WDZ-5242
Transformer Management Relay

Technical instruction

Wiscom System Co., Ltd.

Preface

Thank you very much for purchasing **WDZ-5242** manufactured by Wiscom（Stock code: 002090）.

This technical instruction is for order only and has slight difference with the actual product. Thus if needed, please ask our design engineers for relative design drawings for engineering.

For more product information, instruction manual updates and services, please visit the Wiscom website http://www.wiscom.com.cn/.

Version: V 1.00
This instruction is for reference only.

目录

WDZ-5242 Transformer Management Relay

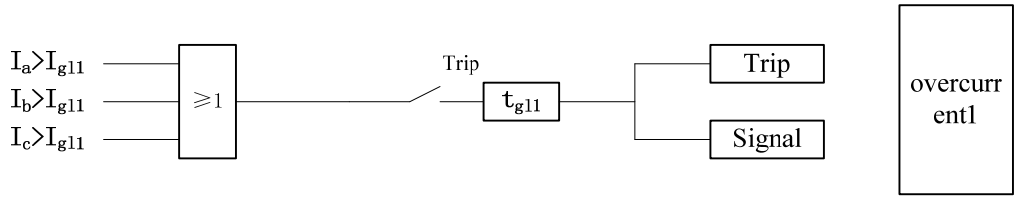
1 Functions

WDZ-5242 transformer management relay is applied to 10KV and below LV transformer for protection, measurement and control functions. For LV transformer with 6300KVA above or 2000KVA above, it should work together with WDZ-5241 transformer differential protection relay or WDZ-5244 3-winding transformer differential protection relay.

2 Protective functions and principles

2.1 1st zone overcurrent

2.1.1 Logic diagram



2.1.2 Action criterion

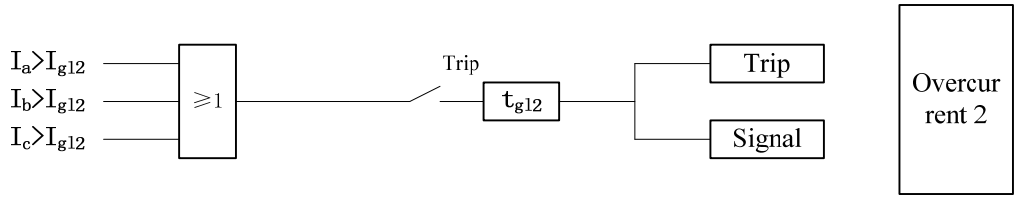
$$\begin{cases} I_{\max} > I_{gl1} \\ t > t_{gl1} \end{cases}$$

Where, I_{gl1}: Action current（A）

t_{gl1}: Time delay（s）

2.2 2nd zone overcurrent

2.2.1 Logic diagram



2.2.2 Action criterion

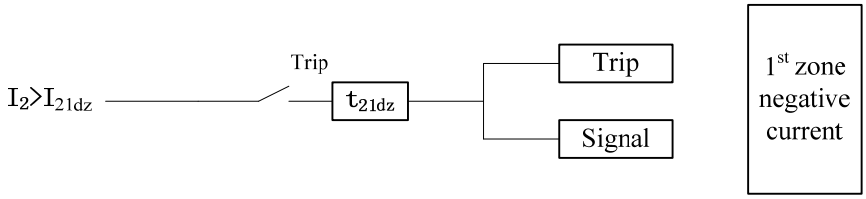
$$\begin{cases} I_{\max} > I_{gl2} \\ t > t_{gl2} \end{cases}$$

Where, I_{gl2}: Action current（A）

t_{gl2}: Time delay（s）

2.3 1st zone negative current protection

2.3.1 Logic diagram



2.3.2 Action criterion

$$\begin{cases} I_2 > I_{21dz} \\ t > t_{21dz} \end{cases}$$

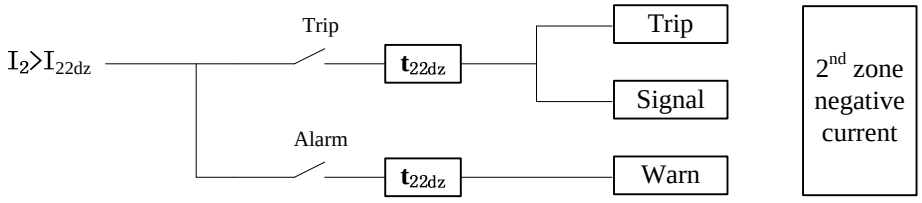
Where, I_{21dz}: Action current（A）

t_{21dz}: Action time（s）

2.4 2nd zone negative current protection

Negative current protection can take the role of unbalanced current protection.

2.4.1 Logic diagram



2.4.2 Action criterion

$$\begin{cases} I_2 > I_{22dz} \\ t > t_{22dz} \end{cases}$$

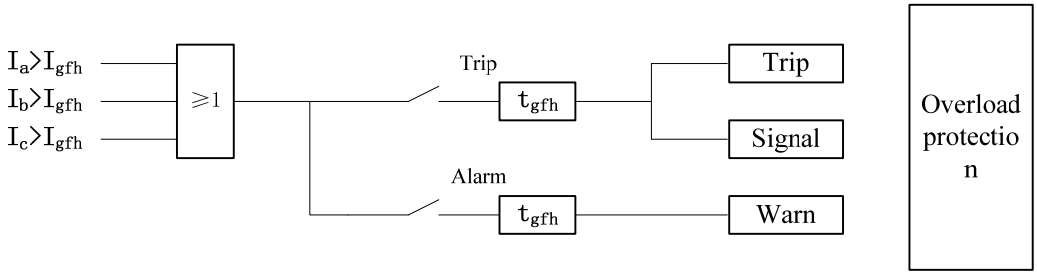
Where, I_{22dz}: Action current（A）

t_{22dz}: time delay（s）

2.5 Overload protection

Overload protection has 4 kinds of time characteristics: definite time, inverse time, very inverse time and extremely inverse time. The inverse time curve accords with IEC 60255-3.

2.5.1 Logic diagram



2.5.2 Definite time

$$\begin{cases} I_{\max} > I_{gfh} \\ t > t_{gfh} \end{cases}$$

Where, I_{gfh}: Action current（A）

t_{gfh}: action time（s）

2.5.3 Inverse time

$$\begin{cases} I_{\max} > I_{gfh} \\ t > \dfrac{0.14}{\left(\dfrac{I_{\max}}{I_{gfh}}\right)^{0.02} - 1} \times t_{gfh} \end{cases}$$

2.5.4 Very inverse time

$$\begin{cases} I_{\max} > I_{gfh} \\ t > \dfrac{13.5}{\dfrac{I_{\max}}{I_{gfh}} - 1} \times t_{gfh} \end{cases}$$

2.5.5 Extremely inverse time

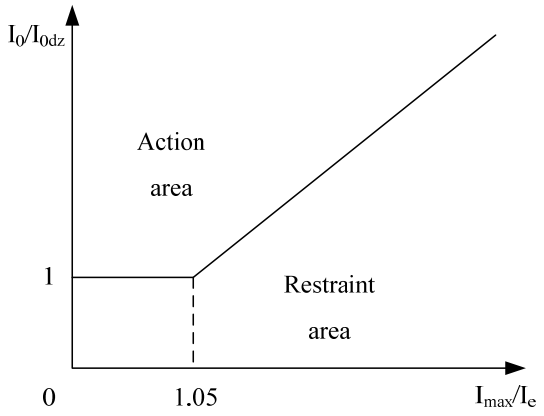
$$\begin{cases} I_{\max} > I_{gfh} \\ t > \dfrac{80}{\left(\dfrac{I_{\max}}{I_{gfh}}\right)^{2} - 1} \times t_{gfh} \end{cases}$$

2.6 1st zone ground fault protection

Zero sequence current is obtained from special zero sequence CT. The external zero sequence current range is 10mA～6A.

If no specialized zero sequence CT is supplied, the zero sequence current can also be produced

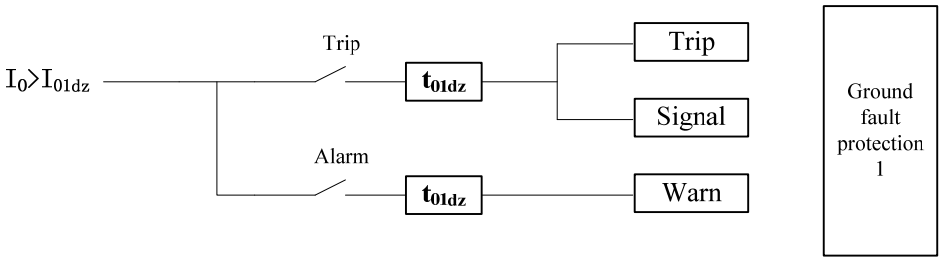
by device software itself, namely, $3\dot{I}_0 = \dot{I}_a + \dot{I}_b + \dot{I}_c$. In order to avoid mis-operation of the ground fault protection due to unbalanced current caused by inconsistent 3-phase CT characteristics, the device adopts I_{max} (the maximum phase current) as the restraint variable.



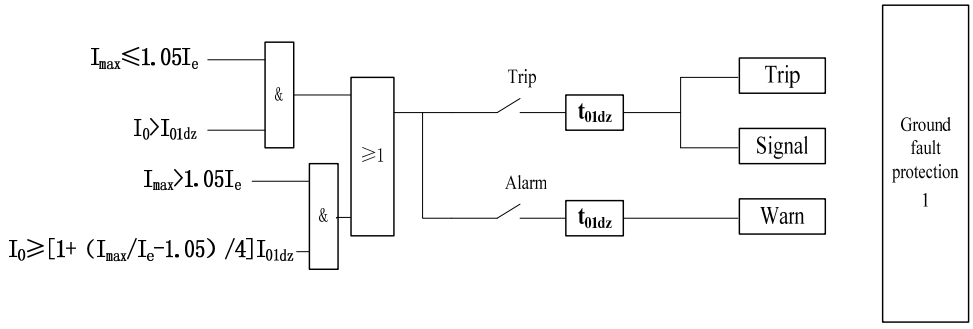
Ground fault protection curve during motor start

2.6.1 Logic diagram

For external zero sequence current with zero sequence overcurrent logic:



For internal zero sequence current with current restraint logic:



2.6.2 Action criterion

Zero sequence overcurrent:

$$\begin{cases} I_0 > I_{01dz} \\ t_0 > t_{01dz} \end{cases}$$

Phase current restraint:

$$\begin{cases} I_0 > I_{01dz} & I_{\max} \le 1.05 I_e \\ I_0 > \left[1+\left(I_{\max}/I_e - 1.05\right)/4\right] I_{01dz} & I_{\max} > 1.05 I_e \\ t_0 > t_{01dz} \end{cases}$$

Where, I_{01dz}: action current（A）

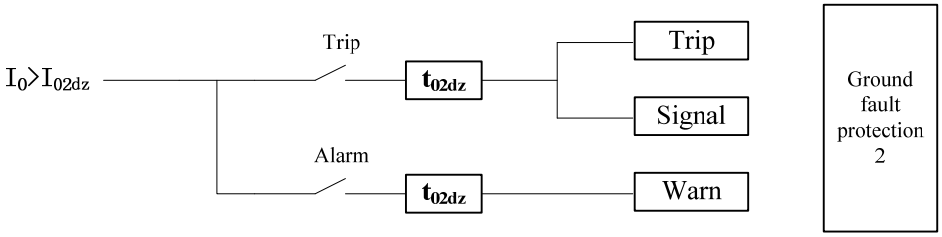
t_{01dz}: action time（s）

I_e: rated transformer secondary current（A）

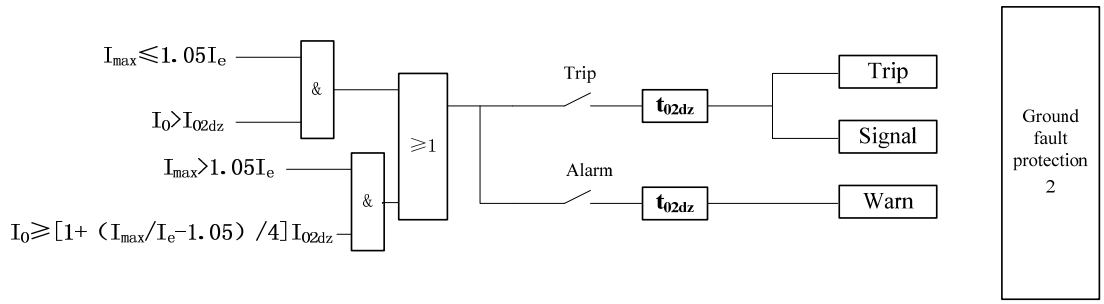
2.7 2nd zone ground fault protection

2.7.1 Logic diagram

For external zero sequence current with zero sequence overcurrent logic:



For internal zero sequence current with current restraint logic:



2.7.2 Action criterion

Zero sequence overcurrent:

$$\begin{cases} I_0 > I_{02dz} \\ t_0 > t_{02dz} \end{cases}$$

Phase current restraint:

$$\begin{cases} I_0 > I_{02dz} & I_{\max} \le 1.05 I_e \\ I_0 > \left[1+\left(I_{\max}/I_e - 1.05\right)/4\right] I_{02dz} & I_{\max} > 1.05 I_e \\ t_0 > t_{02dz} \end{cases}$$

Where, I_{02dz}: action current（A）

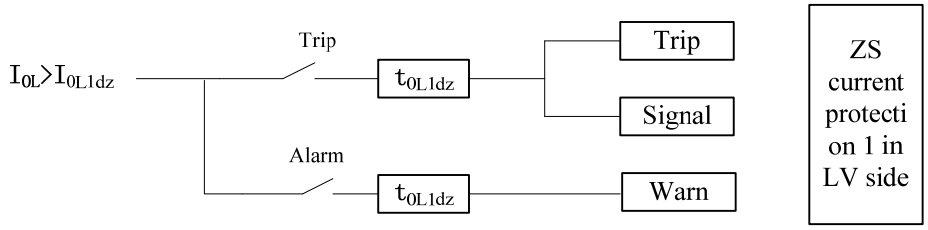
t_{02dz}: action time（s）

I_e: rated transformer secondary current（A）

2.8 1st zone ZS current protection in LV side

The LV side in power plant auxiliary transformer is basically 400V direct grounding system. The device supplies two zones of ZS current protection as the backup protection of 400V system.

2.8.1 Logic diagram



2.8.2 Action criterion

$$\begin{cases} I_{0l} > I_{0L1dz} \\ t > t_{0L1dz} \end{cases}$$

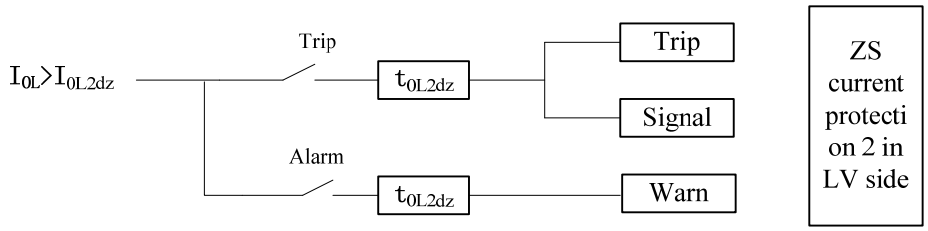
Where, I_{0L1dz}: Action current（A）

t_{0L1dz}: Action time（s）

2.9 2nd zone ZS current protection in LV side

The protection has 4 kinds of time characteristics: definite time, inverse time, very inverse time and extremely inverse time. The inverse time curve accords with IEC 60255-3.

2.9.1 Logic diagram



2.9.2 Definite time

$$\begin{cases} I_{0l} > I_{0L2dz} \\ t > t_{0L2dz} \end{cases}$$

Where, I_{0L2dz}: Action current（A）

t_{0L2dz}: Action time（s）

2.9.3 Inverse time

$$\begin{cases} I_{0l} > I_{0L2dz} \\ t > \dfrac{0.14}{\left(\dfrac{I_{0l}}{I_{0L2dz}}\right)^{0.02} - 1} \times t_{0L2dz} \end{cases}$$

2.9.4 Very inverse time

$$\begin{cases} I_{0l} > I_{0L2dz} \\ t > \dfrac{13.5}{\dfrac{I_{0l}}{I_{0L2dz}} - 1} \times t_{0L2dzh} \end{cases}$$

2.9.5 Extremely inverse time

$$\begin{cases} I_{0l} > I_{0L2dz} \\ t > \dfrac{80}{\left(\dfrac{I_{0l}}{I_{0L2dz}}\right)^2 - 1} \times t_{0L2dz} \end{cases}$$

2.10 FC overcurrent blocking

In the fuse-contactor circuit, if any phase fault current is larger than the rated contactor breaking current, fuse should be fused to cut off the current and block the output so as to protect the contactor.

2.10.1Logic diagram

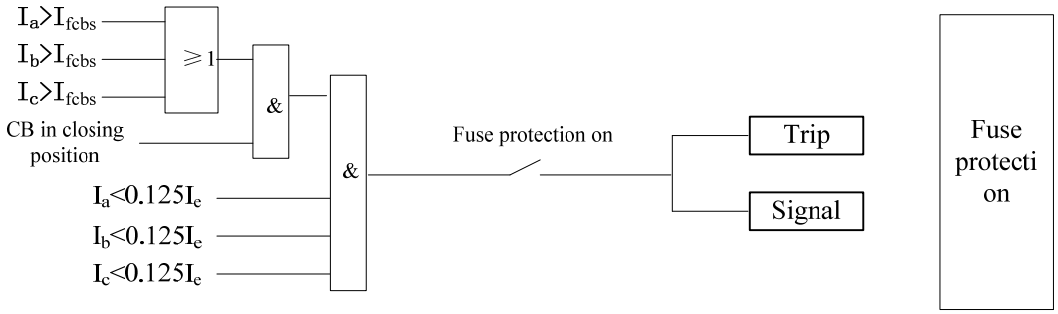
2.11 Fuse protection

In the FC circuit, if any phase fault current is larger than rated contactor breaking current, fuse should be fused to cut off the current, and then trip the contactor to replace the fuse.

The contactor will be tripped only when all 3 phase fuses are broken. If 1-phase fuse breaks, please trip the contactor manually.

Basically, there will be contacts for normal fuse working. If fuse breaks, the relative contact will change, or connect the contact with DI, so as to trip the contactor through non-electrical quantity protection or by operators manually.

2.11.1Logic diagram

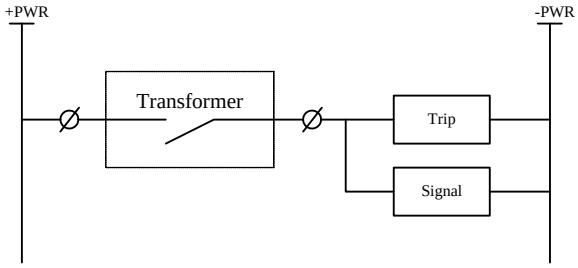


2.12 Non-electrical quantity protection

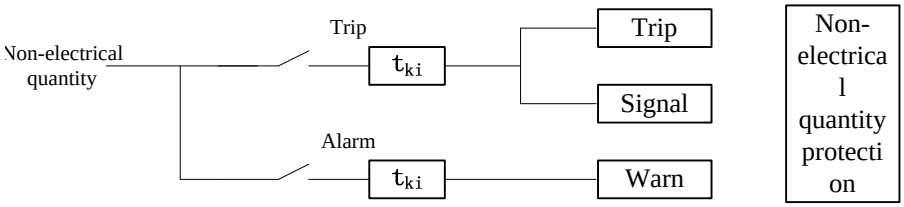
The device supplies non-electrical board, where the non-electrical quantity signals can drive 2 non-electrical quantity output relays to trip directly and supplies 2 groups of non-electrical quantity signal（one is unholding signal output and the other is holding signal output）and the CPU of the device itself can keep record of the actions of the non-electrical quantity protection.

Non-electrical board 1、2 and 3 are 3 channels of non-electrical quantity inputs and non-electrical output 1 and 2 are the direct outputs without time delay. The start voltage of non-electrical trip circuit is 50%~70% rated voltage（below 50%: no action, above 70%: action）and start power is larger than 5W.

Schematic diagram:



2.12.1Logic diagram



2.13 Protection parameters

No.	Name	Symbol	Unit	Range
1	Rated transformer current	I_e	A	0.20In-1.20In
2	Action current, 1st zone overcurrent protection	I_{gl1}	A	0.20In-20.00In
3	Action time, 1st zone overcurrent protection	t_{gl1}	s	0.00-10.00
4	Action current, 2nd zone overcurrent protection	I_{gl2}	A	0.20In-20.00In
5	Action time, 2nd zone overcurrent protection	t_{gl2}	s	0.10-100.00
6	Action current, 1st zone negative current protection	I_{21dz}	A	0.20In-4.00In
7	Action time, 1st zone negative current protection	t_{21dz}	s	0.10-20.00
8	Action current, 2nd zone negative	I_{22dz}	A	0.20In-4.00In

No.	Name	Symbol	Unit	Range
	current protection			
9	Action time, 2nd zone negative current protection	t_{22dz}	s	0.10-20.00
10	Action mode, 2nd zone negative current protection			Alarm /Trip
11	Action current, overload protection	I_{gfh}	A	0.20In-20.00In
12	Action time, overload protection	t_{gfh}	s	0.10-650.00
13	Overload curve			Definite time/Inverse time/Very inverse time/Extremely inverse time
14	Action mode, overload protection			Alarm /Trip
15	Action current, 1st zone ZS current protection	I_{01dz}	A	0.010-6.000
16	Action time, 1st zone ZS current protection	t_{01dz}	s	0.00-10.00
17	Action mode, 1st zone ZS current protection			Alarm /Trip
18	Action current, 2nd zone ZS current protection	I_{02dz}	A	0.010-6.000
19	Action time, 2nd zone ZS current protection	t_{02dz}	s	0.10-100.00
20	Action mode, 2nd zone ZS current protection			Alarm /Trip
21	Action current, 1st zone ZS current protection in LV side	I_{0L1dz}	A	0.20In-20.00In
22	Action time, 1st zone ZS current protection in LV side	t_{0L1dz}	s	0.10-100.00
23	Action mode, 1st zone ZS current protection in LV side			Alarm /Trip
24	Action current, 2nd zone ZS current protection in LV side	I_{0L2dz}	A	0.20In-20.00In
25	Action time, 2nd zone ZS current protection in LV side	t_{0L2dz}	s	0.10-100.00
26	Action curve, 2nd zone ZS current protection in LV side			Definite time/Inverse time/Very inverse time/Extremely inverse time
27	Action mode, 2nd zone ZS current protection in LV side			Alarm /Trip
28	FC overcurrent blocking value	I_{fcbs}	A	1.00In-20.00In
29	Action time, Non-electric quantity	t_{KI1}	S	0.10-650.00

No.	Name	Symbol	Unit	Range
	protection1			
30	Action mode, Non-electric quantity protection1			Alarm /Trip
31	Action time, Non-electric quantity protection2	t_{KI2}	S	0.10-650.00
32	Action mode, Non-electric quantity protection2			Alarm /Trip
33	Action time, Non-electric quantity protection3	t_{KI3}	S	0.10-650.00
34	Action mode, Non-electric quantity protection3			Alarm /Trip

2.14 Soft straps

No.	Name	Symbol	Range
1	1st zone overcurrent protection		On/Off
2	2nd zone overcurrent protection		On/Off
3	1st zone negative current protection		On/Off
4	2nd zone negative current protection		On/Off
5	Overload protection		On/Off
6	1st zone ground fault protection		On/Off
7	2nd zone ground fault protection		On/Off
8	1st zone ZS current protection in LV side		On/Off
9	2nd zone ZS current protection in LV side		On/Off
10	FC overcurrent blocking		On/Off
11	Fuse protection		On/Off
12	Non-electric quantity protection1		On/Off
13	Non-electric quantity protection2		On/Off
14	Non-electric quantity protection3		On/Off

3 Measurement and control functions

3.1 Measurement function

3-phase voltage, 3-phase current, active power, reactive power, power factor and frequency are supplied.

3.2 DIs

Standard 24 DIs.

3.3 DOs

Standard 5 relay outputs with 7 DO contacts.

3.4 Remote control

Remote CB trip/closing operation

3.5 Metering

Forward active power, forward reactive power, reverse active power, reverse reactive power metering function and foreward active/reactive power pulse output function.

Active energy and reactive energy accumulation function can be supplied too.

3.6 Operating circuits

Operating circuit covers trip coil, closing coil, tripping position supervision, closing position supervision, tripping position signal output, closing position signal output, control circuit fuse-loss output, relay tripping output, remote tripping output, remote closing output, manual tripping input, manual closing input, DCS tripping input, relay tripping input, 2 channels of position intertripping or relay intertripping outputs and etc.

3.7 4~20mA output

1 channels of 4～20mA output is supplied; 2 4~20mA outputs are optional.

4 Backboard terminals and connection diagram

4.1 Analog inputs

U_a、U_b、U_c: Transformer voltage (rated: 100A phase-to–phase voltage), used by protection and measurement functions.

I_A、I_B、I_C: Measurement current (rated: 5A or 1A), imported from special measurement CT.

I_a、I_b、I_c: 3-phase protective current (rated: 5A or 1A).

$3I_0$: ZS current in HV side, imported from special ZS CT. Secondary ZS current range:10mA～6A.

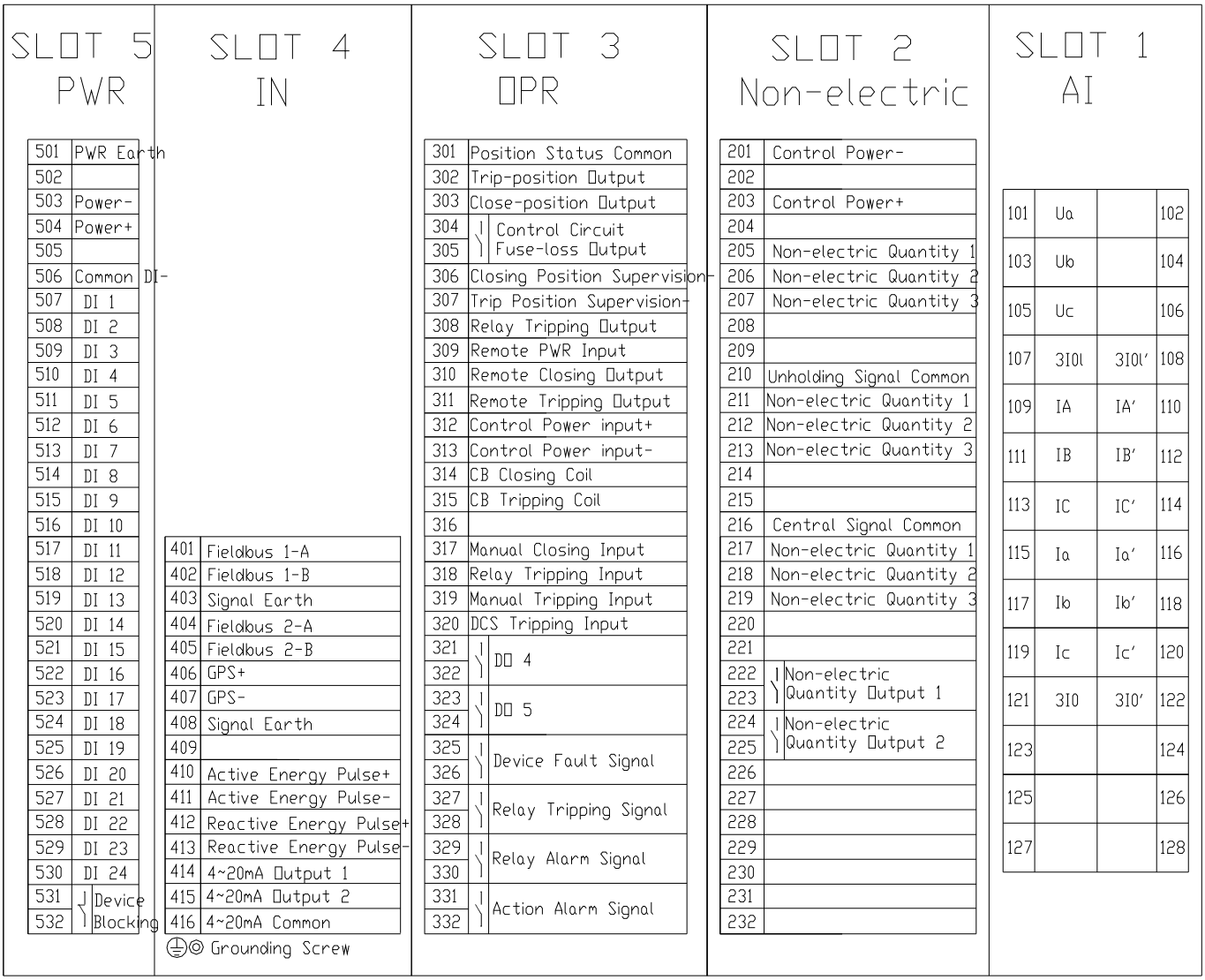
$3I_{0l}$: ZS current in LV side, (rated: 5A or 1A).

4.2 Backboard terminals

From the front view, the slots are arranged with number from 1 to 5 from left to right.

Terminal number has 3 digits. The first digit is the slot number and the last two digits are the terminal series number from above to below. Take 301 for example, it means the first terminal in slot3.

4.2.1 Basic terminal configuration with Operation board



Slot1：AI board

Terminal 101、103 and 105: phase-to-phase voltage inputs;

Terminal 107～108: $3I_{0l}$ input

Terminal 109～110: Phase-A measurement current input;

Terminal 111～112: Phase-B measurement current input;

Terminal 113～114: Phase-C measurement current input;

Terminal 115～116:Phase-A protective current input;

Terminal 117～118:Phase-B protective current input;

Terminal 119～120: Phase-C protective current input;

Terminal 121～122: Zero sequence current 3I0 input;

Slot 2：Non-electric board

Terminal 201: -control power source input;

Terminal 203: +control power source input;

Terminal 205～207: 3 non-electric quantity inputs;

Terminal 210: common terminal of 3 non-electric quantity unholding signal outputs;

Terminal 211～213: 3 non-electric quantity unholding signal outputs;

Terminal 216: common terminal of 3 non-electric quantity central signal outputs;

Terminal 217～219: 3 non-electric quantity central signal outputs;

Terminal 222～223: Non-electric quantity output 1;

Terminal 224～225: Non-electric quantity output 2.

Slot 3: OPR board

Terminal 301~303: Position status output. 302～301: trip-position status output; 303～301:Closing-position status output;

Terminal 304～305: Control circuit fuse-loss output;

Terminal 306: -Closing position supervision relay;

Terminal 307: -Trip position supervision relay;

Terminal 308: Relay tripping output（BTJ）, which can be connected to Terminal 318 directly or via press strap;

Terminal 309: + remote PWR input. Only when it is connected to positive power source, remote tripping/ closing functions can be enabled;

Terminal 310: Remote closing output（YHJ）, which can be connected to Terminal 317 directly or via press strap;

Terminal 311: Remote tripping output (YTJ), which can be connected to Terminal 319 directly or via press strap;

Terminal 312: +control power source input;

Terminal 313: -control power source input;

Terminal 314: CB closing coil;

Terminal 315: CB trip coil;

Terminal 317: Manual closing input;

Terminal 318: Relay tripping input;

Terminal 319: Manual tripping input;

Terminal 320: DCS tripping input;

Terminal 321～322: DO4, Defaulted relay intertripping output, or position intertripping via jumper setting;

Terminal 323～324: DO5, Defaulted relay intertripping output, or position intertripping via jumper setting;

Terminal 325～326: Device fault alarm signal output;

Terminal 327～328: Relay tripping signal output;

Terminal 329～330: Relay alarm signal output;

Terminal 331～332: Action alarm signal output, when relay acts or alarms, the signal will be issued.

Slot 4: IN board

Terminal 401～402: Fieldbus 1 input, 401: positive, 402: Negative. CAN or ProfiBus interface is ok.

Terminal 403: signal earth;

Terminal 404～405: Fieldbus 2 input, 404: positive, 405: Negative. CAN or ProfiBus interface is ok.

Terminal 406～407: GPS timing input, connected to 485 differential level.

Terminal 408: signal earth;

Terminal 410～411: Active energy pulse output, 24V dry idle contact output. 410: positive, 411: Negative.

Terminal 412～413: Reactive energy pulse output，24V dry idle contact output. 412: positive, 413: Negative.

Terminal 414～416: 2 4～20mA outputs. 414～416: the first channel of 4～20mA output, 414: positive, 416: Negative；415～416: the second channel of 4～20mA output, 415: positive, 416: Negative.

Grounding screw must be connected to earth mat reliably and tightly.

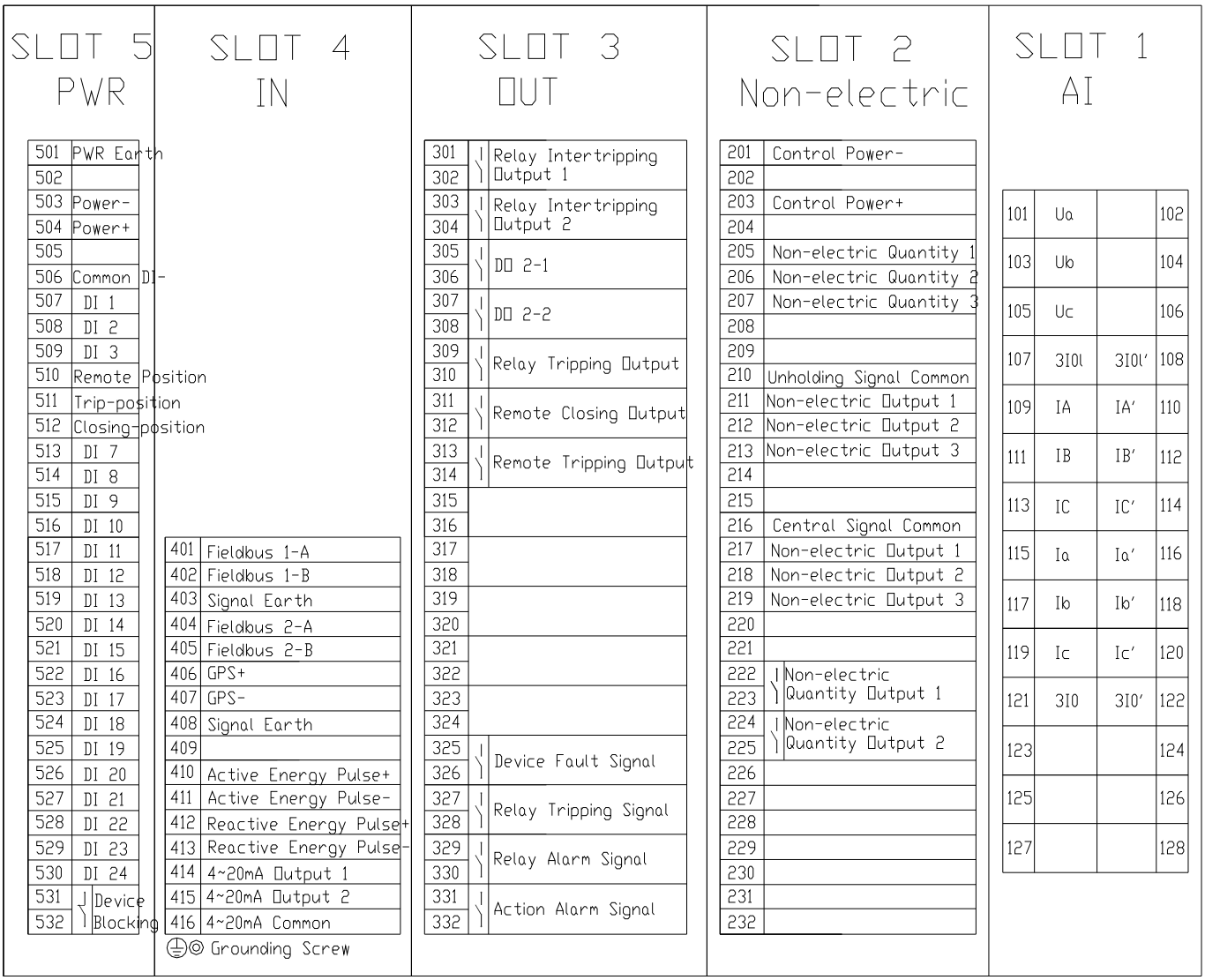
Slot 5: PWR board

Terminal 503～504: Device power source input, DC/AC 220V or DC/AC110V. 503: -Device power source input, 504: + Device power source input;

Terminal 506～530: 24 channels of DC 110V or DC220V strong current inputs. 506: -common DI, 507～530: 24 DIs. 507、508 and 509: defaulted 3 channels of switching quantity protection. 509: LV interlock; 513: locked-rotor protection contact.

Terminal 531～532: Device blocking output, break contact. When the device 24V power is lost or internal CPU fails, the contact will be closed.

4.2.2 Basic configuration without operation board



Slot 1: AI board

The same as explained in operation board configuration.

Slot 2: Non-electric board

The same as explained in operation board configuration.

Slot 3: OUT board

Terminal 301～304: Relay intertripping outputs. 301～302: one pair of contact output；203～204: The other pair of contact output.

Terminal 305～308: DO2. 305～306: one pair of contact output；207～208: the other pair of contact output.

Terminal 309～310: Relay tripping output;

Terminal 311～312: Remote closing output;

Terminal 313～314: Remote tripping output;

Terminal 325～326: Device fault alarm signal output;

Terminal 327～328: Relay tripping signal output;

Terminal 329～330: Relay alarm signal output;

Terminal 331～332: Action alarm signal output, when relay acts or alarms, the signal will be issued.

Slot 4：IN board

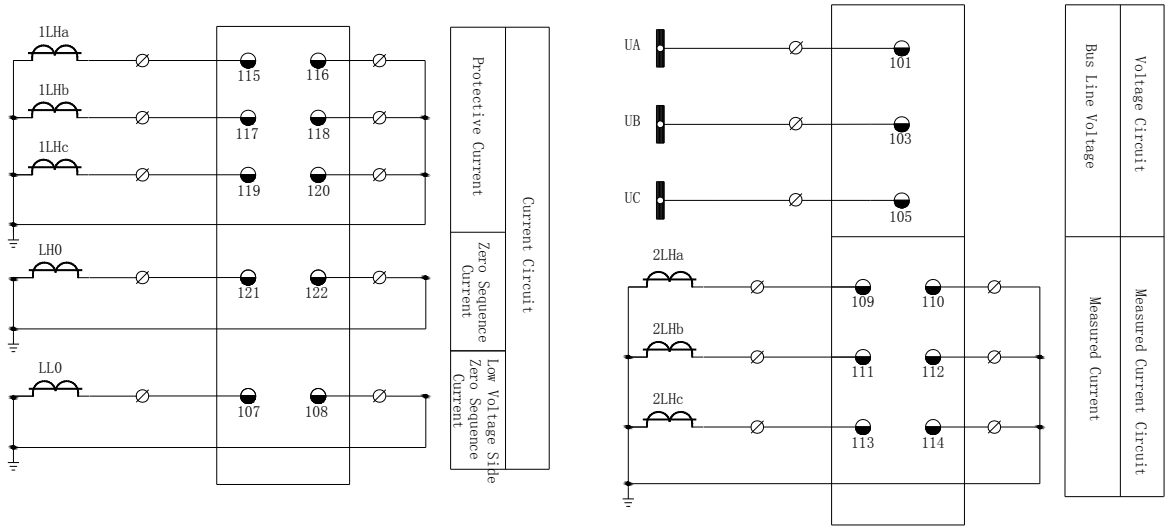
The same as explained in operation board configuration.

Slot 5：PWR board

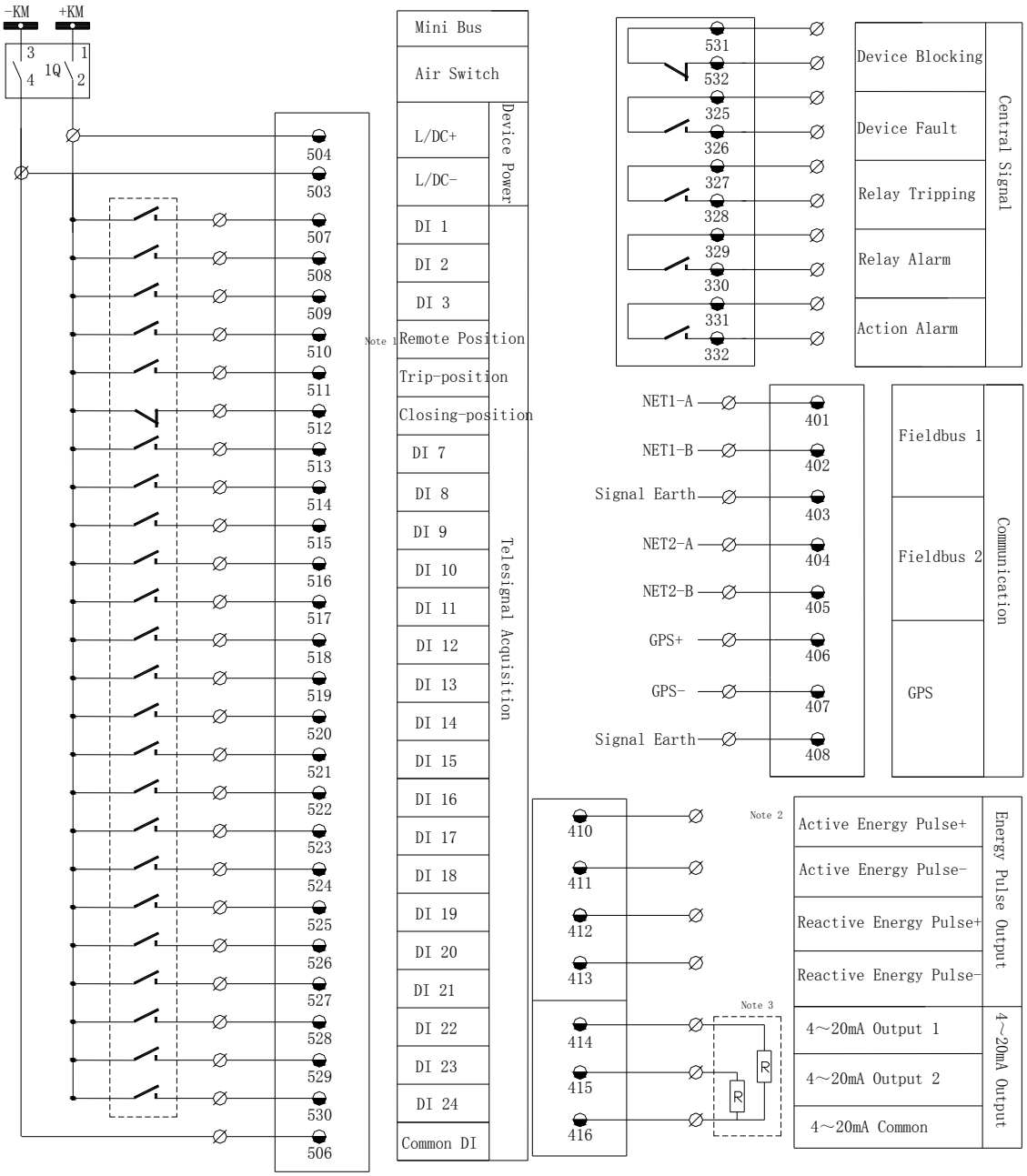
510: default remote position, 511 and 512: Defaulted CB trip-position, closing-position input. Others are the same as explained in operation board configuration.

4.3 Terminal connection diagram

4.3.1 Analog input connection diagram

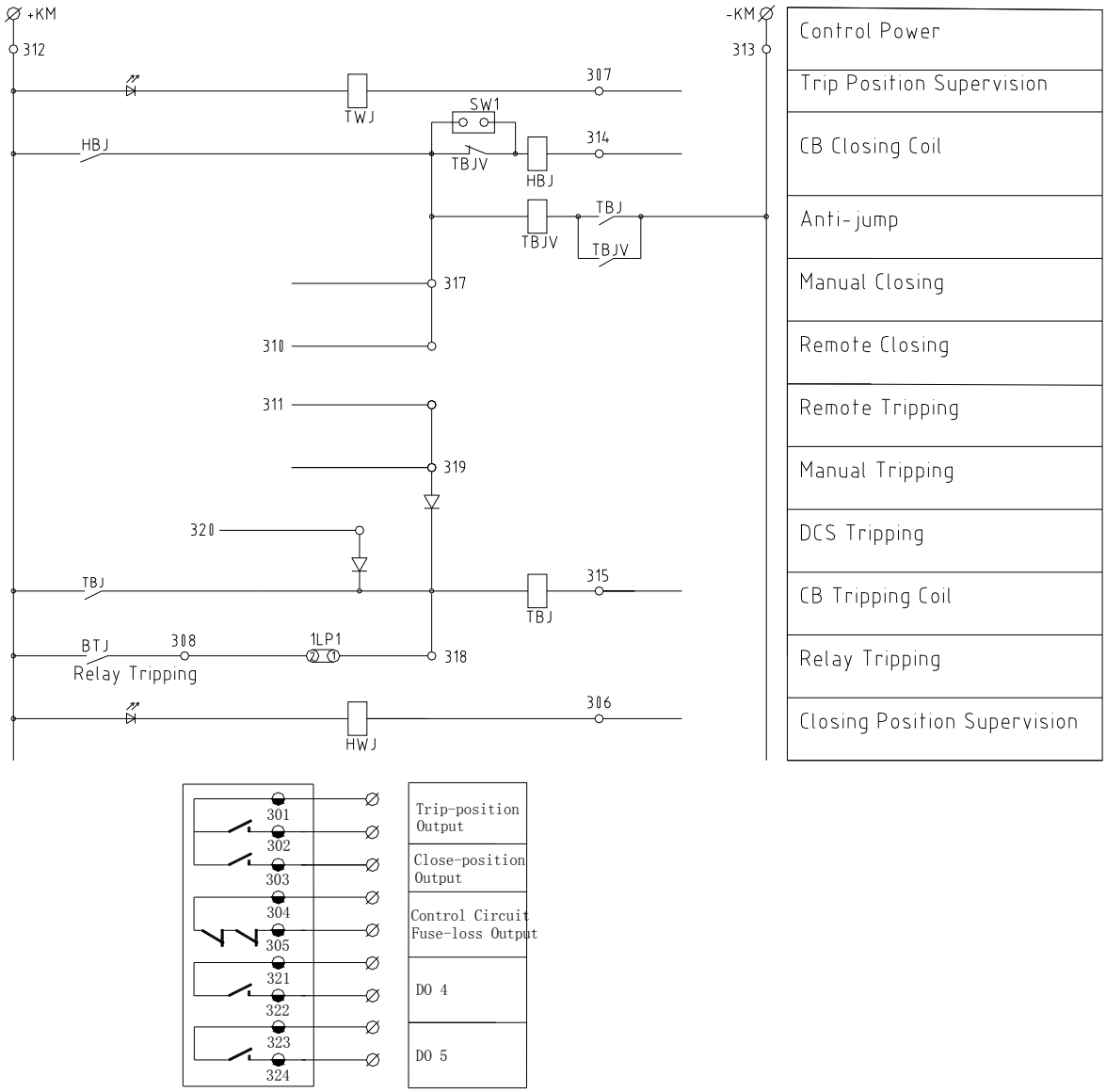


4.3.2 DI、Central signal、network、AO and energy pulse output circuit connection diagram

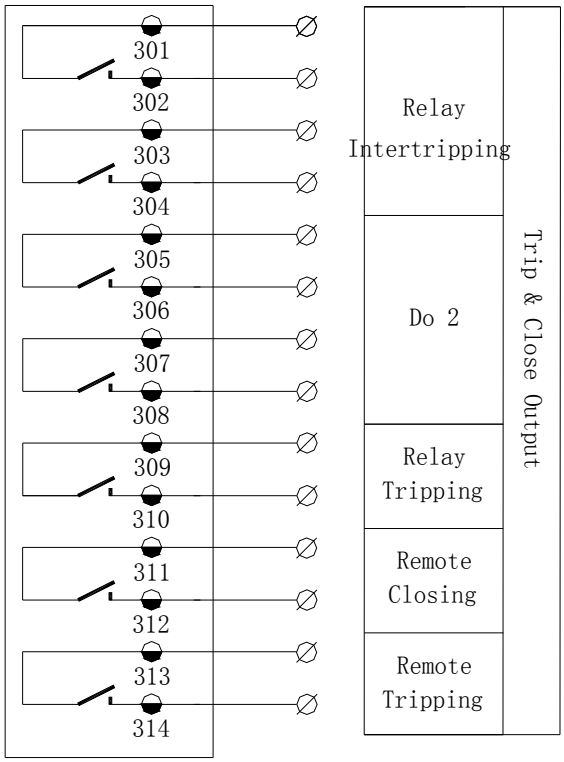


Note 1:If operation board is supplied, remote,closing and trip position signals are not connected.
2:Energy pulse outputs:24V idle contact output,reactive contact.
3:R:External resistance should be smaller than 500Ω,250Ω is suggested.

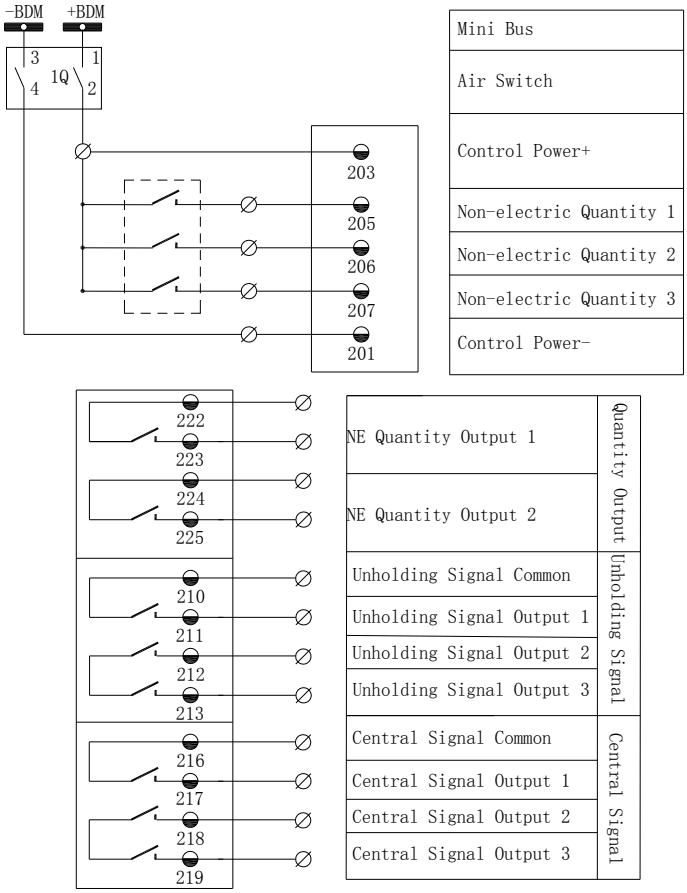
4.3.3 Operation board Operating-circuit diagram



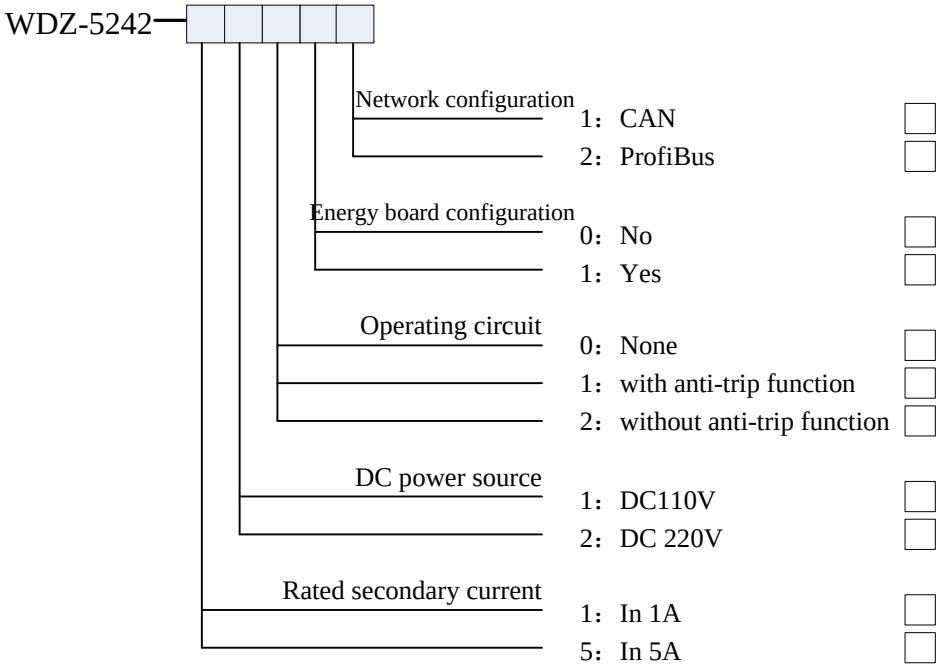
4.3.4 DO circuit connection diagram without operation board



4.3.5 Non-electric board connection diagram



5 Order information



（1） Optional CAN or ProfiBus communication interface, redundant configuration. If RS485 interface is needed, please make requirement especially;

（2） Optional hardware energy board is supported;

（3） Operating-circuit is optional and the anti-trip function can be enabled/disabled manually. Defaulted intertripping relay is protection intertripping and the defaulted operating-circuit tripping/closing current is self-adapted 0.3~4A. If 0.05~0.3A or 4~10A is needed, please note especially;

（4） Operating power source and DI power source can be DC110V or DC220V; while the device power source has no such kind of discrimination;

（5）Rated secondary current, as the protective and measured current, can be 1A or 5A;

（6） The device is equipped with 1 channel of 4~20mA output defaultedly, if no such output is needed or 2 channels 4~20mA are needed, please explain it specially;

（7） ZS CT working range: 10mA~6A. If the zero sequence current is out of the range, just make a special note.

（8） Secondary rated voltage is 100V、50Hz, phase-to-phase voltage input；

6 Settings explanation

6.1 General

This part is for reference only.

6.2 1st overcurrent protection

6.2.1 Action current I_{gl1}

（1） Calculated to avoid 3-phase short current of LV bus in auxiliary transformer:

$$I_{gl1} = K_{rel} I_{K.\max}^{(3)} / n_{TA}$$

Where, K_{rel}: Reliability coefficient, here is 1.3

$I_{K.\max}^{(3)}$: the maximum short current of LV bus of auxiliary transformer, converted to the HV side（A）

n_{TA}: CT ratio

（2） To avoid the excitation surge due to transformer closing without loading:

$$I_{gl1} = KI_e$$

Where, K: Excitation surge times, the times range is 6~12;

I_e: HV side rated current of auxiliary transformer, secondary value（A）

I_{gl1} should be the max of the above two values.

6.2.2 Action time t_{gl1}

Basically t_{gl1}=0.

6.3 2nd overcurrent protection

6.3.1 Action current I_{gl2}

As the backup protection of 1st zone overcurrent protection (short-circuit fault), the current should be calculated to avoid the self-starting motor current.

（1） Self-starting motor current $I_{st.all}$

$$I_{st.all} = \frac{I_e}{X_S + \frac{u_K\%}{100} + \frac{S}{K_{st} S_m}(\frac{U_{M.N}}{U_{T.N}})^2} = \frac{I_e}{X_S + X_T + X_{st.all}}$$

Where, $I_{st.all}$: the total self-starting current of all motors（A）

I_e: HV side rated current of auxiliary transformer（A）

X_S: impedance relative value that the system to 6KV/10KV auxiliary bus（rated transformer capacity as the benchmark）

u_K%: Percentage value of transformer short voltage

S: rated transformer capacity（KVA）

K_{st}: The self-starting current times of motor group, basically 4~4.5 is ok.

S_m: the rated capacity sum of self-started motors（KVA）

$U_{T.N}$: LV side rated voltage of auxiliary transformer（for example, 400V）

$U_{M.N}$: rated motor voltage（for example, 380V）

X_T：The relative value of transformer reactance

$X_{st.all}$：the relative value of self-starting equivalent reactance of motor group（rated transformer capacity as the benchmark）

（2） To avoid self-starting current

$$I_{gl2} = K_{rel} I_{st.all} / n_{TA}$$

Where, K_{rel}: Reliability coefficient, the range is 1.1~1.2

basically I_{gl2}=（3.5~4.5）I_e

6.3.2 Action time t_{gl2}

Matched with the longest action time of 400V LV feeder protection:

$$t_{gl2} = t_{op.\max} + \Delta t$$

Where, $t_{op.max}$: the longest action time of 400V LV feeder protection（s）

Δt : time difference

6.4 1st zone negative current protection

Basically this protection is taken as the backup protection of 2-phase short circuit protection.

6.4.1 Action current I_{21dz}

$$I_{21dz} = \frac{K_{rel} I_K^{(2)}}{\sqrt{3} n_{TA}}$$

Where, K_{rel}: Reliability coefficient, the range is 1.1~1.15

$I_K^{(2)}$: LV bus 2-phase short current of auxiliary transformer, converted to HV side（A）.

6.4.2 Action time t_{21dz}

Matched with the longest action time of 400V LV feeder protection:

$$t_{21dz} = t_{op.\max} + \Delta t$$

Where, $t_{op.max}$: the longest action time of 400V LV feeder protection（s）

Δt : time difference

6.5 2nd zone negative current protection

6.5.1 Action current I_{22dz}

I_{22dz}=（0.4~0.45）I_e

6.5.2 Actiom time t_{22dz}

Matched with the longest action time of HV inter-phase fault backup protection:

$$t_{22dz} = t_{opH} + \Delta t$$

Where, t_{opH}: the longest action time of HV interphase fault backup protection（s）

Δt : time difference

6.6 Ground fault protection

6.6.1 Neutral point non-ground fault system

（1） ZS action current I_{0dz}

Calculated to avoid single-phase ground current passed in protected point:

$$I_{0dz} = K_{rel} I_K^{(1)} = K_{rel} 3I_c$$

Where, K_{rel}: Reliability coefficient, 2~2.5(Alarm); 2.5~3(Trip)

$I_K^{(1)}$: single-phase ground current in short-circuit point supplied by protected device when single-phase ground fault occurs（A）

I_c: single-phase capacitive current of protected device（A）

（2） Action time t_{0dz}

a) When 6KV/10KV ground current is larger than 10A, the protection will act to trip and the action time is t_{0dz}=0.5~1s.

b) When 6KV/10KV ground current is smaller than 10A，for 300MW or above generator unit, if the requirements for selectivity and sensitivity are met, we suggest the protection act to trip and the action time is t_{0dz}=0.5~1s.

c) When 6KV/10KV ground current is smaller than 10A，if the requirements for selectivity and sensitivity cannot be met, we suggest the protection act to issue alarm signals and the action time t_{0dz}=0~0.5s.

（3） Attention

ZS action current of the ground fault protection calculated is the primary current, while the action criterion and set value are secondary value. Since TA0 ratio has relation with zero sequence current circuit impedance and TA0 primary current and secondary current are non-linear relationship, thus in local debugging, primary action current should be imported and secondary current is showed.

6.6.2 Neutral point grounding system via resistance

（1） ZS action current I_{0dz}

a) Calculated to avoid single-phase ground current passed in protected point:

$$I_{0dz} = K_{rel} I_K^{(1)}$$

Where, K_{rel}: Reliability coefficient, 2~2.5(Alarm); 2.5~3(Trip)

$I_K^{(1)}$: single-phase ground current in short-circuit point supplied by protected device when single-phase ground fault occurs（A）

b) To avoid the maximum unbalanced current due to LV bus 3-phase short circuit:

$$I_{0dz} = \frac{K_{rel} K_{unb} I_e}{X_T}$$

Where, K_{rel}: Reliability coefficient, here 1.5 is ok

K_{unb}: 3-phase excitation unbalance error, here is 0.5%

X_T: Relative value of LV auxiliary transformer impedance, the range is 0.045~0.06，here 0.06 is ok

I_{0dz}=（0.1~0.2）I_e

ZS Action current should be the max. of a）and b）

（2） Action time t_{0dz}

t_{0dz}=0.3~0.5s

6.7 Overload protection

6.7.1 Action current I_{gfh}

I_{gfh}=（1.15~1.3）I_e

6.7.2 Action time t_{gfh}

t_{gfh}=5~10s (Alarm)

6.8 LV zero sequence current protection

6.8.1 Action current I_{0Ldz}

（1） To avoid the maximum unbalanced current during normal running.

$$I_{0Ldz} = K_{rel} 0.3 I_{T.L} \Big/ n_{TA0}$$

Where, K_{rel}: Reliability coefficient, the range is 1.1~1.1

$I_{T.L}$: rated transformer current in LV side（A）

n_{TA0}: ZS CT ratio at neutral point

（2） Matched with LV motor and feeder protection. If zero sequence overcurrent protection is available, it should be matched with the maximum action current of zero sequence overcurrent protection:

$$I_{0Ldz} = K_{rel} I_{0.op.L.\max} \Big/ n_{TA0}$$

Where, K_{rel}: Reliability coefficient, the range is 1.15~1.2

$I_{0.op.L.max}$: the maximum primary action current of LV motor or feeder single-phase ground fault protection（A）

（3） Matched with LV motor and feeder protection. If zero sequence overcurrent protection

is unavailable, it should be matched with phase current protection:

$$I_{0Ldz} = K_{rel} I_{op.L.\max} / n_{TA0}$$

Where, K_{rel}: Reliability coefficient, the range is 1.15~1.2

$I_{op.L.max}$: the maximum primary action current of LV motor or feeder phase current protection（A）

If the ZS overcurrent action value in（3）is extremely large and exceeds the range or cannot meet the sensitivity requirement, single-phase ground fault protection should be supplied.

6.8.2 Action time t_{0Ldz}

LV zero sequence protection or overcurrent protection decides the action time characteristic. When the LV feeder has no fuse protection, definite time characteristic is adopted, otherwise, inverse time characteristic is adopted.

（1） Matched with the longest action time of LV feeder zero sequence protection:

$$t_{0Ldz} = t_{0.op.L.\max} + \Delta t$$

Where, $t_{0.op.L.max}$: the longest action time of LV feeder single-phase ground protection（s）

Δt : time difference， the range is 0.3~0.4s

（2） Matched with the longest action time of LV feeder phase current protection:

$$t_{0Ldz} = t_{op.L.\max} + \Delta t$$

Where, $t_{op.L.max}$: the longest action time of LV feeder phase current protection（s）

Δt : time difference， the range is 0.3~0.4s

（3） Matched with fuse characteristic curve, the time difference is 0.5~0.7s

6.9 FC circuit large current blocking

The overcurrent blocking value $I_{fcbs:}$

Contactor interrupting current:

$$I_{fcbs} = I_{brk.FC} / Kn_{TA}$$

Where, $I_{brk.FC}$: the permitted contactor breaking current

K: Reliability coefficient, the range is 1.1~1.2

When the CT ratio is smaller, and I_{fcbs} >100A（rated: 5A）or I_{fcbs} >20A（rated: 1A）, namely the current exceeds the maximum measured current（20times rated current）, the setpoint should be smaller than the maximum and the reliability coefficient is 1.1 to avoid CT saturation.

Take the smaller value of calculated contactor breaking current and 90A（rated: 5A）or 18A（rated: 1A）as the setpoint of I_{fcbs}.