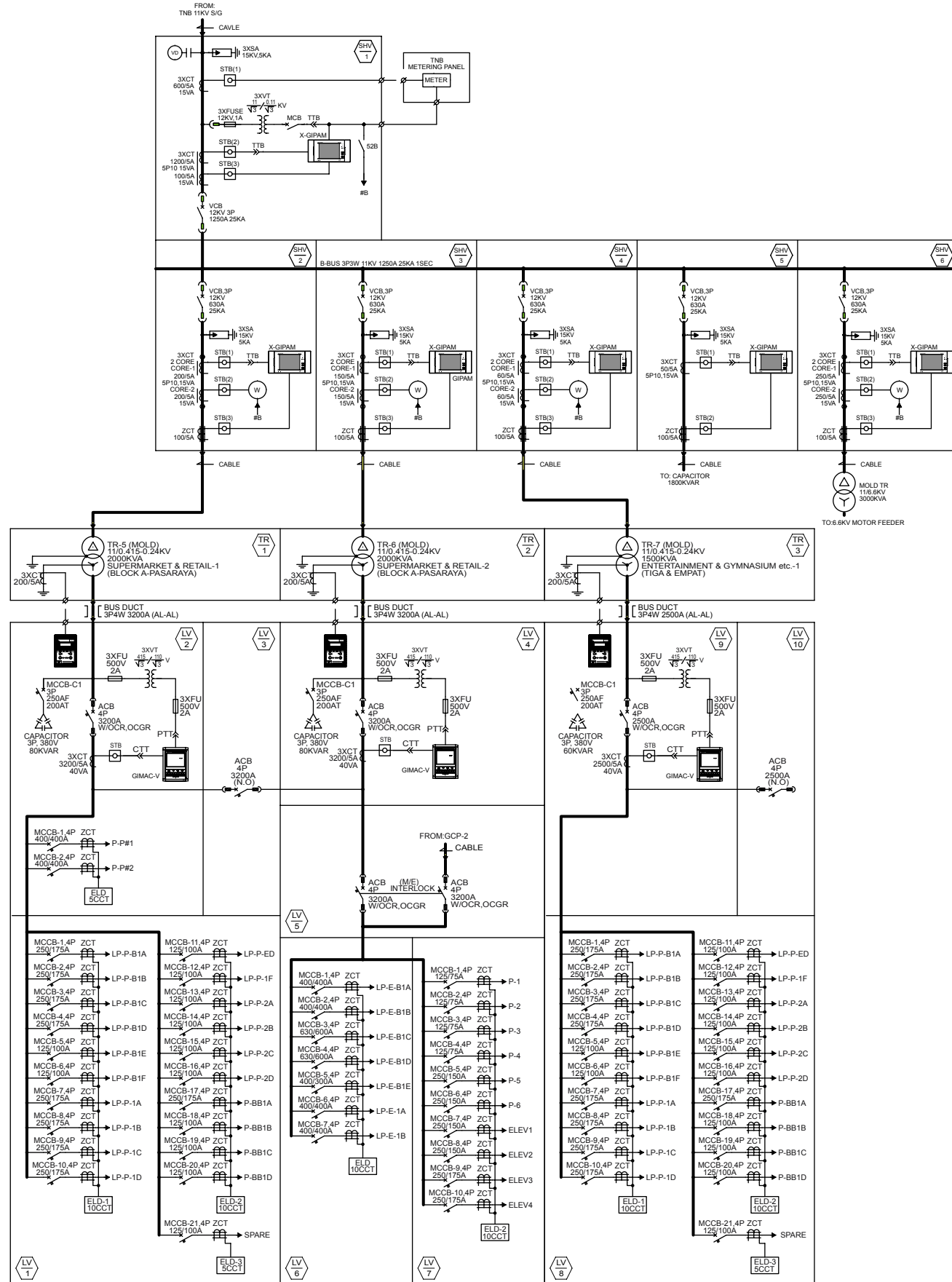
■ Protection of motor circuit

Breaking capacity : @380/415V			
MCCB	N	H	L
TD100	50kA	85kA	150kA
TS100	50kA	85kA	150kA

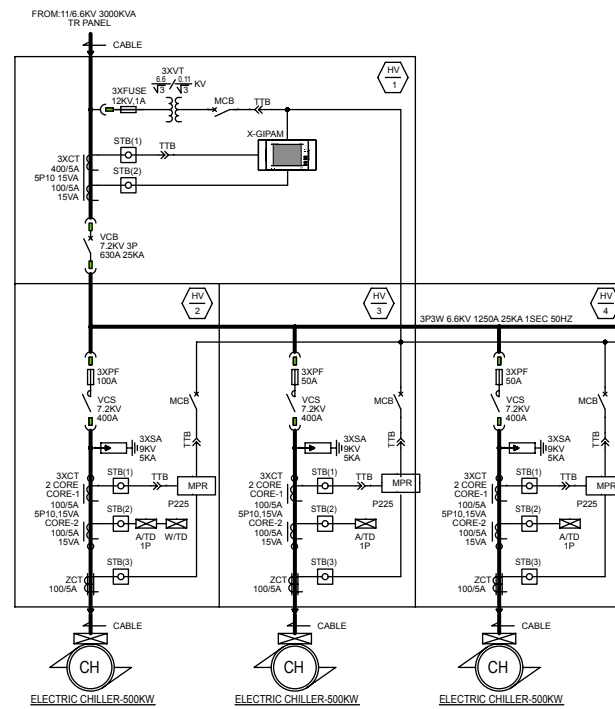


Motor		MCCB		Magnetic contactor	Thermal Overload Relay	
kW	A	Type	Rating (A)	Type	Type	Current (A)
0.37	1.03	TD100	16	MC-9	MT-32	1-1.6
0.55	1.6	TD100	16	MC-9	MT-32	1-1.6
0.75	2	TD100	16	MC-9	MT-32	1.6-2.5
1.1	2.6	TD100	16	MC-32	MT-32	2.5-4
1.5	3.5	TD100	16	MC-32	MT-32	2.5-4
2.2	5	TD100	16	MC-40	MT-63	4-6
3	6.6	TD100	16	MC-40	MT-63	5-8
3.7	7.7	TD100	16	MC-40	MT-63	6-9
4	8.5	TD100	16	MC-40	MT-63	7-10
5.5	11.5	TD100	16	MC-40	MT-63	9-13
7.5	15.5	TD100	16	MC-40	MT-63	12-18
9	18.5	TD100	20	MC-40	MT-63	16-22
10	20	TD100	20	MC-40	MT-63	16-22
11	22	TD100	25	MC-40	MT-63	16-22
15	30	TD100	32	MC-85	MT-95	24-36
18.5	37	TD100 TS100	40	MC-85	MT-95	28-40
22	44	TD100 TS100	50	MC-85	MT-95	34-50
25	52	TD100 TS100	63	MC-85	MT-95	45-65
30	60	TD100 TS100	63	MC-85	MT-95	45-65
33	68	TD100 TS100	80	MC-85	MT-95	54-75
37	72	TD100 TS100	80	MC-85	MT-95	63-85
40	79	TD100 TS100	80	MC-85	MT-95	63-85
45	85	TD100 TS100	100	MC-85	MT-95	70-95

Single line diagram of 22.9kV distribution system



1. DIMM must be the product providing touch type color monitor support, power quality functions (63rd harmonic analysis, Sag, Swell, Interruption), breaker lifetime monitoring, real-time waveform storage, and electric energy demand storage.
2. Demand controller should be suitable for the KSC1213 and capable of demand -data automatic synchronization with the electricity meter supplied from the Utility and, group control, sequential / hybrid control and auto-creating of the report.
3. Transformer should be the one certified as a high-efficiency energy equipment , thus its no-load loss should be better by 50% or more and the load loss by 20% than those of regular transformer. The improvement of noise level shall be at least 7dB based on Korean Standard.
4. DIMC shall meet the following requirements ;
 - Equipped with 6.5-inch color touch graphic LCD
 - Providing measurement accuracy of 0.2% for single and 0.5% for complex in order to display max. 63rd harmonics and THD
 - APFC function to control upto 8 capacitor banks
 - PQ function such as Sag, Swell, Interruption
 - Transient events can be saved
5. ACB's rating shall be at least insulation voltage 1000V and impulse voltage 12kV and must be certified by KSC4620. OCR and OCGR have the functions conforming to IEC60947-2.
6. MCCB is required to be the ratings at least of insulation voltage 750V, impulse voltage 8kV, $I_{cs} = 100\%$ Icu, and breaking capacity shown on the drawings
7. Low-voltage Bus-duct should be made of Aluminum(Al-Al) for the conductor and enclosure and made from the process of batch extrusion coating insulation. If generators and UPS applications, the fire resistance of 840deg./ 180min. must be satisfied.
8. Digital protection relays and meters belong to the work of the switchgear.
9. LV MCCB breaking capacity @460V



Certification

Susol Molded Case Circuit Breakers
Metasol Molded Case Circuit Breakers
Metasol Earth Leakage Circuit Breakers
Metasol Contactors & Thermal Overload Relays
Electronic Motor Protection Relay
Surge Protective Device (SPD)
Susol/Metasol Air Circuit Breakers
VCB/PF/VCS/LBS/ASS/ALTS
Protection & measurement/GIPAM/GIMAC/DPR



Certification

Susol MCCB

A Species of Certification A Species of Standard		Approvals					Certificates	
Type	Mark or certification							
		Korea	Europe	U.S.A	Russia	China	Netherlands	Netherlands
TD100	TD100N	●	●		●	●	●	●
	TD100H	●	●		●	●	●	●
	TD100L	●	●		●	●	●	●
	TD100 NA		●				●	
TD160	TD160N	●	●		●	●	●	●
	TD160H	●	●		●	●	●	●
	TD160L	●	●		●	●	●	●
	TD160 NA		●				●	
TS100	TS100N	●	●		●	●	●	●
	TS100H	●	●		●	●	●	●
	TS100L	●	●		●	●	●	●
	TS100 NA		●				●	
	TS100 MTU	●	●		●		●	
	TS100 ETS	●	●		●	●	●	
TS160	TS160N	●	●		●	●	●	●
	TS160H	●	●		●	●	●	●
	TS160L	●	●		●	●	●	●
	TS160 NA		●				●	
	TS160 MTU	●			●			
	TS160 ETS	●	●		●	●	●	
TS250	TS250N	●	●		●	●	●	●
	TS250H	●	●		●	●	●	●
	TS250L	●	●		●	●	●	●
	TS250 NA		●	●			●	
	TS250 MTU	●						
	TS250 ETS	●	●		●	●	●	
TS400	TS400N	●	●		●	●	●	●
	TS400H	●	●		●	●	●	●
	TS400	●	●		●	●	●	●
	TS400 NA		●	●			●	
	TS400 ETS	●	●			●		
	TS400 ETM	●	●			●		
TS630	TS630N		●		●	●	●	●
	TS630H		●		●	●	●	●
	TS630L		●		●	●	●	●
	TS630 NA		●				●	
	TS630 ETS		●			●		
	TS630 ETM		●			●		
TS800	TS800N		●		●	●	●	●
	TS800H		●		●	●	●	●
	TS800L		●		●	●	●	●
	TS800 NA		●	●			●	
	TS800 ETS		●			●		
	TS800 ETM		●			●		
TS1000	TS1000N		●		●		●	
	TS1000H		●		●		●	
	TS1000L		●		●		●	
	TS1000NA						●	
TS1250	TS1250N		●		●		●	
	TS1250H		●		●		●	
	TS1250NA						●	
TS1600	TS1600N		●		●		●	
	TS1600H		●		●		●	
	TS1600NA						●	
TD125	TD125 NU	●	●	●			●	
	TD125 HU	●	●	●			●	
TS250	TS250 NU	●	●	●			●	
	TS250 HU	●	●	●			●	
TS400	TS400 NU	●	●	●			●	
	TS400 HU	●	●	●			●	
TS800	TS800 NU		●	●			●	
	TS800 HU		●	●			●	

Note : ● (Completion)

Metasol MCCB

A Species of Certification A Species of Standard Mark or certification Type		Approvals					Certificates
		Safety certi	KS	IEC	GB	Gosstandart	IEC
							
		Korea	Korea	Europe	China	Russia	Netherlands
N-type	ABN52c	●	●	●	●		●
	ABN53c	●	●	●	●		●
	ABN54c	●	●	●	●		●
	ABN62c	●	●	●			●
	ABN63c	●	●	●			●
	ABN64c	●	●	●			●
	ABN102c	●	●	●	●		●
	ABN103c	●	●	●	●		●
	ABN104c	●	●	●	●		●
	ABN102d	●	●				
	ABN103d	●	●				
	ABN104d	●	●				
	ABN202c	●	●	●	●		●
	ABN203c	●	●	●	●		●
	ABN204c	●	●	●	●		●
	ABN402c	●	●	●	●		●
	ABN403c	●	●	●	●		●
	ABN404c	●	●	●	●		●
	ABN602c		●				
	ABN603c		●				
	ABN604c		●				
	ABN802c			●	●		●
	ABN803c			●	●		●
	ABN804c			●	●		●
S-type	ABS32c	●	●	●	●		●
	ABS33c	●	●	●	●		●
	ABS34c	●	●	●	●		●
	ABS52c	●	●	●	●		●
	ABS53c	●	●	●	●		●
	ABS54c	●	●	●	●		●
	ABS62c	●	●	●			●
	ABS63c	●	●	●			●
	ABS64c	●	●	●			●
	ABS102c	●	●	●	●		●
	ABS103c	●	●	●	●		●
	ABS104c	●	●	●	●		●
	ABS202c	●	●	●	●		●
	ABS203c	●	●	●	●		●
	ABS204c	●	●	●	●		●
	ABS402c	●	●	●	●		●
	ABS403c	●	●	●	●		●
	ABS404c	●	●	●	●		●

Note: ● (Completion)

Certification

Metasol MCCB

A Species of Certification A Species of Standard Mark or certification Type		Approvals					Certificates
		Safety certi	KS	IEC	GB	Gosstandart	IEC
							
		Korea	KS Korea	CE Europe	CCC China	GOST Russia	KEMA Netherlands
S-type	ABS602c		●				
	ABS603c		●				
	ABS604c		●				
	ABS802c			●	●		●
	ABS803c			●	●		●
	ABS804c			●	●		●
	ABS1003b			●	●		●
	ABS1004b			●			
	ABS1203b			●	●		●
	ABS1204b			●			
H-type	ABH52c	●	●	●	●		●
	ABH53c	●	●	●	●		●
	ABH54c	●	●	●	●		●
	ABH102c	●	●	●	●		●
	ABH103c	●	●	●	●		●
	ABH104c	●	●	●	●		●
	ABH202c	●	●	●	●		●
	ABH203c	●	●	●	●		●
	ABH204c	●	●	●	●		●
	ABH402c	●	●	●	●		●
	ABH403c	●	●	●	●		●
	ABH404c	●	●	●	●		●
	ABL402c	●	●	●	●		●
	ABL403c	●	●	●	●		●
	ABL404c	●	●	●	●		●
L-type	ABL602c		●				
	ABL603c		●				
	ABL604c		●				
	ABL802c			●	●		●
	ABL803c			●	●		●
	ABL804c			●	●		●
	ABL1004b			●			
	ABL1204b			●			
ABE-Fb series	ABE32b		●	●	●		
	ABE33b		●	●	●		
	ABE32Fb		●				
	ABE33Fb		●				
	ABE52Fb		●				
	ABE53Fb		●				
	ABE102Fb		●				
	ABE103Fb		●				

Note: ● (Completion)

Metasol ELCB

A Species of Certification A Species of Standard		Approvals				Certificates
		Safety certi	IEC	GB	JIS	IEC
Mark or certification						
Type		Korea	Europe	China	Japan	Netherlands
N-type	EBN52c	●	●		●	●
	EBN53c	●	●		●	●
	EBN63c	●	●		●	●
	EBN102c	●	●	●	●	●
	EBN103c	●	●	●	●	●
	EBN104c	●	●	●	●	●
	EBN202c	●	●	●	●	●
	EBN203c	●	●	●	●	●
	EBN403c	●	●	●	●	
	EBN404c	●	●	●	●	
	EBN603c				●	
	EBN803c		●	●	●	
S-type	EBS33c	●	●		●	●
	EBS34c	●	●		●	●
	EBS53c	●	●		●	●
	EBS54c	●	●		●	●
	EBS63c	●	●		●	●
	EBS64c	●	●		●	●
	EBS103c	●	●	●	●	●
	EBS104c	●	●	●	●	●
	EBS203c	●	●	●	●	●
	EBS204c	●	●	●	●	●
	EBS403c	●	●	●	●	
	EBS404c	●	●	●	●	
	EBS603c				●	
	EBS803c		●	●	●	
	EBS1003b					
	EBS1203b					
H-type	EBH53c	●	●		●	●
	EBH54c	●	●		●	●
	EBH103c	●	●	●	●	●
	EBH104c	●	●	●	●	●
	EBH203c	●	●	●	●	●
	EBH204c	●	●	●	●	●
	EBH403c	●	●	●	●	
	EBH404c	●	●	●	●	
L-type	EBL403c	●	●	●	●	
	EBL404c	●	●	●	●	
	EBL603c				●	
	EBL803c		●	●	●	

Note: ● (Completion)

Certification

Metasol MC/MS

A Species of Certification A Species of Standard Mark or certification Type		Approvals						Certificates
		Safety certi	IEC	UL	CSA	GB	Gosstandart	IEC
								
		Korea	Europe	U.S.A	Canada	China	Russia	Netherlands
Contactors	MC-6a	●	●	●	●	●	●	●
	MC-9a	●	●	●	●	●	●	●
	MC-12a	●	●	●	●	●	●	●
	MC-18a	●	●	●	●	●	●	●
	MC-6b		●	●			●	●
	MC-9b	●	●	●	●	●	●	●
	MC-12b	●	●	●	●	●	●	●
	MC-18b	●	●	●	●	●	●	●
	MC-22b	●	●	●	●	●	●	●
	MC-32a		●	●	●	●	●	●
	MC-35a	●	●	●	●	●	●	●
	MC-40a	●	●	●	●	●	●	●
	MC-50a	●	●	●	●	●	●	●
	MC-65a	●	●	●	●	●	●	●
	MC-75a		●	●	●	●	●	●
	MC-85a		●	●	●	●	●	●
	MC-100a	●	●	●	●	●	●	●
	MC-130a	●	●	●	●	●	●	●
	MC-150a	●	●	●	●	●	●	●
	MC-185a	●	●	●	●	●	●	●
	MC-225a	●	●	●	●	●	●	●
	MC-265a	●	●	●	●	●	●	●
	MC-330a		●	●	●	●	●	●
	MC-400a		●	●	●	●	●	●
	MC-500a		●	●	●	●	●	●
	MC-630a		●	●	●	●	●	●
	MC-800a		●	●	●	●	●	●
4P Contactors	MC-6a/4	●	●	●				●
	MC-9a/4	●	●	●				●
	MC-12a/4	●	●	●				●
	MC-18a/4	●	●	●				●
	MC-22a/4	●	●	●				●
	MC-32a/4	●	●	●				●
	MC-40a/4	●	●	●				●
	MC-50a/4	●	●	●				●
	MC-65a/4	●	●	●				●
	MC-75a/4	●	●	●				●
	MC-85a/4	●	●	●				●
	MC-100a/4	●	●	●				●
	MC-130a/4	●	●	●				●
	MC-150a/4	●	●	●				●
	MC-185a/4	●	●	●				●
	MC-225a/4	●	●	●				●
	MC-265a/4	●	●	●				●
	MC-330a/4		●	●				●
	MC-400a/4		●	●				●
	MC-500a/4		●	●				●
	MC-630a/4		●	●				●
	MC-800a/4		●	●				●

Note : ● (Completion)

EMPR

Type		A Species of Certification	Approvals					Certificates		
		A Species of Standard	Safety certi	IEC	cUL		GB	Gosstandart	IEC	
		Mark or certification								
			S-Mark	CE	cUL		CCC	GOST	KEMA	One-Tech
		Korea	Europe	U.S.A	Canada	China	Russia	Netherlands	Korea	
GMP type	GMP22-2P	●	●	●		●	●			
	GMP22-3P	●	●	●		●	●	●		
	GMP22-3PR	●	●			●	●	●		
	GMP22-2S	●	●	●		●	●			
	GMP22-3S	●	●	●		●	●	●		
	GMP22-3SR	●	●			●	●	●		
	GMP22-2T	●	●	●		●	●			
	GMP22-3T	●	●	●		●	●	●		
	GMP22-3TR	●	●			●	●	●		
	GMP40-2P	●	●	●		●	●			
	GMP40-3P	●	●	●		●	●	●		
	GMP40-3PR	●	●			●	●	●		
	GMP40-2S	●	●	●		●	●			
	GMP40-3S	●	●	●		●	●	●		
	GMP40-3SR	●	●			●	●	●		
	GMP40-2T	●	●	●		●	●			
	GMP40-3T	●	●	●		●	●	●		
	GMP40-3TR	●	●			●	●	●		
	GMP80-2S	●	●	●		●	●			
	GMP80-3S	●	●	●		●	●	●		
	GMP80-3SR	●	●			●	●	●		
	GMP60-T	●	●	●		●				
	GMP60-TE	●				●				
DMP type	DMP06, 60-S	●	●	●		●	●			
	DMP06, 60-Sa					●				
	DMP06, 60-T	●	●	●		●	●			
	DMP06, 60-Ta					●				
	DMP06, 60-SI	●	●	●		●	●			
	DMP06, 60-SZ	●	●	●		●	●			
	DMP06, 60-SZa					●				
	DMP06, 60-TZ	●	●	●		●	●			
	DMP06, 60-TZa					●				
	DMP06, 60-TI	●	●	●		●	●			
	IMP type	IMP-C-NO		●						
IMP-C-A420			●							
IMP-C-A485			●							

Note : ● (Completion)

Certification

LCP

Type	A Species of Certification	Approvals				Certificates
	A Species of Standard	Safety certi	IEC	UL	GB	IEC
	Mark or certification					
		KR Korea	CE Europe	UL U.S.A	CCC China	TUV Germany
LCP31F		●		●	●	●
LCP32F		●		●	●	●
LCP33F		●		●	●	●

0.3, 5, 30A all certified respectively. Accessories (AX, AL) all certified.

SPD

Type		A Species of Certification	Approvals					
		A Species of Standard	Safety certi	KS	IEC	GB	Gosstandart	IEC
		Mark or certification						
			Korea	Korea	Europe	China	Russia	Korea Netherlands
BKS type (SPD)	BKS-A				●			
	BKS-B				●			
	BKS-C				●			
	BKS-D				●			
	BKS-E				●			

Susol / Metasol ACB

A Species of Certification A Species of Standard		Type test	Certificates					Approvals		Marking
Mark or certification		IEC	KS	UL	Gosstandart	전력기준	IEC	GB	IEC	IEC
Type										
		KERI	KS	UL	GOST	KEPIC	KEMA	CCC	TPC	CE
		Korea	Korea	U.S.A	Russia	Korea	Netherlands	China	Taiwan	Europe
2000AF	AN-06D	●	●		●		●		●	●
	AS-06D	●	●				●			●
	AH-06D	●	●	●	●		●	●	●	●
	AN-08D	●	●		●		●		●	●
	AS-08D	●	●				●			●
	AH-08D	●	●	●	●		●	●	●	●
	AN-10D	●	●		●		●		●	●
	AS-10D	●	●				●			●
	AH-10D	●	●	●	●		●	●	●	●
	AN-13D	●	●		●		●		●	●
	AS-13D	●	●				●			●
	AH-13D	●	●	●	●		●	●	●	●
	AN-16D	●	●		●		●		●	●
	AS-16D	●	●				●			●
	AH-16D	●	●	●	●		●	●	●	●
	AS-20D	●	●		●		●			●
	AH-20D	●	●		●		●	●	●	●
4000AF	AH-06E	●	●	●			●	●	●	●
	AH-08E	●	●	●		●	●	●	●	●
	AH-10E	●	●	●			●	●	●	●
	AH-13E	●	●	●			●	●	●	●
	AH-16E	●	●	●		●	●	●	●	●
	AN-20E	●	●				●			●
	AS-20E	●	●		●		●		●	●
	AH-20E	●	●	●	●	●	●	●	●	●
	AN-25E	●	●				●			●
	AS-25E	●	●		●		●		●	●
	AH-25E	●	●	●	●		●	●	●	●
	AN-32E	●	●				●			●
	AS-32E	●	●		●		●		●	●
	AH-32E	●	●	●	●	●	●	●	●	●
	AS-40E	●	●		●		●		●	●
	AH-40E	●	●		●		●	●	●	●
5000AF	AS-40F	●	●		●	●	●			●
	AS-50F	●	●		●	●	●		●	●
6300AF	AS-40G	●	●		●		●		●	●
	AH-40G	●	●	●	●		●	●	●	●
	AS-50G	●	●		●		●		●	●
	AH-50G	●	●	●	●		●	●	●	●
	AS-63G	●	●		●		●		●	●
	AH-63G	●	●		●		●	●	●	●

Note : ● (Completion)

Certification

Susol VCB

A Species of Certification A Species of Standard Mark or certification		Approvals			Certificates		Approvals		
		KS		V-Check	IEC		Marine classification		
									
Type		KS	KOEMA	Korea	KERI	KEMA	KR	LR	NK
		Korea	Korea	Korea	Korea	Netherlands	Korea	U.K	Japan
Susol	VL-06□-08A/04	●		●	●				
	VCB	●		●	●				
	VL-16□-13A/06	●		●	●				
VCB	VL-06□-20A06			●	●	●			
	VL-06□-20A13			●	●	●			
	VL-06□-20A20			●	●	●			
	VL-06□-25A06			●	●	●			
	VL-06□-25A13			●	●	●			
	VL-06□-25A20			●	●	●			
	VH-06□-50B13			●	●				
	VH-06□-50B20			●	●				
	VH-06K-50D40			●	●				
	VH-12□-50□13			●	●				
	VH-12□-50□20			●	●				
	VH-12□-50□25			●	●				
	VH-12□-50□32			●	●				
	VH-17□-50□13			●	●				
	VH-17□-50□20			●	●				
	VH-17□-50□25			●	●				
	VH-17□-50□32			●	●				
	VH-20□-25D25			●	●				
	VH-20□-32B13			●	●				
	VH-20□-32B(D)20			●	●				
	VH-20□-32B32			●	●				
	VH-20□-40B13			●	●				
	VH-20□-40B(D)20			●	●				
	VH-20□-40D32			●	●				
	VH-36□-25□13			●	●	●			
	VH-36□-25□20			●	●	●			
	VH-36□-25□25			●	●	●			
	VH-36□-32□13			●	●	●			
	VH-36□-32□20			●	●	●			
	VH-36□-32□25			●	●	●			
	VH-36□-40□13			●	●	●			
	VH-36□-40□20			●	●	●			
	VH-36□-40□25			●	●	●			
Pro	LVB-06□-32□/12			●	●				
MEC	LVB-06□-32□/20			●	●				
VCB	LVB-06□-32□/30			●	●				
	LVB-06□-40□/12			●	●	●			
	LVB-06□-40□/20			●	●	●			
	LVB-06□-40□/30			●	●	●			

VCB / PF / VCS / LBS / ASS / ALTS

A Species of Certification A Species of Standard Mark or certification Type		Approvals			Certificates		Approvals		
		KS		V-Check	IEC		Marine classification		
									
		KS Korea	KOEMA Korea	Korea	KERI Korea	KEMA Netherlands	KR Korea	LR U.K	NK Japan
VCB	Pro LVB-06□-40□/12 Power plants			●	●				
	MEC LVB-06□-40□/20 Power plants			●	●				
	LVB-06□-40□/25 Power plants			●	●				
	LVB-06□-40□/30 Power plants			●	●				
	LVB-06□-50□/12 Power plants			●	●				
	LVB-06□-50□/20 Power plants			●	●				
	LVB-06□-50□/30 Power plants			●	●				
	LVB-12□-40□/12			●	●	●			
	LVB-12□-40□/20			●	●	●			
	LVB-12□-40□/32			●	●	●			
	LVB-20□-13□/06			●	●				
	LVB-20□-13□/12			●	●				
	LVB-20□-16□/06			●		●			
	LVB-20□-16□/12			●		●			
	LVB-20□-25□/06			●	●	●			
	LVB-20□-25□/12			●	●	●			
	LVB-20□-25□/20			●	●	●			
	LVB-25□-25□/06 MCSG type			●	●				
	LVB-25□-25□/20 MCSG type			●	●				
PF	LFL-3G	●			●				
	LFL-6G	●			●				
	LFL-20G, 20J		●	●	●				
VCS	LVC-6□-42ED			●	●		●	●	●
	LVC-6□-44ED			●	●		●	●	●
	LVC-6□-42LD			●	●		●	●	●
	LVC-6□-44LD			●	●		●	●	●
	LVC-6D-44ED			●	●		●	●	●
	LVC-6D-44LD			●	●		●	●	●
	LVC-3G□-42ED			●	●		●	●	●
	LVC-3G□-44ED			●	●		●	●	●
	LVC-3G□-42LD			●	●		●	●	●
	LVC-3G□-44LD			●	●		●	●	●
	LVC-6G□-42ED			●	●		●	●	●
	LVC-6G□-44ED			●	●		●	●	●
	LVC-6G□-42LD			●	●		●	●	●
	LVC-6G□-44LD			●	●		●	●	●
LBS	LGS-L (LBS)		●	●		●			
	LGS-L (PF type LBS)		●	●		●			
ASS	LGS-J		●	●		●			
ALTS	LGS-T (New style)		●	●		●			

Note) LVC-3G□/6G□ - DC 110V, AC 110/220V.

Certification

GIPAM/GIMAC/DPR/GMPC/DC

A Species of Certification A Species of Standard		Approvals					Certificates	
				CE	IEC		IEC	
Type	Mark or certification	 KOEMA		 KOLAS	 CE	 DLMS	 KEMA	 KERI
		Korea	Korea	Korea	Europe	Switzerland	Netherlands	Korea
GIPAM	GIPAM-115FI	●						●
	GIPAM-2000	●						●
	GIPAM-2000T	●						●
	GIPAM-2200FN	●						●
	GIPAM-2200FZ	●						●
	GIPAM-2200-T1	●						●
	GIPAM-2200-T2	●						●
	GIPAM-2200-T3	●						●
	GIPAM-2200 IG	●						●
	GIPAM-2200 DG	●						●
X GIPAM	X GIPAM-F	●	●				●	●
	X GIPAM-B	●	●				●	●
	X GIPAM-M	●	●				●	●
	X GIPAM-DG	●	●				●	●
	X GIPAM-T	●	●				●	●
DPR	DPR-OCR/OCGR	●						●
	DPR-SGR	●						●
	DPR-OVGR	●						●
	DPR-OVR/UVR	●						●
DPR-1000	DPR-1000-FN	●						●
	DPR-1000-FZ	●						●
GIMAC	GIMAC-II plus			●	●			
	GIMAC-IV							●
	GIMAC-i			●	●			

Mark	Name
	ISO9001
	ISO14001
	CE (Conformity European)
	UL (Underwriters Laboratories Inc.)
	KS (Korean Standard)
	KR (Korean Resister of Shipping)
	NK (Nippon Kaiji Kyokai)
	BV (Bureau Veritas)
	LR (Lloyd' s Resister of Shipping)
	GL (Germanischer Lloyd)
	CCC (China Compulsory Certification)
	KERI (Korea Electrotechnology Research Institute)
	KEMA (KEMA Powertest, Inc.)
	TÜV (TÜV Rheinland)
	GOST (Russia Standards Institution)
	PSE (Product Safely Electric)

■ Introduction



PT&T, established by LSIS Co., Ltd. in 2000, is operating high-power laboratory with a 1500MVA capacity, high-voltage laboratory reliability testing laboratory and calibration laboratory to aid technical development in product performance and reliability through its sound technical back-ground and impartial operation in testing and evaluation process. PT&TI, as a KOLAS-accredited testing and calibration laboratory, will continue its contribution to promote technical development and competence of electrical industry.

■ Major facilities



① Short-circuit generator

Providing the power capacity up to 1600MVA for short circuit test, which is one of the largest for the purpose.



② Medium and high voltage testing facility

Enables various high voltage tests including a short circuit test up to capacity 1000MVA according to national and international standards



③ Low-voltage testing facility

Enables various low voltage tests including a short circuit test up to 200kA according to national and international standards



④ Environmental test facility

Enables the general and special environmental tests such as harmonics, temperature rise, low-temperature, leakage current, outdoor exposure and etc.



⑤ Calibration laboratories

Equipped with apparatus for checking and calibration of test equipments to increase the accuracy of test equipments. And also high power laboratory and high voltage laboratory are available for the tests under various and special environments. Thanks to these apparatus and equipments our power testing technology center is capable of testing various and rigorous requirements of international standards such as IEC, UL and etc. is available in.



■ Short circuit test of a circuit breaker

Short circuit test is the most important item in the test procedure for circuit breakers. This test is to verify if a breaker is capable of interrupting the fault current due to the short circuit downstream of the breaker so as to prevent the expansion of the fault, which is the key feature that determines the performance of a breaker.

LSIS' circuit breakers under the development and sales are tested periodically at its Power Technology Testing Center (PT&T) for continuous improvement. Left image shows the test scene of a MCCB.

The number of manufacturers capable of carrying this kind of in-house test is very few. Actually in Korea LS Industrial Systems is the only manufacturer other than the Korea Electro-technology Research Institute (KERI). Generally for many manufacturers the short-circuit testing is not carried out any more since the type test because of the high cost and time.



■ Laboratories accredited by KOLAS

LSIS' PT&T is a KOLAS-qualified (Korea Laboratory Accreditation Scheme) accredited testing laboratory. Laboratories that demonstrate competence and meet the requirements of KOLAS are granted accreditation. Laboratories accredited by KOLAS are allowed to use the accreditation logo on their test reports for those tests in its scope of accreditation. And they are publicly listed in the KOLAS Directory and web site to allow customers to readily identify and access reliable testing and calibration services

■ Partnership with international laboratories

In addition PT&T is also fully recognized by foreign testing and certification bodies of high reputation as CESI of Italy, KEMA of Netherlands, UL of America, etc. for its testings.

■ National and international standards

PT&T can perform the testing according to following standards.

- KS: Korea industrial standards
- IEC: International Electrotechnical Commission
- ES, PS: Korea Electric Power Corporation(Provisional) Standards
- KEMC: Korea Electric Manufacturers Cooperative Standards
- ANSI: American National Standard Institute
- VL: Underwriters Laboratories (USA)



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 a 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.

LSIS Co., Ltd.

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■ HEAD OFFICE

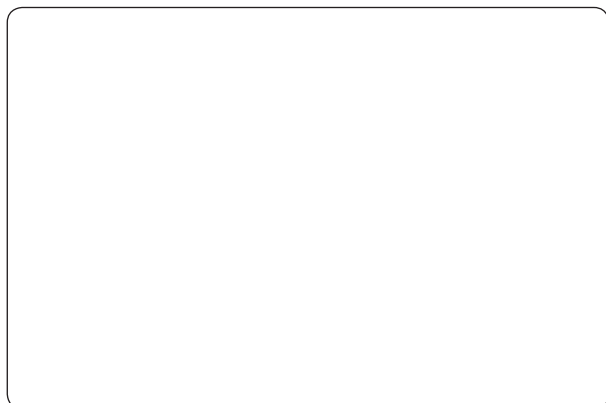
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Specifications in this catalog are subject to change without notice due to continuous product development and improvement.