

# Digital Motor Protection Relay

<DSP-AOL>



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# Digital Motor Protection Relay

<DSP-AOL>

## 1.Abstraction

| Installation        | Model   | Protection                                                                               | Description                     |
|---------------------|---------|------------------------------------------------------------------------------------------|---------------------------------|
| Panel Mounting Type | DSP-AOL | Over/Under Current,Phase Loss,Reverse Phase,Locked Rotor,Current Unbalance, Ground Fault | Password,self-diagnostics,Alarm |

| Panel Mounting Type                                                                 |
|-------------------------------------------------------------------------------------|
|  |
| Terminal Type                                                                       |
|  |

## 2. Main Feature

- To give a guarantee to authorized operator: Password
- MCU based digital control : precised motor protection
- Compact size, Multi-function
  - \*Protection : Over current/Under current/Phase loss/Reverse phase/Locked rotor/Current unbalance,Ground fault
  - \*Indication :Current/L1, L2, L3 , earth current, load factor
- To cover a wide and precised current range for the protection
  - \*10 Type
    - ▶0.5A ~ 10A:definite T-I
    - ▶0.5A~6A:inverse T-I/800% or exclusively for external CT
  - \*70 Type : 5A ~ 70A
    - ▶5A ~ 70A:definite T-I
    - ▶5A~ 40A:inverse T-I/800%
  - \*Extended current range with external CT : 1A ~ 1200A
- To show a trip cause and operation information in character and/or number : 5 Digit Window
- To indicate a necessasary information in every 3 sec
- Possible to use various rated ZCT to sense a zero phase current for GF protection
  - \*Standard type : to use external ZCT

| Type      | External ZCT |
|-----------|--------------|
| DSP-AOL-V | 200mA/100mV  |
| DSP-AOL-A | 200mA/1.5mA  |

- \*Optional type : to use embedded ZCT(**not available for external CT application**)
- High sensitive level and wide range for ground fault protection :  
50mA ~ 2A/Zero-phase sequence current
- Alarm for disconnection with ZCT:in case ZCT is not connected with Z1,Z2 of the converter in motor stopping state after the control power is on initially, “Ec-ct” is flickering 3 times ,and the preset process is ahead /need to preset "Off" in "Ec" mode to clear alarm or to connect ZCT→ Only available for AOL-A Type
- Various way to reset after trip: Manual,Electrical or Automatic /to response flexibly for applied sequence system
- To keep a stable operation under frequency variation from Inverter : 30Hz ~ 300Hz
- Self-diagnostic test by one touch for "CLR" key
- Alarm before Tripping by over current
- To memorize latest number of 8 among trip events
- To have stable state under the noise environment :connection cable with line noise filter between display meter and converter/panel flush mounting type
- Convenient installation into existed meter hole:65Φ hole or rectangular hole/display meter of panel flush mounting type

### 3. Function

| Protection                                                               | Operating time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Description                                                          |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Over current                                                             | ·d-time<br>:1 ~ 300sec/def.<br>·o-time<br>:Definite/1 ~ 60sec<br>:Inverse/5~30 Class                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ·to protect over current of each phase /L1,L2,L3                     |
| Under current                                                            | ·U-time<br>:1 ~ 30 sec/def.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ·to protect under current of each phase /L1,L2,L3                    |
| Current unbalance                                                        | 8 sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ·adjustable:30% ~ 90%:<br>·rate=[(max-min)/max]*100[%]               |
| Phase loss                                                               | 1~5sec/def                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ·to protect phase loss of each phase,L1,L2,L3, based on load current |
| Reverse phase                                                            | within 0.5 sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ·to protect reverse phase based on load current                      |
| Locked rotor                                                             | dt + 0.1 sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ·to protect locked rotor in starting state                           |
| Ground fault                                                             | Edt:1 ~ 25sec,<br>Eot:1 ~ 30sec/def                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ·to protect GF by zero phase sequence current sensed through ZCT     |
| Indication                                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                      |
| Rotated indication during the operation                                  | *Indication in every 3 sec :3 phase current >> Earth current >> Load factor<br>*Load factor :[actual running current / preset value of "oc"]<br>*Possible to fix one of rotated factor or to release :repeated one touch with "CLR" key                                                                                                                                                                                                                                                                                                     |                                                                      |
| to check and/or to change preset value of each mode during the operation | * Possible to check a value and a mode as pressing "SET" key once during the operation<br>▶preset value and mode are appeared alternatively<br>▶next mode as pressing "CLR" Key or previous mode as pressing "SET" key<br>* Possible to change a preset value after entering into working state if the preset value of "OPSET" mode belonged to "CAB" mode group is "ON"/ factory default value is "OFF"<br>* Return to operating mode as pressing both "SET" and "CLR" key in the same time or waiting for 10sec as storing adjusted value |                                                                      |
| Alarm                                                                    | * Able to make alarm before tripping if actual current is kept over preset alarm rate to "OC" preset value over 3 sec<br>* "AL" & "Preset value %" is flickeing in such order of alarmed phase in the rotation                                                                                                                                                                                                                                                                                                                              |                                                                      |

### 4. Technical Specification

| DIV                  |                    | Description                                                                                           |
|----------------------|--------------------|-------------------------------------------------------------------------------------------------------|
| Load Current range   | 10 Type            | *0.5A ~ 10A:definite T-I<br>*0.5A~6A:inverse T-I/800% or exclusively for external CT                  |
| Load Current range   | 70 Type            | *5A ~ 70A:definite T-I<br>*5A~ 40A:inverse T-I/800%                                                   |
| Load Current range   | With External CT   | 1A ~ 1200A                                                                                            |
| Ground fault Current | Zero phase current | *50mA ~ 2A<br>*sensed through external ZCT or embeded ZCT<br>*External CT type is not possible to use |

|                                                              |                                            |                                                                                     |
|--------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------|
|                                                              |                                            | embedded ZCT<br>*External ZCT<br>▶ V Type : 200mA/100mV<br>▶ A Type : 200mA/1.5mA   |
| Time preset                                                  | Starting delay time(dt)                    | 1 ~ 300 sec/def.                                                                    |
|                                                              | Over current trip delay time(ot)           | *1 ~ 60 sec/def.<br>*5 ~ 30 Class/inverse                                           |
|                                                              | Under current trip delay time(ut)          | 1 ~ 30sec/def.                                                                      |
|                                                              | Ground fault starting delay time(Edt)      | OFF, 1 ~ 25 sec/def.                                                                |
|                                                              | Ground fault trip delay time(Eot)          | 1 ~ 30 sec/def.                                                                     |
|                                                              | Phase loss trip delay time(PLC)            | 1~5sec/def                                                                          |
| Allowable tolerance                                          | Current                                    | $C \leq 2A: 0.2A, C > 2A: \pm 5\%$                                                  |
|                                                              | Time                                       | $t \leq 2sec: \pm 0.2sec, t > 2sec: \pm 10\%$                                       |
| Control power                                                |                                            | *AC100V ~ AC240V, 50/60Hz (DC90V ~ DC370V)                                          |
|                                                              |                                            | *DC24V(Optional)                                                                    |
| Trip output relay                                            | Main:95-96-98                              | 1c(1-SPDT), 3A/Resistive                                                            |
|                                                              | Aux:05-06-08                               | 1c(1-SPDT), 3A/Resistive(possible to alarm output one of Ec/Ec-tb/AL/uc/Shoc        |
| Application environment                                      | Temperature                                | Operation -25°C ~ +70°C                                                             |
|                                                              |                                            | Storage -40°C ~ +80°C                                                               |
|                                                              | Humidity 30 ~ 85%/relative, non-condensing |                                                                                     |
| Current tolerance against changeable frequency from inverter |                                            | Average +, - 5%, 30Hz ~ 300Hz                                                       |
| Max Main Conductor Size                                      |                                            | 25SQ                                                                                |
| Screw Torque                                                 |                                            | Max 0.6 N.m                                                                         |
| Insulation Resistance/IEC-60255-5                            |                                            | 100Mohm or more/500VDC, circuit-case                                                |
| High Voltage Withstand Test/ IEC-60255-5                     |                                            | *circuit-case: AC2000V, 60Hz, 1 min<br>*contact-contact: AC1000V, 60Hz, 1min        |
| Lightning Impulse Voltage Withstand Test / IEC-60255-5       |                                            | *Circuit-Ground, Circuit-Circuit: 1.2/50uS, 5KV<br>*Control Circuits: 1.2/50uS, 5KV |
| 1 MHz Burst Immunity Test: IEC-61000-4-18                    |                                            | 2.5KV, Positive/Negative under 2sec                                                 |
| Electrostatic Discharge: IEC-61000-4-2                       |                                            | Air: Level 3, 8KV, Contact: Level 3, 6KV                                            |
| Radiated Electromagnetic Field Disturbance: IEC-61000-4-3    |                                            | Level 3, 10V/m                                                                      |
| Electric Fast Transient Burst : IEC-61000-4-4                |                                            | Power, Really output: Level 4, 4KV                                                  |
| Surge Immunity test: IEC-61000-4-5                           |                                            | Relay output: 1.2X50uS, 2KV (0°, 90°, 180°, 270°)                                   |
| Conducted Disturbance Test: IEC-61000-4-6                    |                                            | 10V, Level 3                                                                        |
| Power consumption                                            |                                            | 4W Max                                                                              |

## 5.Preset Description

### ► Main Mode

Press "SET" key to enter into setting mode ,then enter password. The more detail is described in "Operation of Control key "

| Mode                 | Function/<br>range                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                          | Factory<br>Setting<br>value |
|----------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| P****                | Password                                                   | *need to input a number of digit ,"0000" to enter setting mode<br>*need to move a cursor from first digit(1000unit) to last unit(1unit) to pass over next mode as pushing CLR key(Enter function) 4 times.<br>*possible to change password in "PEdit" mode in CAB mode group                                                                                                                                         | 0000                        |
| Out/a/b              | to define the pattern of main trip output in initial state | *Trip output : 1c(95-96-98)<br>*a:output state is changed from the original state as the control power is ON/96-96→open,95-98→close<br>*b:output state is not changed from the original state as the control power is ON/96-96→close, 95-98→open<br>*Not possible to change the preset value of this mode in any case during operation even if “OPSET” mode of “CAB” mode group is “ON”                              | b                           |
| ct/setting value     | to preset a ratio of external CT                           | *This mode is available for 10 Type<br>*To preset CT ratio[primary value/5]<br>*CT ratio:1~240<br>*2t:twice winding through CT hole/ available range:0.3A~3A<br>*4t:four times winding through CT hole/ available range:0.2A~2A<br>*1:to sense a current through its own CT or external CT with 5/5 ratio<br>*”UC” mode is naturally “OFF” if 2t ,4t is preset , so it is necessary to try to preset “UC” mode again | 1                           |
| oc/<br>setting value | to preset a range to protect over current                  | *current range for over current protection<br>*10 Type : 0.5A ~ 10A or for external CT/0.5A ~ 6A<br>*70 Type: 5A ~ 70A                                                                                                                                                                                                                                                                                               | *10:10A<br>*70:70A          |

|                               |                                                                                   |                                                                                                                                                                                                                                                                                                                                                        |      |
|-------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| dt/OFF/<br>setting<br>value   | to preset<br>starting<br>delay time                                               | *Trip delay time to prevent unwanted trip caused<br>by starting current<br>*1 ~ 300sec<br>*available for sensing current over 0.2A ,<br>otherwise preset dt is not adopted internally                                                                                                                                                                  | 5sec |
| Otc/deF/<br>Inv               | to select<br>time-current<br>characteristics<br>for over<br>current<br>protection | *to decide T-I characteristics:deF/Inv<br>*deF(definite):trip based on preset value for “OC”<br>and “ot”<br>*inverse<br>▶dt=0 : trip based on cold curve<br>▶dt>0 :trip based on hot curve after dt is<br>elapsed(actually dt+calculated time in inverse<br>curve)<br>▶Available multiple value in each type : 800%<br>-10Type:0.5~6A<br>-70Type:5~40A | deF  |
| Ot/<br>setting<br>value       | to preset<br>trip delay<br>time                                                   | *to preset time to make a trip when a current<br>exceeds preset value<br>*definite:1sec ~ 60sec<br>*inverse:5 ~ 30 Class                                                                                                                                                                                                                               | 5sec |
| Lc/oFF/<br>/on                | to protect<br>locked rotor                                                        | *OFF:disable for this mode<br>*ON:to make a trip in 0.1sec after elapsed dt<br>("Otc"=def,inv) if starting current exceeds 300%<br>to oc preset value during dt<br>*This mode becomes disable if “dt=0” and “Inv”<br>preset in “otc” mode,so this function is processed<br>by “Inv” characteristics                                                    | OFF  |
| Shoc/<br>oFF/setting<br>value | Shock<br>protection<br>during working                                             | *OFF:disable for this function<br>*preset to "OC":followed calculation /max 700%<br>-10Type:180% ~ [30/"OC"preset value] %<br>-70Type:180% ~ [210/"OC" preset value] %                                                                                                                                                                                 | oFF  |
| st/setting<br>value           | to preset a time<br>for shock<br>protection                                       | *0.5 ~ 3sec/def.<br>*this mode is shown as "st--" if shock mode is<br>Disable<br>*This function is available after 2 min(120sec) if<br>“dt=0” and “Inv” preset in “otc” mode                                                                                                                                                                           | "--" |
| PLc /oFF/<br>setting<br>value | to protect phase<br>loss by load<br>current                                       | *OFF:disable<br>*1 ~ 5sec/adjustable:to make a trip to protect phase<br>loss based on load current                                                                                                                                                                                                                                                     | OFF  |
| RPc /oFF/<br>setting<br>value | to protect<br>reverse phase<br>by load current                                    | *OFF:disable<br>*ON:to make a trip to protect reverse phase based<br>on load current within 0.5sec                                                                                                                                                                                                                                                     | OFF  |

|                                     |                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |
|-------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Ec/oFF/<br>setting<br>value         | to preset zero<br>phase current                                   | *to protect for ground fault protection<br>*OFF:disable<br>*sensitive range:50mA ~ 2A<br>*Possible to select one of both rating for ZCT<br>:AOL/M-V type:200mA/100mV<br>:AOL/M-A type:200mA/1.5mA<br>*Possible to make alarm for ZCT disconnection in<br>motor stop state after control power is on initially<br>“Ec-ct”is flickering 3 times, and preset process<br>Is going ahead :only for “A” type                                                                                                     | OFF  |
| Edt/oFF/<br>setting<br>value        | to preset<br>starting<br>trip delay<br>time                       | *definite T-I<br>*preset range :1 ~ 25sec<br>*this mode is shown alternatively as "Edt" & "--" if<br>“Ec” mode is disable”                                                                                                                                                                                                                                                                                                                                                                                 | "--" |
| Eot /setting<br>value               | to preset<br>operating<br>trip delay<br>time for<br>GF protection | *1 ~ 30sec/def.<br>*this mode is shown alternatively as "Eot" & "--" if<br>"Ec" mode is disable”                                                                                                                                                                                                                                                                                                                                                                                                           | "--" |
| uc/oFF/<br>setting<br>value         | to preset a<br>range to protect<br>under current                  | *preset range:0.6A ~ under "OC" preset value<br>*In case preset "OC" value is under 0.7A, "UC"<br>function is not available<br>*”UC” mode is naturally “OFF” if 2t ,4t is preset<br>, so it is necessary to try to preset “UC” mode again                                                                                                                                                                                                                                                                  | OFF  |
| ut/setting<br>value                 | to preset trip<br>delay time for<br>under current                 | *trip in preset time after dt is elapsed<br>*1 ~ 30sec                                                                                                                                                                                                                                                                                                                                                                                                                                                     | "--" |
| ub/oFF/<br>value                    | to define<br>current<br>unbalance rate                            | *to protect current unbalance among each phase<br>*calculation : [(max-min)/max]*100[%]<br>*preset range : 30% ~ 90%                                                                                                                                                                                                                                                                                                                                                                                       | OFF  |
| Au-o/<br>oFF/Ec/<br>AL/uc/<br>Ec-tb | to preset a kind<br>of<br>AUX(07-08-10)<br>trip output            | *oFF:to make same output as main trip<br>*trip output for AL/Uc is independent from main<br>trip and selected factor is not available in main<br>trip,also if trip cause is clear, this trip output is<br>reset naturally<br>*Ec:only for ground fault protection<br>*Uc:only for under current protection<br>*AL:only for alarm to oc before trip<br>*Ec-tb: only for ground fault protection,but this is<br>not reset even if trip cause is clear,also main trip<br>is acted with this aux trip together | OFF  |

|                                               |                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| AL/<br>setting<br>value                       | to preset<br>alarm level<br>rate(%) to<br>“OC”                                                                                                                                                                                                                                                                        | *if other factor except "AL" in "Auto" mode is<br>preset, this mode is shown "AL--"<br>*preset range to "OC" :15% ~ 100%<br>*alarm trip is come out in case the condition of<br>preset alarm % is keeping for 3sec or more as<br>"AL" & "preset value %" is flicking in the order<br>of alarmed phase rotation                                                                                                                                                                                                     | -- |
| rESet/<br>Hr/Er/<br>A-rE                      | to decide how<br>to reset trip<br>state                                                                                                                                                                                                                                                                               | *Hr:manual reset/Password input<br>*Er:electrical reset<br>:"Reset" key<br>:"CLR" Key<br>:Control power-off<br>*A-rE:auto reset                                                                                                                                                                                                                                                                                                                                                                                    | Er |
| Aut/<br>setting<br>value                      | to preset auto<br>reset time                                                                                                                                                                                                                                                                                          | *time range :0(instant),1 ~ 300sec<br>*If Hr is preset in "rESet" mode, this mode<br>becomes disable<br>*to show the number of 8 trip cause in the order<br>*press "UP" or "DN" in the "trip" mode state, then<br>trip cause and value is shown alternatively<br>*press "CLR" or "SET" to check next event or<br>previous event<br>*In order to enter setup state on the way of trip<br>condition, press "DN" under pressing "UP" firstly<br>and release "DN" firstly under pressing "UP",<br>finally release "UP" | -- |
| trIP /<br>8 ~ 1/trip<br>cause / trip<br>value | to show latest<br>number of<br>8 trip cause                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |
| Test                                          | *to check if this relay is ready to work normally or not.<br>*"tESet" is appeared in case the operator presses test sw on the converter or "CLR"<br>key for 3 sec or more, then release pressed test sw or "CLR" key<br>*main(95-96-98) & aux trip(05-06-08) output will be trip after counting down<br>preset o-time |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |    |

### ► Cab(calibration) Mode

This mode is appeared as pressing "SET" key for 5 sec or more , and is disappeared as "SET" key once more

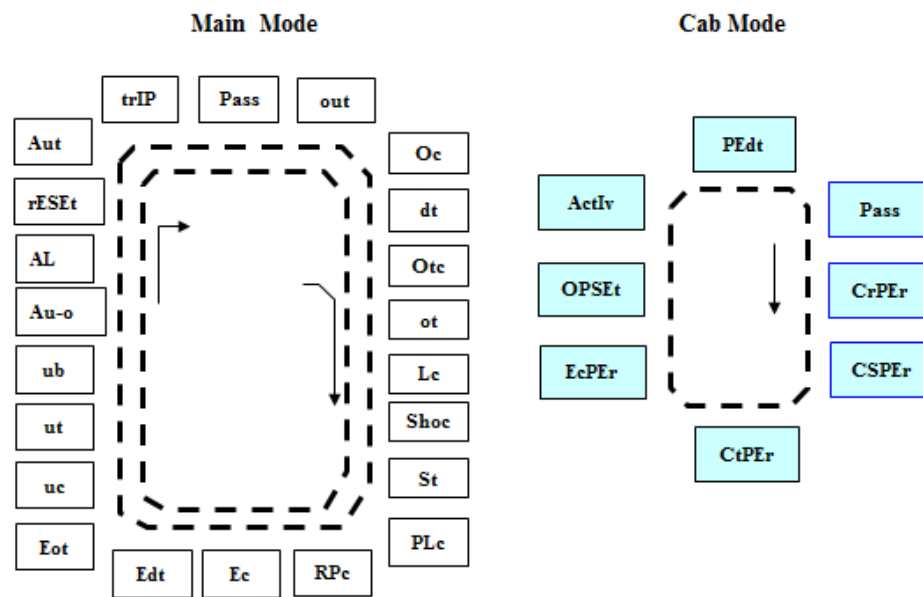
| Mode  | Function/<br>range                                  | Description                                                                                                                                       | Factory<br>Setting<br>value |
|-------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| P**** | Password<br>Input                                   | *need to input password to adjust this mode group so<br>that authorized person may be able to adjust.<br>*How to input is same as it of main mode | 0000                        |
| CrPEr | to have a<br>calibration<br>for phase<br>"R"current | *Possible to adjust within +,- 0.1A~10A by using<br>"UP"."DN" key.                                                                                | 0                           |

|               |                                                              |                                                                                                                                                                                                                                                                                    |     |
|---------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| CSPEr         | to have a calibration for phase "S" current                  |                                                                                                                                                                                                                                                                                    | 0   |
| CtPEr         | to have a calibration for phase "T" current                  |                                                                                                                                                                                                                                                                                    | 0   |
| EcPEr         | to have a calibration for GF current                         | *Possible to adjust within +,- 50% by using "UP"."DN" key.                                                                                                                                                                                                                         | 100 |
| oPSEt/ON /OFF | to decide if it is possible to preset during the operation   | *ON : it is possible for operator to change a preset value during motor normal operation except “out” mode<br>* OFF : it is not possible for operator to change a preset value during motor normal operation                                                                       | OFF |
| ActIv/50/60   | To select power system frequency to use LPF for input of ZCT | *50 : power system frequency is 50Hz<br>*60 : power system frequency is 60Hz                                                                                                                                                                                                       | 60  |
| PedIt         | to change Password                                           | *Possible to enter new digit by using "UP" or "DN" key after positioning a cursor on the required digit as using "SET" & "CLR" key with directional job<br>*How to complete password change: firstly press "CLR" key to come out "setting mode" ,then press both "SET" & "CLR" key |     |

#### Note

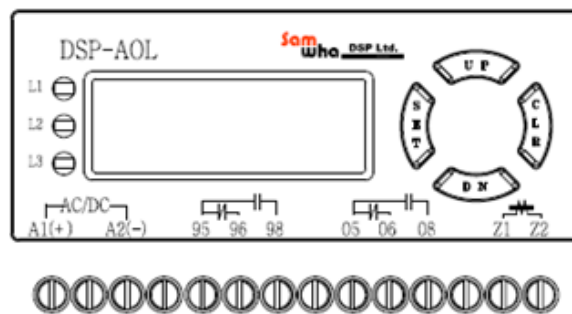
- 1.The operator will has to give an attention in order to apply for the function of preset “OPSET” mode which the operator is possible to change preset value of each mode while the operation is executed normally because the unwanted trip may be happend
- 2.The operator can not preset “out” mode in any case concerned with “OPSET” mode

## 6. The order of Rotated Mode

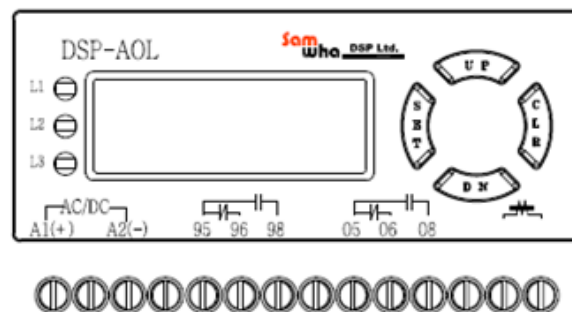


## 7. Input-Output terminal

› DSP-AOL : Standard type/with external ZCT



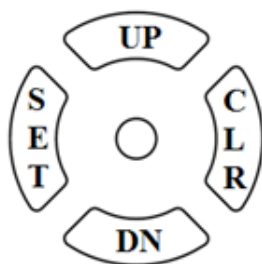
› DSP-AOL : Optional type/with Embedded ZCT



| DIV   | Feature       | Terminal     | Description                           |
|-------|---------------|--------------|---------------------------------------|
| Input | Control power | A1(+), A2(-) | *85 ~ 260VAC, 50/60Hz<br>*90 ~ 370VDC |

|                  |           |              |                                                                                                                          |                                                 |
|------------------|-----------|--------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| Input            | Z1,Z2     | ZCT          | *External ZCT<br>▷V Type : 200mA/100mV<br>▷A Type : 200mA/1.5mA<br>*with Embeded ZCT :Optional Type                      |                                                 |
| State Indication | RED       |              | Operating                                                                                                                | Available for converter with display meter type |
|                  | Green     |              | Power/Stop                                                                                                               |                                                 |
|                  | Yellow    |              | Trip                                                                                                                     |                                                 |
| Output           | Main Trip | *1c:95-96-98 | *Over Current<br>*Under Current<br>*Locked Rotor<br>*Phase Loss<br>*Reverse Phase<br>*Ground Fault<br>*Current Unbalance |                                                 |
| Output           | Aux       | *1c:05-06-08 | *Au-o/oFF/Ec/AL/uc/Ec-tb<br>*Selected factor is excluded from main trip except OFF/Ec-tb                                 |                                                 |

## 8. Operation of Control key

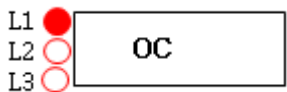
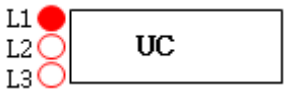
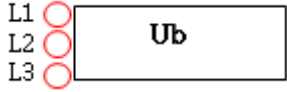


|                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1."SET" key</b>                                | *Press "SET" Key to enter into setting mode, then "P0000" (factory default password) is shown<br>*Move cursor from first digit to right end digit by pressing "CLR" key,finally press once more, if password is not changed from factory default value, but if password is changed, then make required digit by using "UP","DN" key untill operator meets changed password.<br>*If there is no input for 15sec or pressing both "SET" and "CLR" key, it can be entered into operating condition. |
| <b>2.Changed feature of Setting Key</b>           | *After entering into posible state for preset , each key acts its job as follows :SET--->backward direction ,CLR--->forward direction,UP.DN--->able to select number or character in preset mode.<br>*The previous mode based on setting mode is come out as pressing "SET" key during doing a prest job                                                                                                                                                                                         |
| <b>3."SET" Key &amp; "CLR" Key/to select MODE</b> | *Possible to select Mode by using "SET" or "CLR" key                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>4."UP" key &amp; "DN" Key/Adjust</b>           | *Possible to preset required value as selection a character or number by using UP/DOWN                                                                                                                                                                                                                                                                                                                                                                                                           |

|                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>5. "SET" &amp; "CLR" Key/Store</b>                                           | *The storage for preset data is completed by pressing both SET and CLR key in the same time or after 15sec is elapsed                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>6. "CLR" key</b>                                                             | *While each factor is rotated, one of rotated factor is fixed by pressing "CLR" key<br>*After fixing a operating factor, the operator is able to rotate manually one by one as pressing "UP"(forwardly), "DN" (reversely)                                                                                                                                                                                                                                                                                                                   |
| <b>to check and/or to change preset value of each mode during the operation</b> | * Possible to check a value and a mode as pressing "SET" key once during the operation<br>▶preset value and mode are appeared alternatively<br>▶next mode as pressing "CLR" Key or previous mode as pressing "SET" key<br>* Possible to change a preset value after entering into checking state if the preset value of "OPSET" mode belonged to "CAB" mode group is "ON"/factory default value is "OFF"<br>* Return to operating mode as pressing both "SET" and "CLR" key in the same time or waiting for 10sec as storing adjusted value |
| <b>Test/Reset: "CLR" Key</b>                                                    | *to check if this relay is ready to work normally or not.<br>*"tEst" is appeared in case the operator presses test sw on the converter or "CLR" key for 3 sec or more, then release pressed test sw or "CLR" key<br>*main(95-96-98) & aux trip(05-06-08) output will be trip after counting down preset o-time<br>*In case of display meter type, LED on the converter is turned on after a trip<br>*After making trip, press "CLR" key for the reset action                                                                                |

## 9. Trip Indication

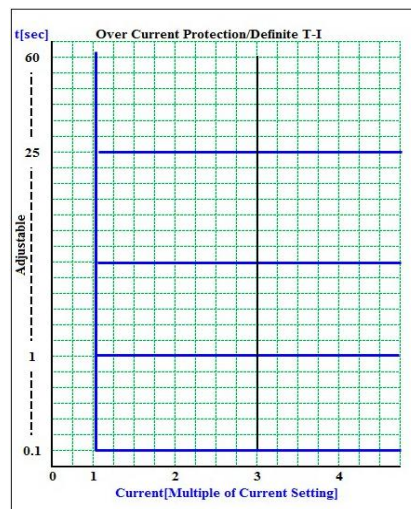
Trip cause and caused value is appeared alternatively

| Trip              | Display                                                                             | Cause                                          |
|-------------------|-------------------------------------------------------------------------------------|------------------------------------------------|
| Over Current (oc) |  | *trip caused by over current in phase L1       |
| Under current(Uc) |  | *trip caused by under current in phase L1      |
| Current unbalance |  | *trip caused by unbalanced current in phase L1 |

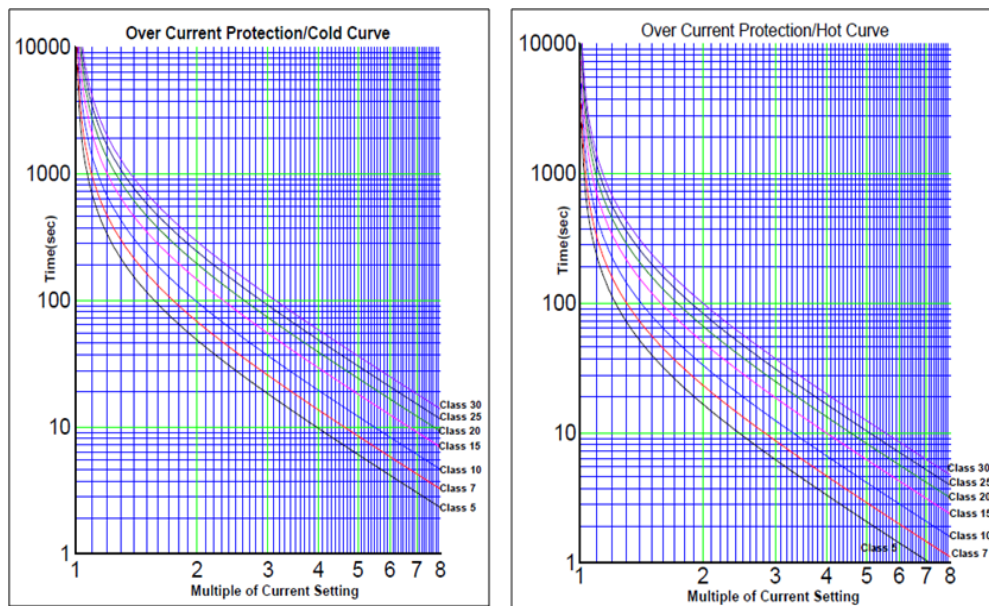
|               |                                                                                                                               |                                                                      |
|---------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| GF            | <div> <div>L1</div> <div>L2</div> <div>L3</div> <div> <div></div> <div></div> <div></div> </div> <div><b>Ec</b></div> </div>  | *trip caused by ground fault current                                 |
| Phase loss    | <div> <div>L1</div> <div>L2</div> <div>L3</div> <div> <div></div> <div></div> <div></div> </div> <div><b>PLc</b></div> </div> | *trip caused by phase loss of phase L2 in load part                  |
| Reverse phase | <div> <div>L1</div> <div>L2</div> <div>L3</div> <div> <div></div> <div></div> <div></div> </div> <div><b>rPc</b></div> </div> | *trip caused by reverse phase in load part                           |
| Locked Rotor  | <div> <div>L1</div> <div>L2</div> <div>L3</div> <div> <div></div> <div></div> <div></div> </div> <div><b>Lc</b></div> </div>  | *trip caused by locked rotor current in phase L2 during motor starts |

## 10.T-I Characteristics

### ►Definite

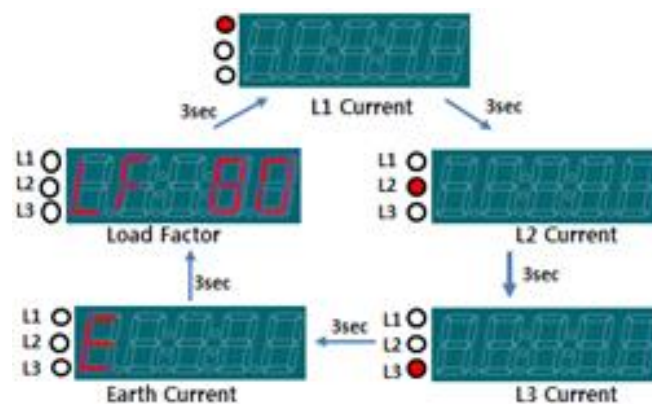


►Inverse



## 11. Rotated indication

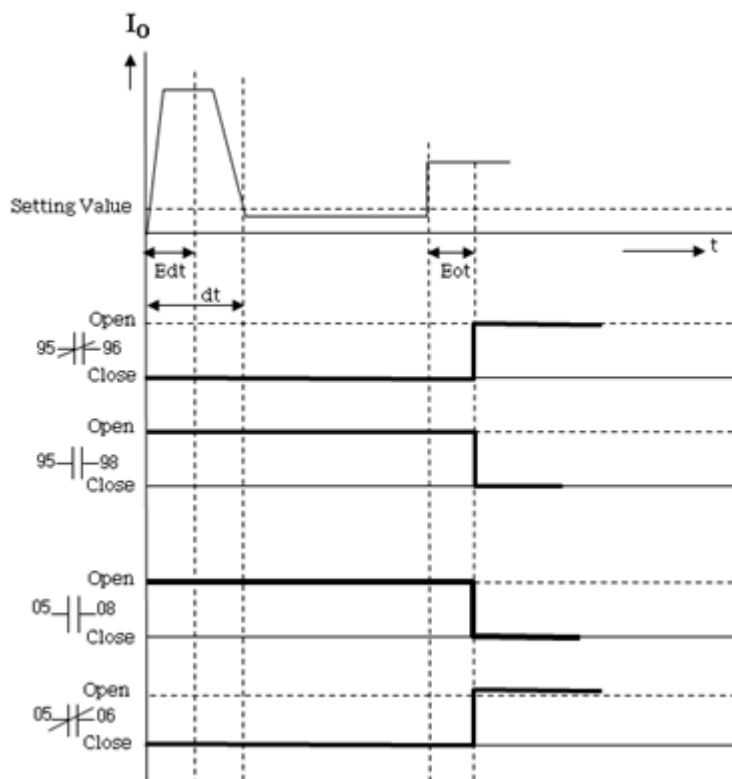
- 3 phase current(L1,L2,L3),Earth current,Load factor



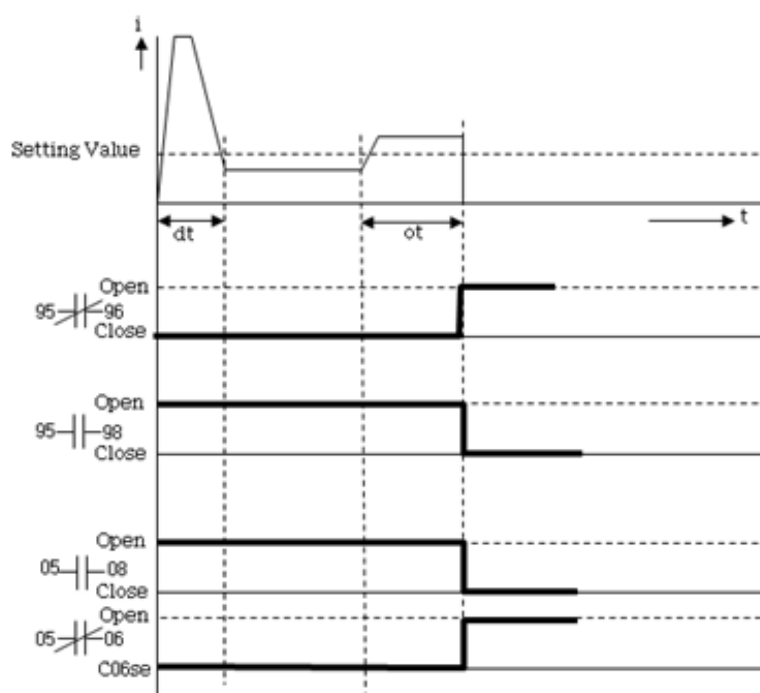
- ☞ "Ec-ct" is flickering 3 times if ZCT is not connected with a terminal of Z1-Z2 in motor stop state while the condition of "Ec" is available, then the preset is ahead

## 12. Time Based Trip relay Output

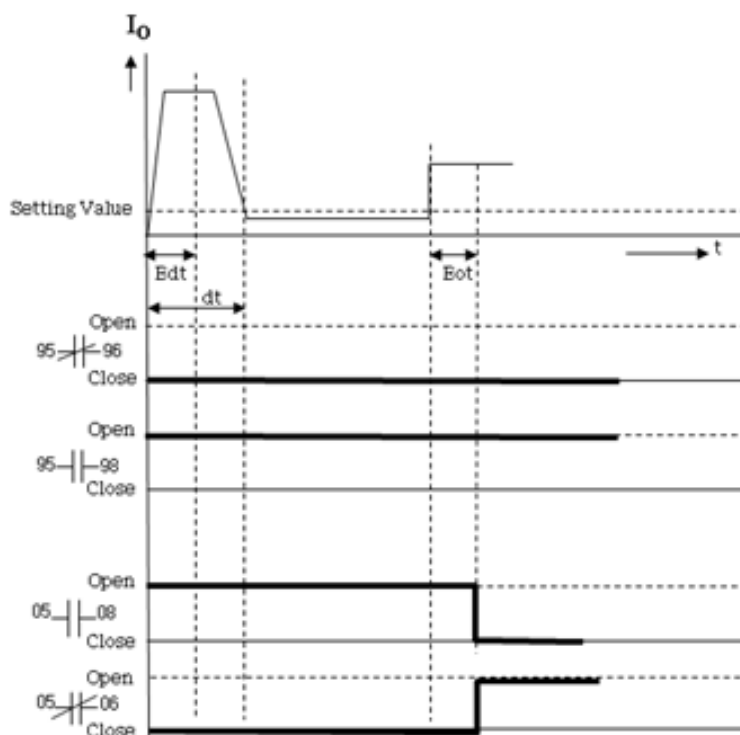
- Over current protection/"Au-o" mode:OFF/"out" mode:b



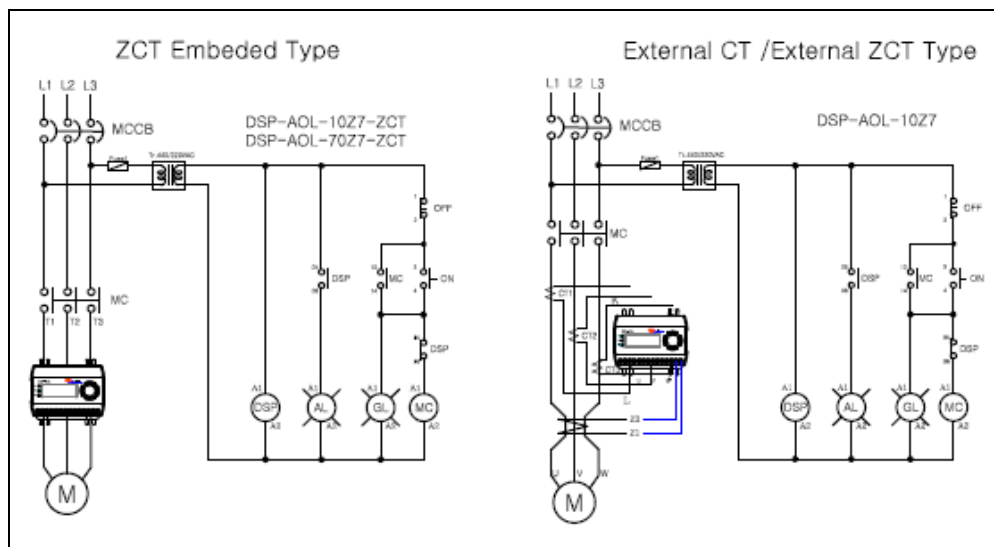
- GF protection/"Au-o" mode:Ec(05-06-08)



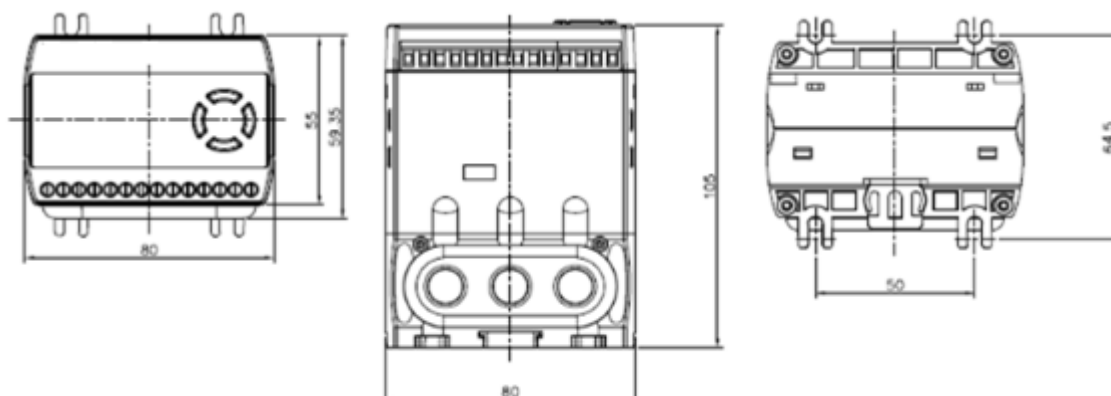
- GF protection/"Au-o" mode:Ec-tb(05-06-08)



### 13. Application Sequence Diagram



## 14. Dimension



## 15. Order form

DSP-1(Type)-2(Rating current)-3(Control power)-4(ZCT rating)- 5(ZCT Embedded )  
-6(Optional condition)

| Item    | Reference Code    | Description                                                                                                                                     |
|---------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| DSP-AOL | DSP-AOL-10B-V     | Panel MountingType, 0.5A ~ 10A,External CT/0.5A ~ 6A, 24VDC, available for external ZCT/ 200mA:100mV,LPF for GR protectuion                     |
|         | DSP-AOL-70B-V     | Panel MountingType, 5A ~ 70A, 24VDC,available for external ZCT/ 200mA:100mV,LPF for GR protectuion                                              |
|         | DSP-AOL-10B-A     | Panel MountingType, 0.5A ~ 10A,External CT /0.5A ~ 6A, 24VDC,available for external ZCT/200mA:1.5mA ,LPF for GR protectuion                     |
|         | DSP-AOL-70B-A     | Panel MountingType, 5A ~ 70A, 24VDC ,available for external ZCT/ 200mA: 1.5mA,LPF for GR protectuion                                            |
|         | DSP-AOL-10B-ZCT   | Panel Mounting Type,0.5A ~ 10A, 24VDC, ZCT embedded/not posible to use external CT                                                              |
|         | DSP-AOL-70B-ZCT   | Panel Mounting Type,5A ~ 70A, 24VDC, ZCT embedded/not posible to use external CT,LPF for GR protectuion                                         |
|         | DSP-AOL-10B-V- I  | Panel MountingType, 0.5A ~ 10A,External CT/0.5A ~ 6A, 24VDC with Isolation Mode, available for external ZCT/ 200mA:100mV,LPF for GR protectuion |
|         | DSP-AOL-70B-V- I  | Panel MountingType, 5A ~ 70A, 24VDC with Isolation Mode,available for external ZCT/200mA :100mV,LPF for GR protectuion                          |
|         | DSP-AOL-10B-A- I  | Panel MountingType, 0.5A ~ 10A,External CT /0.5A ~ 6A, 24VDC with Isolation Mode,available for external ZCT/200mA:1.5mA,LPF for GR protectuion  |
|         | DSP-AOL-70B-A- I  | Panel MountingType, 5A ~ 70A, 24VDC with Isolation Mode ,available for external ZCT/ 200mA: 1.5mA,LPF for GR protectuion                        |
|         | DSP-AOL-10B-ZCT-I | Panel Mounting Type,0.5A ~ 10A, 24VDC with Isolation Mode, ZCT embeded/not posible to use external CT,LPF for GR protectuion                    |

|                   |                   |                                                                                                                                                               |                           |
|-------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
|                   | DSP-AOL-70B-ZCT-I | Panel Mounting Type, 5A ~ 70A, 24VDC with Isolation Mode, ZCT embedded/not possible to use external CT, LPF for GR protection                                 |                           |
|                   | DSP-AOL-10Z7-V    | Panel Mounting Type, 0.5A ~ 10A, External CT/0.5A ~ 6A, AC100V ~ AC240V, 50/60Hz(90 ~ 370VDC), Available for external ZCT/200mA:100mV, LPF for GR protection  |                           |
|                   | DSP-AOL-70Z7-V    | Panel Mounting Type, 5A ~ 70A, AC100V ~ AC240V, 50/60Hz(90 ~ 370VDC), available for external ZCT/200mA:100mV, LPF for GR protection                           |                           |
|                   | DSP-AOL-10Z7-A    | Panel Mounting Type, 0.5A ~ 10A, External CT /0.5A ~ 6A, AC100V ~ AC240V, 50/60Hz(90 ~ 370VDC), available for external ZCT/200mA:1.5mA, LPF for GR protection |                           |
|                   | DSP-AOL-70Z7-A    | Panel Mounting Type, 5A ~ 70A, AC100V ~ AC240V, 50/60Hz(90 ~ 370VDC), available for external ZCT/200mA: 1.5mA, LPF for GR protection                          |                           |
|                   | DSP-AOL-10Z7-ZCT  | Panel Mounting Type, 0.5A ~ 10A, AC100V ~ AC240V, 50/60Hz(90 ~ 370VDC), ZCT embedded/not possible to use external CT, LPF for GR protection                   |                           |
|                   | DSP-AOL-70Z7-ZCT  | Panel Mounting Type, 5A ~ 70A, AC100V ~ AC240V, 50/60Hz(90 ~ 370VDC), ZCT embedded/not possible to use external CT, LPF for GR protection                     |                           |
| Terminal Type     | Basic code+T      | 3 Terminal through each CT Hole                                                                                                                               |                           |
| Combined with 3CT | Basic code + C1   | with 100/5 CT                                                                                                                                                 | Not used for embedded ZCT |
|                   | Basic code + CC   | with 150/5 CT                                                                                                                                                 |                           |
|                   | Basic code + C2   | with 200/5 CT                                                                                                                                                 |                           |
|                   | Basic code + C3   | with 300/5 CT                                                                                                                                                 |                           |
|                   | Basic code + C4   | with 400/5 CT                                                                                                                                                 |                           |

\*Accessory

| Item          | Reference     | Description                | Remarks                  |
|---------------|---------------|----------------------------|--------------------------|
| Cable         | DSP -CABLE-12 | 1.2m                       |                          |
|               | DSP -CABLE-18 | 1.8m                       |                          |
|               | DSP -CABLE-30 | 3m                         |                          |
|               | DSP -CABLE-50 | 5m                         |                          |
| ZCT           | DSP -ZCT-A-XX | 100mA/1.5mA                | XX:Inner diameter of ZCT |
| Display Meter | DSP -ID-AOM   | Input device/Display Meter |                          |