OZtherm™

Digital Power Controller

F-311

SINGLE PHASE S.C.R. CONTROLLER

INSTALLATION AND COMMISSIONING MANUAL

DESIGNED
and
MANUFACTURED
by

Fastron
Electronics

Fastron Electronics
• Power Semiconductors
• Electrical Measurement
• Process Control
Web: www.fastron.com.au
Email: sales@fastron.com.au
Telephone: + 61- 3 - 97635155
Facsimile: + 61- 3 - 97635206
9B Lakewood Blvd
Braeside VIC 3195 Australia

RE: FAN COOLED UNIT

NOTE: **CONNECT NEUTRAL TO TERMINAL PROVIDED (MARK "N") IN ORDER TO OPERATE FAN.**

HOWEVER, IF NEUTRAL TERMINAL IS NOT PROVIDED, THEN NEUTRAL CONNECTION IS UNNECESSARY.

OZtherm™

F311 INSTALLATION AND COMMISSIONING MANUAL
REVISION 1.1 JUNE 1994

OZtherm™

1.0 OZTHERM POWER PRODUCTS

Thyristor based power controllers offer numerous benefits.
They are a reliable replacement for electromechanical contactors , being virtually maintenance free.
Thyristor based power controllers are ideal for controlling complex loads , such as heating elements that change resistance over time or temperature , transformer coupled loads , plating rectifiers and fast systems.

1.1 PRINCIPAL OF OPERATION

Oztherm power controllers consist of two main parts , the control electronics and the power switching electronics.
Thyristors , also known as SCRs , are used as the power switching devices.
A thyristor functions like a diode that can be "turned on" by a momentary pulse to its gate.When a thyristor has been turned on via its gate and its anode is positive relative to its cathode it will conduct.
The thyristor turns itself off when there is near zero current through it.
To control full wave AC over the positive and negative half cycle two thyristors arranged in inverse parallel are required.
The control electronics provide the firing impulses for the thyristor gates.The control input signal is measured and the timing of the gate firing impulses are varied in response to it.

Two types of firing mode are available on Oztherm power controllers.
Phase angle control works by varying the conduction angle of the AC sine wave.
Burst control modulates power by turning the thyristors on and off for whole AC cycles.The control electronics turn the thyristors on at zero voltage and off at zero current. The output is the ratio of OFF time to ON time.
F300 series power controllers use the phase angle firing mode.
F400 series controllers use the burst firing mode.

1.2 SELECTING A POWER CONTROLLER

The following points are important in specifying a power controller for an application.

SELECTING THE CORRECT CONTROLLER FOR HEATING ELEMENT TYPES

Heating elements can be broadly divided into three categories:-

CLASS A
These elements have negligible resistance variation with either temperature or time. Examples include: Nickel/Chromium or similar alloys.

CLASS B

These elements have a low cold temperature resistance that increases greatly at operating temperature. Examples include:
Molybdenum Disilicide
Platinum
Molybdenum Tungsten

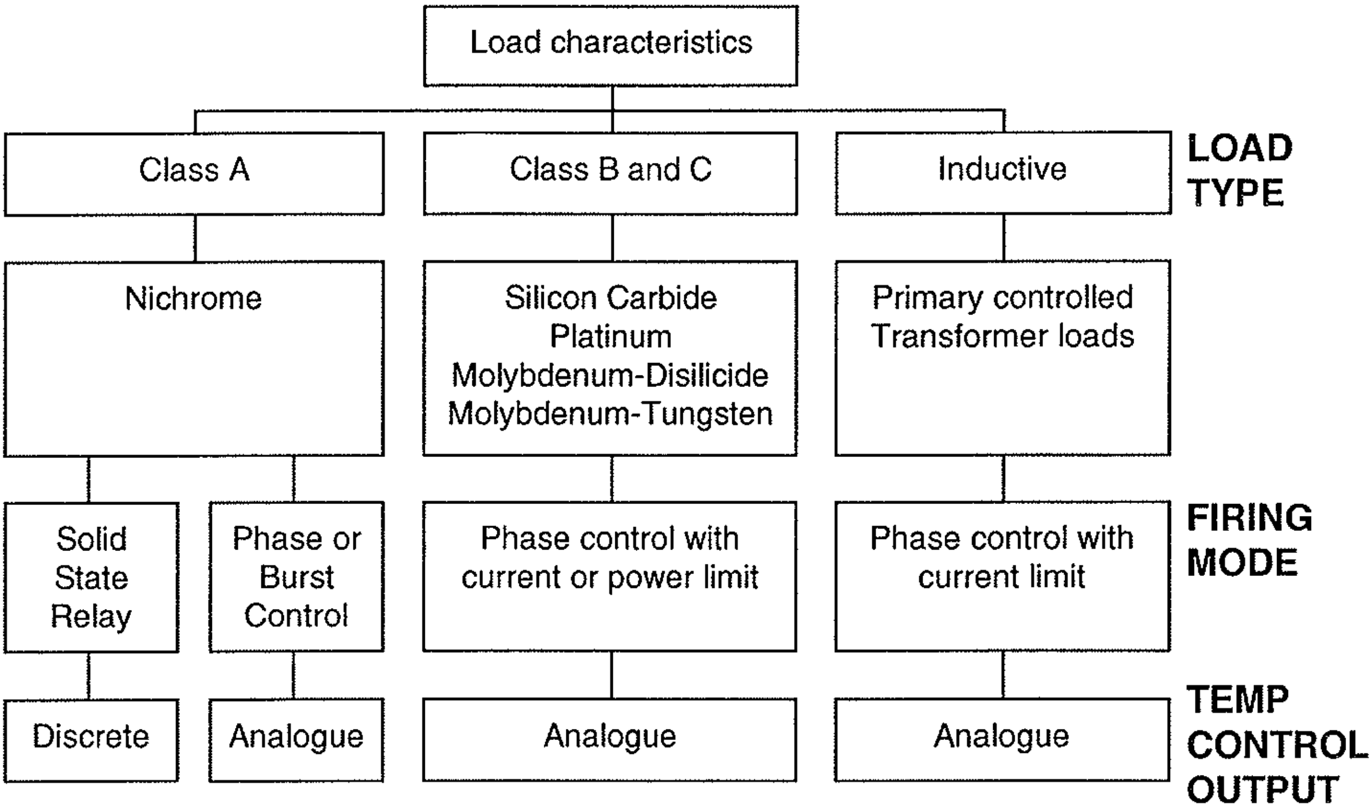
Class B elements usually require current limit on start up, as their low cold resistance results in high currents at the operating supply voltage.These elements may also require a stepdown transformer to match the supply voltage to the rated element voltage.
Because current limit is required,and the element voltage ratings are less than line voltage,phase angle control is the recommended firing mode.

CLASS C

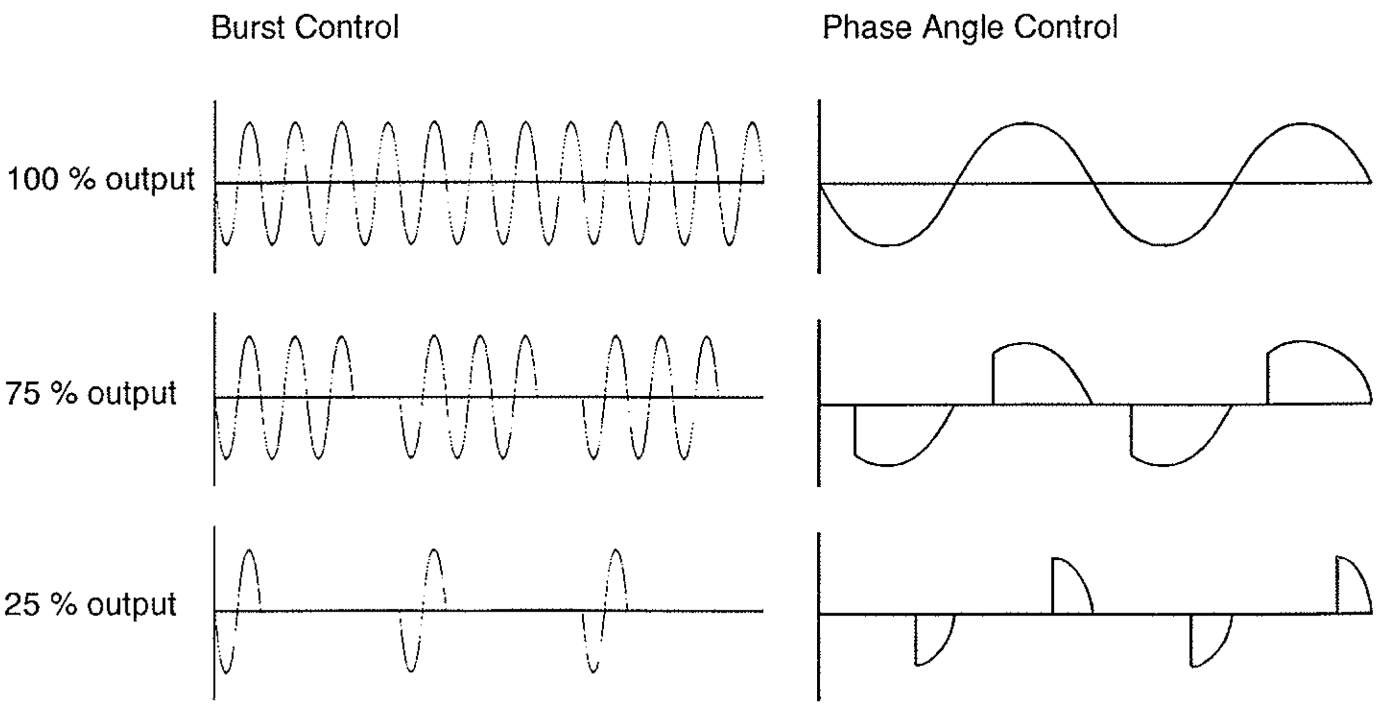
The resistance of these elements increases greatly with time in use (typically 2 to 4 times) and with temperature.Silicon carbide is a common example .The power controller must be sized so that it can deliver the higher currents required to maintain the desired power when the elements are new.
The power limit (PW) option is recommended for this class of element as it compensates for element ageing and limits the maximum load power (see appendix 3).

OZtherm™

CONTROLLER SELECTION AND ELEMENT TYPE



VOLTAGE WAVEFORMS FOR BURST AND PHASE ANGLE CONTROL



2.0 DESCRIPTION OF OPTIONAL FUNCTIONS

2.1 CURRENT LIMIT (C)

Current limit is often used with class B heating elements.On cold start up , low element resistance causes excessive current.The current limit option restricts maximum current until the elements reach operating temperature.
F311 and F330 controllers also have a current trip function which disables the controller if the trip current is exceeded.
Current transformers are supplied loose with this option.

2.2 CONSTANT CURRENT (CC)

This option gives a constant current output proportional to the control input signal.It is primarily used in plating rectifier applications.
Current is measured via current transformers on the AC side.Current transformers are supplied loose.
A current trip function is also supplied.

2.3 SEMICONDUCTOR PROTECTION FUSING (F)

Semiconductor protection fuses are required for thyristor protection.These fuses are for thyristor protection only and do not protect associated wiring except in the case of a short circuit.Wiring protection should also be installed in accordance with local regulations.
Fuses are supplied loose with mounting hardware.

2.4 POWER LIMIT (PW)

Fluctuations in supply voltage or load impedance will result in variations in the power developed through the heating elements.
This option measures load voltage and current and limits output power .
When used with class C elements power limit increases the output voltage to compensate for element ageing , eliminating the need for transformer tap changes or other manual adjustments.
The power feedback option must be used in combination with options C and A.

2.5 AVERAGE CURRENT METER OUTPUT (MI) *

Provides a non isolated 0-1 mA meter output corresponding to the average of RMS output currents in the three phases.
Option C or CC required.

2.6 AVERAGE VOLTAGE METER OUTPUT (MV) *

Provides a non isolated 0-1 mA meter output corresponding to average of output voltages in the three phases.
Option A required.

2.7 AVERAGE POWER METER OUTPUT (MP) *

Provides a non isolated 0-1 mA meter output corresponding to average of output power in the three phases.
Option PW required.

2.8 CONTROL SIGNAL METER OUTPUT (MD) *

Provides a non isolated 0-1 mA meter output corresponding to control input signal.
* Options MI , MV , MP and MD are mutually exclusive.Only one of these options may be specified.

2.9 THERMAL CUTOUT (T)

If the safe operating temperature of the controller is exceeded the thermal cutout disables the unit until the temperature drops. Thermal cutout is often used to disable a fan cooled unit if the fan is blocked or stopped for any reason. This cutout will prevent thermal damage to the unit. This option is automatically specified with a fan cooled unit.

2.10 AC VOLTAGE REGULATION (A)

Maintains output voltage constant relative to the control input signal irrespective of supply fluctuation.

3.0 INSTALLATION & WIRING

3.1 LOCATION

Power controller mounting location is important.
The controller must be oriented so that the cooling fins are aligned vertically.On fan cooled models the fans should be blowing upward towards the top of the enclosure.Fan inlets should be free from any obstruction.
The enclosure must be adequately ventilated.Maximum ambient temperature at full rated current for F311 controllers is 50 degrees C unless otherwise specified.Some enclosures may require fan forced cooling.
As a rule of thumb about 1 watt of heat is dissipated per amp conducted through the controller.
The controller must not be installed in excessively humid or corrosive atmospheres.
Where excessive vibration is present the controller should be mounted using shock isolation techniques.

3.2 WIRING

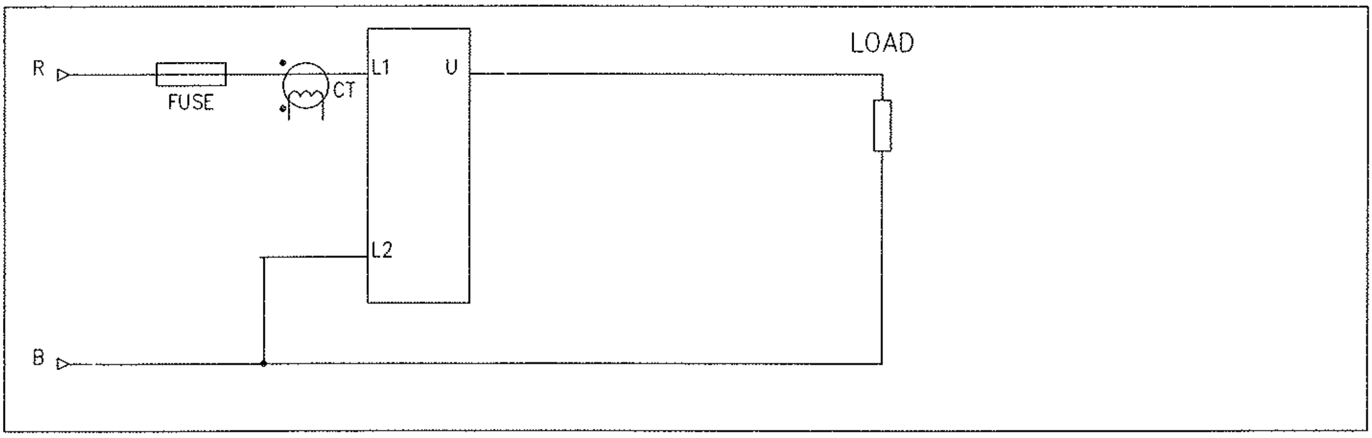
All wiring to the controller should comply with AS3000 (or the relevant national standard). Power cable connections must be tight to minimise heating , electrical compound should be used to improve thermal and electrical conductivity. Refer to diagram for correct power wiring.
Control input signal wiring must be run separately from power wiring.Screened cable is recommended for this purpose. If screened cable is not available then a twisted pair should be used.

3.3 TRANSFORMER COUPLED LOADS

The F311 power controller can be safely used with primary control of transformer coupled loads.

The F311 controller can be run on the secondary of any transformer as long as the voltage on the F311 power controller is the same as the secondary voltage of the transformer.

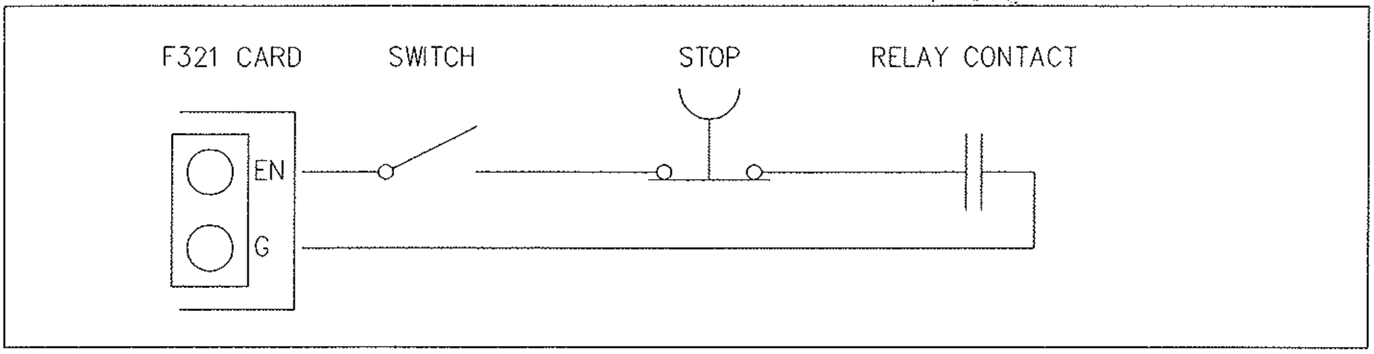
Current or power limit options should always be specified due to the high potential fault currents that are possible with primary control of transformer coupled loads as a safety measure.



OZtherm™

3.4 ENABLE LINK

The ENABLE link must be closed for the controller to operate. The ENABLE link can be conveniently used as an interlock by wiring limit switches , push buttons etc. in series with it.
Note: any interlocks wired to the ENABLE link must be volt free.



3.5 CURRENT TRIP OUTPUT

A volt free normally open contact is provided for current trip output.Current rating is 1A @ 240 VAC

3.6 CURRENT TRANSFORMERS

(Applicable to options C and PW only)

CTs must be installed as shown in the diagram.

3.7 METER OUTPUT

(Applicable to options MI , MV , MP & MD only)

Note that these outputs are not isolated and must not be commoned up with the control input or any other signals.

3.8 FUSES

(Applicable to F option only)

Fuses must be installed exactly as shown in diagram.
Fuse ratings are calculated for free air and must be installed on the standoffs provided.Do not use fuse holders.
Semiconductor protection fuses are designed to protect the SCRs in the power controller from surge or ambient currents.They are underrated to prevent nuisance fuse blowing and therefore cannot be relied on for steady state overload protection. Separate fusing or circuit breakers must be installed to protect wiring.

4.0 ADJUSTMENTS AND CALIBRATION

WARNING-Controller adjustment requires access to control cards with lethal AC voltages present.High voltage sections of the control card are marked. Adjustments must only be made by qualified persons taking the appropriate precautions.

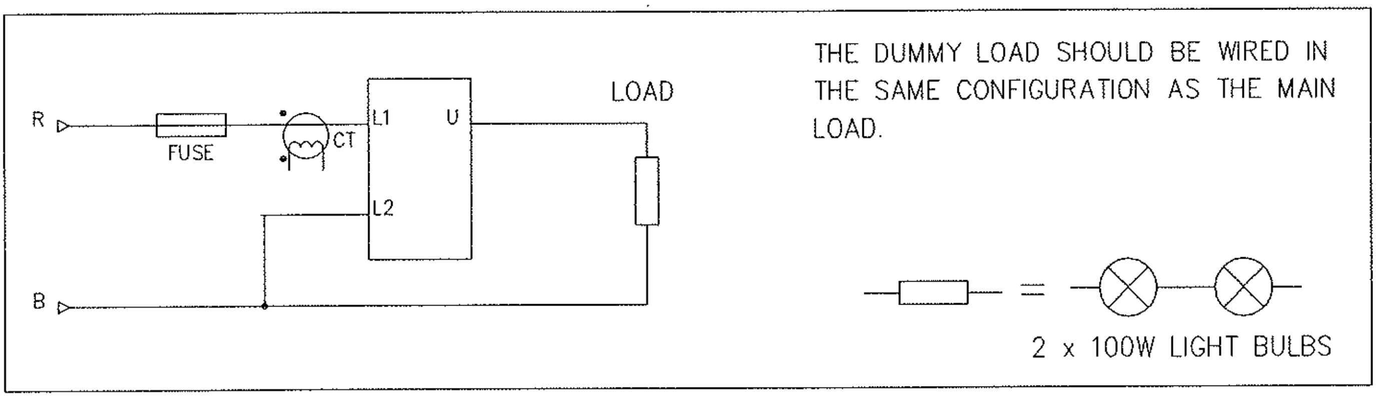
4.1 BEFORE STARTING

With the power off loosen the four half turn captive screws on the controller cover and remove it. The adjustment potentiometers will be found on the circuit card marked F321 .

4.2 DUMMY LOAD

To function correctly the controller must be connected to a load. Many heating elements can be damaged by excessive power, voltage or current.
To avoid damage to heating elements it is recommended that for initial adjustment of BIAS , GAIN and RAMP a "dummy" load be connected.
A suitable "dummy" load is two 240V light bulbs wired in series as per diagram.
After initial adjustment the dummy load can be removed and the working load can be reconnected.
The dummy load cannot be used to adjust current limit/trip due to the small current it draws.

Dummy load wiring:



4.3 ADJUSTMENTS TO VOLTAGE OUTPUT MODELS

(Applies to all controllers except those specified with option CC)
Note: ZERO, SPAN, and RAMP adjustments must always be done before current or power limit is adjusted.

4.3.1 BIAS ADJUSTMENT (ZERO)

Set the GAIN potentiometer fully anticlockwise.
Using a portable calibrator or similar , input the minimum control input signal.Adjust the BIAS potentiometer for zero voltage across the controller output terminals.

4.3.2 GAIN ADJUSTMENT (SPAN)

Wind the GAIN potentiometer fully anticlockwise and apply the maximum control input signal. Adjust the GAIN potentiometer until the maximum desired voltage is measured across the controller output terminals.
Check output voltage at minimum and maximum control input and readjust BIAS and GAIN if necessary.

4.3.3 RAMP ADJUSTMENT

The RAMP potentiometer sets the response of the controller output to the control input signal. Adjust the RAMP potentiometer until the desired level of response has been reached. Response time can be checked by introducing a step control input signal change to the controller and measuring the output response time.

4.3.4 CURRENT LIMIT

(Applies only to options C only)

Set the LIM potentiometer fully anticlockwise and the FBG (feed back gain) and TRIP potentiometers fully clockwise. With the control input signal set to maximum gradually turn the LIM potentiometer clockwise until the required current limit level , measured through the load , has been reached. When the controller is limiting the current the LIM led will light.

NOTE:The current wave form through the power controller will not , in general , be sinusoidal.Current measurement using conventional ammeters can be grossly inaccurate. For accurate current measurement a true RMS meter such as the HEME Analyst 2000P should be used.

If the output oscillates under current limit turn the FBG potentiometer anticlockwise until the current output is stable.

4.3.5 POWER LIMIT

(Applies to option PW only)

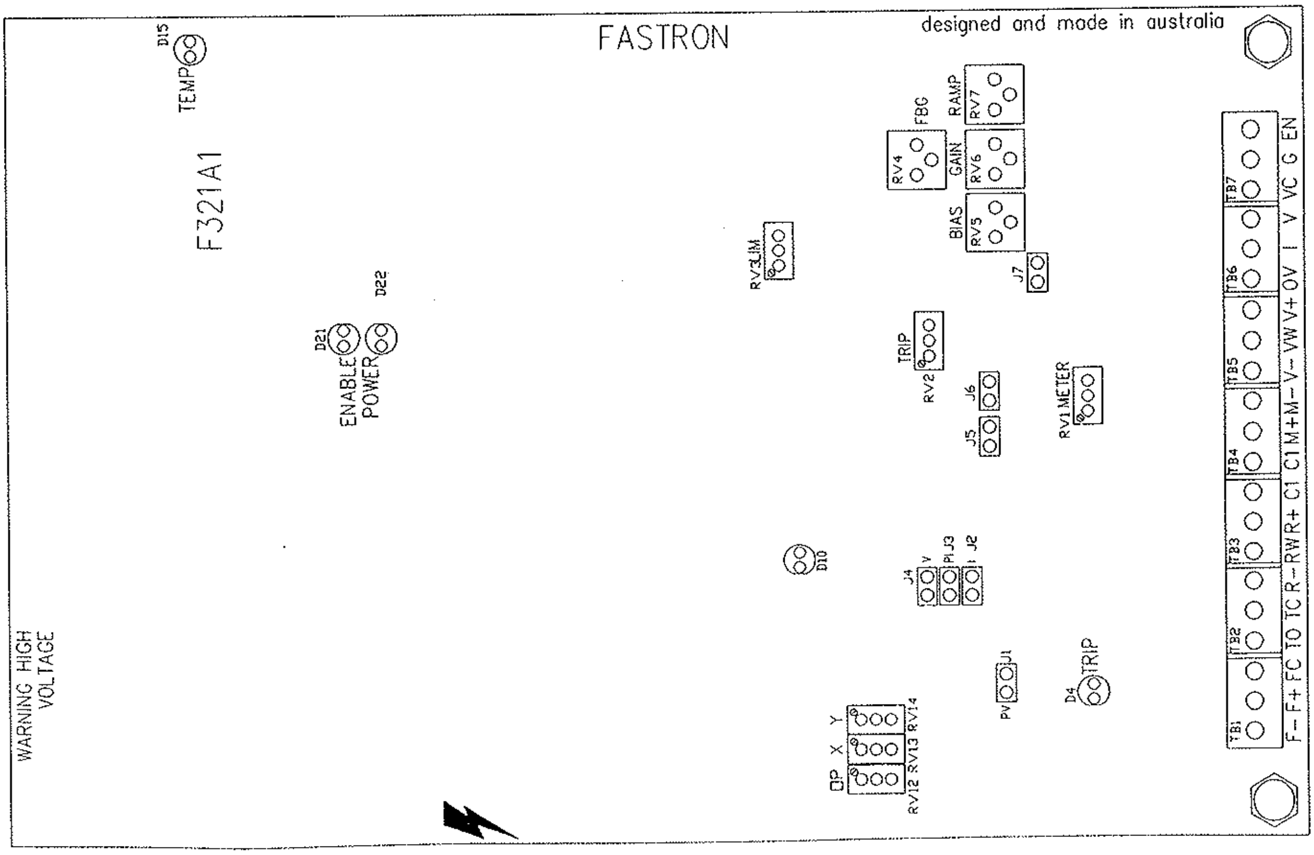
Set the LIM potentiometer fully anticlockwise and the FBG (feed back gain) and TRIP potentiometers fully clockwise. With the control input signal set to maximum gradually turn the LIM potentiometer clockwise until the required power limit level , measured through the load , has been reached.

If the output oscillates under current limit turn the FBG potentiometer anticlockwise until the power output is stable.

4.3.6 CURRENT TRIP

With the control input signal set to maximum and the controller outputting full current to the load gradually turn the TRIP potentiometer anticlockwise until the TRIP is activated (indicated by TRIP led).TRIP is now set at maximum current.Turn trip potentiometer another one to two turns clockwise.If the odd nuisance trip still occurs turn the TRIP potentiometer a further half to one turn clockwise. On current trip the trip relay energises and the controller is disabled.Both are latched. Current trip may be reset by opening the ENABLE link or by turning off the mains supply.

F321 Board potentiometer layout



4.4 ADJUSTMENTS TO CONTROLLERS USED IN CONSTANT CURRENT MODE

(Applies to options CC only)

The following adjustments should be carried out with the load connected. An external 10 K ohm potentiometer will be required (AUX-V).
Current should be measured with either a true RMS ammeter on the incoming AC side or a hall effect type ammeter on the DC output if DC is the final controller output, eg: the F311 controls the primary of a transformer with a diode bridge and DC output.

4.4.1 BIAS ADJUSTMENT (ZERO)

Set the GAIN & AUX-V potentiometers fully anticlockwise , and the BIAS potentiometer in the centre position .
Using a portable calibrator or similar , input the minimum control input signal.Gradually turn the AUX-V potentiometer clockwise until the output current is about 5 amps then adjust the BIAS potentiometer for zero current through the load.

4.4.2 GAIN ADJUSTMENT (SPAN)

Apply the maximum control input signal and turn the GAIN potentiometer fully clockwise . Gradually turn the AUX-V potentiometer clockwise until about 5 amps more than the maximum desired output current is measured , taking care not to exceed the maximum load current .

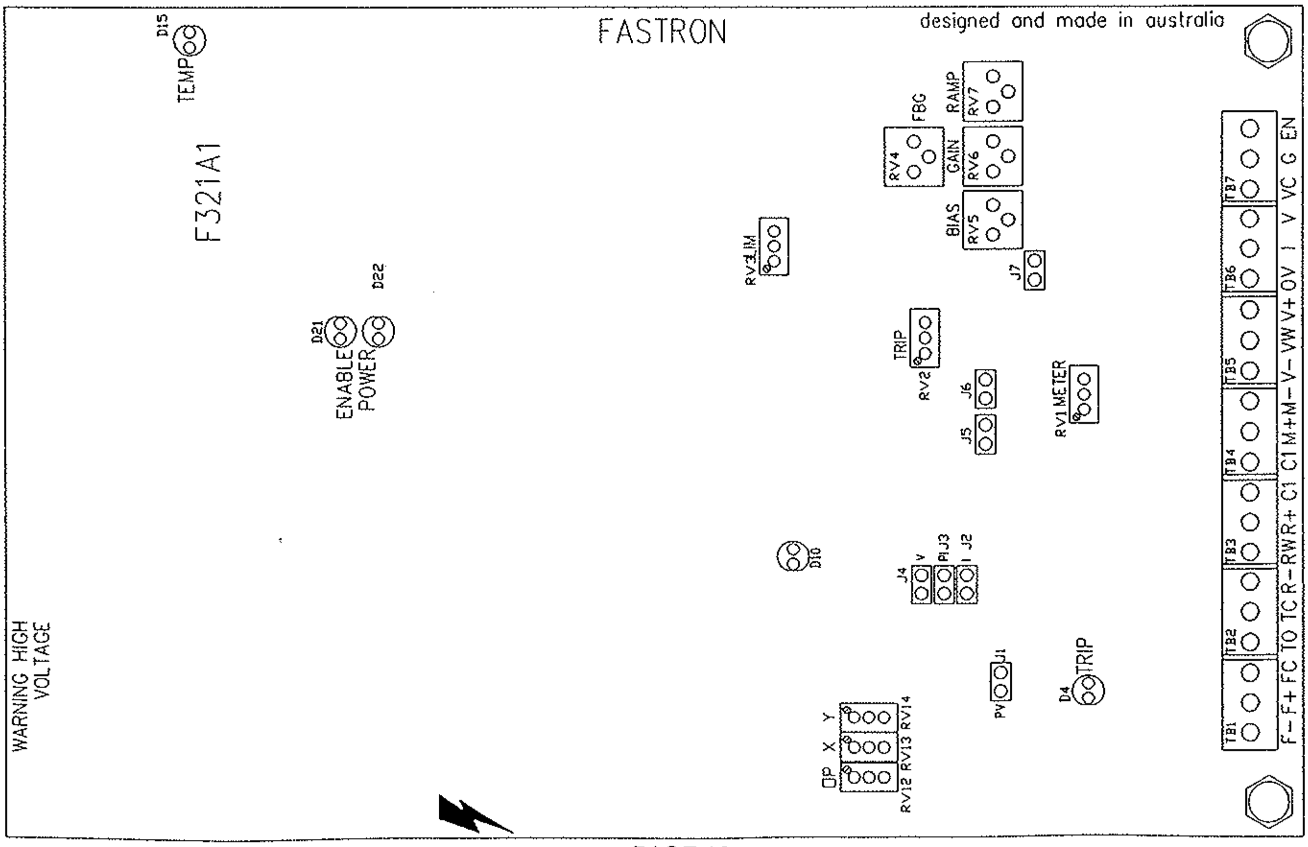
Now adjust the GAIN potentiometer so that the output current is at the maximum desired level.

Finally recheck output current at minimum and maximum control input and readjust BIAS and GAIN as necessary. The AUX-V potentiometer controls the output voltage and can be left as a maximum limit or adjusted as required taking care not to output overvoltage to the load.

4.4.3 RAMP ADJUSTMENT

The RAMP potentiometer sets the response of the controller output to the control input signal. Adjust the RAMP potentiometer until the desired level of response has been reached. Response time can be checked by introducing a step control input signal change to the controller and measuring the output response time.

F321 Board potentiometer layout



OZtherm™

4.5 METER ADJUSTMENTS

(Applies to options MI , MV , MP & MD only)

Full scale output is adjusted by the METER potentiometer . There is no zero bias adjustment.
Output is 1mA full scale.

4.5.1 OPTION MI

Run the controller up to maximum operating current and adjust the METER potentiometer for full scale meter deflection.

4.5.2 OPTION MV

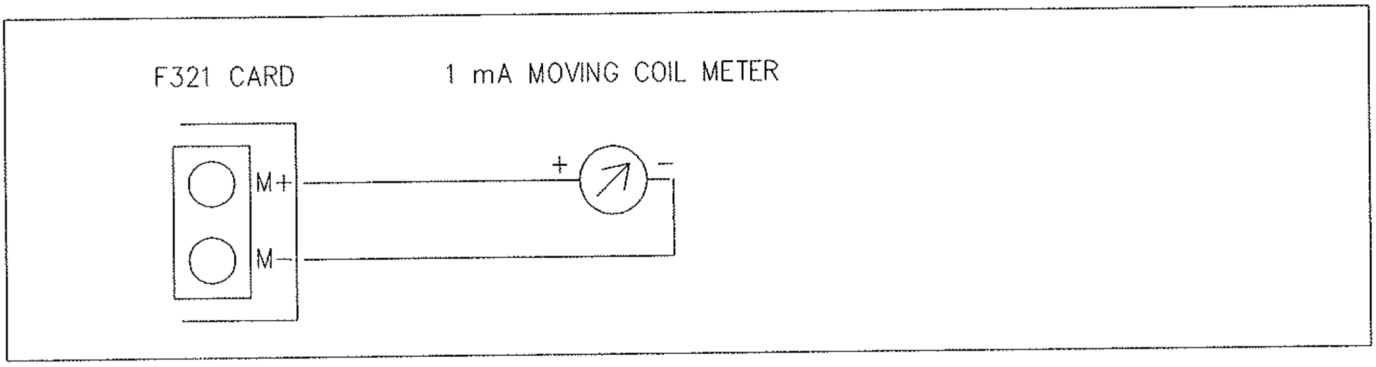
Run the controller up to maximum operating voltage and adjust the METER potentiometer for full scale meter deflection.

4.5.3 OPTION MP

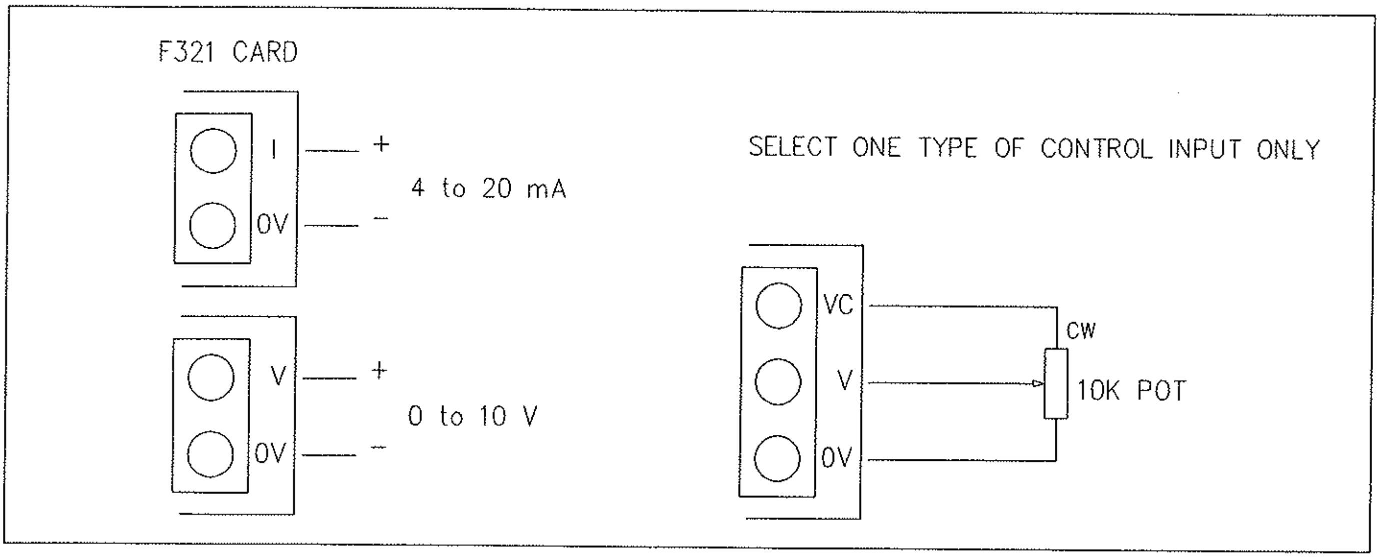
Run the controller up to maximum operating power and adjust the METER potentiometer for full scale meter deflection.

4.5.4 OPTION MD

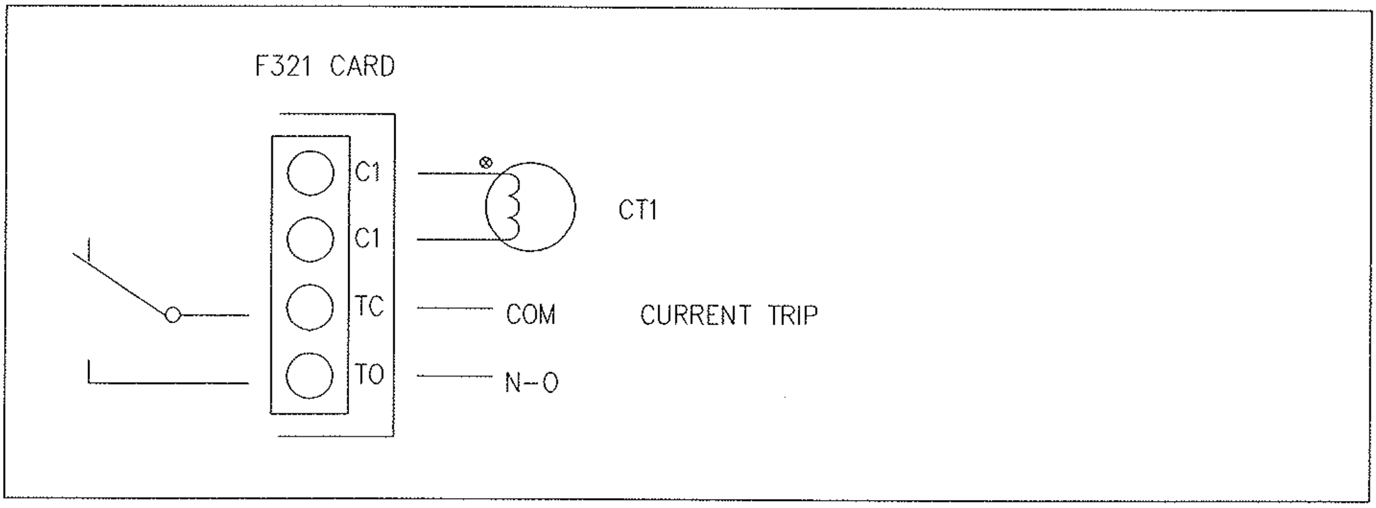
Apply the maximum control input signal and adjust the METER potentiometer for full scale meter deflection.



4.6 CONTROL INPUT WIRING



4.7 RELAY , METER OUTPUT AND CURRENT TRANSFORMER WIRING



OZtherm™

5.0 SPECIFICATIONS

Control Mode	Phase angle. (soft start provided as standard)
Control Range	0 - 100%
Maximum Current	25 - 1100 amperes (higher currents available on request)
Power Supply	110 / 240 / 415 volts A.C . 50 HZ. +/- 10% (60Hz and other voltages on request)
Transient Protection	Internal R.C snubber
Control Input	4 - 20 milliamps (receiving impedance 100 ohms) 0 - 10 volts (receiving impedance 10K ohms) 10K ohms potentiometer
Adjustments	Ramp (soft start time) 1-20 seconds Zero (- 20% to +20%) ; span (0 - full scale)
Ambient Temperture	0 - 50 degrees Celsius (Maximum temperture of cooling air)
Ambient Humidity	0 - 85% relative humidity
Power Factor	Unity

6.0 DIMENSIONS AND MOUNTING DETAILS

Shown mounted vertically in cabinet

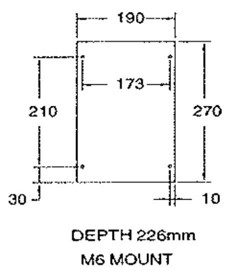


Fig.4

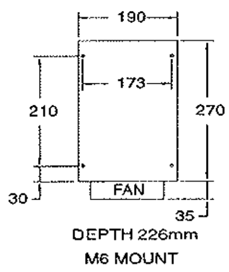


Fig.5

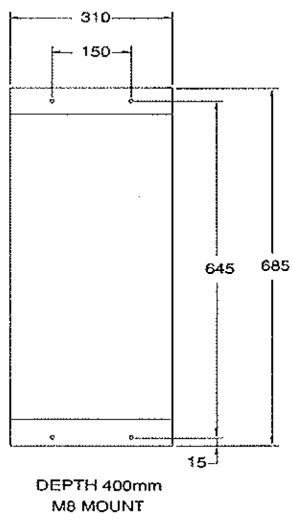


Fig.6

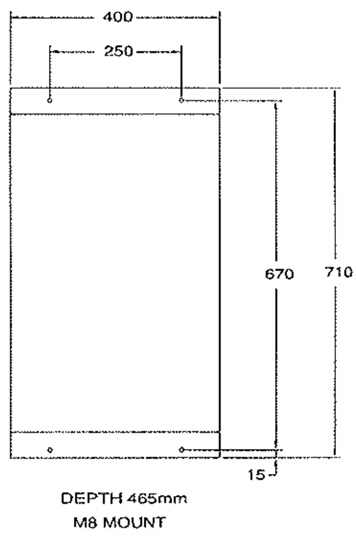


Fig.7

7.0 TROUBLE SHOOTING GUIDE

FAULT	POSSIBLE CAUSE	REMEDY
No output from controller	ENABLE link open	Close link and check any interlocks wired in series with the ENABLE link
	Over temperature cutout TEMP activated	Turn off power and allow unit to cool down
	No control input signal	Ensure input signal is present and polarity is correct
	Current trip is activated	Check TRIP led. If lit find and correct source of trip. Break and make ENABLE link or turn off power to reset
	Input phase lost or missing	Check POWER led. If unlit, check fuse with power off. Determine cause of blown fuse and replace if necessary
	Load circuit open	Check load circuit continuity and repair if necessary
Controller not modulating with respect to control input signal	No control input signal	Ensure input signal is present and polarity is correct
	Current limit set too low	Check current limit LIMIT led and readjust current limit if necessary
	Power limit set too low	Check power limit LIMIT led and readjust power limit if necessary
	Current transformer disconnected or damaged or incorrectly installed	Inspect current transformer and wiring and correct if necessary
	Load circuit open	Check load circuit continuity and repair if necessary
	Current trip is activated	Check TRIP led. If lit find and correct source of trip. Break and make ENABLE link or turn off power to reset
Load current non zero for minimum control signal	BIAS and GAIN not set correctly	Readjust BIAS and GAIN if necessary
	Current transformer disconnected or damaged or incorrectly installed	Inspect current transformer and wiring and correct if necessary

OZtherm™

APPENDIX 1

USEFUL FORMULAS

Peak voltage Vpeak = 1.414 x Rms voltage Vrms
Total power delivered to the load Ptot = VL x IL
= VL x IL x cos(a)

Ohms law : V = I x R
P = V x I = I x I x R = V x V / R
Resistors in series: Total resistance Rtot = resistance one R1 + resistance two R2 + ...
Resistors in parallel: Total resistance Rtot = 1 / (1 / R1 + 1 / R2 + ...)
V rms = 1.1 x V average for a pure sine wave
I rms = 1.1 x I average for a pure sine wave
pi = 3.1416

APPENDIX 2

CONVERSION FORMULAS FOR FAN FLOW RATES

FROM	TO	MULTIPLY BY
Cubic m / min	CFM (cubic feet / minute)	35.3
	L / sec (litres per second)	16.67
	m / sec (metres per second) 120 mm fan	1.577
	m / sec (metres per second) 92 mm fan	2.679
	m / sec (metres per second) 80 mm fan	3.579

APPENDIX 3

CONTROLLER SIZING FOR SILICON CARBIDE LOADS

The elements should be sized so that the starting voltage is in the range of line voltage / 2 to 2.8 approximately to allow for ageing . From the watts per square centimeter rating of the element the starting current can be calculated using ohms law above. The Power Controller should be rated for this current level and option PW (power limit) specified in the part number.

For 415 VAC the starting voltage range is from 150 to 210 VAC approximately. For 240 VAC the starting voltage range is from 86 to 120 VAC approximately. Elements outside this range may need a transformer for voltage matching. Elements of lower voltage may be connected in series as required to meet the requirements of the starting voltage ranges above and remove the need for a transformer.The Silicon Carbide elements are extremely sensitive to an excess of power being applied to them, and they may fracture or break as a consequence. A safety factor of 10 to 25 % of the maximum power rating for the element should be used.

For a Kanthal element (2 W/square cm, 1000 square cm, 186 Volts) :
Maximum power = 2 W/square cm x 1000 square cm = 2000 W
Allow for safety of 80 % the maximum power = 2000 x 0.8 = 1600 W
Current = Power / Voltage = 1600 / 186 = 8.6 Amp per element
The first controller above this current rating should be used ; ie the 20 Amp power controller.
This example assumes the elements are connected for a 415 VAC supply
Please contact the factory if you have any queries regarding element selection or controller selection.

APPENDIX 4

APPROXIMATE THERMAL CALCULATIONS FOR FAN COOLED ENCLOSURES

H = heat loss from power controller (kW)
T1 = inlet air temperature (deg C)
T2 = outlet air temperature (deg C)
V = volumetric flow through enclosure, fan flow required (cubic m / s)
Cp = a constant = 1.01 (kJ / kg x K)
P = density of air = 1.13 at 40 deg C and at sea level (kg / cubic m)

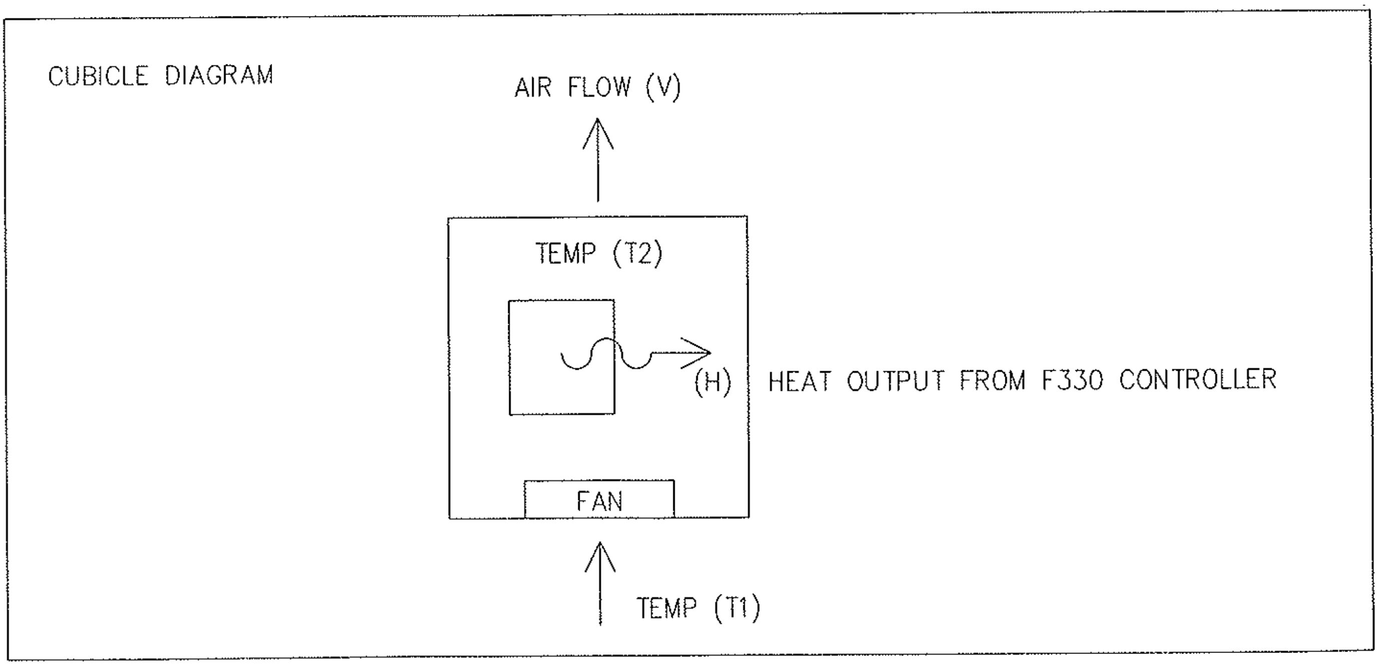
1: Calculate H, heat dissipated by power controller and fuses. As a rule of thumb the controller dissipates 1 Watt of heat per amp. The exact figure at full load can be obtained Appendix 5. Fuse heating should be added, see appendix 6.
For a 100 Amp controller H = 1Watt / amp x 100 Amp / phase = 1 x 100 = 100 Watt + Fuse heating of 1 x 17 Watt per fuse = 117 Watt
from the definitions above, H is in kW so 117 Watt = 0.117 kWatt

2: T1 is the maximum external ambient air temperature. 40 deg C is usually a good conservative number
T2 should be the maximum operating temperature of the F311 power controller. 50 deg C is standard for all OZTHERM power controllers

3: For heat balance:
H = V x P x Cp x (T2 - T1)
or V = H / (P x Cp X (T2 - T1))

for the above example:
P = 1.13
Cp = 1.01
T2 - T1 = 50 - 40 = 10 deg C
H = 0.117 kWatt from step one

so: V= 0.117 / (1.13 x 1.01 x 10) = 0.0103 cubic m/s
multiply by 60 for cubic m / minute = 0.615 cubic m/min



OZtherm™

APPENDIX 5

PART NUMBER BREAKDOWN

F311 - [ ] - [ ] - [ ] - [ ]

Code	DESCRIPTION	Fuse Rating	Case Size	Weight KG	Cable Termination mm^2	Dissipation Watts	I^2t Thyristor Rating
1	110 volt A.C line input						
2	240 volt A.C line input						
4	415 volt A.C line input						
25	25 amperes A.C line current	25	fig.4	5	2.5 - 6.	48	610
40	40 amperes A.C line current	45	fig.4	5	10 - 16.	68	1,060
50	50 amperes A.C line current	55	fig.4	5	10 - 16.	72	2,300
65	65 amperes A.C line current	75	fig.4	5	10 - 25.	88	5,000
75	75 amperes A.C line current	90	fig.4	5	10 - 25.	94	9,100
100	100 amperes A.C line current	125	fig.4	5	10 - 25.	111	16,200
110	110 amperes A.C line current	125	fig.4	5	M10 bolt	122	27,600
125	125 amperes A.C line current	150	fig.4	5	M10 bolt	124	97,000
150F	150 amperes A.C line current - fan	150	fig.5	6	M10 bolt	176	16,200
180F	180 amperes A.C line current - fan	225	fig.5	6	M10 bolt	194	84,000
200F	200 amperes A.C line current - fan	225	fig.5	6	M10 bolt	204	97,000
250	250 amperes A.C line current	300	fig.6	26	M10 bolt	345	90,600
300	300 amperes A.C line current	400	fig.6	26	M10 bolt	423	106,000
350	350 amperes A.C line current	400	fig.6	26	M10 bolt	458	238,000
400F	400 amperes A.C line current - fan	400	fig.6	26	M10 bolt	533	106,000
500F	500 amperes A.C line current - fan	500	fig.6	26	M10 bolt	593	238,000
650F	650 amperes A.C line current - fan	350x2	fig.6	26	M10 bolt	795	781,000
750F	750 amperes A.C line current - fan	400x2	fig.6	26	M10 bolt	826	2x10^6
900F	900 amperes A.C line current - fan	500x2	fig.7	40	M10 bolt	1174	781,000
1100F	1100 amperes A.C line current - fan	600x2	fig.7	40	M10 bolt	1270	2x10^6

A	A.C. Voltage regulation.	
C	Current limit and trip.	A.C. current measurement.
CC	Voltage limit and current trip. Current source	A.C. current measurement.
F	High speed fuses.	
MD	Meter output of input control signal.	
MI	Meter output of average current.	Requires C or CC option.
MP	Meter output of average power.	Requires PW option.
MV	Meter output of average voltage.	Requires A or D option.
PW	Power limit.	Requires A and C options.
T	Thermal cutout.	Standard on fan models.

OZtherm™

APPENDIX 6

FUSE HEATING AND DIMENSIONS

CONTROLLER CURRENT	FUSE	WATTS PER PHASE
25 AMP	25 AF	12
40 AMP	45 AF	12
50 AMP	55 AF	16
65 AMP	75 AF	17
75 AMP	90 AF	17
100 AMP	125 BF	17
110 AMP	125 BF	31
125 AMP	150 BF	33
150 AMP	150 BF	33
180 AMP	225 BF	37
200 AMP	225 BF	37
250 AMP	300BBF	66
300 AMP	400BBF	75
350 AMP	400BBF	75
400 AMP	400BBF	75
500 AMP	500BBF	75
650 AMP	350BBF x 2	132
750 AMP	400BBF x 2	150
900 AMP	500BBF x 2	150
1100 AMP	600BBF x 2	150

FUSE SIZE	MOUNTING CENTRES	BOLT SIZE	HEIGHT	WIDTH	DEPTH
AF	63.5 mm	M5 - M6	76 mm	17 mm	20 mm
BF	86 mm	M8 - M10	113 mm	38 mm	43 mm
BBF	86 mm	M8 - M10	113 mm	38 mm	86 mm

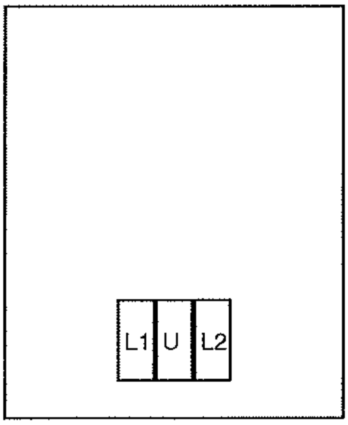
OZtherm™

APPENDIX 7

MAINS TERMINAL LAYOUT

Shown mounted vertically in cabinet

25 to 200 Amp controllers



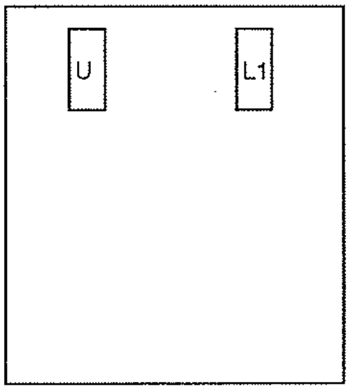
All controllers have bottom entry for cable connection. Appendix 5 (page 17) has information regarding cable termination in square mm, and section 6 (page 13) has external dimensions for the F311 power controllers.

All control wiring (including Current Transformer wiring where appropriate) is bottom entry also.

Fuses are external to the F311 power controller and should be mounted using the standoffs provided (option F only).

Airflow to the F311 power controller should not be obstructed and if mounting the F311 power controller in an enclosure then Appendix 4 (page 16) has details on heat loss and enclosure sizing.

250 to 1100 Amp controllers



All controllers have top entry for cable connection. Appendix 5 (page 17) has information regarding cable termination in square mm, and section 6 (page 13) has external dimensions for the F311 power controllers.

All control wiring (including Current Transformer wiring where appropriate) is bottom entry direct to the circuit board.

Fuses are internal to the F311 power controller (option F only).

Airflow to the F311 power controller should not be obstructed and if mounting the F311 power controller in an enclosure then Appendix 4 (page 16) has details on heat loss and enclosure sizing.

PRODUCTS AND SERVICES

POWER ELECTRONIC COMPONENTS

BRIDGE RECTIFIERS	- Single and Three Phase
CHOKES	- Line, RFI, EMC
DIODES	- Std., Fast. (Stud, Puk, Module)
FANS/ACCESSORIES	- AC/DC to 150mm dia.
FILTERS	- Line, RFI, EMC
FUSES	- Semiconductor Protection
HEAT SINK	- Extruded, Cast & Fabricated types machined to order
IGBT's	- 1, 2 & 6 pack modules
POWER CAPACITORS	- Power, PFC, DC Link and Electrolytic types
PULSE TRANSFORMERS	- PCB type, leaded and SMD
SCR / DIODE BRIDGES	- Single / Three Phase - Half / Full Control
SOLID STATE RELAYS	- AC & DC Input / Output - PCB & Module Type
THYRISTORS	- Std., Fast (Stud, Puk, Module)
SCR / DIODE MODULES	- Std., Fast
VARISTORS	- High power module type, versions with thermal disconnect

AUTOMATION / INSTRUMENTS / PROCESS CONTROLLERS

SMART RELAYS	- Millenium EVO 24 I/O Programable Relays
PROCESS CONTROLLERS	- Pressure, R. Humidity, other.
ELECTRICITY METERS	- I, V, kW, kWh, kvar, kvarh, PF, Freq, THD, Pulse, Comms, Load Shedding - Panel & Din Mount Type
PROGRAMABLE LOGIC CONTROLLERS(PLC)	- Crouzet 26 I/O, Compact, Blind, Expanadable 3G, Bluetooth versions
HMI TOUCH SCREENS	- Ethernet, Modbus, 4,7,10 Inch
TEMP. CONTROLLERS	- Shinko, Single / Multi-Point - Pattern Control

POWER SUPPLIES / SIGNAL CONDITIONERS / MONITORING RELAYS

CURRENT TRIP MODULES	- Measurement / Alarm
LOOP POWER SUPPLIES	- Process type, 24V/ 4 - 20mA
MONITORING RELAYS	- V, I, Watts, Temp, Level etc.
SENSOR POWER SUPPLY	- +/- 15v for Hall Effect Sensors
TEMPERATURE TRANSMTR	- Thermocouple / RTD
VOLTAGE TRIP MODULES	- Measurement / Alarm
SIGNAL CONDITIONERS	- DC/AC, I/V, Trip/Reset and Alarms

SENSORS / PROBES / TRANSDUCERS

CURRENT AC / DC	- Hall Effect Sensors, CT types
DCCT's	- Hall Effect Sensors
LEVEL	- Paddle Switch Type
POWER (kW, kWh, kVa,kVarh)	- Process Level O/P and Pulse
RELATIVE HUMIDITY	- Room/Duct Sensors
TEMPERATURE	- Thermocouples, RTD's, Infra-Red
VOLTAGE AC / DC	- Hall Effect Sensors, VT types
	- Oztherm (Fastron in-house design)

POWER SEMICONDUCTOR HEAT-SINK ASSEMBLIES AND ACCESSORIES

HEAT SINK ASSEMBLIES	- AC, Single/ 3 Phase & multi-phase - DC Bridge and DC switch - Convection, Fan forced, oil or water cooled
WATER COOLERS	- Non-isolated & Isolated water path
SEMICONDUCTOR CLAMPS	- Single and Double sided
SNUBBERS	- AC Single / 3 Phase / DC
DC SUBSTATION DIODES	- Blocking Diode Cubicles

SOLID STATE SWITCHES AND POWER CONTROLLERS

SOLID STATE CONTACTORS	- AC/DC Input or Output - Single, 3 Phase - Solid State Relay & Thyristor Types.
THYRISTOR CONTROLLER (SCR)	- Single & 3 Phase - Phase Angle, Burst Control - OZtherm Brand (Fastron in-house design)

SOFTWARE

ENERGY MONITORING	- Ergo Energy monitoring software - Cloud or local data collection options - Real-time monitoring and profiling - Wi-Lem Wireless Energy Moitoring - Crouzet Smartphone PLC app
POWER QUALITY	- RS485 MOBUS / Ethernet TCP/IP Comms - Power Quality Analysers, MiQEN and MiSMART software.
DATA ACQUISITION	- Electrical and Process Parameters
TEMPERATURE MONITORING & CONTROL	- Single and Multi-point - Pattern Control
DATA LOGGING	- Historical Analysis - Trending & Reporting

SYSTEMS SOLUTIONS & ENGINEERING SERVICES

ENERGY MONITORING, POWER ELECTRONICS AND AUTOMATION

ENERGY MONITORING, POWER QUALITY, DATA AQUISITION, ELECTRICAL & PROCESS MEASUREMENT SOLUTIONS
PROGRAMABLE LOGIC CONTROLLERS, HMI TOUCH SCREENS, TEMPERATURE, HUMIDITY, AND LIGHT SENSORS
PRODUCT DESIGN AND DEVELOPMENT; CONTROL CUBICLE DESIGN, ASSEMBLY AND TESTING
APPLICATIONS ENGINEERING AND CONSULTANCY
POWER SEMICONDUCTOR REPLACEMENT; TESTING AND MATCHING TO CRITICAL PARAMETERS
REPAIR & REFURBISHMENT OF SEMICONDUCTOR ASSEMBLIES & POWER ELECTRONIC EQUIPMENT
REPAIR, TESTING, UPGRADE AND TRAINING ON ALL PRODUCTS

Fastron Electronics

ABN: 38 622 808 137

9B Lakewood Blvd Braeside
Victoria, Australia 3195
Email: sales@fastron.com.au

Tel: +61-3-9763 5155
Fax: +61-3-9763 5206
Web: www.fastron.com.au

PROUDLY SUPPORTING

ALISH	Digital Power Meters, Digital Panel Meters, Isolated Transmitters, Transducers, Converters, I/O Controllers, Current Shunts and Current Transformers.
CROUZET AUTOMATION	Programmable Logic Controllers(PLC), Smart Relays, HMI Touch Screens, Encoders, Brushless DC Motors, Motor Controllers, Smartphone/Tablet PLC apps, Intuitive Crouzet Touch software.
Ergo SERIES	Energy monitoring real time software including data recovery and graphic functions for single or multi site environments with live dashboard, costing, alarming, reporting and bill checking options, specialising in custom applications. **Designed and Manufactured by** Fastron Electronics
Hirect Hind Rectifiers Ltd.	Power Semiconductors including Thyristors and Diodes for applications in Rectifiers, Converters, Power Supplies for Industrial, Traction and test and instrumentation equipment.
HOBUT	Ring and Split core CT's, Shunts and Meters, DC kWh Meters
IXYS	Discretes, IGBTs, Power Modules, Bridge Rectifiers & AC Controllers, Thyristor and Diode modules, Specialist Semiconductors including Silicone carbide
infineon	IGBTs, Power Modules, Bridge Rectifiers & AC Controllers, Thyristor and Diode modules, IGBT driver boards, Stacks and Assemblies. eupec
Iskra® Iskra Sistemi	Monitoring, Control and Measurement of electrical parameters related to Energy Monitoring and Power Quality including Power Factor Correction products. Single and 3 phase Energy Meters, Measuring Centres and Network Analyzers with MiQEN and MiSMART software; Measuring Transducers. MV and LV, PFC capacitors and contactors. DC Link capacitors. Synchronisation Meters.
Itelcond	Electrolytic Capacitors for DC Link, Ripple, and AC Filter Application
Leclanché Capacitors A FISCHER & TAUSCHE COMPANY	Power Capacitors for critical applications and extreme environments including snubber energy absorbers
LEM	Voltage & Current Transducers for industrial drives, robots & cranes, cable cars & ski lifts, elevators & escalators, ventilation & conditioning, medical systems and power supplies for computer & mobile systems. Battery Monitoring system and Wi-Lem Energy Monitoring Solutions.
MAGNELAB	Rope CT's, Rogowski Coils with Integrators, Standalone Integrators, Teardrop Coils, Standard CT's
ND Metering Solutions	Electricity Measurement, including Voltage, Current, Power, Power Factor, Total Harmonic Distortion, with analogue outputs and MODBUS / Ethernet communications available for all of your energy measurement requirements. Current and Voltage Transducers, Clamp on Current Sensors.
OZtherm	SCR (thyristor) Power Controllers complete with Control Electronics and Power Semiconductor heat sink assembly, (Phase angle, burst firing, ON/OFF switching) Solid State Contactors, Signal Conditioners and custom products. **Designed and Manufactured in Australia**
POWERSEM	Power Modules and Solid State Relays, 3 phase and single phase for ac/dc motor drives, welding, power supplies, and UPS, used in temperature, medical, traffic signals and home appliance applications.
PROTON-ELECTROTEX	High Power Thyristors, (phase control, fast and ultrafast), Diodes (rectifier, avalanche and welding types), IGBT's and heat sink and assemblies.
RADA ENGINEERING	Custom Heatsink Extrusions, Bonded Heatsink, Water cooled Heatsink, Thermal Analysis Services
Rishabh Instruments	CT's, Shunts, Signal Conditioners, Electrical Energy Meters and Software Systems Solutions for Measurement, Test and Energy Management applications in the industrial, commercial and government sectors.
SCHURTER	Surge Suppression, Chokes, EMC Filters, Power Input Filter, Pulse Transformers.
Sensata Technologies	Solid State Relays, I/O Modules, Filters, Heat Sinks, Din Rail Mounting systems, for low power and high power electrical switching and control applications. SCR/Diode Bridges and Modules. crydom
Shinko	Temperature, Process and Humidity Controllers, Sensors and Recorders for a wide range of applications including furnaces, boilers, ovens, kilns and extruders as well as a range of Signal Conditioners.
SanRex	Silicone Carbide Mosfets & Schottky Diodes, Power Modules, Fast Diodes, Bridge Rectifers, Controlled Rectifers, SCR's, Power Supplies for Plasma heating, Metal Finishing, and Power Regulation
Trent	Semiconductor Fuses for power control applications. **Designed and Manufactured by** Fastron Electronics Private label name brand replacement(NBR) Semiconductors and Solid Sate Relays
VARSI	High energy Varistors and thermal disconnects for voltage transient suppression used in telecommunications, rectifier electronics, power electronics, measurement & control, process systems, computers, medical, automotive, test and instrumentation.

Fastron Electronics
ABN: 38 622 808 137

9B Lakewood Blvd Braeside
Victoria, Australia 3195
Email: sales@fastron.com.au

Tel: +61-3-9763 5155
Fax: +61-3-9763 5206
Web: www.fastron.com.au