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GIMAC-V User Manual

Digital Integrated Metering & Control Device

Safety Instructions

- Read this manual carefully before installing, wiring, operating, servicing or inspecting this equipment.
- Keep this manual within easy reach for quick reference.

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Contents

Cautions for safety

Please read carefully before putting the product into service for the proper operation of GMAC-V.

- Please keep the safety caution to prevent any accident that may happen by using the product incorrectly.
- Safety cautions is classified with caution and danger and Indication of them is as follows.

⚠ 경 고	**Not following the instruction may result in serious Injury or even death.**
⚠ 주 의	**Not following the instruction may result in Serious injury or product damage.**

Symbols used in this manual is indicated as follows.

⚠	**This symbol is for warning the hazardousness under the specific condition**
⚠	**This symbol is for warning the electric shocks or any accidents under the specific condition.**

This manual must be kept at a close place to GIMAC-V.

⚠ Caution

- **Never work with , test, or set up the equipment alone.**
- **Do not work on the wiring when the power is on or in operation.**
  It may be a cause of electric shock.
- **Do not work on any wiring when the busbar is in live state.**
  It may cause electric shock, charging voltage of current transformer, or damage and fire of the product.
- **Connect equipment to the earthing.**
  It may cause electric shock.
- **Do not disassemble the product even if the power is off.**
  The internal charge electricity may cause electric shock.
- **Do not short circuit the PT secondary.**
  It may cause fire.
- **Do not short circuit the CT secondary.**
  It may cause fire or explosion.

- **Do not work on or set up the equipment with wet hands.**
  It may cause electric shock.
- **Do not use damaged cables.**
  It may cause electric shock.
- **Work on terminal when wiring the cable.**
  It causes electric shock on the spiral part of the cable.
- **Work after wearing protective gear.**
- **Put on warning sign before working.**
  When testing the innate insulation pressure of the wiring board of product or when checking the insulation resistance, do it after removing all INPUT, OUTPUT wiring.

⚠ Caution

■ Safety caution for installation & terminal wiring

- **Apply the rated voltage to the power supply terminal of the product.**
  It may result in damage in the product or fire.
- **Keep away product from screws, metals, water, or oil.**
  It may result in fire.
- **Keep the rated load and polarity of the input and output point.**
  It may result in damage of the product or fire.
- **While connecting to a terminal block, check the number of terminal before wiring.**
  It may result in damage in the product or fire.
- **Assemble the cover of the terminal after disconnecting the terminal.**
- **Product must be installed and managed by a specialist.**
  Otherwise, wrongly installed product may cause malfunction or accident.
- **Use circuit breaker input/output auxiliary relay only.**
  In case of controlling a circuit breaker directly, inner RELAY flame may result.
  Turn the power OFF when changing the communication card.
  All DO is reset when the power is turned OFF.
- **The suitable thickness of the cable is AWG 14 to AWG12(2.1~3.3 mm2).**
- **The tightening torque of the terminal screw(kgf-mm) is 10 or less.**

■ Checklist before input of power

- **Check the polarity and voltage of control power and GPT etc.**
- **Check wiring of the input/output terminal.**

■ Caution for storage and handling

- **Store at dry and dust-free areas.**
- **Do not throw or put too much power on product while handling.**

■ Caution for disposal

- **Dispose product according to the industrial waste regulation.**

1. Characteristics of GIMAC-V

- GIMAC-V uses a 6.5 type 640 x 480, 262k Color Graphic LCD in order to let the user see the various measurements and real-time waves of the electric power system in form of Graphic, and let the user use languages of both Korean and English for convenience in using the equipment.
  . Comprehensive measurement screen
  . Measurement display with large fonts
  . Real time wave expression and wave Capture
  . Easy harmonic wave analysis
  . Expression of Power Quality, Transient wave and DI input wave

- GIMAC-V is a digital concentrated control equipment using Gapless Sampling and calculation for the renewal period of 200 msec(50 Hz 10 periods, 60 Hz 12 periods), has a broad voltage measurement range(AC 10~452V) and frequency range(40~70Hz), has a high preciseness in single amount(voltage, current) 0.2%, complex amount(power, integrated energy) Class 0.5(IEC 62053-21, IEC 62053-22), and also has 105 measurement elements such as up to 63ch phase voltage, conductor voltage, current harmonic wave, THD, K-Factor, Crest Factor.

- GIMAC-V has an electric power quality analysis function that analyzes Sag, Swell, Interruption and other quality deterring factors when they happen, and it also records the certain event wave form up to 60period/accident for after-accident analysis. The electric power quality event can be saved up to 512 events and has a memory of 8 Mbytes for the savings of these events.

- GIMAC-V detects and analyzes sharp Transient voltage in electric power systems with 1,024 Sampling(50Hz 19.53 usec, 60Hz 16.28 usec), and has a function to save the certain event wave form. Transient event can be saved up to 512 events and has a memory of 372kbytes for the savings of waveforms.

- GIMAC-V has a statistics function that can save the maximum value of the 43 measurements elements, the minimum value of the 19 measurement elements, the maximum/minimum/average of moment values of the events

Of pre-event Demand and pre-event Demand time, maximum/minimum Demand value. Also it saves and expresses a Trend data on the 10 measurement elements for 110 days(15 minutes standard).

- GIMAC-V has a circuit breaker control function for the observation on the state of the circuit breaker and the function of SBO(Select Before Operation), and also has 6 DIs for the function of Wave Capture and 8 normal DOs for the use of various uses.

- GIMAC-V has a RS-485 2Port that allows full dualization and has a Ethernet communication function of the 10Base-T/100Base-TX, and therefore has a variety of communication system composition.

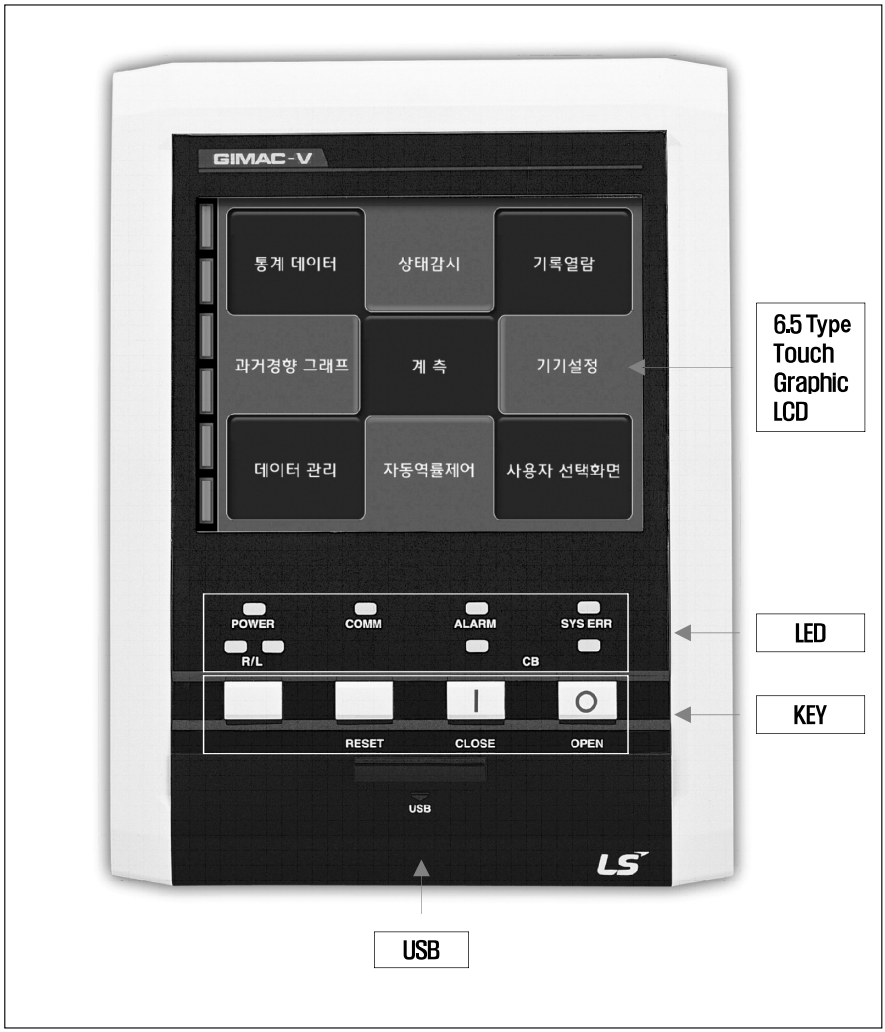
- GIMAC-V saves up to 512 events of state change in equipment, RESET, Clear and control etc. and provides the information to the user.

- GIMAC-V has a self-diagnosis function, and uses it to check the abnormality in the outer power system(wiring error , frequency problems) and the inner function(memory function), and if there is a problem it warns the user of it.

- GIMAC-V has a Power Factor Control function and two 4~20 mA AI functions as an Option.

2. Outer Layout and Composition

2.1 Outer Layout and Composition



- **6.5 type Touch Graphic LCD**

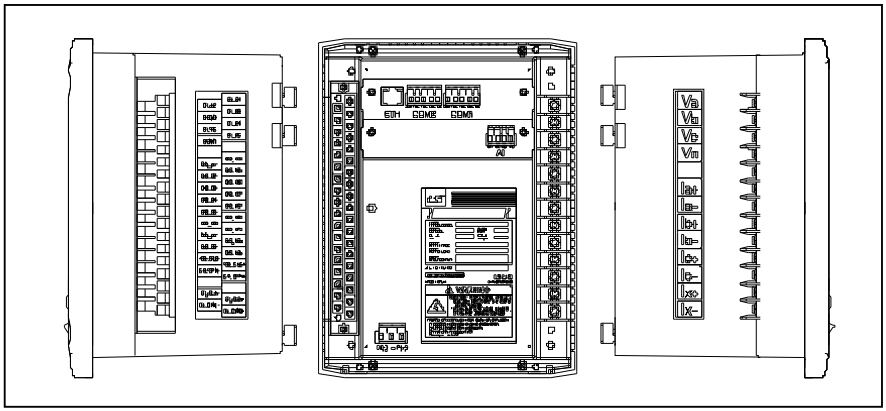
  6.5 type Touch Graphic LCD shows the measurement value and the input state of DI, DO output state, various setup Data, Event, PQ Event, Transient Event, statistics Data, past trends Data, APFC related Data.

- **LED**
  - POWER LED : Lights when the control power is normal.
  - R/L LED : Lights the Green LED when REMOTE, and Red LED when Local.
  - COMM LED : Lights when Communication Data is sent through Rs485 and Ethernet.
  - ALARM LED

    Lights when PQ Event(Sag, Swell, Interruption, Transient) happen.
    Light-outs when Fault Reset order(Key 또는 통신) is input.
    Lights in the event of APFC Event, and Lights-out automatically when the Event is solved.
    Lights when Fault DI is input, and Lights-out when Fault Reset is input.
  - SYS ERR LED : Lights when an error is found in the power system like voltage wiring error, frequency problems etc. or H/W problems in the inside of the product happen, and lights-out when the problem is solved.
  - CB LED: When the circuit breaker state is Close, the Red LED lights, and when the circuit breaker state is Open the Green LED lights.
- **KEY**
  - R/L KEY : Changes the state of Remote / Local.
  - RESET KEY : Realizes and informs of Fault DI, PQ Event, APFC Event, System Error state, and can select cancellation when checking the Confirm in events such as circuit breaker control.
  - CLOSE KEY : KEY for the circuit breaker Close control order.
  - OPEN KEY : KEY for the circuit breaker Open control order.
- **USB**

  Can connect to GIMAC-V Manager using a USB port.

2.2 Terminal composition



Terminal name	Use	Note
P(+), N(-)	Control power input terminal	
Va,Vb,Vc,Vn	PT input terminal	
Ia+, Ia-, Ib+, Ib-, Ic+, Ic-, Ix+, Ix-	CT input terminal	
DI_01,DI_02,DI_03,COM1	DI 1,2,3 input terminal	
DI_04,DI_05,DI_06,COM2	DI 4,5,6 input terminal	
DO_01+, DO_01-	DO 1 output terminal	
DO_02+, DO_02-	DO 2 output terminal	
DO_03+, DO_03-	DO 3 output terminal	
DO_04+, DO_04-	DO 4 output terminal	
DO_05+, DO_05-	DO 5 output terminal	
DO_06+, DO_06-	DO 6 output terminal	
DO_07+, DO_07-	DO 7 output terminal	
DO_08a, DO_08-, DO_08b (C contact point)	DO 8 output terminal DO_08a,DO_08- : A contact point DO_08b,DO_08- : B contact point	
CB_CLS+, CB_CLS-	REALY output terminal for circuit breaker input	
CB_OPN+, CB_OPN-	RELAY output terminal for circuit breaker trip	
DI_CLS+, DI_CLS-	Circuit breaker CLOSE state input terminal	
DI_OPN+, DI_OPN-	Circuit breaker OPEN state input terminal	
ETH	Ethernet Communication terminal(RJ-45)	
COM1	RS485 Channel 1 Communication terminal	
COM2	RS485 Channel 2 Communication terminal	
AI	AI(4~20mA) Connecting terminal	

3. Rated Values for Product

3.1 Standard Usage Environment

The following product must be used in the following standard usage environment unless stated otherwise.

1) Temperature
   - Normal usage temperature: -10 C ~ 55 C
   - Storing temperature: -25 C ~ 75 C
2) Humidity conditions: 80% or less of humidity (There must be no dew.)
3) Usage spot
   - Altitude: 2,000m or lower.
   - Places with no vibration or impact.
   - Places without substantial amounts of dirt, humidity, caustic Gas etc.

3.2 Rated values for input/output

Division	Application limit	Note
Lining method	3P4W, 3P3W(Y), 3P3W(OPEN-DELTA), 1P3W, 1P2W	
Rated Frequency	60 Hz or 50 Hz	60 Hz type, 50 Hz type Are separate
Measurement voltage range	10 ~452 V	Va,Vb,Vc <-> Vn Both ends voltage
Measurement current rage	0.05 ~ 6 A	
PT,CT input burden	0.2 VA or less on each	
Rated control power	DC 110 V ± 20%	
Digital Input power	DC 110 V	
Rated value for DO output	AC250V 5A, DC30V 5A	DO 1~7 RELAY
	AC250V 12A, DC24V 12A	DO 8 RELAY(C contact point)
	AC230V 16A, DC30V 16A	CB_ON,CB_OFF RELAY
Power consumption	20 W or less at normal state, 30 W or less at operation state	

3.3 Environment Specifications

This product satisfies the environment specification the below.

Content	Specification	Relevant standard
Impact withstand voltage	5kV/3kV	KEMC60255-5
Commercial frequency withstand voltage	2kV/1kV, 10mA	KEMC 1110
Insulation resistance	10MΩ/5MΩ	KEMC 1110
Vibration-proof	class 1	KSC IEC 60255-21-1
Impact-proof	class 1	KSC IEC 60255-21-2
Overload tolerant dose	Ix*10 1sec, Vn*2 5sec	KEMC 1110
Outer magnetic inducement test	100A/m, 1000A/m	EN61000-4
1MHz Burst tolerance	2.5kV/1kV 1min	KSC IEC 60255-22-1
Static tolerance	8kV/6kV	KSC IEC 60255-22-2
Sharp excessive Burst influence	4kV/2kV,3min	KSC IEC 60255-22-4
Radio noise	5W : 150MHz /220MHz /400MHz	-
Radio frequency radiation tolerance	10V/m	IEC 60255-22-3
Radio Frequency conductivity tolerance	10V	IEC 60255-22-6
Electromagnetic wave radiation	40/47 dB	IEC 60255-25
Electromagnetic wave conduction	-	IEC 60255-25
Impulse noise	3kV/2kV 1min	-
Surge Tolerance	6kV/3kV	KSC IEC 60255-22-5

4. Measuring function and allowable error

4.1 Measuring Element and preciseness specifications

Content	Measured Element	Specific Measured element	Precise ness	Note
Voltage	Line voltage	Vab, Vbc, Vca, VLAVG	0.2 %	
	Phase voltage	Va, Vb, Vc, VNAVG	0.2 %	
	Zero phase voltage	V0	-	
	Normal voltage	V1	-	
	Reverse phase voltage	V2	-	
	UBV	V2/V1	-	
	Crest Factor	Vab, Vbc, Vca, Va, Vb, Vc	-	
Current	Each phase current	Ia, Ib, Ic, IAVG	0.2 %	
	Ix phase current	Ix	0.2 %	
	Zero Phase current	I0	-	
	Normal current	I1	-	
	Reverse Phase current	I2	-	
	UBA	I2/I1	-	
	Crest Factor	Ia, Ib, Ic	-	
Phase	Line voltage	∠Vab,∠Vbc,∠Vca	0.5 °	
	Each phase voltage	∠Va,∠Vb,∠Vc,	0.5 °	
	Each phase current	∠Ia,∠Ib,∠Ic,∠Ix	0.5 °	
Power	Active power	Pa, Pb, Pc,ΣP	class 0.5	IEC 62053 -22
	Reactive power	Qa, Qb, Qc,ΣQ	class 0.5	
	Apparent power	Sa, Sb, Sc,ΣS	class 0.5	
Electric Energy	Active power energy	Wha, Whb, Whc,ΣWh	class 0.5	
	Reactive power energy	VARha, VARhb, VARhc,ΣVARh	class 0.5	
	Export active power energy	rWha, rWhb, rWhc,ΣrWh	class 0.5	
	Export reactive power energy	rVARha, rVARhb, rVARhc,ΣrVARh	class 0.5	
	Apparent power energy	VAha, VAhb, VAhc,ΣVah	class 0.5	
Freq	Frequency	F(Hz)	0.1%	
Power factor	Power Factor(PF)	PFa, PFb, PFc,ΣPF	Follows phase error.	
	Fundamental wave phase factor(DPF)	DPFa, DPFb, DPFc,ΣDPF		
Harmonic wave	Line voltage	Vab, Vbc, Vca 1~63th 고조파		
	Phase voltage	Va, Vb, Vc 1~63th 고조파		
	Each phase current	Ia, Ib, Ic 1~63th 고조파		
Content	Measured element	Specific measured element	Precise ness	Note
Harmonic wave	THD	Vab, Vbc, Vca, Va, Vb, Vc, Ia, Ib, Ic		
	TDD	Ia, Ib, Ic		
	K-FACTOR	Ia, Ib, Ic		
AI	AI(4~20mA)	AI01, Ai02	0.5%	

4.1.1 Voltage

1) Measuring range: 10 ~ 452 V(Norm : phase voltage , 3P3W-OpenDelta : line voltage)
2) Preciseness
   - 100 V or more : 0.2 %(Real Scale)
   - Less than 100 V : ±0.2 V

4.1.2 Current

1) Measuring Range: 0.05 ~ 6 A
2) Preciseness
   - 1 A or more: 0.2 %(Real Scale)
   - Less than 1 A: ±0.002 A

4.1.3 Phase

1) Phase error between voltage and current
   : 50 V or larger voltage, 0.5 A or larger current: 0.5 degrees
   : Other than the above: 1 degree
2) Phase voltage between voltage and voltage
   : 50 V or larger voltage: 0.5 degrees
   : Other than the above each: 1 degree

4.1.4 Power and Electric Energy(Commonly applied in active/reactive/export active/export reactive/apparent power and energy)

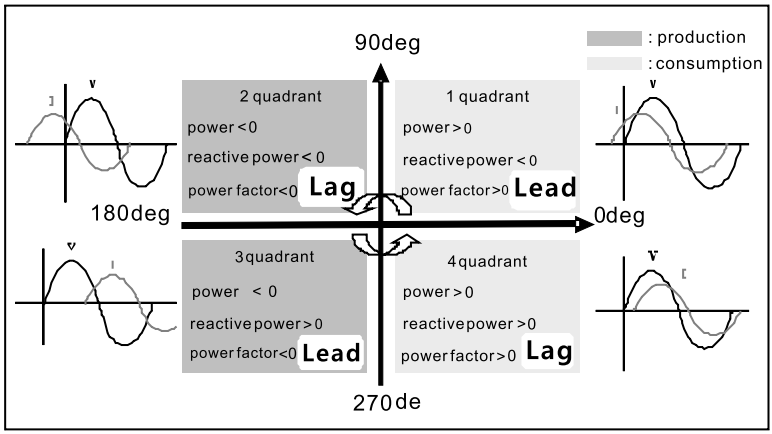
1) Error : Class 0.5 (IEC 62053-22)

The meaning of sign in power, reactive power

1) "+" : means power consumption.
   Active and reactive power occurs, and active and reactive power energy is integrated.
   When active power(1quadrant, 4quadrant) and reactive power(4 quadrant, 3quadrant) is at power factor.

2) "-" : means power production.
   Export active power and reactive power occurs, and only export active power energy is added up.
   When active power(2quadrant, 3quadrant) and reactive power(1 quadrant, 2quadrant) is at power factor.

4.1.6 Power-factor and the Power-factor of the fundamental wave



1) Power factor error : Applies as phase error.
2) Power factor indication method(Do not be confused with the sign of power factor in the image above)
   - In case of Lead : "-" sign.
   - In case of Lag : "+" sign.
   - In cases at 1 quadrant, 4quadrant, " F " is indicated which means electricity consumption.
   - In cases at 2 quadrant, 3 quadrant, " R " is indicated which means electricity production.

4.1.7 Frequency

1) Measuring range : 40 ~ 70 Hz
2) Error of measurement : 0.1%

4.1.8 Harmonics

1) Measurement : 63 harmonics
2) Degree of Precision: No standard for the degree of precision.

4.1.9 AI(4 ~ 20 mA) - Option

1) Port : 2 ports

2) Degree of precision : 0.5 %(Full Scale)

$$V_{THD} = \frac{\sqrt{V_2^2 + V_3^2 + ... + V_n^2}}{V_1} \times 100[\%]$$

V1 : Fundamental wave

V2, V3, … Vn : Harmonic voltage for each degree

4.1.11 TDD(Total Demand Distortion)

$$I_{TDD} = \frac{\sqrt{I_2^2 + I_3^2 + ... + I_n^2}}{I_L} \times 100[\%]$$

IL : Maximum demand load current

I2, I3, … In : Harmonic current for each degree

4.1.12 K-Factor

$$K - factor = \sum_{h=1}^{\infty} \left[\frac{I_h}{I_R} \right]^2 h^2 = \frac{1}{I_R^2} \sum_{h=1}^{\infty} I_h^2 h^2$$

IR : Current RMS

h : Harmonic degree

Ih : Harmonic current for each degree

4.1.13 Crest Factor

$$Crest - factor = \frac{|x|_{peak}}{x_{rms}}$$

xpeak : Maximum instantaneous value

xrms : Measured RMS

When a sine wave which only has a fundamental wave, the Crest-Factor value becomes = 1.414. If lots of harmonic elements is contained, the value becomes larger.

However, since the evaluation of the Peak value uses only 128 samplings out of 1,024 samplings, the peak value of the transient may not be reflected.

5. Power Quality Detecting & Analysis

When SAG, SWELL, INTERRUPTION and other hindrance in the quality of power occurs because of reasons such as voltage to the ground or receiving voltage, it detects and analyzes the cause and for the use in after-event analysis, the 4 phase voltage, current wave can be recorded up to 60 period/accident.

5.1 PQ Function

5.1.1 PQ sensing voltage

1) 3phase4wire, 3phase 3wire Y connection: Va, Vb, Vc(phase voltage)
2) 3phase3wire Open Delta connection: Vab, Vcb(line voltage)
3) 1phase3wire: Va, Vb
4) 1phase2wire: Va

5.1.2 PQ Sampling : 32 sampling/period

5.1.3 PQ Monitoring period : 4 times/period

5.1.4 PQ Event : 512 events

5.1.5 PQ Wave saving

1) The 4 phase voltage/current of 60 cycles * 32 sampling is saved
   - 3phase4wire, 3phase3wire Y connection: Va, Vb, Vc, Ia, Ib, Ic, Ix
   - 3phase3wireOpenDeltaconnection:Vab,Vcb,Ia,Ib,Ic,Ix
   - 1phase3wireconnection:Va,Vb,Ia,Ib,Ix
   - 1phase2wireconnection:Va,Ia,Ix

2)8MbytesofFlashmemory(Minimumof250PQWavescanbesaved)

※ SincethePQWaveandtheDIWaveusesthesamememoryforsaving,soif waveisfrequentlysaveddduetotheinputofDI,thesavedPQWavemaybeerased.

5.2 Sag

5.2.1 Condition: When the effective value of the voltage falls below the Sag voltage set-up value (40%~90% of the rated voltage), it happens.

5.2.2 Record and analysis

1) Wave form: 60period 3phase voltage and 4phase current wave is saved.

2) Event content: Accident occurrence time, Accident conclusion time, Sag event outbreak voltage, the minimum voltage record during Sag event

5.2.3 Other functions

1) Alarm LED

2) During the output of DO, contact point is output which is set up as Sag.

5.3 Swell

5.3.1 Condition: When the effective value of the voltage goes over the Swell voltage set-up value (110%~200% of the rated voltage), it happens.

5.3.2 Record and analysis

1) Wave form: 60period 3phase voltage and 4phase current wave is saved.

2) Event content: Accident occurrence time, Accident conclusion time, Swell event outbreak voltage, the maximum voltage record during Swell event

5.3.3 Other functions

1) Alarm LED

2) During the output of DO, contact point is output which is set up as Swell.

5.4 Interruption

5.4.1 Condition: When the effective value of the voltage falls below the Interruption voltage set-up value (30%~10% of the rated voltage), it happens.

5.4.2 Record and analysis

1) Wave form: 60period 3phase voltage and 4phase current wave is saved.

2) Event content: Accident occurrence time, Accident conclusion time, Interruption event outbreak voltage, the minimum voltage during Interruption event is recorded.

5.4.3 Other functions

1) Alarm LED

2) During the output of DO, contact point is output which is set up as Interruption

6. Transient Detecting & Analysis (dV/dt)

In wave forms such as sine waves, the change in each Sampling value is smaller than a certain value. On the other hand in cases in abnormal voltage due to events such as noise or inflow of noise from voltage to the ground, the dV/dt value is large. Using these events, when the alteration value(dV/dt) of each sampling goes over the set up value, it is judged that abnormal voltage has been input, and the wave form and various data is saved from that point.

6.1 Transient Function

6.1.1 Transient Detecting voltage

1) 3phase4wire, 3phase3wire Y connection: Va, Vb, Vc(phase voltage)
2) 3phase3wire Open Delta connection : Vab, Vcb(conductor voltage)
3) 1phase3wire: Va, Vb
4) 1phase2wire: Va

6.1.2 Transient Sampling : 1,024 sampling

(dt : In the case of 60Hz, 16.28 usec, in the case of 50Hz 19.53 usec)

6.1.3 Transient Set-up voltage : PT secondary voltage standard 60V~150V

6.1.4 Transient Event : 512 events

6.1.5 Transient Wave savings

1) The 4 phase voltage/current of 1 cycle * 1,024 sampling is saved
   - 3phase4wire, 3phase3wire Y connection: Va, Vb, Vc, Ia, Ib, Ic, Ix
   - 3phase3wire Open Delta connection: Vab, Vcb, Ia, Ib, Ic, Ix
   - 1phase3wire connection: Va, Vb, Ia, Ib, Ix
   - 1phase2wire connection: Va, Ia, Ix
2) Memory capacity: 372 kbytes of nonvolatile memory
   (At least 20 or more Transient Waves are saved)

***Using the content of Transient Event as reference data of GIMAC-V manager for the analysis of the waveform, more specific information may be obtained.**

***Transient detecting function uses dt as the standard, and so the signal that alters below that time is negligible.**

***If signals such as strong surge voltage are input in one phase, a weak Transient event can be detected in other soundness.**

***Signals that exceed the measurement limit(±1.6kV) is indicated in a saturated value, so the transient waveform analysis must be referred upon.**

7. Statistics

7.1 Statistics function

7.1.1 Normal maximum instantaneous value : The maximum of the instantaneous value in normal measurement elements is saved every 200 msec.

- Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.
- Phase voltage: Va, Vb, Vc, VNavg
- Conductor voltage: Vab, Vbc, Vca, VLavg
- Current: Ia, Ib, Ic, Iavg
- Frequency: Freq
- Ix current: Ix
- Active/reactive/apparent power : ΣP, ΣQ, ΣS
- Power-factor/fundamental wave power-factor: ΣPF, ΣDPF

7.1.2 Harmonics moment value maximum: The maximum of the instantaneous value related to harmonic measurement elements is saved every 200 msec.

- Harmonics measurement element: 24types – Since the measured elements differ according to the connection of system, it differs according to the connection method.
- THD : Va, Vb, Vc, Vab, Vbc, Vca, Ia, Ib, Ic
- TDD : Ia, Ib, Ic
- K-Factor : Ia, Ib, Ic
- Crest-Factor : Va, Vb, Vc, Vab, Vbc, Vca, Ia, Ib, Ic

7.1.3 Normal moment value minimum: The minimum of the instantaneous value in normal measurement elements is saved every 200 msec.

- Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.

7.1.4 Brink DEMAND : The DEMAND VALUE during the Brink DEMAND period is saved.

1) Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.

7.1.5 Maximum of the instantaneous value during brink DEMAND time

The maximum of instantaneous value during the brink Demand period is saved every 200 msec.

1) Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.

7.1.6 Minimum of the instantaneous value during brink DEMAND time

The minimum of instantaneous value during the brink Demand period is saved every 200 msec.

1) Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.

7.1.7 DEMAND Maximum

The maximum of Demand Value is saved.

1) Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.

7.1.8 DEMAND Minimum

The minimum of Demand Value is saved.

1) Normal measurement elements: 19types – Since the measured elements differ according to the connection of system, it differs according to the connection method.

7.2 Trend Function

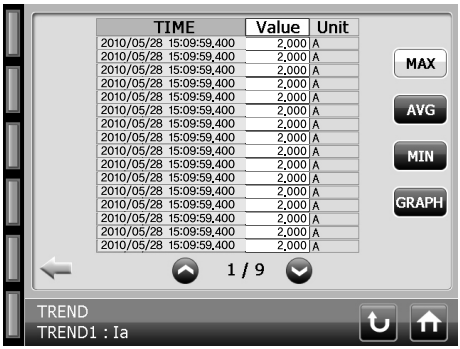
10 out of the 19 types of normal measurement elements are chosen and with the cycle of Demand time that is set up, the average, maximum, minimum value is saved with time(15min standard 110days saved). Also it is indicated in form of Graphic, so it is easy user to check the tendency of the past.

7.2.1 Trend type : 10 out of the 19 types of normal measurement elements can be chosen

– Since there are measurement elements that differ according to the connection of the system, it differs according to the connection method.

7.2.2 Trend data saving period(Default 1min)

- Same with Demand Time(1min, 2min, 5min, 10min, 15min, 20min, 30min, 60min)



8. APFC : Auto Power Factor Controller function

: Controls the outer capacitor BANK in order to limit the power-factor to its target value.

8.1 Terminology

8.1.1 Maximum power-factor: The maximum of goal power-factor. If the power factor exceeds the maximum power-factor, the capacitor opens.

8.1.2 Minimum power-factor: The minimum of goal power-factor. If the power factor exceeds the maximum power-factor, the capacitor is inserted.

8.1.3 Alarm power-factor: If the value is below the set-up alarm power-factor, the alarm rings.

8.1.4 DELAY TIME : If the control condition is satisfied during the DELAY TIME, true control occurs.

8.1.5 DEAD TIME : Considering either the capacitor charging time after the input of capacitor BANK or the capacitor discharging time after the opening of the capacitor BANK, this is the period where controlling the capacitor is prohibited during the DEAD TIME.

8.2 Control conditions

8.2.1 Capacitor opening conditions: If the power-factor exceeds the Maximum power-factor and is sustained for the DELAY TIME, the capacitor opens.

8.2.2 Capacitor inserting conditions: If the power-factor is below the minimum power-factor and is sustained for the DELAY TIM, the capacitor is inserted.

8.3 Setup clause

8.3.1 Maximum power-factor : 0.95 ~ **-** 0.90 (**-** means the actual phase)

8.3.2 Minimum power-factor : 0.80 ~ 0.95

Caution) If the maximum power-factor and the minimum power-factor is set as the same value, since there is no margin for action, there is danger of malfunction. Set the difference between the maximum and minimum power-factor of at least 0.05 or more.

8.3.3 Alarm power-factor: 0.00 ~ 0.90

8.3.4 DELAY TIME : 10 ~ 300 sec

8.3.5 DEAD TIME : 10 ~ 300 sec

8.3.6 Capacitor BANK setup

1) BANK control RELAY setup: DO 1 ~ DO 8
2) Capacitor capacity setup: 0 ~ 999 MVA
3) Alarm RELAY setup: DO 1 ~ DO 8
4) EVENT setup and EVENT control setup
   - LOW CURRENT : In the case where the average of the three phase current is 1A, whether EVENT and the control occurs is setup is set.
   - UNDER VOLTAGE : In the case where the phase voltage(3phase3wire case conductor voltage) is 80V or less, whether EVENT and control occurs is setup is set
   - OVER PF: In the case of where the maximum power-factor is exceeded, whether the EVENT occurs is set.
   - UNDER PF: In the case of where the value is lower than the minimum power-factor, whether the EVENT occurs is set
   - OVER THD & OVER VOLT THD : In the case where the THD of the voltage exceeds the set value, whether the EVENT and BANK opening is controlled is set.

8.4 Power-factor control Sequence

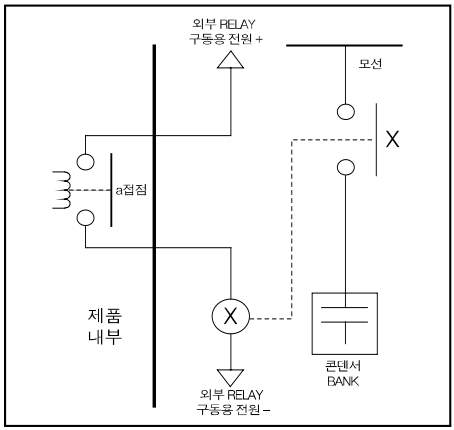
8.4.1 Association control: This is the control method where the capacity of the capacitor is all set. This is the method using control with association compatible to the capacity of the needed capacitor in order to sustain the power-factor in the target power-factor.

8.4.2 Rotation control: This is the method used when the capacity of the capacitor is not set. The first input capacitor is first developed, and the latest capacitor is input first.

8.5 APFC (Auto Power Factor Controller) EVENT

Contents	EVENT condition	EVENT setup	EVENT contents	Control setup corresponding to EVENT	The control action state in control setup
ZERO VOLTAGE	Occurs when the input voltage is all 0 V	(DEFAULT)	1. ZERO VOLTAGE EVENT occurs 2. Occurred OVER PF, UNDER PF, ALARM PF EVENT CLEAR	No corresponding control	
ZERO CURRENT	Occurs when the input current is all 0 A	(DEFAULT)	1. ZERO CURRENT EVENT occurs 2. Occurred OVER PF, UNDER PF, ALARM PF EVENT CLEAR	No corresponding control	
ALARM PF	Occurs when sustained during DELAY TIME under the value of ALARM PF	(DEFAULT)	1. ALARM LED lights 2. ALARM DO output 3. ALARM PF EVENT occurs	No corresponding control	
REVERSE CURRENT	When inverse power occurs and is sustained during DELAY TIME (When the power factor is at 2, 3quadrant)	(DEFAULT)	1. ALARM LED lights 2. ALARM DO output 3. REVERSE CURRENT EVENT occurs	(DEFAULT)	All states of capacitor is LATCHed (Cannot be controlled because AUTO mode)
LOW CURRENT	When average input current is 1 A or lower during DELAY TIME	Setup is possible	1. ALARM LED lights 2. ALARM DO output 3. LOW CURRENT EVENT occurs	Setup is possible	All states of capacitor is LATCHed (Cannot be controlled because AUTO mode)
UNDER VOLTAGE	Phase voltage(3P3W-OD case conductor	Setup is possible	1. ALARM LED lights 2. ALARM DO output	Setup is possible	All states of capacitor is
	voltage) is sustained at Sag voltage or lower during DELAY TIME		3. UNDER VOLTAGE EVENT occurs		LATCHed (Cannot be controlled because AUTO mode)
OVER THD	When the THD of the Phase voltage(3P3W-OD case conductor voltage)의 is set higher than the set value of the THD during DELAY TIME.	Setup is possible	1. ALARM LED lights 2. ALARM DO output 3. OVER THD EVENT occurs	Setup is possible	All capacitor state is opened.
OVER PF	When the power-factor is set higher than the maximum power-factor during the DELAY TIME	Setup is possible	1. ALARM LED lights 2. ALARM DO output 3. OVER PF EVENT occurs	No control	
UNDER PF	When the power factor is set lower than the minimum power factor during the DELAY TIME	Setup is possible	1. ALARM LED lights 2. ALARM DO output 3. UNDER PF EVENT occurs	No control	

8.6 BANK Setup and connection



1) The capacitor BANK is input when the RELAY inside the product acts.
2) Be careful of the automatic opening of the capacitor BANK when GIMAC-V power is cut off and the outer RELAY's residual opens

3) Use the outer RELAY (RELAY residual current specifications) appropriate to RELAY specifications inside the product.
Apply product input/output rated RELAY specifications corresponding to clause 3.2.

9. Circuit breaker control function

The CB input/opening control order can be carried out using the CB CLOSE/OPEN KEYin Local state or using communication at Remote state.

9.1 Monitoring of circuit breaker state

9.1.1 Circuit breaker ON/OFF state monitoring contact

- Circuit breaker ON state monitoring contact: DI_CLS+, DI_CLS-
- Circuit breaker OFF state monitoring contact: DI_OPN+, DI_OPN-

9.1.2 Circuit breaker monitoring Delay Time

- State CLOSE change: Recognized as ON when 10msec or more ON state is sustained
- State OPEN change: Recognized as OFF when 100msec or more OFF state is sustained.

9.1.3 Outer power specification: DC 110 V

9.1.4 Maximum consumption current: MAX 5 mA

9.2 Circuit Breaker control

9.2.1 Circuit breaker input/opening RELAY

- Circuit breaker CLOSE output contact: CB_CLS+, CB_CLS-
- Circuit breaker OPEN output contact: CB_OPN+, CB_OPN-
- RELAY Rating : AC230V 16A, DC30V 16A(Resistance Load)

※If the circuit breaker input/opening residual coil is directly controlled by the circuit breaker input/opening Relay, the inner Relay is damaged. Be sure to use circuit breaker input/opening auxiliary Relay.

9.2.2 Circuit breaker control and control Fail

- Input control: In the case where circuit breaker state is at Open state, the circuit breaker input RELAY 500 msec Pulse is output(Output during 500 msec and goes back to normal state)
  - Key Control: Possible when product state is LOCAL
  - Communication control: Possible when product state is REMOTE
- Opening control: When circuit breaker is Close state, the circuit breaker opening RELAY 500 msec Pulse is output (Output during 500 msec and goes back to normal state)
  - Key Control: Possible when product state is LOCAL
  - Communication control: Possible when product state is REMOTE
- Circuit breaker control Fail: Happens when the circuit breaker state does not change within 500 msec after the circuit breaker input/opening control.

※ Separate the circuit breaker monitoring contact and the power for DI input with the control power.

10. DI(Digital Input) monitoring function

10.1 DI (Digital Input) state monitoring

10.1.1 DI state monitoring contact

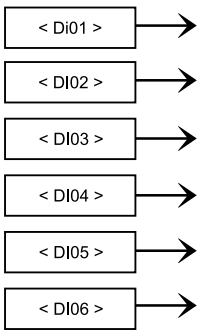
: 6 point(DI01/DI02/DI03<->COM1, DI04/DI05/DI06<->COM2)

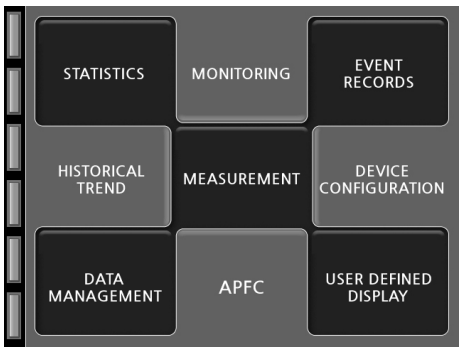
10.1.2 DI monitoring Delay Time

- State ON change: Recognized as ON when 10msec or more ON state is sustained
- State OFF change: Recognized as OFF when 100msec or more OFF state is sustained.

10.1.3 DI input power specification: DC 110 V

10.1.4 Maximum consumption current: MAX 5 mA





10.2 DI (Digital Input) State indication

10.2.1 FAULT/DI state indication

DI setup state	At normal state	At abnormal state (DI signal input)	RESET after removal of hindrance		RESET after removal of hindrance	
			Removal of hindrance	RESET	RESET	Removal of hindrance
FAULT DI	Light out	Lights(Red)	Lights(Red)	Light out	Lights(Red)	Light out
DI	Light out	Lights(Yellow)	Light out	–	–	Light out

10.2.2 Wave saving – When set at Capture in setup clause

1) CAPTURE function is a function that saves the current/voltage wave form when DI is ON.
2) 8 Mbytes Flash memory saving capacity (Minimum of 250 or more DI Wave can be saved)

※ Since the PQ Wave and the DI Wave uses the same memory for saving, so if wave is frequently saved due to the input of DI, the saved DI Wave may be erased

11. DO(Digital Output) output function

11.1 Operation according to the DO (Digital Output) setup

DO	Capacity	Setup	Action	Return condition
DO01 ~Do08	* DO01~7 : AC250V 5A, DC30V 5A * DO08 : AC250V 12A, DC24V 12A	NONE		
		SAG	Outputs when PQ and SAG EVENT occurs	Returns when FAULT RESET
		SWELL	Outputs when PQ and SWELL EVENT occurs	Returns when FAULT RESET
		INTERRUPTION	Outputs when INTERRUPTION EVENT of PQ occurs	Returns when FAULT RESET
		TRANSIENT	Outputs when TRANSIENT EVENT of PQ occurs	Returns when FAULT RESET
		DI	When DI specified is ON state	When DI state is OFF state
		LATCH	When DI specified is ON state	When DI state is OFF state and at FAULT RESET
		APFC Alarm	Outputs when alarm of APEC occurs	Returns when FAULT RESET or Alarm is settled
		APFC Bank	Outputs when the APFC input control conditions is satisfied	Returns when APFC BANK opening control condition is satisfied or communication/KEY is used to input opening order.
Do08		LOCAL/REMOTE	Outputs at REMOTE state	Returns at LOCAL state

12. Self Diagnosis Function

12.1 Frequency ERROR

12.1.1 Condition: Rated frequency is set beyond ±5 Hz range.

12.1.2 Indicated contents

1) LCD : “FREQUENCY ERROR” is indicated

2) LED : Sys Err LED lights

12.1.3 Return conditions: The symptom disappears with RESET or automatically

12.1.4 Others : The sample outside the frequency measurement range is neglected.

12.2 Wiring ERROR

12.2.1 Condition: When the voltage phase rotation is not the direction of counter-clockwise (Occurs when the phase of Vb phase is smaller than phase of Vc phase)

12.2.2 Indicated contents

1) LCD : "WIRING ERROR" is indicated

2) LED : Sys Err LED lights

12.2.3 Return conditions: The symptom disappears with RESET or automatically

12.2.4 Others : Applied only at 3phase 4wire and 3phase 3wire.

12.3 Circuit breaker control problem ERROR

12.3.1 Condition: Occurs when the circuit breaker does not change within 500msec after circuit breaker control order.

12.3.2 Indicated contents

1) LCD : "CB Controlling is Failed" is indicated

2) LED : Sys Err LED lights

12.3.3 Return conditions: RESET

12.4 Power Fail

12.4.1 Power Fail observation goal: For the safety when accident occurs by limiting the control and manipulation when problem occurs in the control power.

12.4.2 Power Fail operation content

1) Power Fail observation voltage: Observed at DC 60V ~ 80V

2) Representation, KEY recognition, control function: No action

3) LED : POWER LED lights, Other LED lights

12.4.3 Return Condition: Power returns normally (Returns if DC standard is 88V or more)

12.5 RTC ERROR

12.5.1 Condition: Occurs when the inner IC, RTC, that has time value does not act normally.

12.5.2 Representation contents

1) LCD: "RTC ERROR" is indicated

2) LED: Sys Err LED lights

12.5.3 Return condition: Returns when IC RTC acts normally.
(Receive checkup with the company customer service.)

12.6 SDRAM ERROR

12.6.1 Conditions: Occurs when inner IC SDRAM for DATA saving has an error.

12.6.2 Indicated contents

1) LCD: "SDRAM ERROR" is Indicated

2) LED: SysErr LED lights

12.6.3 Return conditions: Returns when the IC SDRAM acts normally.
(Receive checkup with the company customer service.)

12.7 SETTING DATA ERROR

12.7.1 Conditions: When setup DATA disappears

12.7.2 Indicated conditions

1) LCD: "SETTING DATA ERROR" is indicated

2) LED: SysErr LED lights

12.7.3 Return conditions: Returns when the setup DATA is saved again.
(Receive checkup with the company customer service.)

12.8 CALIBRATION DATA ERROR

12.8.1 Conditions: Happens when collaboration DATA is lost.

12.8.2 Indicated contents

1) LCD: "CALIBRATION DATA ERROR" is Indicated

2) LED: SysErr LED lights

12.8.3 Return condition: Returns when Calibration happens again.
(Receive checkup with the company customer service.)

12.9 FLASH MEMORY ERROR

12.9.1 Conditions: Happens when there is probleminFLASH MEMORY.

12.9.2 Indicated contents

1) LCD: "FLASH MEMORY ERROR" is indicated.

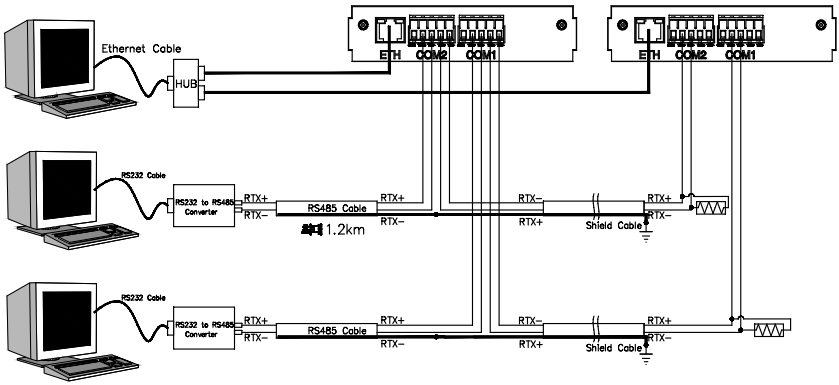
2) LED: SysErr LED lights

12.9.3 Returns condition: Returns when FLASH MEMORY returns to normal state.
(Receive checkup with the company customer service.)

13. Communication

Using the 2 communication ports and 1 Ethernet communication port inside the GIMAC-V, individual threefold system is possible.

13.1 Communication connection



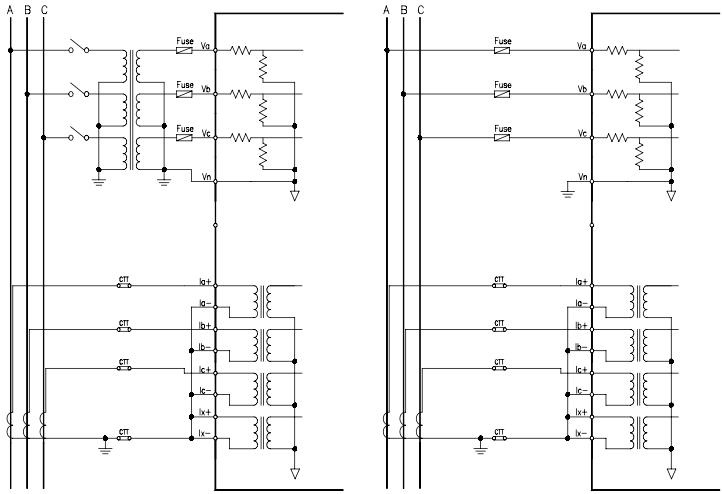
※ RS485 communication cable is shielded and cable for twisted communication use must be used.

※ RS485 communication cable shield must be connected to the ground in order to prevent the communication cable induction disturbance.

※ The maximum distance for communication of RS485 is 1.2km, and the maximum connection is 32 ports.

14. Connection diagram

14.1 3phase 4wire Connection diagram



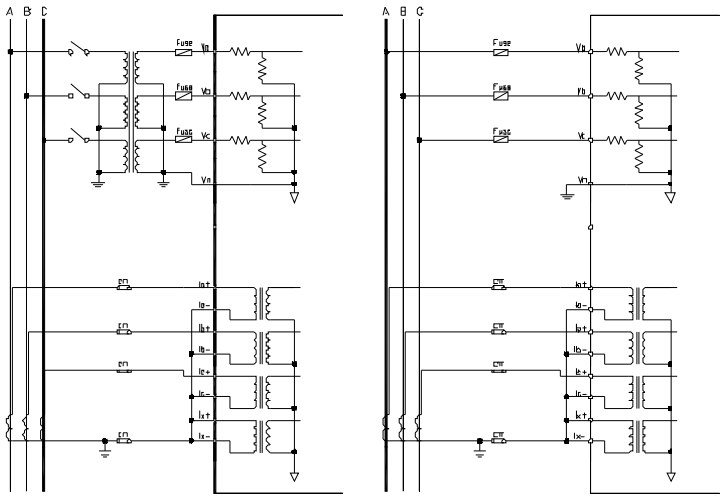
※ PT, CT Secondary coil must be connected to the ground.

※ Power Quality function monitors Va, Vb, Vc voltage.

※ Use Power Transformer when Va-Vn, Vb-Vn, Vc-Vn is larger than 452V.

※ Terminals that are not used must be connected to the ground.

14.2 3phase 3wire-Y Connection Diagram



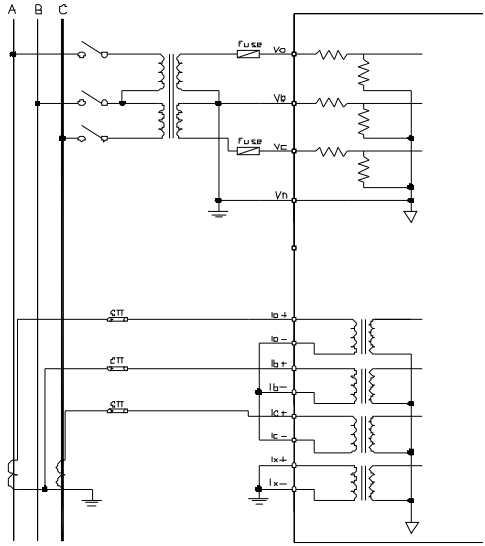
※ PT, CT Secondary coil must be connected to the ground.

※ Power Quality function monitors Va, Vb, Vc voltage.

※ Use Power Transformer when Va-Vn, Vb-Vn, Vc-Vn is larger than 452V.

※ Terminals that are not used must be connected to the ground.

14.3 3phase 3wire Open Delta Connection Diagram



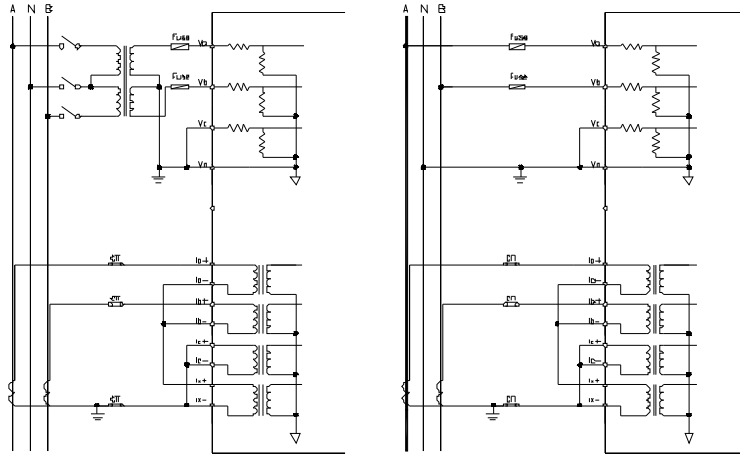
※ Use at parallel load. Error occurs at non-parallel load in power/integrated power.

※ The electricity quality monitoring and wave form indication is applied only at Vab. Vcb phase.

※ PT, CT Secondary coil must be connected to the ground.

※ Terminals that are not used must be connected to the ground.

14.4 1P 3W connection connection diagram



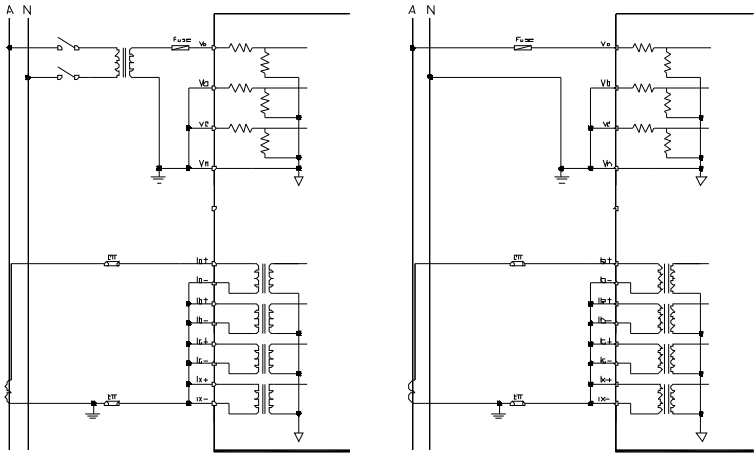
※ PT, CT Secondary coil must be connected to the ground.

※ Power Quality function monitors Va, Vb, Vc voltage.

※ Use degenerator when Vn(Phase voltage) standard 380V or larger.

※ Terminals that are not used must be connected to the ground.

14.5 One phase 2wire connection connection diagram



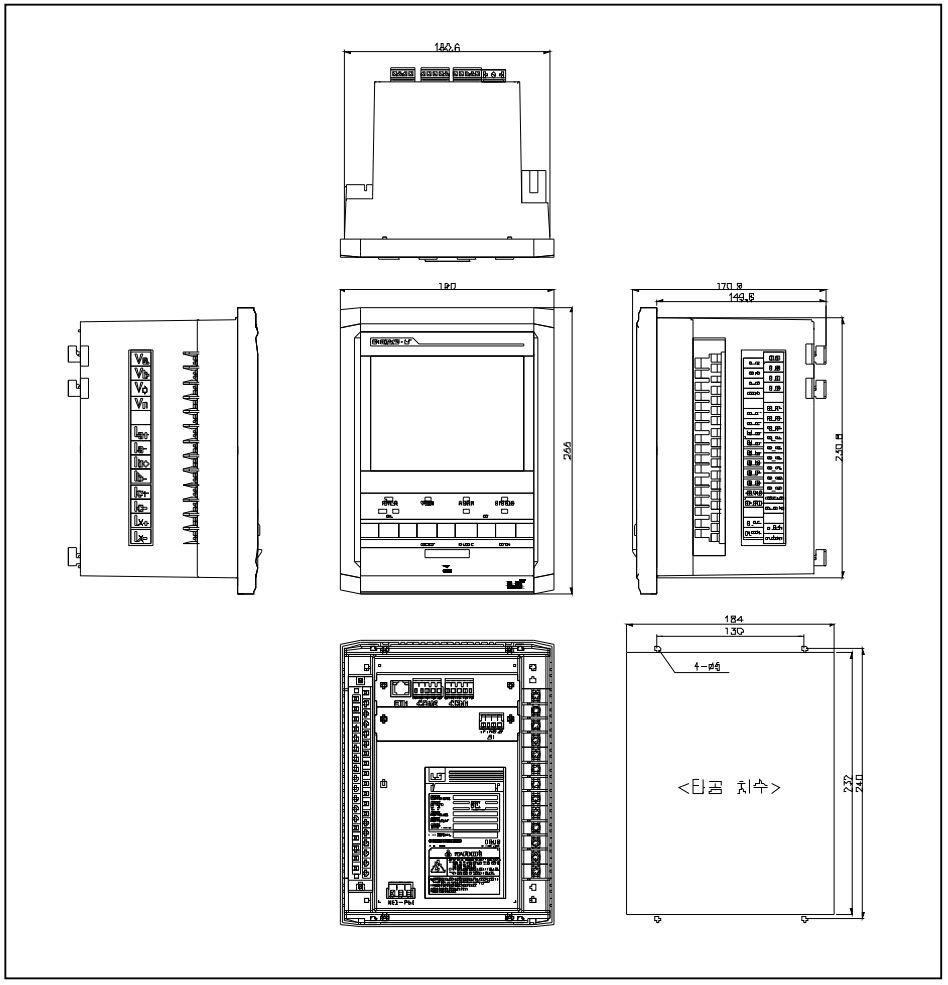
※ PT, CT Secondary coil must be connected to the ground.

※ Power Quality function monitors Va, Vb, Vc voltage.

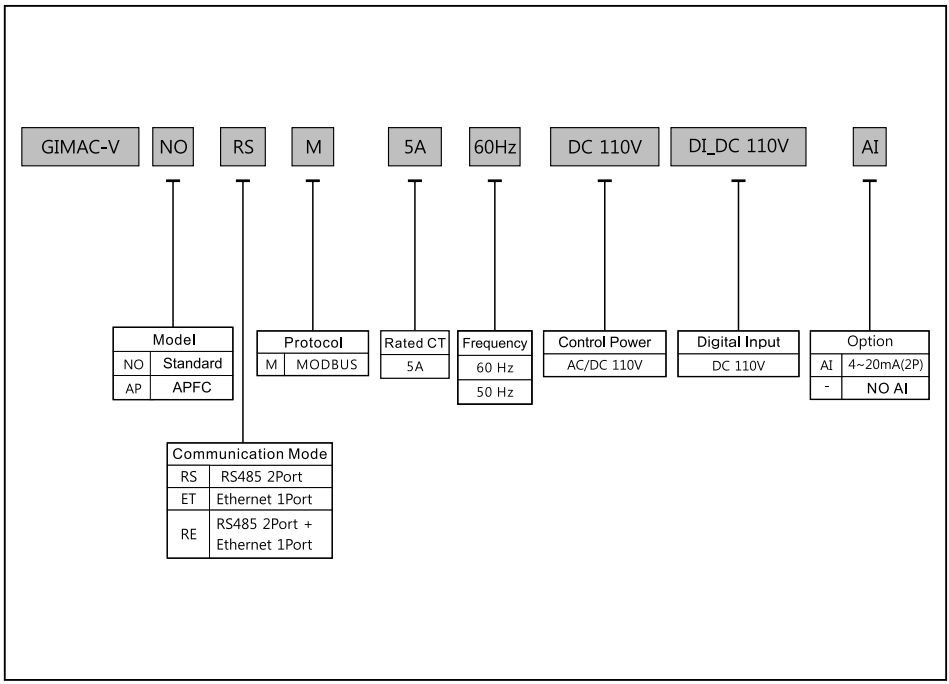
※ Use degenerator when Vn(Phase voltage) standard 380V or larger.

※ Terminals that are not used must be connected to the ground.

15. External Dimension



16. Ordering Information



17. Directions for the use of broadcasting equipment for business use

Kind of machine	User direction
Grade A equipment (Broadcasting equipment for business use)	The users or sellers should be aware that this equipment is an electromagnetic wave approved equipment for business use(Grade A), and should be used in other places other than home.

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