Digital Motor Protection Relay

<DSP-AOL/AOM>

Samwha DSP Ltd.

Contents

Digital Motor Protection Relay

<DSP-AOL/AOM>

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 Flush Mounting Type	DSP-AOM		Password,self-diagnostics, Alarm

Panel Mounting Type	**Panel Flush Mounting Type**
	
Terminal Type	
	

2. Main Feature

◯ To give a gurantee 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 or exclusively for external CT/ 0.5A~6A
*70 Type : 5A～70A
*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
◯ Convenient installation of ZCT to sense a zero phase current for GF protection
*Standard type : to use external ZCT

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

*Optional type : to use embeded 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, the preset process is not ahead anymore as flickering "Ec-ct" /need to preset "Off" in "Ec" mode to clear alarm.
◯ Various way for reset: Manual or Automatic /to response flexibly for applied sequence system
◯ To keep a stable operation under frequency variation from Inverter : 30Hz ～ 300Hz
◯ Self-diagonostic test by one touch for "SET" key
◯ Alarm befor 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 indication 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 :1～300sec/def. • o-time :Definite/1～60sec :Inverse/5~30 Class	• to protect over current of each phase /L1,L2,L3
Under current	• U-time :0.5～30 sec/def.	• to protect under current of each phase/L1,L2,L3
Current unbalance	8 sec	• adjustable:30%～90%: • rate=[(max-min)/max]*100[%]
Phase loss	within 3 sec	• to protect phase loss of each phase,L1,L2,L3, based on load current
Reverse phase	within 0.5 sec	• to ptotect reverse phase based on load current
Locked rotor	dt + 0.1 sec	• to protect locked rotor in starting state
Ground fault	Edt:1～25sec, Eot:1～30sec/def	• trip by zero phase sequence current sensed through ZCT
Indication	**Description**	
Rotated indication during the operation	*Indication in every 3 sec :3 phae current >> Earth current >> Load factor *Load factor :[actual running current / preset value of "oc"] *Possible to fix one of rotated factor or to release :repeated one touch with "CLR" key	
Check preset value of each mode during the operation	* Possible to check a value and a mode as pressing "SET" key once during the operation * preset value and mode are appeared alternatively * possible to check next mode as pressing “CLR” Key * Return to operating mode as pressing both “SET” and "CLR" key in the same time or waiting for 15sec	
Alarm	* Able to make alarm before tripping if actual current is kept over preset alarm rate to "OC" preset value over 3 sec * "AL" & "Preset value" is flickeing in the order of alarmed phase rotation	

4. Technical Specification

DIV		Description
Load Current range	10 Type	0.5A～10A or external CT(0.5~6A)
	70 Type	5A～70A
	With External CT	1A～1200A
Ground fault Current	Zero phase current	*50mA～2A *sensed through external ZCT or embeded ZCT *External ZCT type is not possible

			to use embeded ZCT *External ZCT ▷ V Type : 200mA/100mV ▷ 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. *5～30 Class/inverse
	under current trip delay time(ut)		0.5～30sec/def.
	Ground fault starting delay time(Edt)		OFF,1～25 sec/def.
	Ground fault trip delay time(Eot)		*1～30 sec/def.
Allowable tollerance	Current		C<=2A:0.2A,C>2A:±5%
	Time		t<=2sec:± 0.2ec, t>2sec:±10%
Control power			*AC 85V ～ AC260V,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/Ect/AL/uc/Shoc
Application environment	temperature	Operation	-25^{O}C～+70^{O}C
		Storage	-40^{O}C～+80^{O}C
	Humidity		30～85%,non-condensing
Current tollerance against changeable frequency from inverter			Average +,- 5%,20Hz～300Hz
Max Main Conductor Size			25SQ
Insulation Resistence			10 Mohm or more/500VDC, circuit-case
Withstanding Voltage			*circuit-case:AC 2000V,60Hz, 1 min *contact-contact:AC1500V,60Hz,1min
Screw Torque			Max0.6N.m
Frame:IEC/EN 60695-2-12			650^{O}C
Shock:IEC/EN 60068-2-27			1/2 sine wave,15g/11ms
Dielectric Strength:IEC/EN 60947-4-1			AC 100~240V input,output contact :4KV, Air:8KV
Electrostatic Discharge:IEC/EN 61000-4-2			Air :Level 3, 8KV, Contact:Level3,6KV
Radiated Electromagnetic Field Disturbance:IEC /EN 61000-4-3			Level 3, 10V/m
Electric Fast Transient Burst:IEC/EN 61000-4-4			*Power,relay output:Level 4, 4KV *others:Level 3,2KV
Surge:IEC/EN 61000-4-5			relay output:1.2X50uS, 2KV(0^{O},90^{O},180^{O},270^{O})

Immunity to conducted disturbence:IEC/EN61000-4-6	10V,Level 3
Voltage variation:IEC-61000-4-11	3ms/0, 300ms/70%
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/ range	Description	Factory Setting value
P****	Password	*need to input a number of digit ,"0000" to enter setting mode *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. *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) *a:output state is changed from the original state as the control power is ON/96-96⇢open,95-98⇢close *b:output state is not changed from the original state as the control power is ON/96-96⇢close, 95-98⇢open	b
ct/setting value	to preset a ratio of external CT	*This mode is available for 10 Type *To preset CT ratio[primary value/5] *CT ratio :1~240 *2t:twice winding through CT hole *4t:four times winding through CT hole *1:to sense a current through its own CT or external CT with 5/5 ratio	1
oc/ setting value	to preset a range to protect over current	*current range for over current protection *10 Type : 0.5A～10A or for external CT/0.5A～6A *70 Type: 5A～70A	*10:10A *70:70A
dt/OFF/ setting value	to preset starting delay time	*Trip delay time to prevent unwanted trip caused by starting current *1～300sec *available for sensing current over 0.2A , otherwise preset dt is not adopted internally	5sec
Otc/deF/ Inv	to select time-current	*to decide T-I characteristics:deF/Inv *dt=0 and inverse	deF

	chracteristics for over current protection	▶ actual current<preset value:hot curve from initial start ▶ actual current>preset value :cold curve for 3 sec,then hot curve is available ▶ time point from cold to hot:the instant point which actual current is under the preset current. *dt>0 and inverse ▶ protection is not available during dt ▶ actual current>preset value :cold curve for 3 sec,then hot curve is available ▶ actual current<preset value : hot curve is available ▶ trip is done right after dt,if the calculated time by curve is within dt	
Ot/ setting value	to preset trip delay time	*to preset time to make a trip when a current exceeds preset value *definite:1sec～60sec *inverse:5～30 Class	5sec
Lc/oFF /on	to protect Locked Rotor	*OFF:disable for this mode(in case of def) *ON:to make a trip in 0.1sec after eleapsed dt("Otc"=def,inv) if starting current exceeds 300% to oc preset value during dt *In case "Otc" is inverse, this is protected by the condition of over current through cold curve	OFF
PLc /oFF/ on	to protect phase loss by load current	*OFF:disable *ON:to make a trip to protect phase loss based on load current within 3 sec	OFF
RPc /oFF/ on	to protect reverse phase by load current	*OFF:disable *ON:to make a trip to protect reverse phase based on load current within 0.5sec	OFF
Ec/oFF/ setting value	to preset zero phase current	*for ground fault protection *OFF:disable *sensitive range:50mA～2A *Possible to select one of both rating for ZCT :AOL/M-V type:200mA/100mV :AOL/M-A type:200mA/1.5mA *Possible to make alarm for ZCT disconnection in motor stop state: "Ec-ct" is flickering and can not be ahead for the preset	OFF
Edt/oFF/ setting	to preset starting	*definite T-I *preset range :1～25sec	"--"

value	trip delay time	*this mode is shown alternatively as "Edt" & "--" if “Ec” mode is disable”	
Eot /setting value	to preset operating trip delay time for GF protection	*1～30sec/def. *this mode is shown alternatively as "Eot" & "--" if "Ec" mode is disable”	"--"
uc/oFF/ setting value	to preset a range to protect under current	*preset range:0.6A～under "OC" preset value *In case preset "OC" value is under 0.7A, "UC" function is not available	OFF
ut/setting value	to preset trip delay time for under current	*0.5～30sec	2sec
ub/oFF/ value	to define current unbalance rate	*to protect current unbalance among each phase *calculation : [(max-min)/max]*100[%] *preset range : 30%～90%	50%
Au-o/ oFF/Ec/ AL/uc/ Ec-tb	to preset a kind of AUX(07-08 -10) trip output	*oFF:to make same output as main trip *trip output for AL/Uc is independent from main trip and selected factor is not available in main trip,also if trip cause is clear, this trip output is reset naturally *Ec:only for ground fault protection *Uc:only for under current protection *AL:only for alarm to oc before trip *Ec-tbt: only for ground fault protection,but this is not reset even if trip cause is clear,also main trip is acted with this aux trip together	OFF
AL/ setting value	to preset alarm level rate(%) to “OC”	*if other factor except "AL" in ”Auo” mode is preset, this mode is shown “AL--“ *preset range to"OC" :65%～100% *alarm is come out as the condition of preset alarm % is keeping for 3 sec or more	90
rESEt/ Hr/Er/ AuL	to decide how to reset trip state	*Hr:manual reset/Password input *Er:electrical reset :"Reset" key :"CLR" Key :Control power-off *AuL:auto reset	Hr
Aut/ setting value	to preset auto reset time	*time range :0(instant),1～300sec *If Hr is preset in "rESEt" mode, this mode becomes disable	"--"

trIP /8 ~1/trip cause / trip value	to show latest number of 8 trip cause	*to show the number of 8 trip cause in the order *press "UP" or "DN" in the "trip" mode state, then trip cause and value is shown alternatively *press "CLR" or ""SET" to check next event or previous event *In order to enter setup state on the way of trip condition, press "DN" under pressing "UP" firstly and release "DN" firstly under pressing "UP", finally release "UP"
Test	*to check if this relay is ready to work normally or not. *"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 *main(95-96-98) & aux trip(05-06-08) output will be trip after counting down preset o-time(definite T-I)	

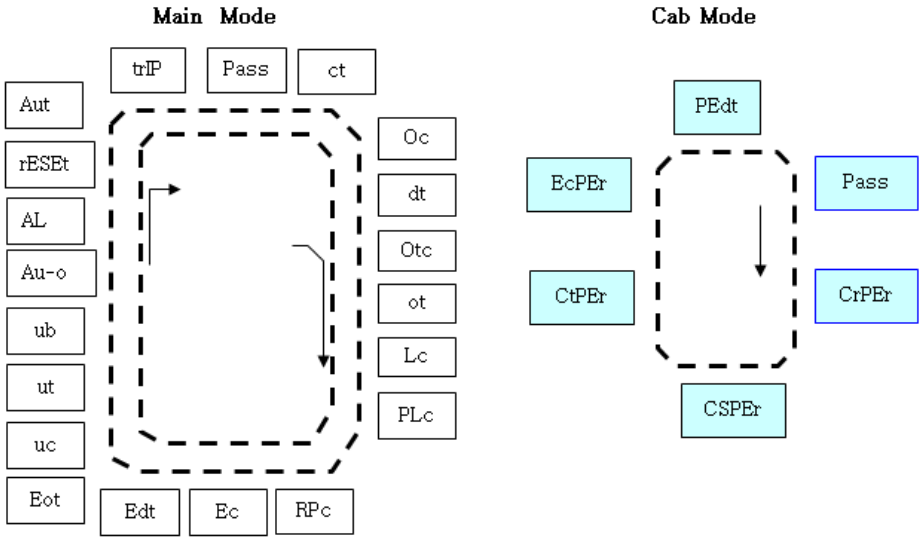
▶ Cab(calibration) Mode

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

Mode	Function/ range	Description	Factory Setting value
P****	Password Input	*need to input password to adjust this mode group so that authorized person may be able to adjust. *How to input is same as it of main mode	0000
CrPEr	to have a calibration for phase "R"current	*Possible to adjust within +,- 50% by using "UP"."DN" key.	100
CSPEr	to have a calibration for phase "S" current		100
CtPEr	to have a calibration for phase "T" current		100
EcPEr	to have a calibration for GF current		100
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 *How to complete password change: firstly press "CLR" key to come out "setting mode" ,then press both "SET" & "CLR" key	

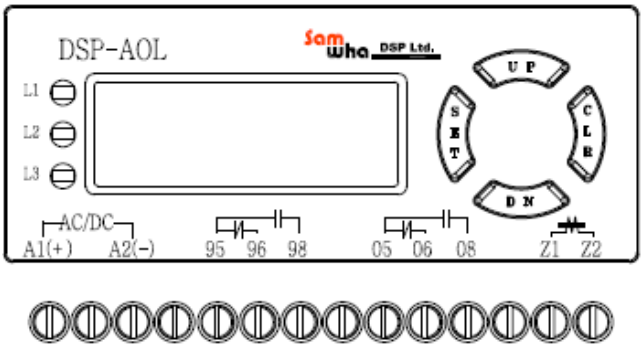
6. The order of Rotated Mode

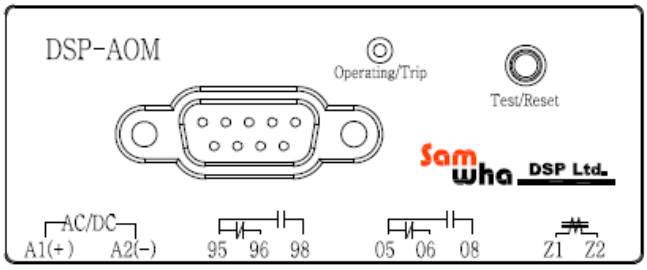


7.Input-Output terminal

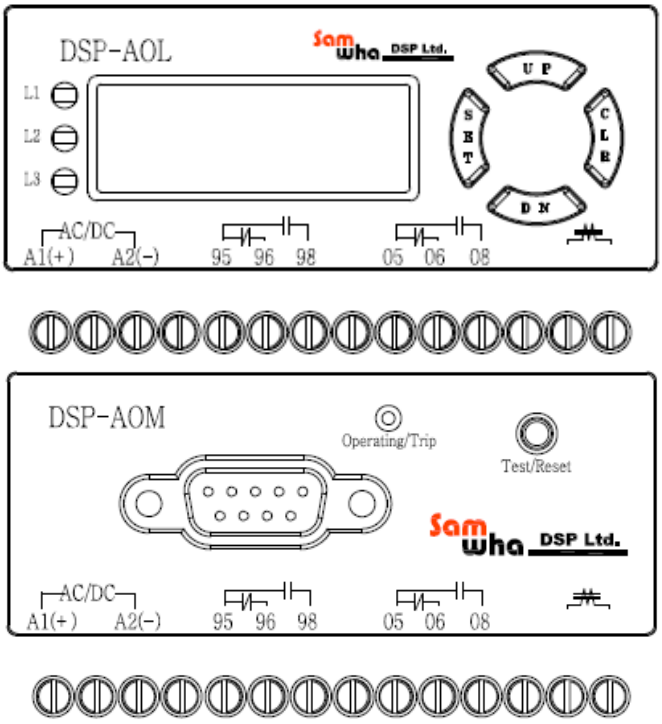
◯ DSP-COM/CTM

▸DSP-AOL/AOM : Standard type/with external ZCT





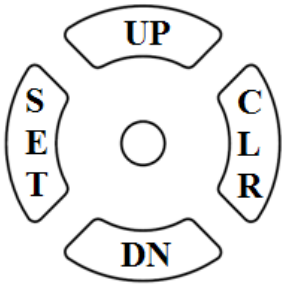
▸**DSP-AOL,AOM : Optional type/with** Embeded ZCT



DIV	Feature	Terminal	Description	
Input	Control power	A1(+),A2(-)	*85～260VAC,50/60Hz *90～370VDC	
	Z1,Z2	ZCT	*External ZCT ▸V Type : 200mA/100mV ▸A Type : 200mA/1.5mA *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 *Under Current *Locked Rotor	

			*Phase Loss *Reverse Phase *Ground Fault *Current Unbalance
	Aux trip	1c:05-06-08	*Au-o/oFF/Ec/AL/uc/Ec-tb *Selected factor is excluded from main trip except OFF/Ec-tb

8. Operation of Control key

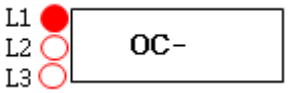
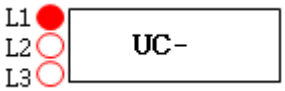
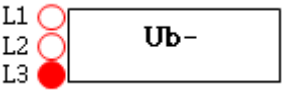
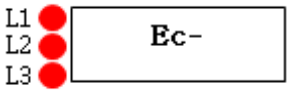
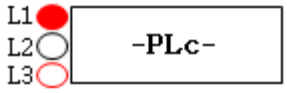
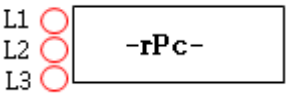
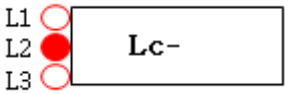


1."SET" key	*Press "SET" Key to enter into setting mode, then "P0000"(factory default password) is shown *Move cursor from first digit to right end digit by pressing "CLR" key,finally press once more, if password is not changed from factory default value, but if password is changed, then make required digit by using "UP","DN" key untill operator meets changed password. *If there is no input for 15sec or pressing both "SET" and "CLR"key, it can be entered into operating condition.
2.Changed feature of Setting Key	*After entering into posible state for preset , each key acts its job as follows :SET--->backward direction ,CLR--->foward direction,UP.DN--->able to select number or character in preset mode. *The previous mode based on setting mode is come out as pressing "SET" key during doing a prest job
3."SET" Key & "CLR" Key/to select MODE	*Possible to select Mode by using "SET" or "CLR" key
4."UP" key & "DN" Key/Adjust	*Possible to preset required value as selection a character or number by using UP/DOWN
5."SET" & "CLR" Key/Store	*The storage for preset data is completed by pressing both SET and CLR key in the same time or after 15sec is elapsed
6."CLR" key	*While each factor is rotated, one of rotated factor is fixed by pressing "CLR" key *After fixing a operating factor, the operator is able to rotate manual one by one as pressing "UP"(forwardly), "DN"(reversely)
To check preset value of each	*possible to check value and mode as pressing “SET” key once during operation,

mode during operation	*preset value and mode are appeared alternatively *possible to check next mode as pressing “CLR” Key *return to operating mode as pressing both “SET” and "CLR" key in the same time or waiting for 10sec without any touch *Not possible to change existed preset value
Test/Reset:"CLR" Key	*to check if this relay is ready to work normally or not. *"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 *main(95-96-98) & aux trip(05-06-08) output will be trip after counting down preset o-time(definite T-I) *In case of display meter type, LED on the converter is flickering after a trip *After making trip, press "CLR" key for the reset action

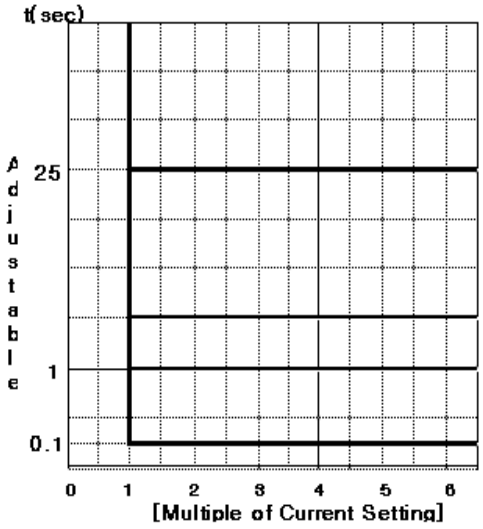
9. Trip Indication

Trip cause and caused value is appeared alternatively

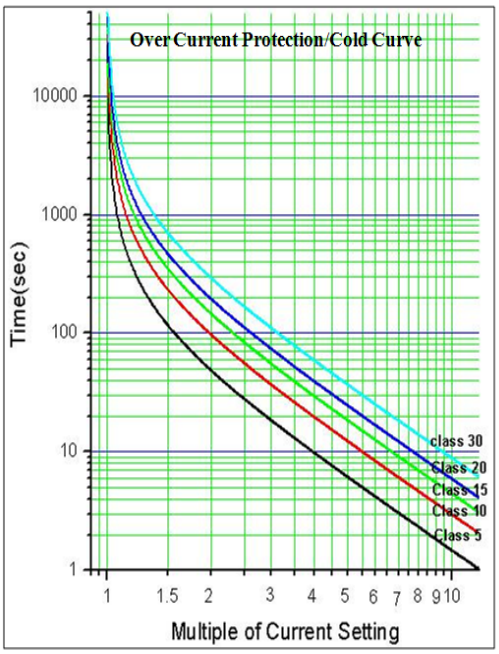
Trip	Display	Cause
Over current(oc)		*trip caused by over current in phase L1
Under current(Uc)		*trip caused by under current in phase L1
Current unbalance		*trip caused by unbalanced current in phase L1
GF		*trip caused by ground fault current
Phase loss		*trip caused by phase loss of phase L2 in load part
Reverse phase		*trip caused by reverse phase in load part
Locked Rotor		*trip caused by locked rotor current in phase L2 during motor starts

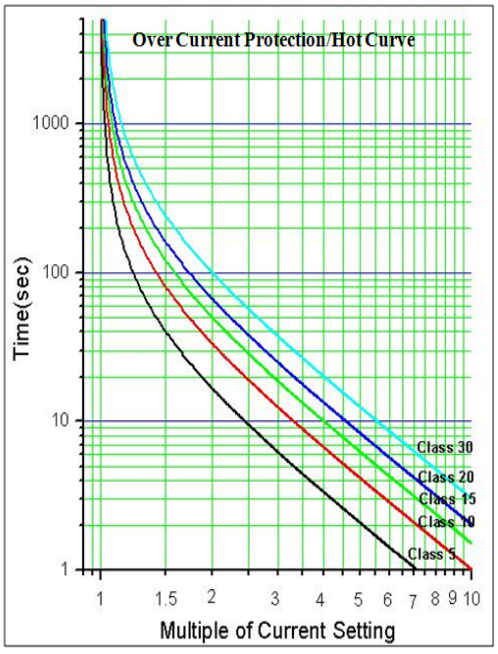
11.T-I Characteristcs

- Definite



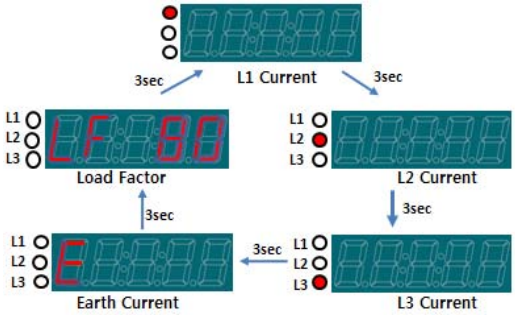
- Inverse





12. Rotated indication

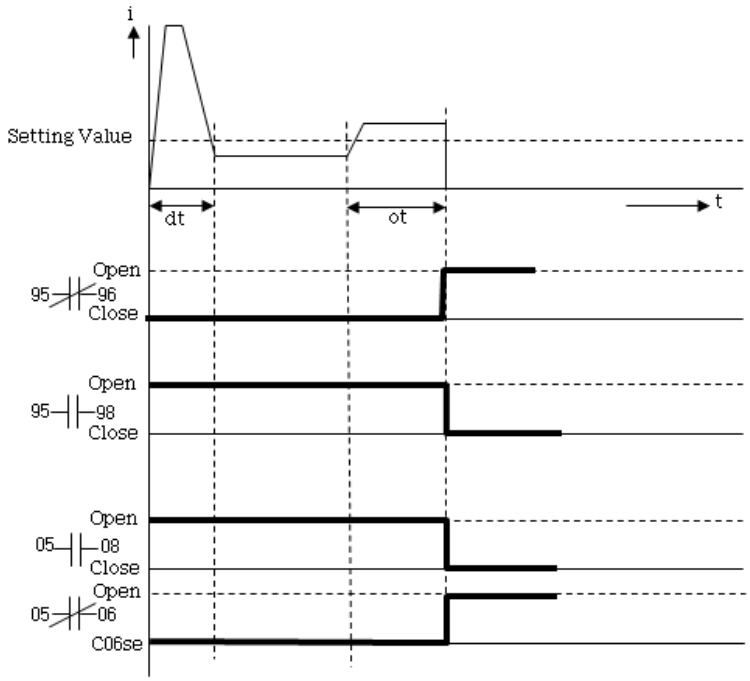
- 3 phase current(L1,L2,L3),Earth current,Load factor



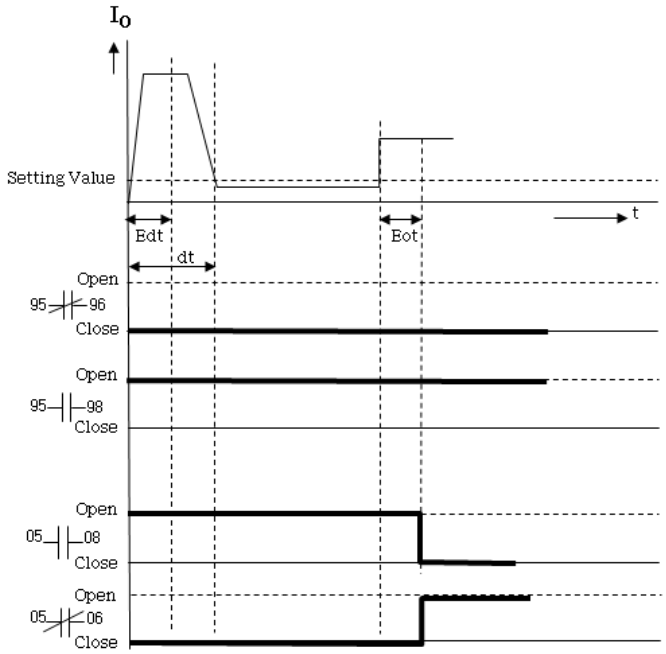
☞ "Ec-ct" is flickering if ZCT is not connected with a terminal of Z1-Z2 in motor stop state while the condition of "Ec" is available and the preset is not ahead anymore

13. Time Based Trip relay Output

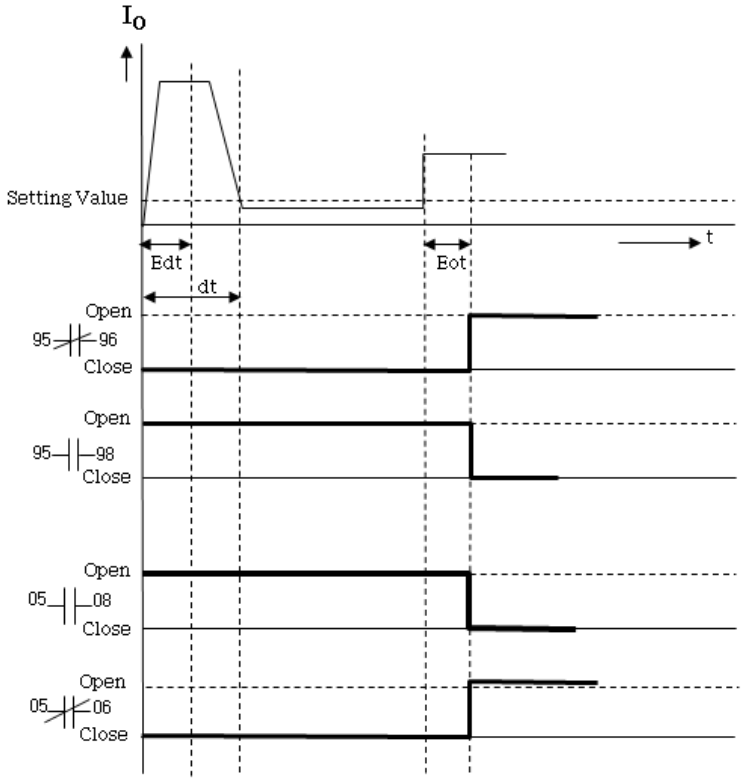
- Over current protection/"Au-o" mode:OFF/AUX(05-06-08)



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

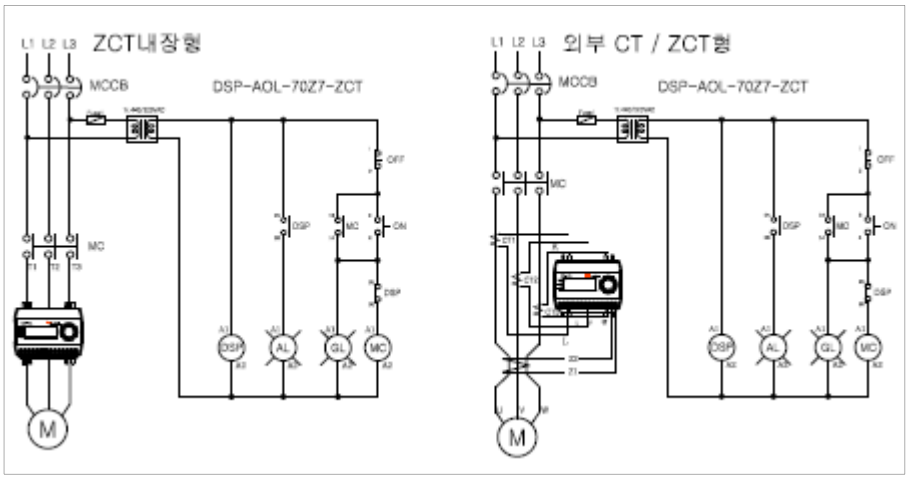


▶ GF protection/"Au-o" mode:Ec-tb(05-06-08)

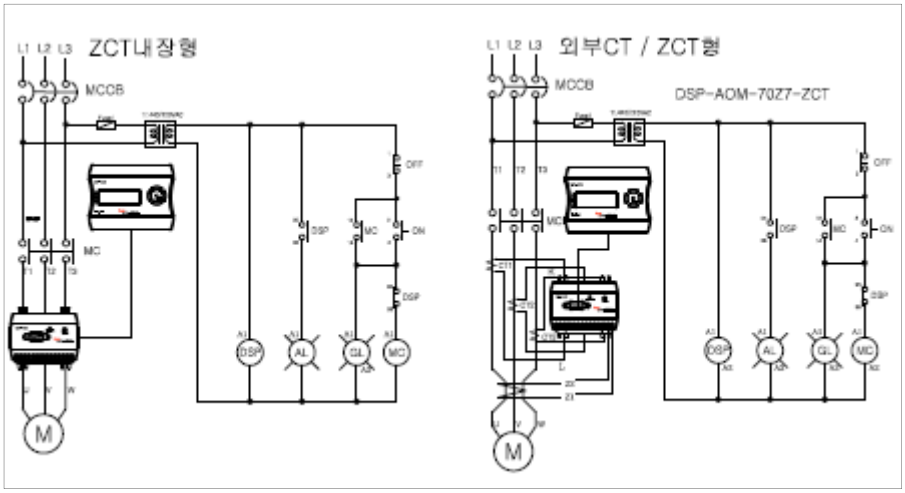


14. Application Sequence Diagram

▶DSP-AOL

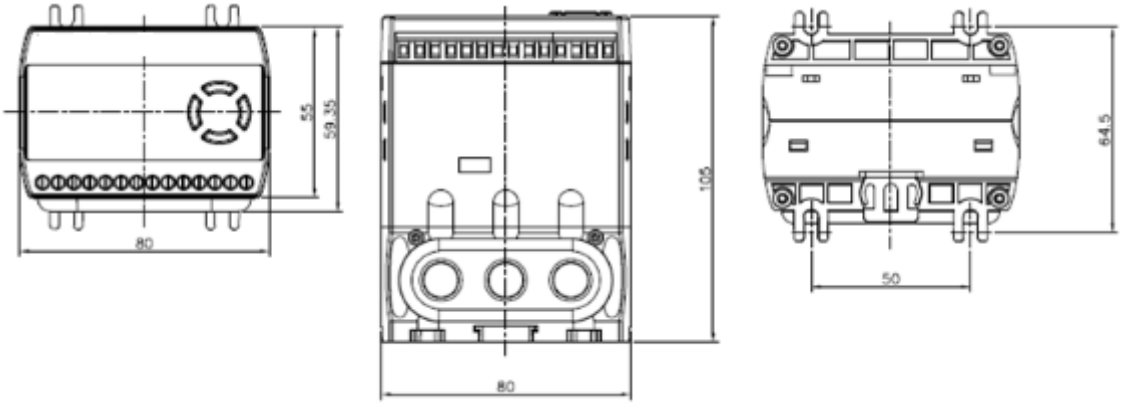


▶DSP-AOM

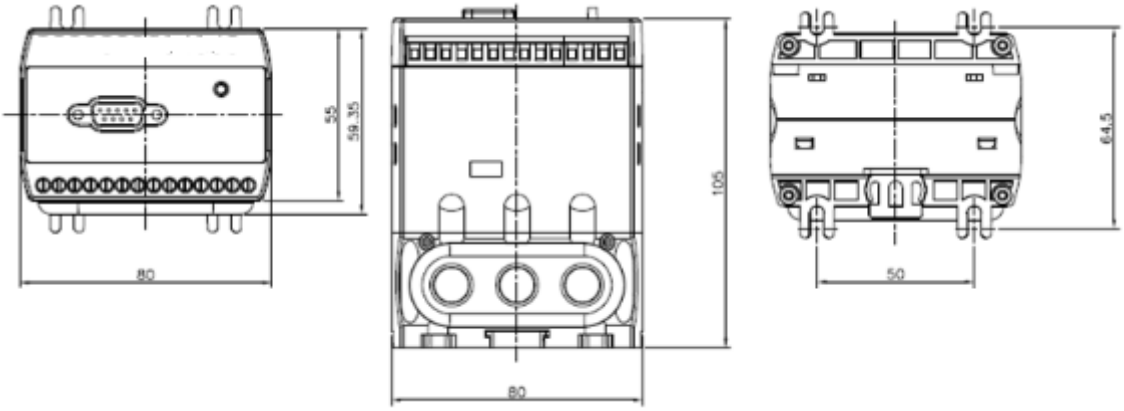


15. Dimension

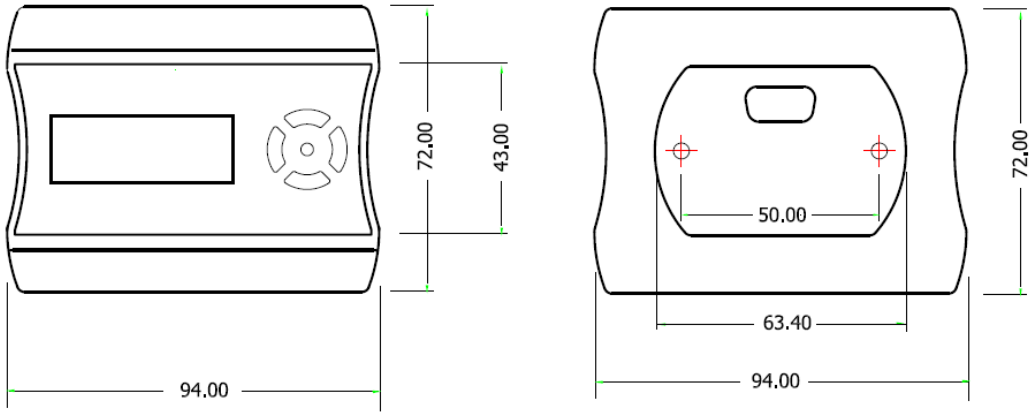
- AOL Type



- AOM Type
- Converter



- Display Meter



16. Order form

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

Item	Reference Code	Description
DSP-AOL	DSP-AOL-10Z7-V	Panel MountingType, 0.5A~10A, External CT/0.5A~6A, 85~260VAC ,50/60Hz(90~370VDC), available for external ZCT/200mA:100mV
	DSP-AOL-70Z7-V	Panel MountingType, 5A~70A, 85~260VAC ,50/60Hz(90~370VDC),available for external ZCT/ 200mA:100mV
	DSP-AOL-10Z7-A	Panel MountingType, 0.5A~10A, External CT/0.5A~6A, 85~260VAC ,50/60Hz(90~370VDC),available for external ZCT/200mA:1.5mA
	DSP-AOL-70Z7-A	Panel MountingType, 5A~70A, 85~260VAC ,50/60Hz(90~370VDC) ,available for external ZCT/ 200mA: 1.5mA
	DSP-AOL-10Z7-ZCT	Panel Mounting Type,0.5A~10A, 85~260VAC,50/60Hz(90~370VDC),ZCT embeded/not posible to use external CT
	DSP-AOL-70Z7-ZCT	Panel Mounting Type,5A~70A, 85~260VAC,50/60Hz(90~370VDC), ZCT embeded/not posible to use external CT
DSP-AOM	DSP-AOM-10Z7-V	Panel Flush Mounting Type, 0.5A~10A,External CT/0.5A~6A , 85~260VAC ,50/60Hz(90~370VDC) , available for external ZCT/200mA :100mV
	DSP-AOM-70Z7-V	Panel Flush Mounting Type, 5A~70A,85~260VAC ,50/60Hz(90~370VDC),available for external ZCT/ 200mA :100mV
	DSP-AOM-10Z7-A	Panel Flush Mounting Type, 0.5A~10A,External CT/0.5A~6A, 85~260VAC ,50/60Hz(90~370 VDC),available for external ZCT/200mA :1.5mA
	DSP-AOM-70Z7-A	Panel Flush Mounting Type, 5A~70A,85~260VAC ,50/60Hz(90~370 VDC),available for external ZCT/200mA :1.5mA
	DSP-AOM-10Z7-ZCT	Panel Flush Mounting Type, 0.5A~10A,85~260VAC, 50/60Hz(90~370 VDC),ZCT embeded/not posible to use external CT

	DSP-AOM-70Z7-ZCT	Panel Flush Mounting Type, 5A~70A,85~260VAC, 50/60Hz(90~370 VDC),ZCT embeded/not posible to use external CT	
Terminal Type	Basic code+T	3 Terminal through each CT Hole	
combined with 3CT	Basic code + C1	with 100/5 CT	Not use for ZCT embeded
	Basic code + CC	with150/5 CT	
	Basic code + C2	with200/5 CT	
	Basic code + C3	with300/5 CT	
	Basic code + C4	with400/5 CT	

*Accessory

Item	Refeence	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	