SDS Enclosed Star-Delta Starter User Guide

(7.5kW~90kW)

V2.1.3

PLEASE NOTE: AS STANDARD AND UNLESS OTHERWISE SPECIFIED, THIS PRODUCT IS EQUIPPED WITH A BASIC LOW INTEGRITY EMERGENCY STOP CIRCUIT

STOPPING METHOD:

A "CATEGORY 0" E-STOP SYSTEM/BUTTON (immediate removal of power from the motor when E-Stop button pressed).

INTEGRITY OF EMERGENCY STOP CIRCUIT:

The Key Release Emergency Stop Button on this equipment gives a 'category zero stop' (coast to stop). It is a low integrity level, PLa system. Therefore a single fault can lead to a loss of the safety function.

PLEASE CHECK THAT THE STANDARD OF THE EMERGENCY STOP FUNCTION ON THIS PANEL IS ADEQUATE FOR YOUR MACHINE/APPLICATION BY CARRYING OUT THE REQUIRED RISK ASSESSMENT.

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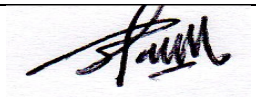
Declaration Of Conformity

Willpower Electrical Ltd trading as Motor Control Warehouse hereby states that the enclosed star delta starter range SDS075EN400V to SDS90EN400V conforms to the relevant safety provisions of the **Low Voltage Directive 2006/95/EC** and the **EMC Directive 2004/108/EC** and have been designed and manufactured in accordance with the following harmonised European standards:

EN61000-6-2	EMC immunity in industrial environment
EN61000-6-4	EMC emission in industrial environment
EN61010-1	Safety
EN60529: 1992	Specifications for the degrees of protection provided by enclosures

Model	kW Rating	Input Voltage
SDS075EN400V10/20	7.5kW	380-440V
SDS11EN400V10/20	11kW	380-440V
SDS15EN400V10/20	15kW	380-440V
SDS185EN400V10/20	18.5kW	380-440V
SDS22EN400V10/20	22kW	380-440V
SDS30EN400V10/20	30kW	380-440V
SDS37EN400V20	37kW	380-440V
SDS45EN400V20	45kW	380-440V
SDS55EN400V20	55kW	380-440V
SDS75EN400V20	75kW	380-440V
SDS90EN400V20	90kW	380-440V

Signed	
Position	Director
Date	20.03.2018

Safety Information

This chapter provides very important information so that you can use the **SDS Enclosed Star-Delta Starter** safely, prevent injury or death, or damage to equipment.

Please read this information thoroughly and make sure you observe all the safety information shown below and elsewhere in this manual. Please make this User Guide available for the end user.

Safety symbols

Danger: Danger of electrical shock which can cause injury or death, or damage to equipment

Warning: Potential hazard, other than electrical, that can cause physical injury or damage to equipment

Danger

- **The SDS Enclosed Star-Delta Starter should ONLY be installed, commissioned and maintained by qualified and competent personnel.**
- **The SDS must be installed to the latest IEE wiring regulations taking into account local regulations.**
- **Before power is applied to the SDS, ensure the SDS cubicle door is closed.**
- **Dangerous voltages are present when the input power supply is connected to the SDS. Before attempting any work on the SDS cubicle or motor, isolate and lock off the input power supply. Prove dead using a voltage tester. The voltage tester itself should be proved immediately before and after testing using a proving unit with a low power output.**
- **The SDS cubicle must be connected to system ground using the cubicles earth terminals. The size of the earth conductor and earth loop impedance must comply with national and local electrical regulations.**
- **The SDS is a non-field repairable unit. Contact the supplier of the SDS.**
- **The SDS cubicle has internal MCB/Fuses to protect the SDS wiring. The supply to the SDS cubicle must be protected by suitable rated fuses/MCB.**
- **The Remote Control Terminals within this equipment can be rated at 415Vac/240Vac/110Vac, care should be taken during installation.**

Warning

- **All machinery, in which this SDS is used, within the European Union, must comply with directive 98/37/EC, Safety of Machinery.**
- **Do not install the SDS in an explosive environment.**
- **The motor must be used within the manufacturers guidelines.**
- **Do not allow conductive material to enter the components within the SDS, e.g. from drilling during installation.**
- **If the SDS external start circuit is used, the external start contact MUST be a momentary contact and NOT a latching/stay-put contact.**
- **The Key Release Emergency Stop Button on this equipment gives a 'category zero stop' (coast to stop). It is a low integrity level, PLa system. Therefore a single fault can lead to a loss of the safety function. Please check this is adequate for your machine/equipment.**

Technical data

Trip Class 10

Model	kW rating	Input phase	Input voltage (VAC)	Max allowed motor current (A)	Motor current (A) (overload range) Trip class 10	Overload range (A)	Typical Motor (A)
SDS075EN400V10	7.5	3	400	17	15.5 to 22	9 to 13	16
SDS11EN400V10	11	3	400	22	20 to 31	12 to 18	20
SDS15EN400V10	15	3	400	29	29 to 43	17 to 25	27
SDS185EN400V10	18.5	3	400	36	29 to 43	17 to 25	34
SDS22EN400V10	22	3	400	44	39.5 to 55	23 to 32	41
SDS30EN400V10	30	3	400	59	52 to 69	30 to 40	55

Trip Class 20

Model	kW rating	Input phase	Input voltage (VAC)	Max allowed motor current (A)	Motor current (A) (overload range) Trip class 20	Overload range (A)	Typical Motor (A)
SDS075EN400V20	7.5	3	400	17	15.5 to 77	9 to 45	16
SDS11EN400V20	11	3	400	22	15.5 to 77	9 to 45	20
SDS15EN400V20	15	3	400	29	15.5 to 77	9 to 45	27
SDS185EN400V20	18.5	3	400	36	15.5 to 77	9 to 45	34
SDS22EN400V20	22	3	400	44	15.5 to 77	9 to 45	41
SDS30EN400V20	30	3	400	59	31 to 155	18 to 90	55
SDS37EN400V20	37	3	400	75	31 to 155	18 to 90	72
SDS45EN400V20	45	3	400	89	31 to 155	18 to 90	86
SDS55EN400V20	55	3	400	108	31 to 155	18 to 90	98
SDS75EN400V20	75	3	400	135	31 to 155	18 to 90	129
SDS90EN400V20	90	3	400	170	103 to 206	60 to 120	158

NOTE: The thermal overload setting is set to minimum as default. It should be adjusted to suit the motor used.

To calculate the thermal overload setting = Actual motor nameplate current ÷ 1.7 X 1.1 (10% safety margin to prevent spurious tripping).

NOTE: Due to the large range of the thermal overloads on the Trip Class 20 star delta starters, please make sure the thermal overload is adjusted correctly to suit the motor.

NOTE: Starting the motor more than once every 10 minutes will alter the thermal overload tripping characteristic by heating the current sensing elements, making the overload trip more quickly for a given setting.

SDS MCB/Fusing

The SDS cubicle has internal MCB/Fuses to protect the SDS wiring. The supply to the SDS cubicle must be protected by suitable rated MCB/Fuses.

The following table gives details on which SDS is protected by what protection device.

Trip Class 10 Model	MCB/Fuses	Trip Class 20 Model	MCB/Fuses
SDS075EN400V10	Type D MCB	SDS075EN400V20	Type D MCB
SDS11EN400V10	Type D MCB	SDS11EN400V20	Type D MCB
SDS15EN400V10	Type D MCB	SDS15EN400V20	Type D MCB
SDS185EN400V10	Type D MCB	SDS185EN400V20	Type D MCB
SDS22EN400V10	aM Fuses	SDS22EN400V20	aM Fuses
SDS30EN400V10	aM Fuses	SDS30EN400V20	aM Fuses
		SDS37EN400V20	aM Fuses
		SDS45EN400V20	aM Fuses
		SDS55EN400V20	aM Fuses
		SDS75EN400V20	aM Fuses
		SDS90EN400V20	aM Fuses

Approvals	**CE approval**	CE
Environment	**Altitude**	1000m rated
		1000m～3000m, 1% rated current de-rating per 100m above 1000m
	Operating Temperature	−10°C～+40°C
	Max. Humidity	≤90%RH, non-condensing
	Vibration	≤5.9m/s^2 (0.6g)
	Storage Temperature	−40°C～+70°C
	Running Environment	Non-flammable, No corrosive gasses, no contamination with electrically conductive material
Supported Power Supply Systems		TT
		TN
SDS Enclosure		IP65
Input supply frequency		50 to 60Hz
Input supply voltage		3 phase 400VAC ±10%
***Breaking capacity of protective devices**		10kA (MCB) 80kA (Fuses)
***Contactor coil voltage**		400VAC / 240VAC / 110VAC (+/-10%)

*Model dependant

SDS Cubicle Dimensions

Model	Dimensions (H x W x D) Trip Class 10	Dimensions (H x W x D) Trip Class 20	Approx. Weight (kg)
SDS075EN400V	400 x 300 x 200	400 x 300 x 200	10
SDS11EN400V	400 x 300 x 200	400 x 300 x 200	10
SDS15EN400V	400 x 400 x 200	400 x 400 x 200	16
SDS185EN400V	400 x 400 x 200	400 x 400 x 200	16
SDS22EN400V	400 x 400 x 200	500 x 500 x 200	20
SDS30EN400V	500 x 500 x 200	500 x 500 x 200	20
SDS37EN400V		600 x 600 x 200	30
SDS45EN400V		600 x 600 x 200	30
SDS55EN400V		800 x 600 x 250	45
SDS75EN400V		800 x 600 x 250	45
SDS90EN400V		800 x 600 x 250	45

SDS Trip Class
The MCW Enclosed star delta starters are fitted with either a **Trip Class 10** thermal overload relay which is suitable for the majority of light to medium industrial type load applications or a **Trip Class 20** thermal overload relay which is suitable for medium to heavy industrial loads.

The MCW Enclosed star delta starter range is not suitable for applications that have a very heavy load on start that takes greater than 20s to start or very high inertia loads such as high inertia fans, centrifuges or loaded crushers.

Starting the MCW Enclosed star delta starters more than once every 10 minutes will alter the thermal overload tripping characteristics making the overload trip more quickly for a given thermal overload current setting.

Trip Class Explained
At 600% of the maximum current rating of the motor the **Trip Class 10** unit will trip in 10 seconds or less, **Trip Class 20** will trip in 20 seconds or less, and **Trip Class 30** will trip in 30 seconds or less.

The class number indicates the thermal overload trip characteristics from cold state.

Ir = Current setting of overload relay. This should be the Full Load Current (FLC or FLA) shown on motor rating plate.

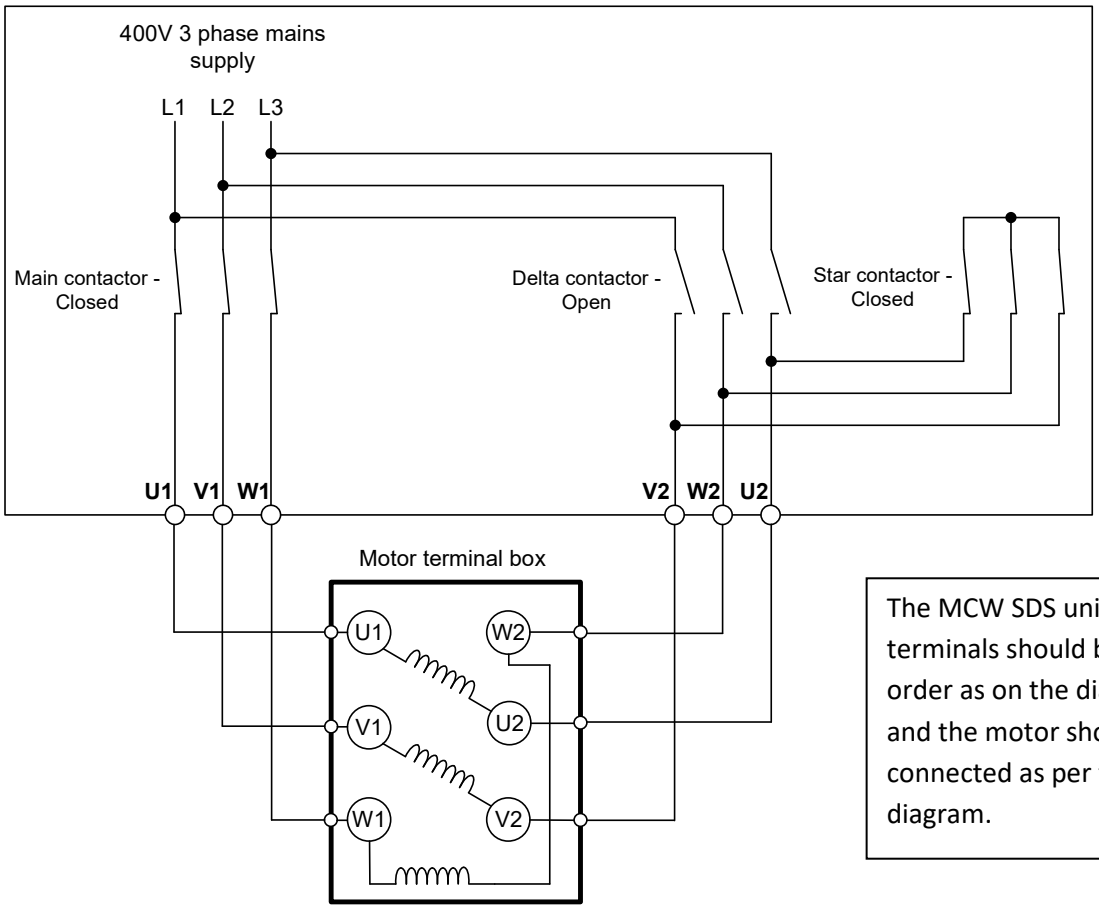
	1.05 x Ir	1.2 x Ir	1.5 x Ir	7.2 x Ir
	Time to trip from a cold start			
Trip Class 10	>2 hours	<2 hours	<4 minutes	2s< to <10s
Trip Class 20	>2 hours	<2 hours	<8 minutes	2s< to <20s
Trip Class 30	>2 hours	<2 hours	<12 minutes	2s< to <30s

NOTE:
The enclosed star delta starter can only be used with motors that have 400V delta and 690V star windings.

They cannot be used with motors that have 200V delta and 400V star windings.

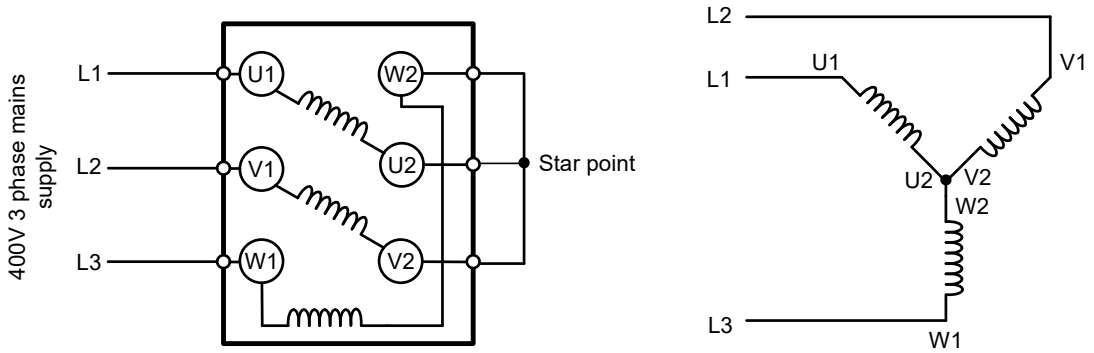
SDS Circuit diagram with Main and Star contactors closed

This is equivalent to connecting the motor in the star 690V configuration. This is the start configuration for the motor. This configuration draws less current from the mains supply during starting then if the motor was started in the delta configuration. Please connect to the motor as per this top diagram.



The MCW SDS unit motor terminals should be in the order as on the diagram and the motor should be connected as per the diagram.

Equivalent to -

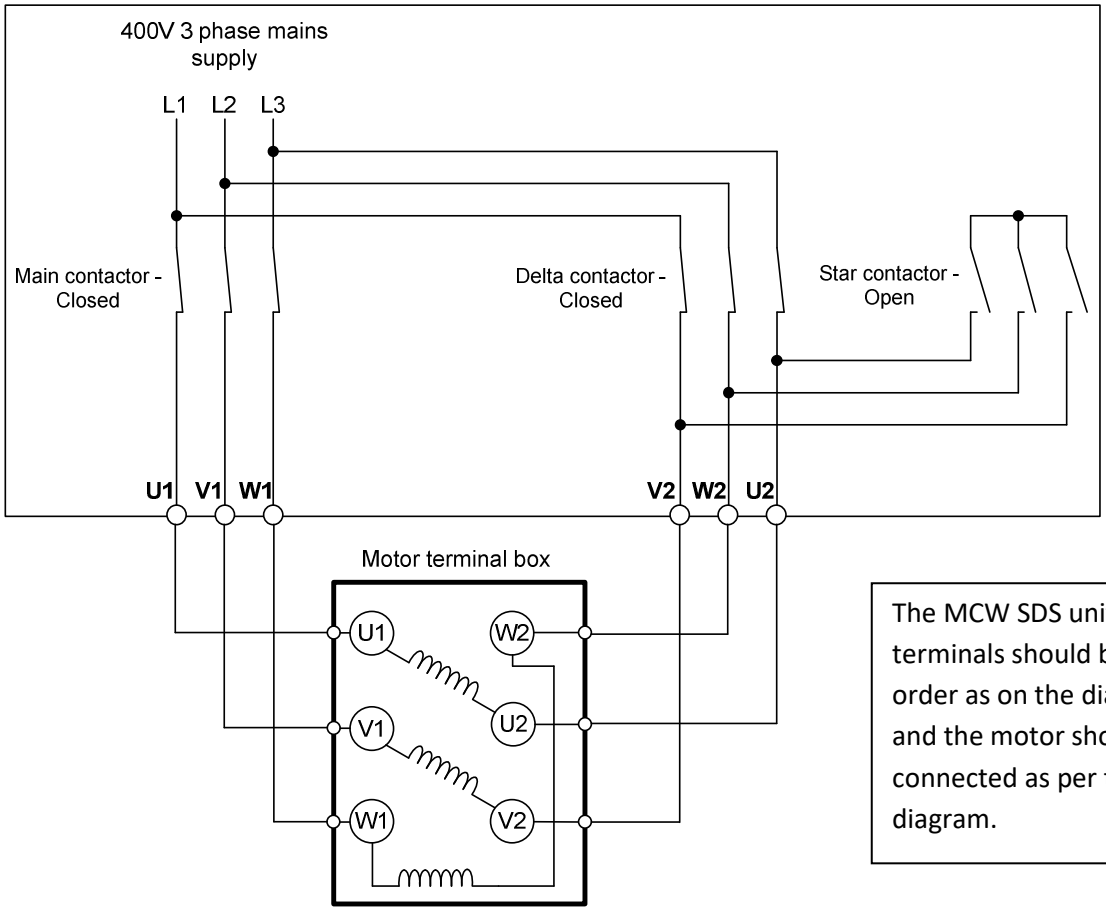


NOTE: The above 'Equivalent to' diagrams just give information on how the motor would be connected to a 3-phase supply if the motor was connected in the 'star' configuration

NOTE: Please remember to remove the shorting bars from the motor terminals as these are not required with a star-delta starter.

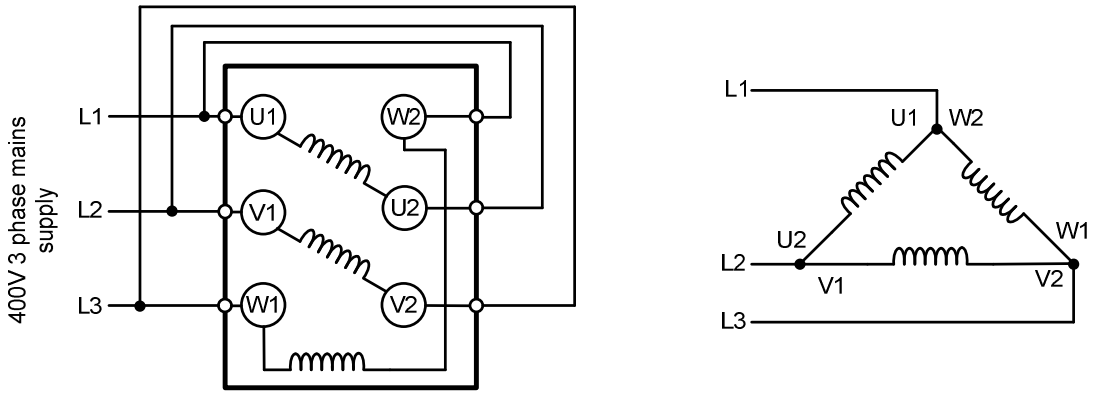
SDS Circuit diagram with Main and Delta contactors closed

This is equivalent to connecting the motor in the delta 400V configuration. The delta connection is the running connection for the motor. Please connect to the motor as per this top diagram.



The MCW SDS unit motor terminals should be in the order as on the diagram and the motor should be connected as per the diagram.

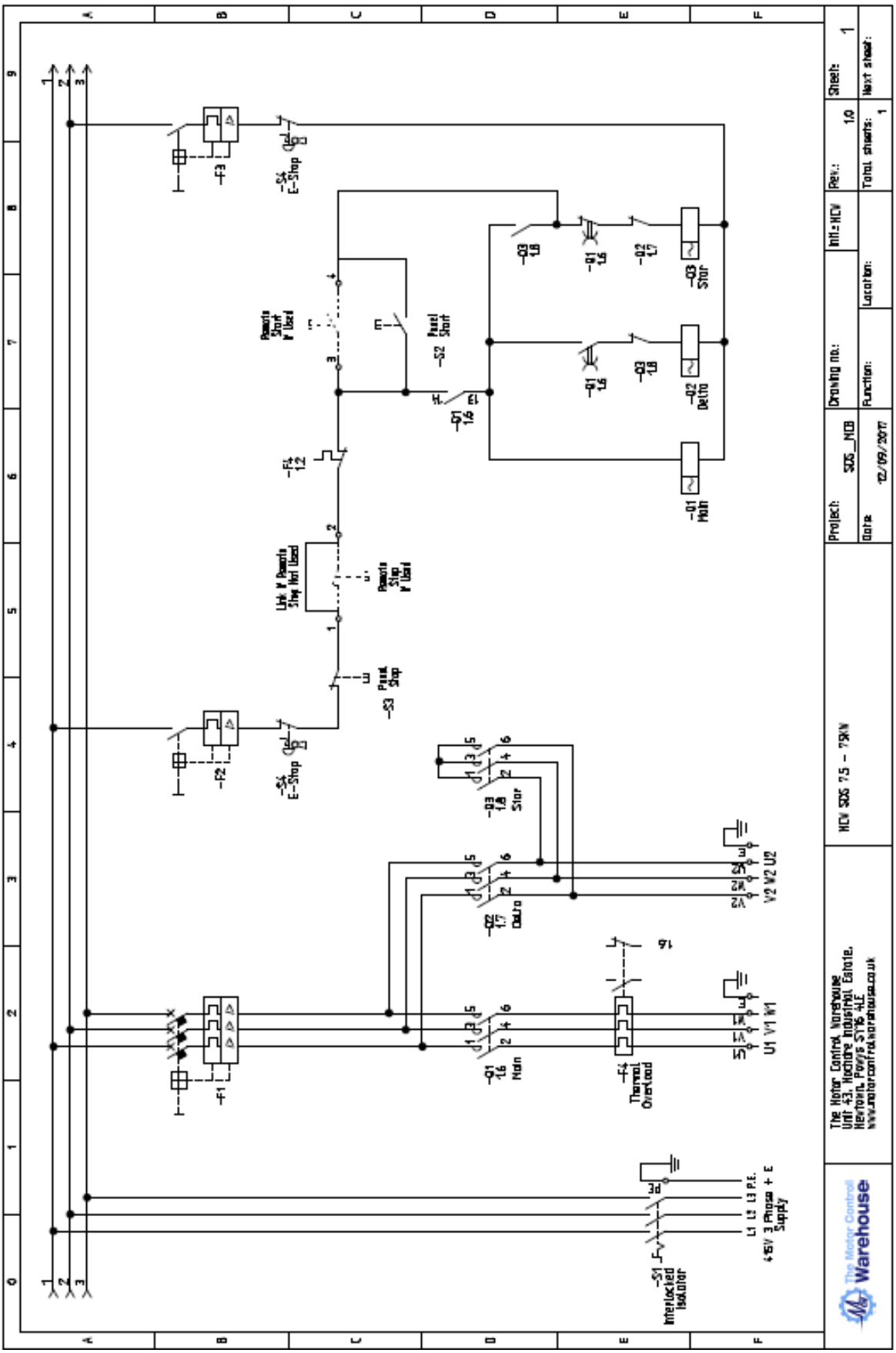
Equivalent to -



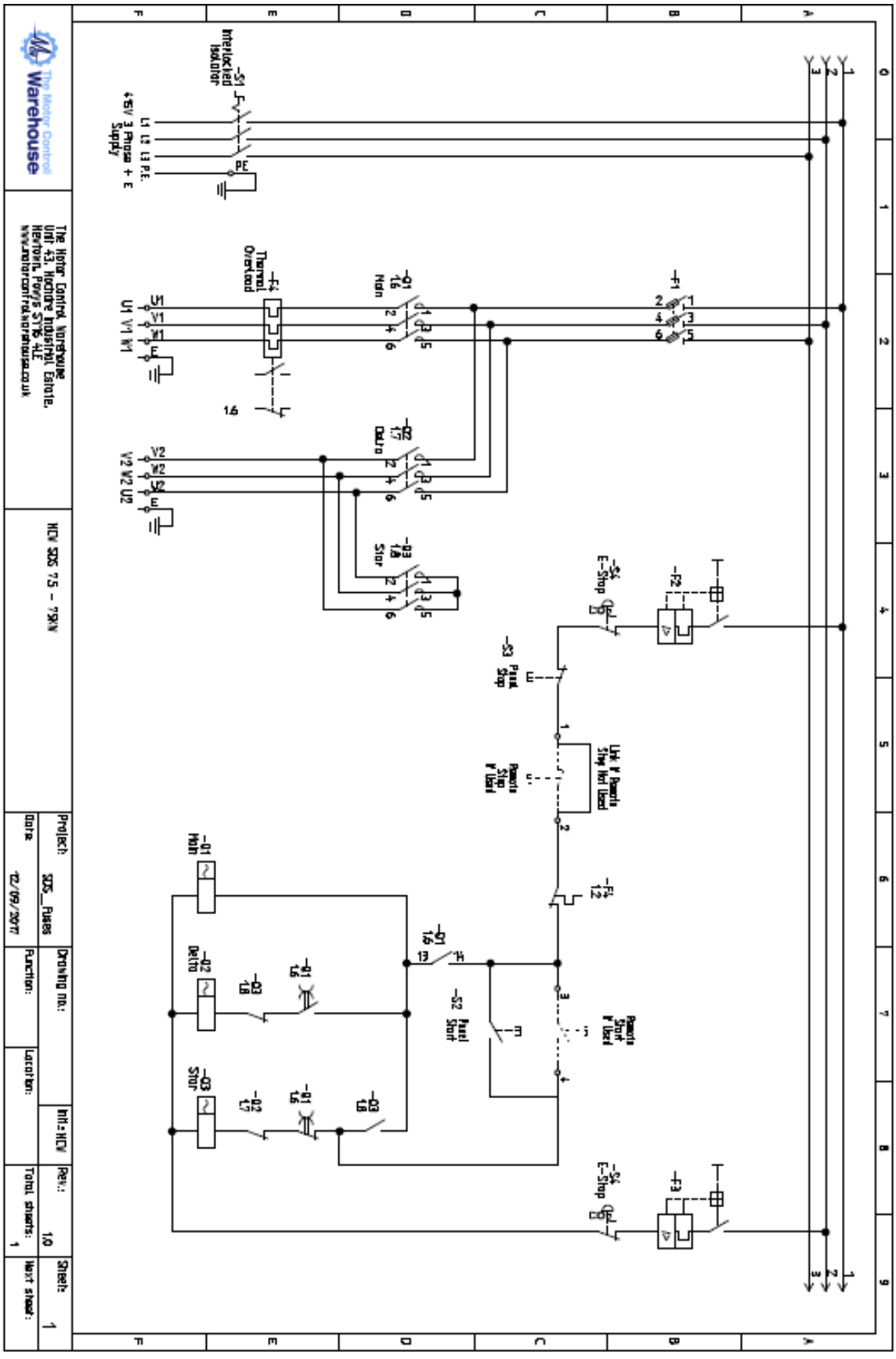
NOTE: The above 'Equivalent to' diagrams just give information on how the motor would be connected to a 3-phase supply if the motor was connected in the 'delta' configuration

NOTE: Please remember to remove the shorting bars from the motor terminals as these are not required with a star-delta starter.

SDS Circuit diagram – With MCB



SDS Circuit diagram – With Fuses



Operation & Timer Setting

The SDS range of enclosed star-delta starters is designed to be as close to a plug and play product as possible. They require a suitable 3 phase and earth power supply and a 6-wire and earth motor cable.

The SDS is equipped with:

- Green start button
- Red stop button
- Red keyed latching Emergency Stop button (Category 0)
- An interlocked mains isolator is also provided; the enclosure door cannot be opened unless the isolator is in the off position.

Start Button - When pressed (providing the Emergency Stop button is not pressed) the star-delta contactors will initiate starting the motor.

The 'Main' and 'Star' contactors will pull in. The supply voltage (400VAC) is connected across the star connected motor. Because the motor is connected in star which is the 690V winding but with only 400V across it, the current the motor draws during starting will be reduced. After the time delay of the timer elapses, the 'Star' contactor will drop out and the 'Delta' contactor will pull in. Now the motor will be connected in its delta (running) winding with 400V across its windings.

Stop Button - When pressed, the star-delta contactors will open and the motor will 'coast to a stop'.

Emergency Stop Button - When pressed the star-delta contactors will open and the motor will 'coast to a stop'. This is a twist release button and can be locked in the "in" position.

WARNING

The Emergency Stop button on this equipment provides a 'Category 0' emergency stop only by removing power immediately from the motor and has no built in redundancy or safety relay control. This is a low integrity PLa emergency stop system. This may not be adequate for the type of machinery that this equipment is used on.

Mains Isolator - With the mains isolator in the off position mains power will be removed from the control box. Mains power will still be present at the input connections to the isolator only.

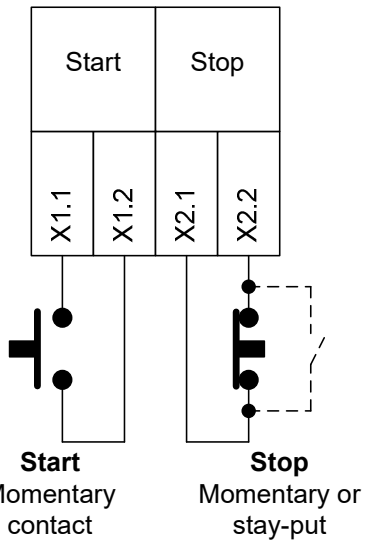
External Start & Stop Connections

If the SDS is to be controlled from the external start connections, the external start must be from a momentary contact and NOT from a latching / stay-put contact. See diagram on page 8.

The external start must be a momentary contact to prevent the SDS automatically starting after the STOP button has been pressed and released or after the E-STOP button has been released.

The external stop contact can be either a momentary or stay-put contact.

External Start/Stop connections diagram



Timer Setting

The timer setting is dependent on the driven load and inertia and can be determined as follows:

There are two basic ways of determining the correct point at which the timer should change the winding configuration from 'star' (starting mode) to 'delta' (running mode). Both methods determine the point at which the rotor has achieved its maximum speed in star, and therefore the point at which the starter should change to delta.

Current measurement method

Set the delta timer to its maximum setting. Put a clip-on ammeter on one of the lines FEEDING the starter. Set a stopwatch going when you press the start button. Watch the ammeter - it will peak immediately on start up, then the current will drop off as the load accelerates. As soon as the current steadies off, stop the watch. At this point (approximately 85% full load speed) the motor can achieve nothing more by remaining in star, and this is the latest point in time that delta changeover should be made.

Speed measurement method

Use a tachometer on the motor shaft (mechanical or optical) to measure motor speed. Set the delta timer to its maximum setting. Again, use a stop watch. Observe the Tacho. Acceleration characteristics will vary dependent on the driven load, but the speed will settle out at approx. 85% full load speed (this can usually be heard by the tone in the motor being constant). Stop the watch at this point. Set the timer to the time recorded on the stop watch.

Fault Finding

The enclosed star delta starter has been tested to make sure it operates correctly when connected correctly to a motor. Before more in-depth fault finding is carried out, check the following points:

1. Make sure the Star delta starter motor terminals and motor terminals are wired correctly. Make sure the motor terminal shorting bars are removed.
See Section 3, Motor Connections.

2. Make sure the thermal overload is set to the correct current for the motor being used.
See Section 2, Technical Specification.

3. Make sure the timer star to delta changeover time is set correctly for the application. The bigger the motor and the higher the trip class, the longer the changeover time required.
See Section 4, Operation and Timer Setting.

Further fault finding

If the star delta starter contactors do not pull in.
Or if the motor doesn't start.
Or if the motor starts but then stops.
Or if the motor starts but sounds rough:

With 'power off' to the star delta starter
Check the control and power connections to make sure cables haven't become dislodged and all connections are tight.

Check that the main fuses/ circuit breaker or control circuit breakers are OK or in the ON position.

Check the correct connections between the star delta starter motor terminals and the motor. It is critical that these connections are correct. See the 'Connection to Motor' section of this user guide.

Check the E-stop contacts are closed when the E-Stop push button is released.

The thermal overload is reset and the connection between terminals 95 and 96 is closed.

The contactor coils are OK. Measure between A1 and A2 on each contactor to make sure there is a low coil resistance.

With 'power on' to the star delta starter

Danger: Please take care when measuring the supply voltage.

Check that the correct supply voltage is on the input of the main contactor.

Thermal overload tripping
If the motor starts but the thermal overload trips during starting:

Is the thermal overload trip class correct for the application?

Is the timer set correctly for the application?

Has the star delta starter been started and stopped a number of times in short succession during commissioning so that the thermal overload has over heated?

Is there enough torque in the motor to bring to motor up to speed before the star delta starter switches into delta.

NOTES

Thermal Overload Setting:

Date	Setting

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Other Enclosed Products from Motor Control Warehouse

- **Enclosed Inverter Drives**, single phase input from 0.75kW to 4kW. Three phase input from 0.75kW to 45kW.

Features
IP54 powder coated steel enclosure
Interlocked mains isolator
10kA MCBs – power and control
Tri rated cable
Keyed Inverter Disable button
IP rated speed pot
Motor connections to terminals
Fwd/Rev switch
Stop/Start buttons
Indication lamps
Thermostat controlled cooling fans
HD/ID700 industrial inverter

- **Enclosed Soft Starters**, from 7.5kW to 55kW, three phase input. All these products are rated at trip class 10 (medium industrial loads).

Features
IP65 powder coated steel enclosure
10kA MCBs – power & control
Interlocked mains isolator
Motor thermal overload relay
Internal bypass contactor
Stop/start pushbuttons
Keyed soft stop button
Running and healthy lamps
Customer terminals
24Vdc power supply
Tri-rated cable
Fairford Electronics DFE Soft Start