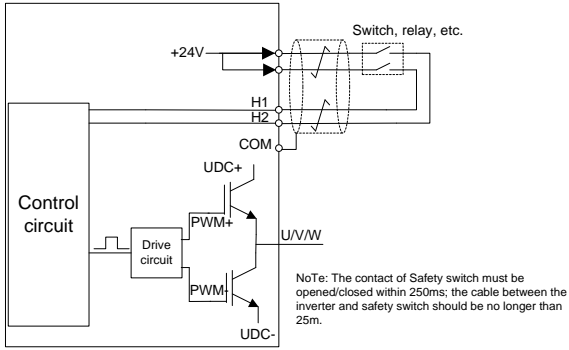


This supplementary instruction manual shall be used together with the instruction book for DRV-24

Overview of STO function

Reference standards: IEC 61508-1, IEC 61508-2, IEC 61508-3, IEC 61508-4, IEC 62061, ISO 13849-1, IEC 61800-5-2

The STO function can be used where main power of the drive is on to prevent unexpected start. The function cuts off the drive signal to disable the drive output, thus preventing motor from unexpected start (refer to below figure). After enabling STO function, short-time operations (like non-electrical cleaning-up in lathe industry) and/or maintenance on non-electrical parts can be conducted.



Features of STO function

1. Logic table for STO function

Input states and corresponding faults of STO function:

STO input state	Corresponding STO fault
H1, H2 opens simultaneously	Trigger STO function, the drive can't operate normally
H1, H2 closes simultaneously	Don't trigger STO function, the drive can operate normally
Either H1 or H2 opens or closes	Trigger STL1/STL2/STL3 fault, fault code: 38: Safety circuit of channel 1 is abnormal (STL1) 39: Safety circuit of channel 2 is abnormal (STL2) 40: Channel H1 and H2 become abnormal simultaneously (STL3)

2. Description of STO channel delay

STO channel trigger and indication delay time:

STO mode	STO trigger and indication delay ¹ , ²
STO fault: STL1	Trigger delay < 10ms, Indication delay < 280ms
STO fault: STL2	Trigger delay < 10ms, Indication delay < 280ms
STO fault: STL3	Trigger delay < 10ms, Indication delay < 280ms
STO fault: STO	Trigger delay < 10ms, Indication delay < 100ms

¹ STO trigger delay = the delay between triggering STO and cutting off drive output

² STO indication delay= the delay between triggering STO and indicating STO output state

3. Self-inspection on STO installation

Before installing STO, please perform self-inspection according to below table to ensure the effectiveness of STO

	Actions
<input type="checkbox"/>	Ensure that the drive can be run and stopped freely during commissioning.
<input type="checkbox"/>	Stop the drive (if running), cut off input power and isolate the drive from the power cable via the switch
<input type="checkbox"/>	Check STO circuit connection against circuit diagram.
<input type="checkbox"/>	Check that the shield of STO input cable is connected to +24V reference GND COM
<input type="checkbox"/>	Power on

<input type="checkbox"/>	<p>Test the operation of STO when the motor is stopped:</p> <ul style="list-style-type: none"> Give a stop command to the drive (if running) and wait until the motor shaft is at standstill. Activate STO function and give a start command to the drive, ensure the motor stays at standstill Inactivate STO circuit
<input type="checkbox"/>	Restart the drive and check if the motor runs normally
<input type="checkbox"/>	<p>Test the operation of STO function when the motor is running:</p> <ul style="list-style-type: none"> Start the drive and ensure the motor runs normally. Activate STO circuit. The drive reports STO fault (refer to fault and countermeasure in page X), ensure that motor coast to stop and stops rotation. Inactivate STO circuit
<input type="checkbox"/>	Restart the drive and check if the motor runs normally

2.4 Type designation key

2.5 Rated value

Model	Voltage class	Output power (kW)	Input current (A)	Output current (A)	STO function
AS24DRV20C4	1PH 230V	0.4	6.5	2.5	Class SIL2 PLd CAT.3
AS24DRV20C7		0.75	9.3	4.2	
AS24DRV21C5		1.5	15.7	7.5	
AS24DRV22C2		2.2	24	10	
AS24DRV40C7	3PH 400V	0.75	3.4	2.5	Class SIL2 PLd CAT.3
AS24DRV41C5		1.5	5.0	4.2	
AS24DRV42C2		2.2	5.8	5.5	
AS24DRV44C0		4	13.5	9.5	Class SIL3 PLe CAT.3
AS24DRV45C5		5.5	19.5	14	
AS24DRV47C5		7.5	25	18.5	
AS24DRV4011		11	32	25	
AS24DRV4015		15	40	32	
AS24DRV4018		18.5	47	38	
AS24DRV4022		22	51	45	
AS24DRV4030		30	70	60	
AS24DRV4037		37	80	75	
AS24DRV4045		45	98	92	
AS24DRV4055		55	128	115	
AS24DRV4075		75	139	150	
AS24DRV4090		90	168	180	
AS24DRV4110		110	201	215	

3.2.4 Wiring diagram of control circuit

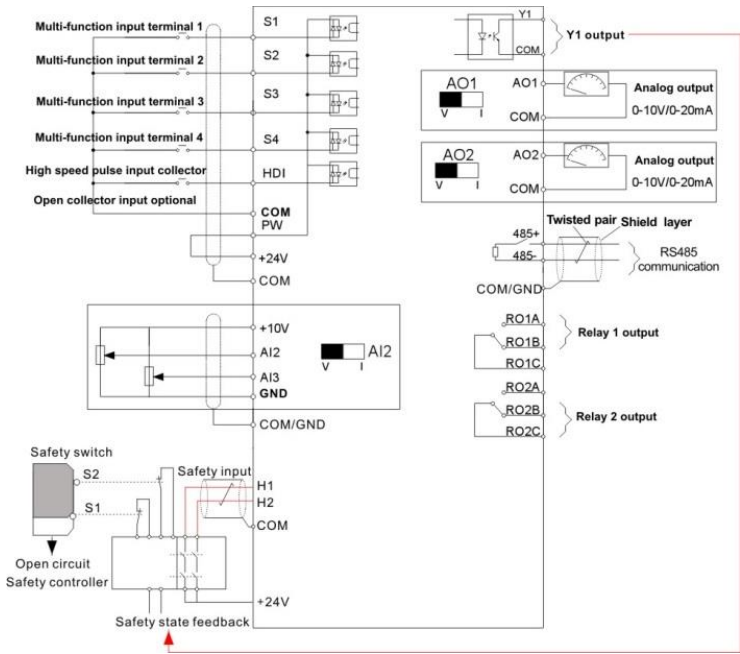


Fig 3-9 Control circuit

3.2.5 Control terminal diagram

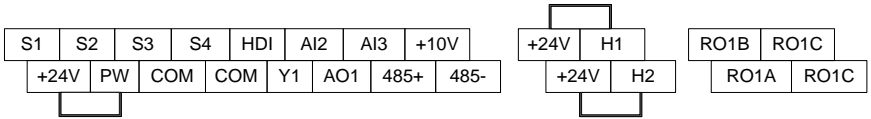


Fig 3-10 Connection terminal diagram for inverters ≤ 2.2kW

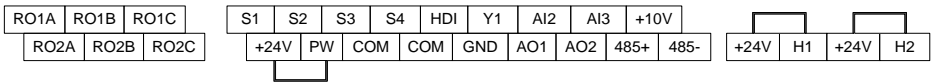


Fig 3-11 Connection terminal diagram for inverters ≥ 4kW

Function description of control terminal

Item	Terminal symbol	Terminal name	Terminal function	
Analog output	AO1-GND	Analog output 1	1. Output range: 0~10V voltage or 0~20mA current; 2. Voltage or current output is set by jumpers or toggle switch; 3. Error ±1%, 25°C; 4. There is only one AO1 for inverters ≤ 2.2kW.	
	AO2-GND	Analog output 2		
Digital output	Y1-COM	Digital output		1. Contact capacity: 50mA/30V; 2. Output frequency range: 0~1kHz; 3. Default is STO state output indicator.
STO function input	24V-H1	STO input 1		1. Safety torque stop (STO) redundant input, externally connected to NC contact, STO acts when the contact is open, and the drive stops output; 2. The safe input signal cable should be shield cable within 25m. 3. When employing STO function, please disassemble the short circuit plate on the terminals shown in fig 3.10 and fig 3.11.
	24V-H2	STO input 2		
Relay output	RO1A	NO contact of relay 1	1. Contact capacity: 3A/AC250V, 1A/DC30V; 2. Please note that it should not be used as high frequency switch output;	
	RO1B	NC contact of relay 1		
	RO1C	Common terminal of		

Item	Terminal symbol	Terminal name	Terminal function
		relay 1	3. There is only one relay output for inverters $\leq 2.2\text{kW}$.
	RO2A	NO contact of relay 2	
	RO2B	NC contact of relay 2	
	RO2C	Common terminal of relay 2	

5. Function parameter table

Newly added function codes are listed as below:

Function code	Name	Instruction	Default value	Modify
P06.01	Y1 output selection	0: Invalid	27	<input type="radio"/>
P06.03	Relay RO1 output selection	1: In operation 25: Reserved	1	<input type="radio"/>
P06.04	Relay RO2 output selection	26: DC bus voltage build-up is completed 27: STO action 28~30: Reserved	5	<input type="radio"/>
P07.27	Current fault type			<input checked="" type="radio"/>
P07.28	Type of the previous one fault	0: No fault 1: Inverter unit U phase protection (OUT1)		<input checked="" type="radio"/>
P07.29	Type of the previous two faults 35: Maladjustment fault (STo) 36: Underload fault (LL)		<input checked="" type="radio"/>
P07.30	Type of the previous three faults	37: Safety torque stop (STO) 38: Channel 1 is abnormal (STL1) 39: Channel 2 is abnormal (STL2)		<input checked="" type="radio"/>
P07.31	Type of the previous four faults	40: Channel H1 and H2 become abnormal simultaneously (STL3) 41: Safety code FLASH CRC check fault (CrCE)		<input checked="" type="radio"/>
P07.32	Type of the previous five faults			<input checked="" type="radio"/>
P11.16	Extension function selection	0x000~0x111 LED ones: Automatic frequency downgrade at voltage drop 0: Automatic frequency downgrade at voltage drop is invalid 1: Automatic frequency downgrade at voltage drop is valid LED tens: The second ACC/DEC time selection 0: The second ACC/DEC time detection selection is invalid 1: The second ACC/DEC time detection selection is valid, when the operation is above P08.36, ACC/DEC time is switched to the second ACC/DEC time LED hundreds: STO function selection 0: STO alarm locked Alarm lock means when STO appears, reset is a must after state recovery. 1: STO alarm unlocked STO alarm unlocked means when STO appears, STO alarm will disappear automatically after state recovery.	0x000	<input type="radio"/>

Function code	Name	Instruction	Default value	Modify
		Note: STL1~STL3 are fault lock and cannot be reset		

6. Fault

Instruction for newly added fault codes:

Fault code	Fault type	Possible cause	Countermeasure
STO	Safe torque off	STO function operates normally	
STL1	Channel H1 abnormal	Fault or internal hardware circuit fault occurred to H1 channel	Replace STO switch; if problem persists after replacement, contact the manufacturer.
STL2	Channel H2 abnormal	Fault or internal hardware circuit fault occurred to H2 channel	
STL3	Channel H1 and H2 abnormal simultaneously	Fault or internal hardware circuit fault occurred to H1 and H2 channels simultaneously	
CrCE	Safe code FLASH CRC check fault	Error occurred to STO safe code FLASH CRC check	Contact the manufacturer.

◆ STO alarm

- 1) When the hundreds of P11.16 is set to 1, the STO alarm is locked

As shown in below fig 1, When H1 and H2 are 'OFF' during operation (safety function is required), the drive enters safety mode and stops output. STO alarm will only be disappeared once reset action is valid. External running command need to be reset for the drive to execute running command again.

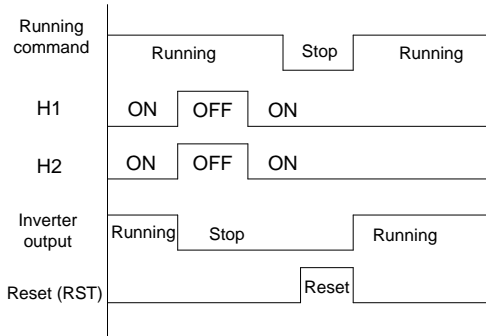


Fig 1

- 2) When the hundreds of P11.16 is set to 2, the STO alarm will not be locked

As shown in below fig 2, alarm non-lock means when STO appears, the STO alarm will disappear automatically after state restoration, which requires no reset action. After reset of external running command, the drive will execute running command again.

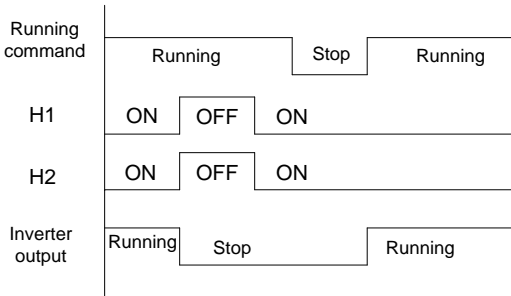


Fig 2

◆ STL1 fault

As shown in below fig 3, when the hardware circuit of safety circuit 1 is abnormal while that of H2 signal is normal, namely, when H1 is abnormal during operation (safety function is required), the

drive enters safety mode and stops output no matter whatever the running command is. Despite of reset commands and external running command reset, the drive will not execute running command again, and it is STL1 alarm lock all the time.

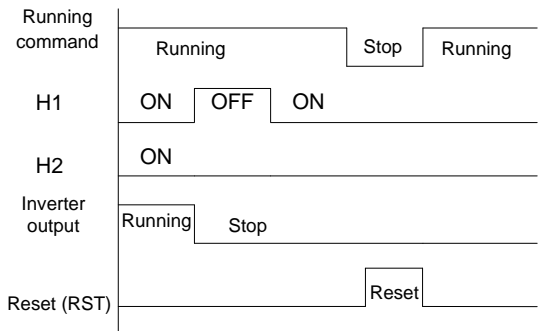


Fig 3

◆ STL 2 fault

As shown in below fig 4, when the hardware circuit of safety circuit 2 is abnormal while that of H1 signal is normal, namely, when H2 is abnormal during operation (safety function is required), the drive enters safety mode and stops output no matter whatever the running command is. Despite of reset commands and external running command reset, the drive will not execute running command again, and it is STL2 alarm lock all the time.

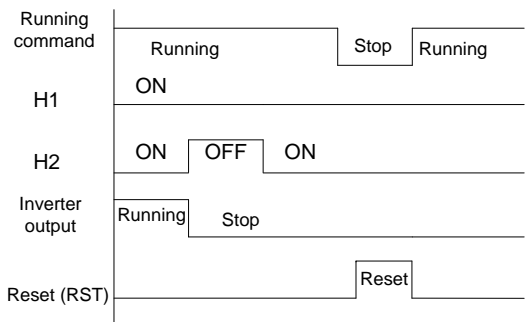


Fig 4