SAFTRONICS SH4-70 Heater Controller User Guide

Contents

SAFTRONICS SH4-70 Heater Controller

DESCRIPTION

FEATURES

Saftronics Heater Controller SH4 series are solid-state, burst-firing controllers for three-phase resistance loads. Each controller contains 4 x SCRs in the power circuit. The power of the circuit is controlled using a Saftronics SH4 series control card.

Saftronics solid-state controllers are constructed in a manner, that permits rapid removal, and replacement of PC boards, SCRs, control fuses, etc. This ensures minimum downtime in the unlikely event of failure of one of these devices. In the case of loss, or insufficient cooling air resulting in overheating of the heat sink, a thermal switch will open and shut down the controller thereby protecting the SCRs from excessive heating.

CONFIGURATION

The SH4 range of heater controllers covers power ratings from 69Kw to 730Kw with 380V or 525V supplies as standard. Larger powers and different voltages are available on request.

TABLE 1.1 380v SH4 SERIES

TYPE	LOAD POWER (380 V)	LOAD POWER (525 V)	(NOMINAL) LINE VOLTAGE	LOAD CURRENT	SIZE
SH4 – 100	**70 kW**	**90 kW**	**380V / 525V**	**100 Amps**	**B**
SH4 – 200	**130 kW**	**180 kW**	**380V / 525V**	**200 Amps**	**B**
SH4 – 300	**200 kW**	**270kW**	**380V / 525V**	**300 Amps**	**C**
SH4 – 400	**260 kW**	**360 kW**	**380V / 525V**	**400 Amps**	**D**
SH4 – 600	**400 kW**	**550 kW**	**380V / 525V**	**600 Amps**	**E**
SH4 – 800	**525 kW**	**730 KW**	**380V / 525V**	**800 Amps**	**E**

The SH4 range of heater controllers comes in two configurations.

KIT FORM (ENCLOSED) for mounting between an existing MCC and ELEMENTS.
This consists of a thyristor stack and SH4 control card in an IP00 enclosure.

STANDARD FORM
This is a complete heater controller consisting of; a thyristor stack and, an SH4 control card. Isolator, high-speed fuses, potentiometer, and stop/start pushbuttons in an IP23 enclosure.

OPTIONAL FEATURES

1. Line disconnect
2. Line fuses
3. Isolating contactor
4. Start / Stop pushbuttons

TECHNICAL DATA

CYCLE TIME ADJUST
Units are factory set as slow cycle unless the customer has specified the cycle time, to reduce mains disturbance. All SH4 units ‘CYCLE TIME’ pots (Ctpot) are set mid-position, for faster cycle time, adjust the CT pot clockwise.

SPECIFICATION

Supply Voltage (Specify when Ordering)	:	**240V, 380V, 525V, 690V**
Supply Frequency	:	**47Hz to 63Hz**
Operating temperature	:	**0°C to 50°C for natural cooling. 0°C to 45°C for fan cooling**
Storage Temperature	:	**-10°C to 80°C**
Input Signal	:	**0-5Vdc, 0-10Vdc, 4-20m– 300 Ohm Max**
Cycle Time (half power) Units < 100A	:	**Fast Cycle : 120mSec to 700mSec Slow Cycle : 0.8 Sec to 5 Sec.**
Cycle time (half power) Units > 100A	:	**Fast Cycle :0.8 Sec to 5 Sec. Slow Cycle :10 Sec to 2Min**
Isolation	:	**Control inputs are completely Isolated from the loads supplies; 2500V rms**

SH4 Thyristor burst Firing Heater Controller OPERATION. All units accept a control signal from a temperature controller and switch the entire load on and off in the time-proportioning bursts. These bursts are proportional to the controller's analog output signal and produce a very accurate control of the heater, saving energy. This switching takes place at or near the zero crossing point of the AC sine wave, resulting in minimal interference with the supply, far less than that produced with contactor switching. As no switch arcing takes place the controller has a long service life.

PROTECTION

Some specifications call for ultra HRC fuse links to protect the semi-conductor junction should a direct short-circuit occur. The large fault currents that can develop in these situations may damage the semiconductors before the main fuse or MCB responds. Due to the cost of the Thyristor fitted to these units, ultra-fast fuse-links are incorporated into the unit as a standard.

WIRING

The SH4 units should be connected according to the wiring diagram shown on page 2. Cable sizes for the DC control signal should be larger than 5 mm^2 and the power cables to L1 & L2 sized sufficiently to withstand the maximum current rating of the load while meeting the current SABS 0142-1 wiring regulations.

SET-UP PROCEDURE

After connecting the load to the SH4 unit, set the input signal to a minimum (0V or 4 mA). Switch on the mains supply and with a clamp ammeter check the current output to the load should be zero. There may be a small leakage current or suppression circuit current which is typically less than 10mA gradually increasing the input signal while checking the output power (in time bursts) increases proportionally.

INPUT SIGNAL.
Located at the rear of the circuit board are four miniature

DIPswitches labeled SW1.

SIGNAL	1	2	3
0-10Vdc	OFF	ON	OFF
0-5Vdc	ON	OFF	OFF
4-20mA	ON	ON	ON

These select the type of DC input signal as shown in the table below.

SH4 INPUT DATA
NOTE: The stack input voltage and the control circuit supply must be synchronized i.e. R to R, S to S, T to T!!

STACK INPUT

- Voltage Type – 3 Phase Input
- SCR Voltage Rating – 2,5 x line-line AC Voltage (min)
- Type SH4-XX-3 – 420V Max Continuous
- RMS voltage
- Type SH4-XX-5 – 580V Max Continuous
- RMS Voltage
- Line Frequency – 50Hz +2Hz

SH4 CONTROL SUPPLY

- Voltage Type – 3 Phase Input
- Selectable 380/525V
- Link at 380V Position – 340v – 420v
- Link at 525V Position – 470v – 580v
- Line Current – Less than 25mA
- Line Frequency – 50Hz ± 2Hz

FAN SUPPLY
Type SH4 -100 to SH4-800 – AC220V, 50Hz, 0,5A

SH4 OUTPUT DATA
Unless otherwise specified, the currents listed below are the maximum at a maximum ambient temp of 40 DegºC and an altitude of 1500m max.

OUTPUT CURRENT

OVER CURRENT
Amount – 110% (Max Continuous Current) Max Different ratings are available on request.

DERATING
At higher temperatures than 40 Deg. C. – 1.5% per 1 Deg.C. At higher altitudes than 1500m – 1% per 100m

PROTECTIVE MEASURES
To ensure high system reliability protective measures have been taken which protect both the controller and the motor.

DRIVE PROTECTION MEASURES THERMAL CUT-OUT – A thermal cut-out element is mounted near the power devices. This element is a normally closed contact, which opens at approximately 80 degrees. To protect the drive, should the temperature rise, the element must be connected to the stop circuit of the drive. dv/dt SUPPRESSION – The power devices have been suppressed using an RC network to ensure that their dv/dt ratio is not exceeded.

LINE IMPEDANCE – For increased protection against noise and overvoltages as well as for short circuit protection it is recommended that AC line reactors are used. Consult Saftronics in this regard.

ISOLATION – The control circuits are electrically isolated from the power circuits.

INDICATORS
There is 1 LED indicator on the SH4 control card. PULSE – When the drive is started the RUN LED will light. The RUN LED is extinguished when the drive is stopped.

MECHANICAL LAYOUT AND MOUNTING UNIT DIMENSIONS
The complete range of SH4 soft starters is divided into 4 physical sizes. Namely Sizes B, C, D, and E.

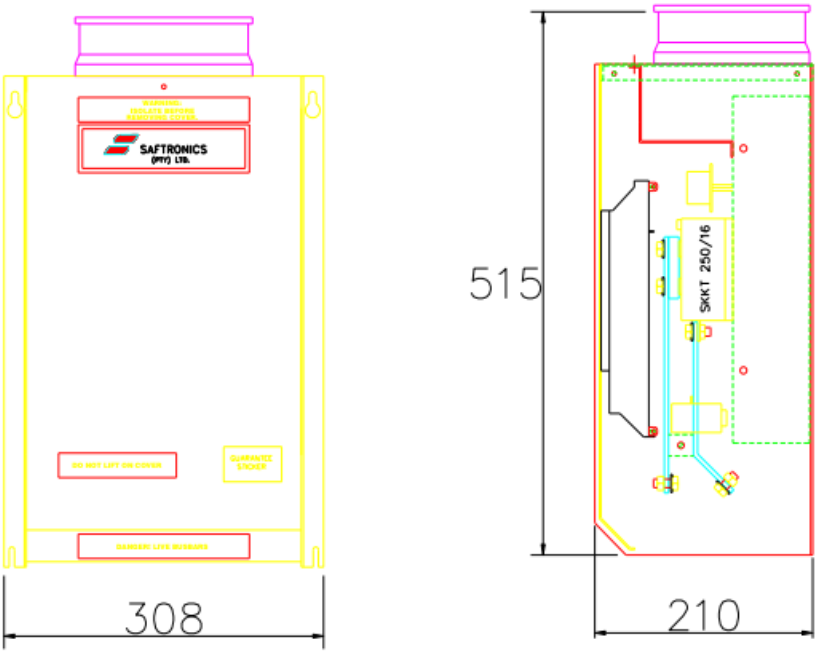
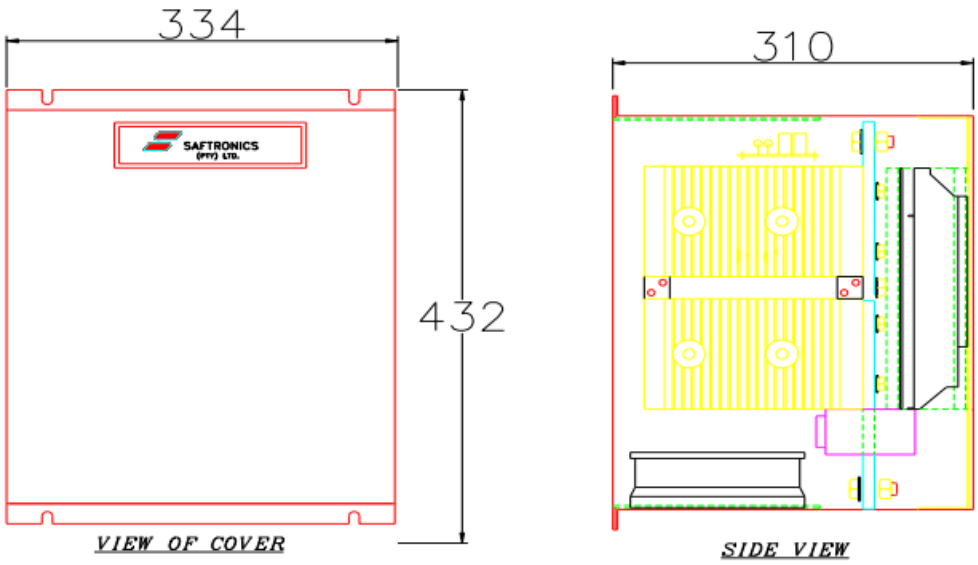


FIG 2.1 – SH4 SERIES – SIZE B OVERALL DIMENSIONS FIG



2.2 – SH4 SERIES – SIZE C OVERALL DIMENSIONS

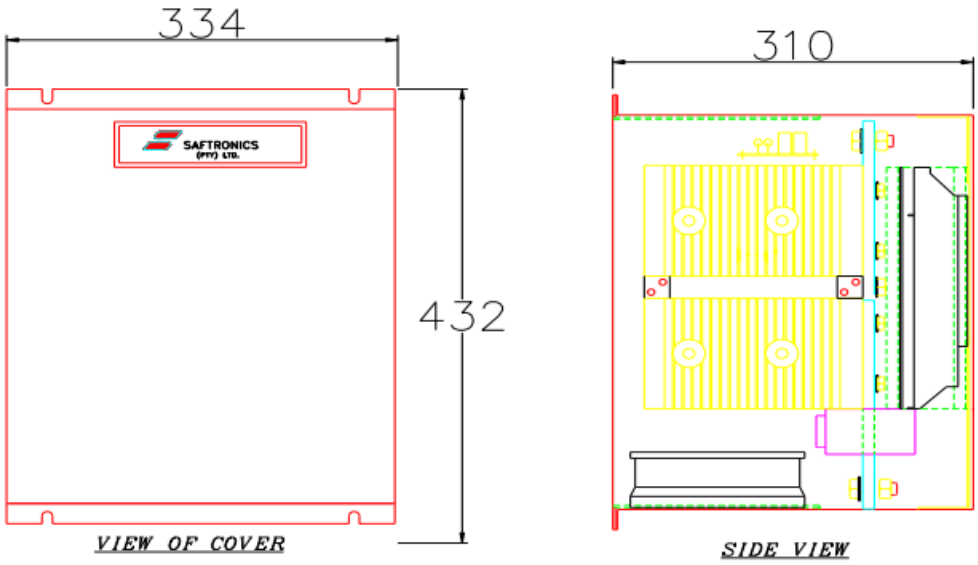


FIG 2.3 – SH4 SERIES – SIZE D OVERALL DIMENSIONS

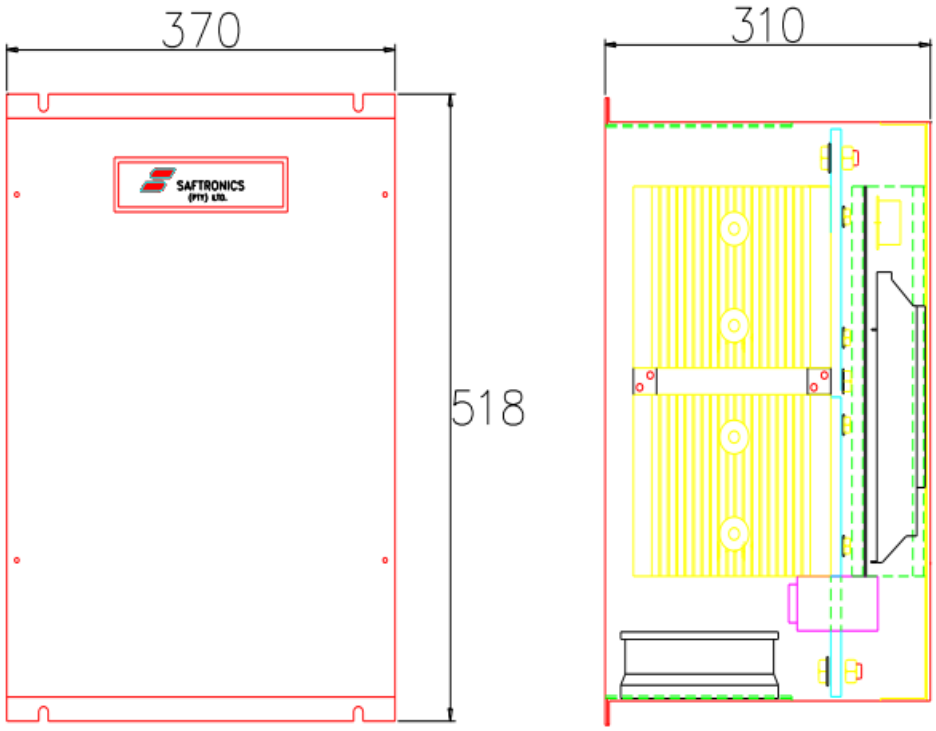


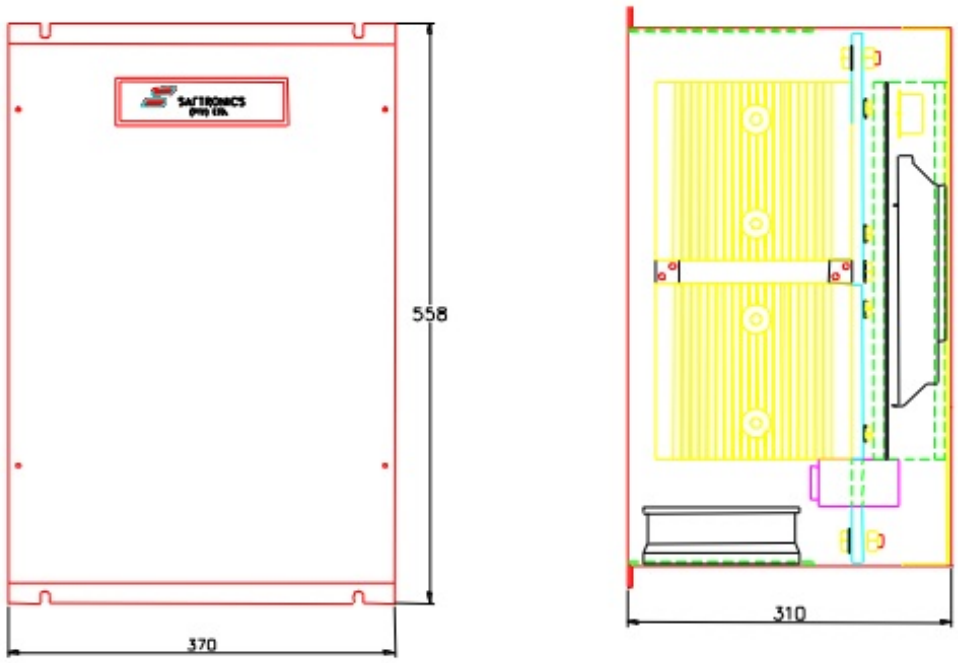
FIG 2.4 – SH4 SERIES – SIZE E OVERALL DIMENSIONS

ACCESS
The SH4 is designed to allow easy access to major components for easy maintenance.

WARNING: The unit contains non-insulated HIGH VOLTAGE points. MAKE SURE that all the power inputs are isolated before trying to access any internal point !!

NOTE: It is NOT recommended that the unit be customer-serviced unless there are skilled and well-trained personnel who can do the job.

ACCESSIBILITY – SIZE B, C, D, and E. Remove the SH4 Control Card by unscrewing the 4 screws (1) as indicated in Fig. 2.5.



COOLING
NOTE: All SH4 specifications are subject to proper cooling! The following cooling requirements MUST be met to ensure proper operation and high reliability.

POSITION
All SH4 drives are to be mounted vertically. Any other rotation will impede the cooling of the drive.

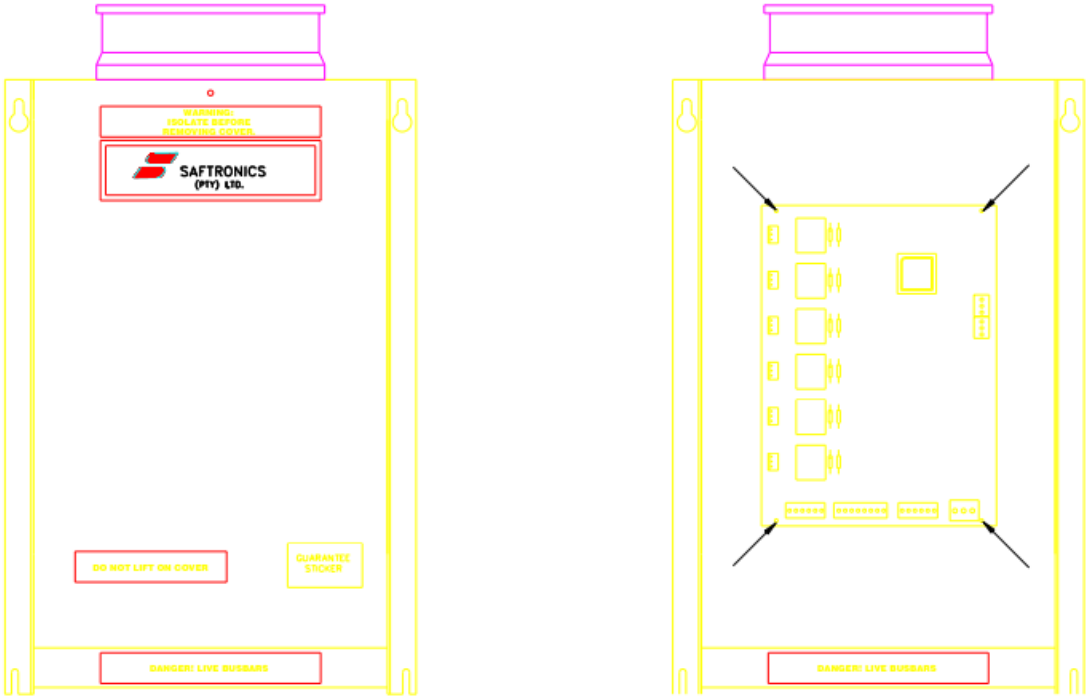
FREE AIR
The SH4 heater controller must be provided with a free air supply, i.e.

- a) Mount the unit in a ventilated space of at least ten cubic meters! If this space is unavailable see Sect. 2.3.3 (mounting in an enclosure).
- b) 100mm of uninterrupted air above and below the drive must be left to ensure adequate cooling.

CONNECTIONS

Figures 3.1 to 3.4 show the physical positions of the control and power connections for the SH4 range of soft starters.

FIG 3.1 – SIZE B CONNECTION LAYOUT



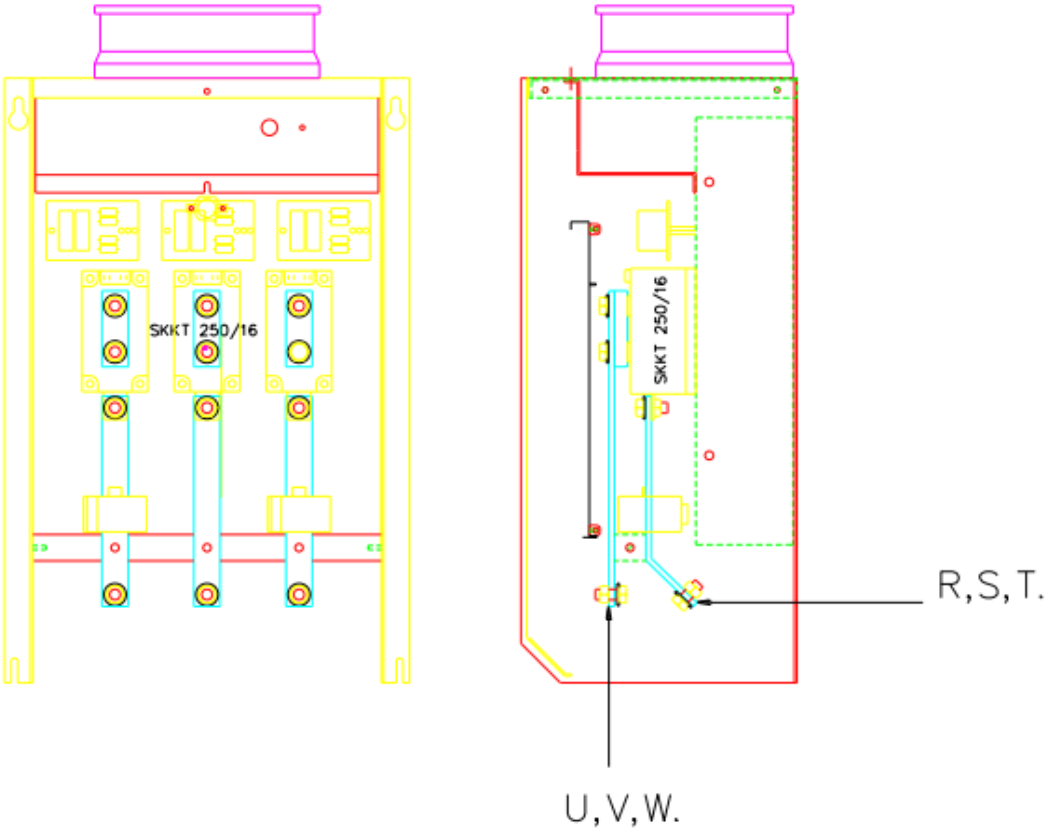


FIG 3.2 – SIZE C CONNECTION LAY

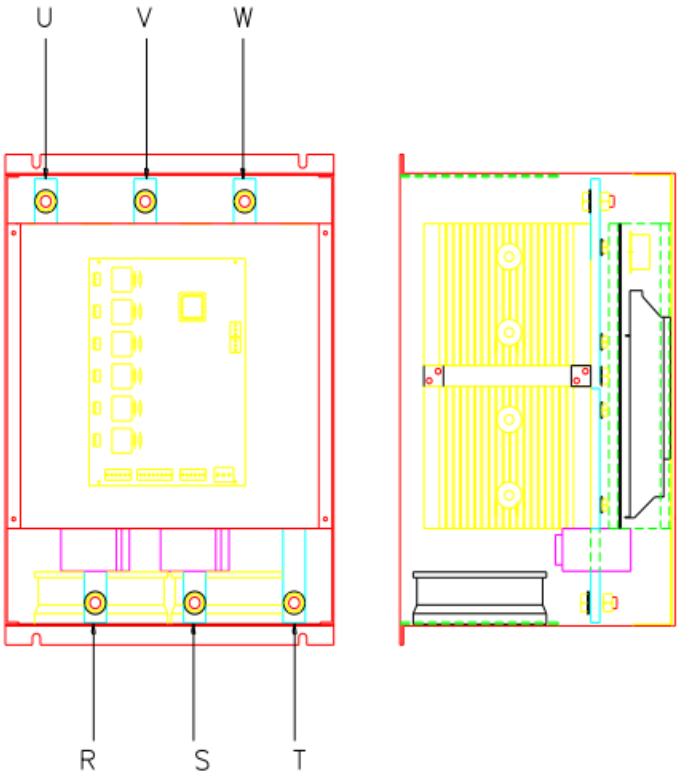


FIG 3.3 – SIZE D CONNECTION LAYOUT

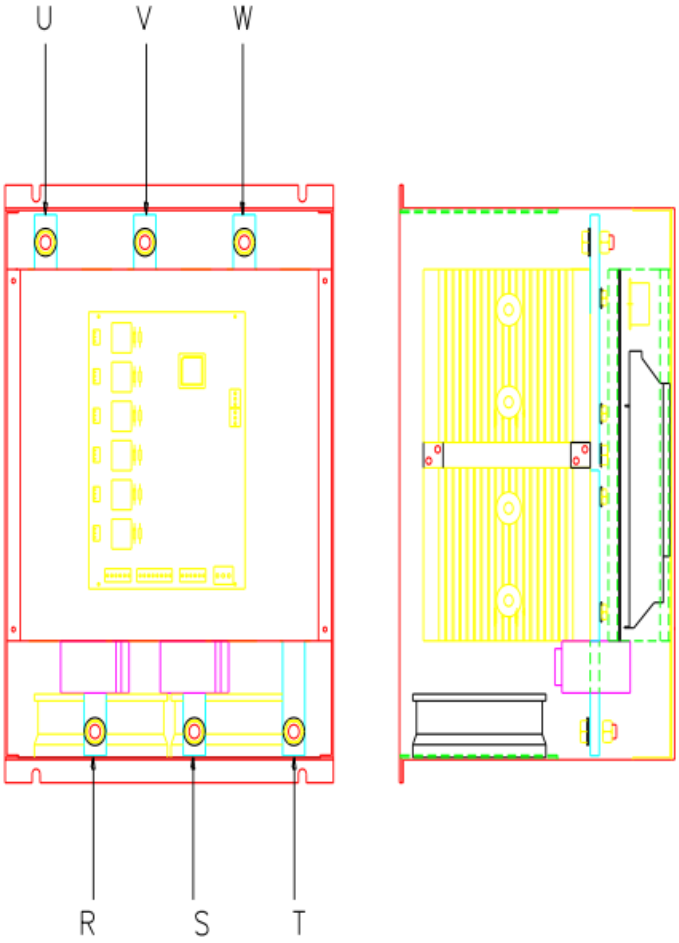
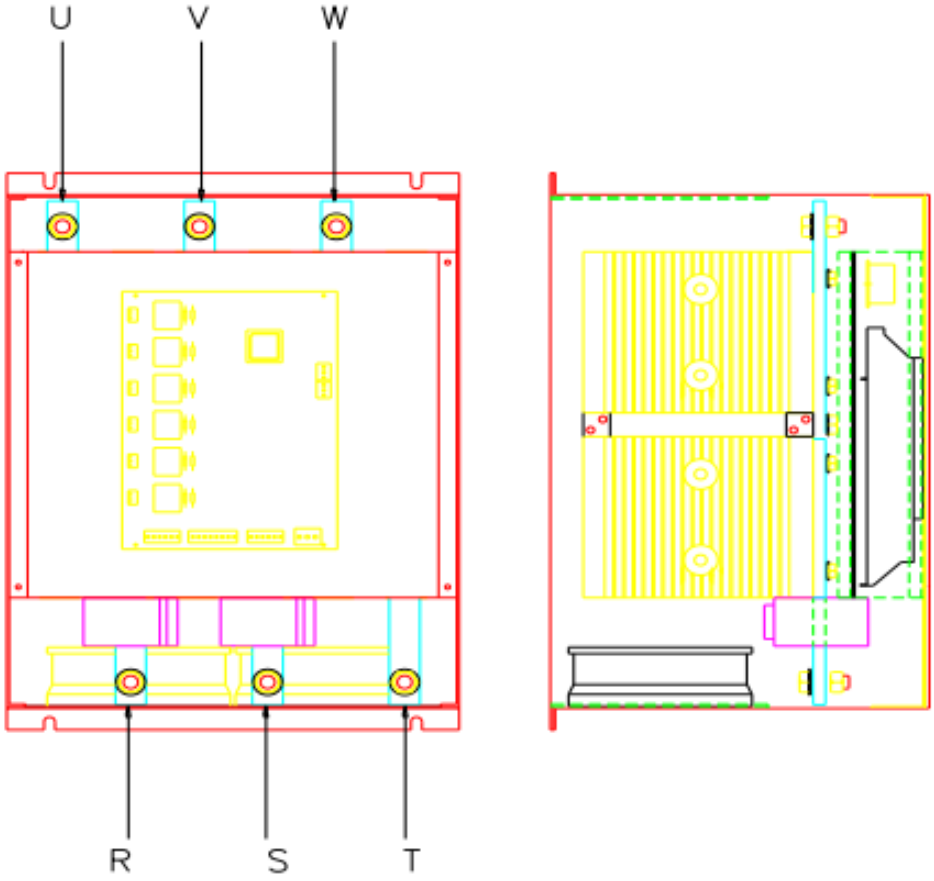


FIG 3.4 – SIZE E CONNECTION LAYOUT



SH4 CONTROL TERMINALS

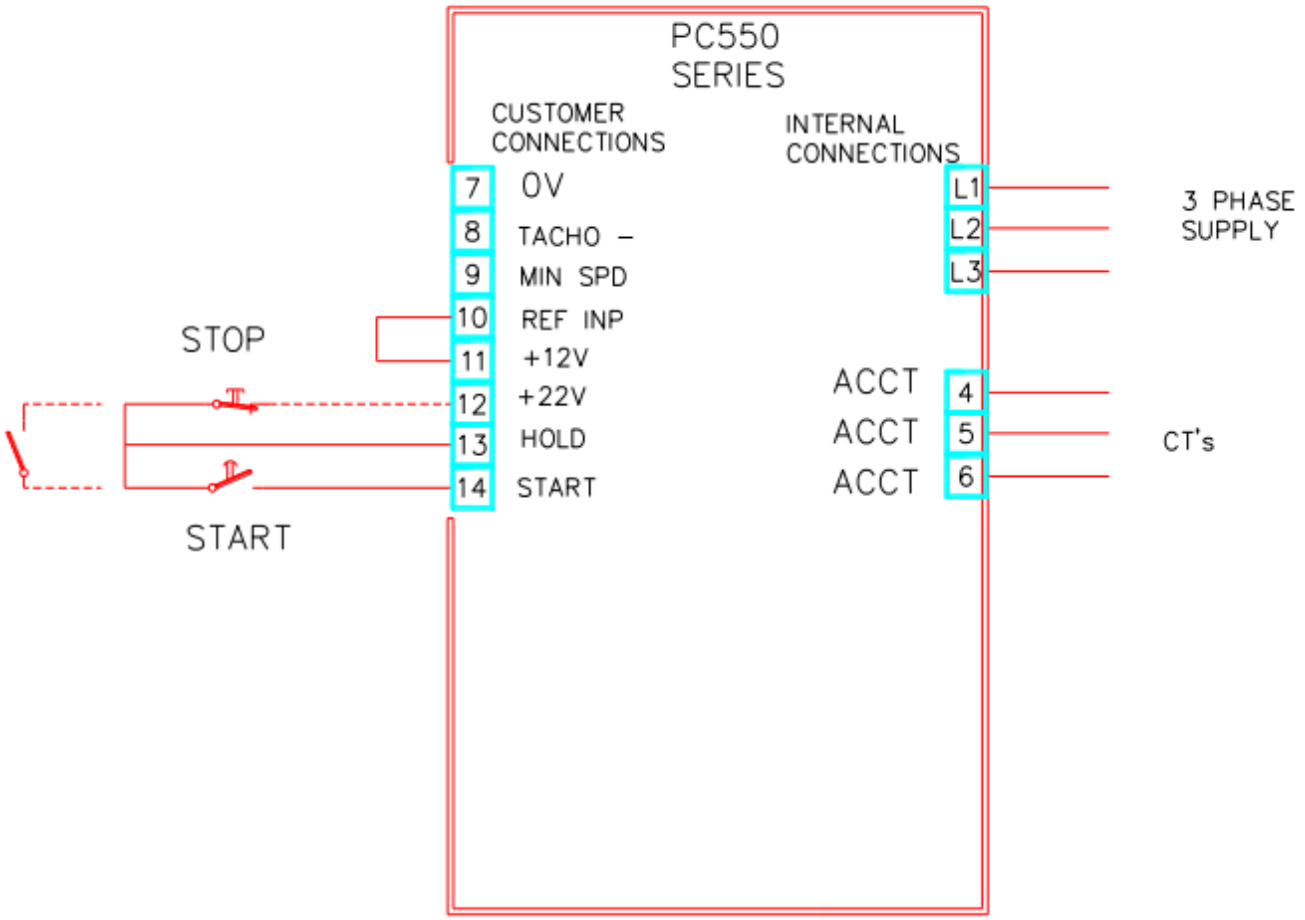


FIG 3.5 – SH4 CONTROL TERMINALS

- L1, L2, L3 The 3-phase supply to the SH4 control card.
- Care must be taken since the rotation order of the phases is critical. (Internal connection).
- REF INP The input reference from either a local potentiometer or remote 0-10VDC, 4-20 mA signal.
- STOP/START Stop/Start pushbuttons are connected to these inputs. A PLC start input is also shown. All interlocks i.e. overtemp etc should be wired in the series with the stop Circuit.

The following table summarises the fused value.

TYPE	FUSE RATING
SH4-100	**125 AMP, 660V**
SH4-200	**250 AMP, 660V**
SH4-300	**315 AMP, 660V**
SH4-400	**400 AMP, 660V**
SH4-600	**630 AMP, 660V**
SH4-800	**800 AMP, 660V**

TABLE 3.1 – AC FUSE RATINGS

POWER CONNECTIONS

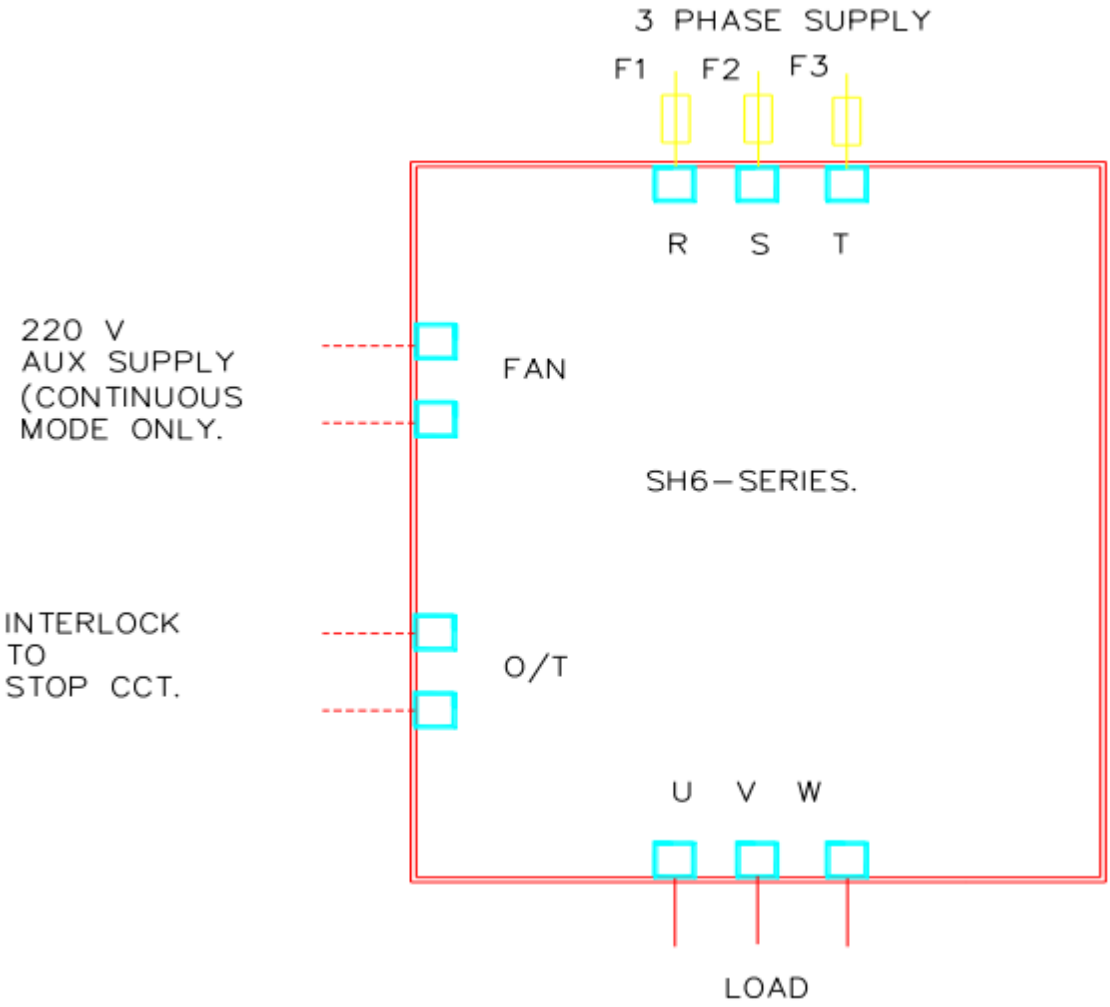


FIG 3.6 – SH4 POWER CONNECTIONS

Figure 3.6 shows a typical power connection diagram. The input terminals R, S, and T are supplied with a 3-phase, fused supply. The load is connected to U, V, and W. The FAN input requires a 220V aux supply to be connected to ensure adequate cooling of the stack. Failure to connect a FAN supply can cause damage to the drive. The O/T output is on an overtemperature interlock, which must be wired in series with the STOP circuit.

START-UP INSTRUCTIONS AND CALIBRATION PROCEDURE

Don't apply power to the system yet!!!

NOTE: Before continuing with this procedure make sure that the connections are by an approved system diagram

SYSTEM SET UP BEFORE OPERATION

SH4-100-X THROUGH SH4-800-X

Check that the switches and potentiometers on the SH4 series control cards are set as given in Table 4.1 for the specific heater controller.

SWITCHES	**POSITION**
	SH4-100 THRU -800
SW1	**ON**
SW2	**OFF**

POTENTIOMETERS	POSITION
	SH4-100 THRU -800
SPD STAB	FULLY CCW
CURR STAB	MID-RANGE
MIN SPD	FULLY CCW
MAX CURR	FULLY CCW
MAX SPD	FULLY CCW
DECEL	FULLY CW
ACCEL	FULLY CW
TORQ	FULLY CCW

TABLE 4.1 – CONFIGURATION SETUP

START-UP PROCEDURE

Before turning on power to the drive confirm that the voltage rating of the drive is the same as that of the 3-phase input supply.

SH4-XX-3 – 380V SUPPLY

SH4-XX-5 – 525V SUPPLY

Check the LK1 on SH4 is set to the correct input voltage. If there are any problems during start-up refer to Section 5 – Trouble Shooting, for assistance

SH4-100-X THROUGH SH4-800-X

This range of heater elements uses the current control method. Two current transformers are used to provide current feedback to the SH4 control card. The burden resistor R63 on the SH4 card is selected so that the current drawn by the load can be limited to a max of 100% of FLC. See Table R63 Current Burdens. (Value 1 must be in parallel with Value 2).

	R63	
	VALUE 1	VALUE 2
SH4-100	100Ω/5W	220Ω/5
SH4-200	39Ω/5W	
SH4-300	47Ω/5W	47Ω/5W
SH4-400	22Ω/5W	
SH4-600	15Ω/5W	
SH4-800	3.3Ω/5W	

TABLE 4.1 – R63 CURRENT BURDEN

The drive will ramp up under current control. The current limit is set to limit the maximum current drawn by the load.

- Check that R63 is installed and is the correct value. Note failure to do this can result in damage to the controller.

- Set REF INP to ZERO
- Apply power to the drive.
- Press the start button.
- Check that the drive can be stopped by pressing the stop button.
- Restart the drive.
- Slowly increase REF INP (Max 10V).
- Adjust ACCEL pot to give desired ramp time.
- Measure the current drawn by the load with a clip-on ammeter.
- Check that the elements are drawing the desired current once acceleration is complete and there is a 10VDC reference.
- The controller is now set for operation.

TROUBLESHOOTING

The Saftronics SH4 range of Heater Controllers is thoroughly checked mechanically and electrically before leaving the factory. Therefore, if the system is correctly connected and the start-up procedures are carefully followed there should be no problems. However, if something goes wrong and the system is not operating as expected consult our Service Technicians or our Application Engineers.

STOCK LIST

The following table is a summary of the power devices, fuses, and transformers used in the SH4 range. It is recommended that these components be held in stock to enable on-site repairs.

SERIAL NO:	DESCRIPTION	QTY	APPLICABLE
	PCB		
1	**SH4 CONTROL CARD**	**1**	**ALL UNITS**
	DEVICES 1600 V		
2		**3**	**SH4-100 TO -300**
3		**3**	**SH4-400 TO -600**
	TRANSFORMERS		
4	**CURRENT TX**	**2**	**SH4-100 UPWARDS**
	CONTROL FUSES		
5	**2 AMP, 660 V**	**10**	**SH4-100 UPWARDS**
	MAIN FUSES		
6	**125 AMP, 660V**	**3**	**SH4-100**
7	**250 AMP, 660V**	**3**	**SH4-200**
8	**315 AMP, 660V**	**3**	**SH4-300**
9	**400 AMP, 660V**	**3**	**SH4-400**
10	**630 AMP, 660V**	**3**	**SH4-600**
11	**800 AMP, 660V**	**3**	**SH4-800**

TABLE 5.1 – RECOMMENDED SPARES

TROUBLESHOOTING TABLE

The following table is a basic troubleshooting table intended to assist in fault finding during installation. It does not pretend to and cannot cover every possibility. This is beyond the scope of this manual. When you go through the troubleshooting table, bear in mind that it is arranged as much as possible in a logical order.

TROUBLESHOOTING

CONDITIONS AND SYMPTOMS	POSSIBLE REASON	PROPOSED CHECKS	PROBLEM ELIMINATION
– POWER ON	THERE IS NO AC POWER ON TERMINALS LINE 1, 2, AND 3	MEASURE INCOMING VOLTAGES	CHECK EXTERNAL WIRING
	BLOWN F1, F2 OR F3 OR BLOWN F4, F5 OR F6	ISOLATE DRIVE, CHECK THE FUSES	REPLACE THE FUSES
	FAULTY SH4 CARD		REPLACE THE CONTROL CARD
– START IS PRESSED PULSE LED NOT LIT	FAULTY PUSHBUTTON	CHECK P/B	REPLACE P/B
	FAULTY SH4	CHECK FOR 24VDC BETWEEN TERMINALS 14 AND 7 ON SH4	REPLACE SH4
		CHECK VALUE OF R63 WITH TABLE 4.1	REPLACE R63 WITH CORRECTLY RATED VALUE
– DRIVE STOPS DURING ACCEL	OVERLOAD RELAY HAS TRIPPED	CHECK SETTING AND RATING OF O/LOAD	RESET O/LOAD OR REPLACE WITH CORRECT RATING.
	MAIN FUSES HAVE TRIPPED	CHECK FUSE RATING AND CONTINUITY	TURN MAX CURR POT CW TO THE DESIRED CURR LIMIT
	EXTERNAL START COMMAND MISSING	CHECK START SIGNAL	RECTIFT START SIGNAL CCT

Documents / Resources

	**SAFTRONICS SH4-70 Heater Controller** [pdf] User Guide SH4-70, SH4-130, SH4-200, SH4-260, SH4-400, SH4-525, SH4-90, SH4-180, SH4-270, SH4-360, SH4-550, SH4-730, SH4-70 Heater Controller, SH4-70, Heater Controller, Controller

References

- **User Manual**