ITW ESTAT POWER SUPPLY HANDBOOK

4/8/2009

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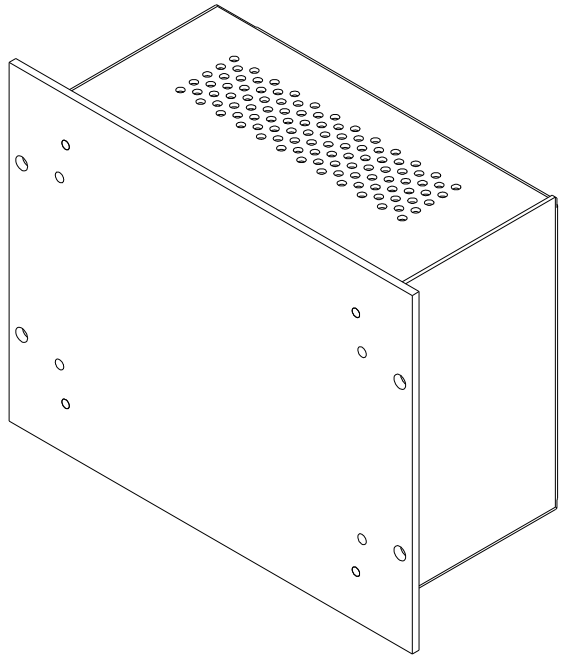
1.0 PHYSICAL CHARACTERISTICS

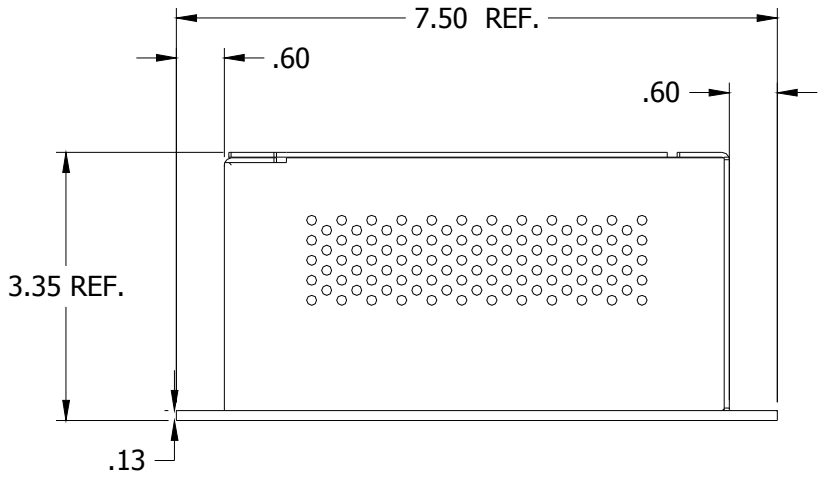
1.1 INSTALLATION CONDITIONS

Operating Temperature (ambient)	0-+50 degrees Centigrade
Storage & Shipping	-40 to +85 degrees Centigrade
Humidity	95% Non-Condensing
DC supply Power Required	24VDC @ 2.5 Amps max (@ sea-level), regulated, with over voltage protection. Note: For every 1,000 feet of increased elevation the max current is increased by 3%.
HV Fault Output	24 volts, 1 Amp, Form C relay contact

1.2 MOUNTING DIMENSIONS

The estat power supply is intended to be mounted into a cutout of a grounded metal enclosure. This provides display and access to the front panel and protects the rear of the power supply.

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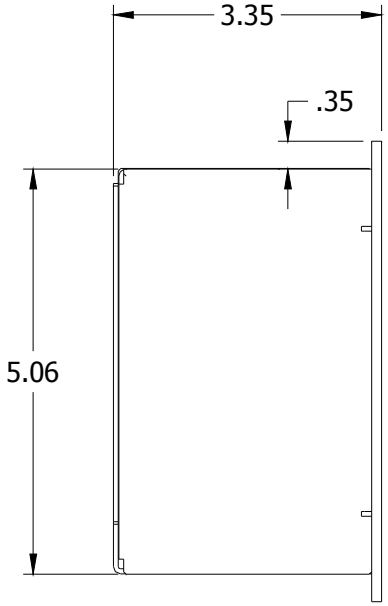
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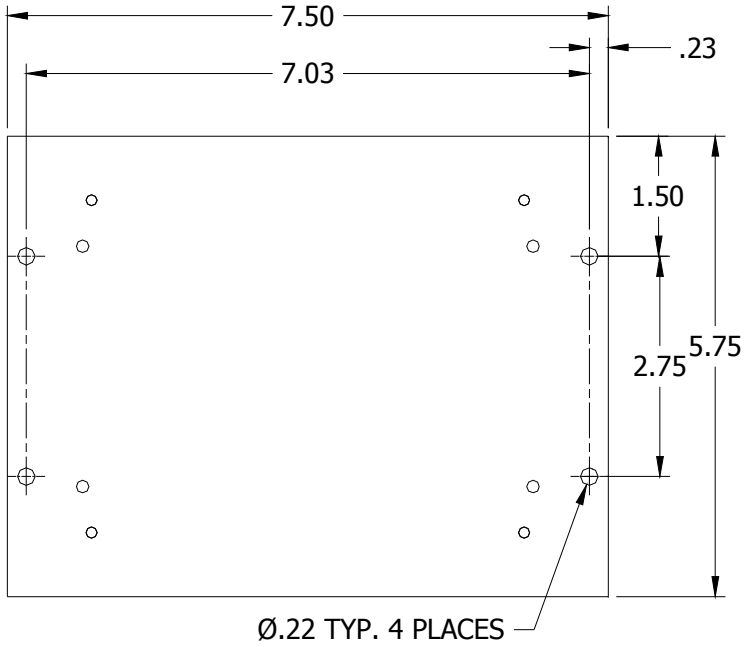
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2.0 ELECTRICAL CONNECTIONS

2.1 24VDC CONNECTOR

There is a 4 pin removable screw terminal block on the rear of the power supply for DC power.

+VIN	24 VDC power supply connection
GND	0 VDC power supply connection
CGND	Chassis connection, tie to ground source
CGND	

2.2 ETHERNET CONNECTOR

There is one standard RJ45 connector on the rear of the power supply. This is the primary source of communication in Automatic mode.

2.3 CASCADE CONNECTOR

There is a 7 pin removable screw terminal block on the rear of the power supply for the cascade interconnect cable.

HVGND	0VDC for R+ and E+ power
R+	Analog DC cascade drive signal (0-24VDC)
E+	Nominal 15VDC for cascade electronics
GND	0VDC for analog cascade voltage feedback
U-FB	Analog cascade voltage feedback signal (4-20mA)
SC	0VDC for analog cascade current feedback
I-FB	Analog cascade current feedback signal (4-20mA)

2.4 NO FAULT CONTACT

There is a 3 pin removable screw terminal block on the rear of the power supply for a hardwired FAULT output.

NC	Normally closed, closed when there is no fault condition
COM	Common
NO	Normally open, closed when there is a power off or fault condition

3.0 ETHERNET I/P CONFIGURATION

MAC ADDRESS:	Unique hard coded by manufacturer, displayed on unit
IP ADDRESS:	User setable from front panel
INPUT INSTANCE:	113
INPUT WORDS:	4
INPUT WORD SIZE:	16 bits
OUTPUT INSTANCE:	112
OUTPUT WORDS:	4
OUTPUT WORD SIZE:	16 bits
CONFIG INSTANCE:	100
RPI:	32ms

4.0 SETUP

4.1 I/P ADDRESS

Turn on the power supply with the rocker switch on the front.
Press and release the SCREEN key until the IP address is displayed.
Use the up and down arrow keys to select the field to edit.
Press SET to be prompted for a password.
Use the up and down arrow keys to select the password digit.
Use the right and left arrow keys to scroll through available numeric values.
Press SET after each digit is selected.
Scroll through and enter the I/P address as needed.
Cycle power with the rocker switch after you are finished.

4.2 PARAMETERS

Use the pendant with the I/P address password to reset the parameters to their default setting in REMOTE mode.

-OR-

Enter the user password and edit parameters as needed in LOCAL mode. Here are defaults and ranges:

DV/DT Default: 16 Low value: 3 High value: 24 Units: KV/100ms
This parameter protects the environment by establishing the maximum rate of change of voltage over time when DX/DT is enabled in current mode.

DI/DT Default: 40 Low value: 8 High value: 50 Units: uA/100ms
This parameter protects the environment by establishing the maximum rate of change of current over time when DX/DT is enabled in voltage mode.

KV LIM HI Default: 103 Low value: 20 High value: 103 Units: KV
This parameter establishes a maximum voltage to protect the power supply and cascade.

uA LIM HI Default: 80 Low value: 10 High value: 150 Units: uA
This parameter protects the environment by establishing a maximum current value.

KV LIM LO Default: 25 Low value: 10 High value: 80 Units: KV
This parameter protects the environment by establishing a minimum voltage value in current mode.

DX/DT Default: 1 Low value: 0 High value: 1 Units: N/A
This parameter enables or disables the DV/DT and DI/DT fault limits.

5.0 MANUAL OPERATION

5.1 FRONT PANEL DISPLAY

Boot up screen:

```
          I T W   R A N S B U R G
S N   X X X X - X X X X     ©   2 0 0 8
s w V e r X . X X     h w V e r X . X X
M A C 0 0 - 0 0 - 0 0 - 0 0 - 0 0 - 0 0
```

Voltage mode status:

```
K V S E T   8 0     # # #
K V A C T   0         u A A C T   0
C H K :   O K     C O M :   O K
H V :   O F F     S T S :   O K
```

Current mode status:

```
u A S E T   5 0     # # #
K V A C T   0         u A A C T   0
C H K :   O K     C O M :   O K
H V :   O F F     S T S :   O K
```

5.2 LOCAL MODE

Turn the power supply rocker switch to ON.
Turn the LOCAL/REMOTE toggle switch to LOCAL.
Move the cursor to the Voltage or current, depending on the operating mode.
Press SET to select the data field.
Use the right and left arrow keys to set the desired value.
Press SET to select the value.
Use the HV ON/OFF toggle switch to turn on and off the electrostatic voltage/current.
Should a fault occur, select HV OFF momentarily to reset the fault.

6.0 ETHERNET I/O

6.1 POWER SUPPLY OUTPUTS

There are 4 output words of 16 bits each mapped to inputs on the robot controller.

	OUTPUT WORD 1	OUTPUT WORD 2	OUTPUT WORD 3	OUTPUT WORD 4
BIT	**DESCRIPTION**	**DESCRIPTION**	**DESCRIPTION**	**DESCRIPTION**
0	IN CONTROL	Over CURRENT WARNING	param data word bit 0	actual KV bit 0
1	RAMPING	Over VOLTAGE WARNING	param data word bit 1	actual KV bit 1
2	CONTROL OK TO START	Under VOLTAGE WARNING	param data word bit 2	actual KV bit 2
3	REMOTE MODE		param data word bit 3	actual KV bit 3
4	HV On Echo		param data word bit 4	actual KV bit 4
5	Warning		param data word bit 5	actual KV bit 5
6	Fault	COMM FAULT	param data word bit 6	actual KV bit 6
7		H/W FAULT	param data word bit 7	actual KV bit 7
8		LOW VOLTAGE FAULT	parameter bit 0	actual uA bit 0
9		DV/DT FAULT	parameter bit 1	actual uA bit 1
10		DI/DT FAULT	parameter bit 2	actual uA bit 2
11		MINIMUM OUTPUT FAULT	parameter bit 3	actual uA bit 3
12		MAXIMUM OUTPUT FAULT	parameter bit 4	actual uA bit 4
13		OVER VOLTAGE FAULT	parameter bit 5	actual uA bit 5
14		OVER CURRENT FAULT	parameter bit 6	actual uA bit 6
15	HEARTBEAT	CABLE FAULT	parameter acknowledge	actual uA bit 7

IN CONTROL: The control parameter is within 3KV or 3uA of the setpoint

RAMPING: The KV or uA is ramping up or down tot he setpoint

CONTROL OK TO START: The power supply is ready for an ENABLE signal

REMOTE MODE: The REMOTE/LOCAL toggle switch is in REMOTE

HV ON ECHO: The high voltage is ON

WARNING: There is a warning present, see warning bits

FAULT: There is a fault present, see fault bits

HEARTBEAT: This output is cycled on and off every second

OVER CURRENT WARNING: Warning active, see Warning section and Troubleshooting section for additional information.

OVER VOLTAGE WARNING: Warning active, see Warning section and Troubleshooting section for additional information.

UNDER VOLTAGE WARNING: Warning active, see Warning section and Troubleshooting section for additional information.

COMM FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

H/W FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

LOW VOLTAGE FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

DV/DT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

DI/DT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

MINIMUM OUTPUT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

MAXIMUM OUTPUT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

OVER VOLTAGE FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

OVER CURRENT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

CABLE FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

PARAM DATA WORD BIT 0-7: Used to tell the system the value of a parameter

PARAMETER BIT 0-6: Used to tell the system which parameter is being displayed

PARAMETER ACKNOWLEDGE: Used to acknowledge a parameter read or write request

ACTUAL KV BIT 0-7: Real time feedback of the voltage at the output of the cascade

ACTUAL UA BIT 0-7: Real time feedback of the current draw from the output of the cascade

6.2 POWER SUPPLY INPUTS

There are 4 input words of 16 bits each mapped to outputs on the robot controller.

	INPUT WORD 1	INPUT WORD 2	INPUT WORD 3	INPUT WORD 4
BIT	**DESCRIPTION**	**DESCRIPTION**	**DESCRIPTION**	**DESCRIPTION**
0	HV ENABLE	KV Set Point word bit 0	param data word bit 0	
1	RESET FAULT	KV Set Point word bit 1	param data word bit 1	
2	CURRENT MODE	KV Set Point word bit 2	param data word bit 2	
3		KV Set Point word bit 3	param data word bit 3	
4		KV Set Point word bit 4	param data word bit 4	
5		KV Set Point word bit 5	param data word bit 5	
6		KV Set Point word bit 6	param data word bit 6	
7		KV Set Point word bit 7	param data word bit 7	
8		uA Set Point word bit 0	set param bit 0	request param bit 0
9		uA Set Point word bit 1	set param bit 1	request param bit 1
10		uA Set Point word bit 2	set param bit 2	request param bit 2
11		uA Set Point word bit 3	set param bit 3	request param bit 3
12		uA Set Point word bit 4	set param bit 4	request param bit 4
13		uA Set Point word bit 5	set param bit 5	request param bit 5
14		uA Set Point word bit 6	set param bit 6	request param bit 6
15		uA Set Point word bit 7	set param strobe	request param strobe

HV ENABLE: Enables high voltage if conditions are OK at the rising edge

RESET FAULT: The rising edge clears any fault that no longer exists

CURRENT MODE: Turned OFF for Voltage mode and ON for Current mode

KV SET POINT WORD BIT 0-7: The voltage setting in voltage mode or the voltage ceiling in current mode

UA SET POINT WORD BIT 0-7: The current setpoint in current mode

PARAM DATA WORD BIT 0-7: The data word used to set parameters

SET PARAM BIT 0-6: The parameter number to be set

SET PARAM STROBE: The indication to set the indicated parameter to the specified value

REQUEST PARAM BIT 0-6/REQUEST PARAM STROBE: The parameter to be read and the read request

6.3 POWER SUPPLY PARAMETERS

There are 10 parameters to control power supply performance.

PARAMETERS						
#	**DESCRIPTION**	**READ/WRITE**	**UNITS**	**DEFAULT VALUE**	**MIN VALUE**	**MAX VALUE**
1	DV/DT LIMIT	READ/WRITE	KV/100ms	16	3	24
2	DI/DT LIMIT	READ/WRITE	uA/100ms	40	8	50
3	V-MAX	READ/WRITE	KV	103	20	103
4	I-MAX	READ/WRITE	uA	80	10	150
5	V-MIN	READ/WRITE	KV	25	10	80
6	DX/DT ENABLE	READ/WRITE	n/a	1	0	1
7	USER PW DIGIT 1	READ ONLY	n/a	0	0	9
8	USER PW DIGIT 2	READ ONLY	n/a	0	0	9
9	USER PW DIGIT 3	READ ONLY	n/a	0	0	9
10	USER PW DIGIT 4	READ ONLY	n/a	0	0	9

TO READ A PARAMETER:

Set input word 4 bits 8-14 to indicate the desired parameter
Set input word 4 bit 15 to request the parameter
Output word 3 bit 15 will come on
Read output word 3 bits 8-14 to verify you are getting the requested parameter
Read output word 3 bits 0-7 to get the parameter data
Reset input word 4 bit 15
Output word 3 bit 15 will turn off
Reset input word 4 bits 8-14

TO WRITE A PARAMETER:

Set the data for the parameter on input word 3 bits 0-7
Set the parameter to change on input word 3 bits 8-14
Set the parameter strobe on input word 3 bit 15
The parameter acknowledge on output word 3 bit 15 will turn on
Reset the parameter strobe on input word 3 bit 15
The parameter acknowledge on output word 3 bit 15 will turn off
Reset the data for the parameter on input word 3 bits 0-7
Reset the parameter to change on input word 3 bits 8-14

7.0 REMOTE OPERATION

7.1 VOLTAGE MODE

See SETUP to set the ethernet I/P address as desired.
Turn the power supply rocker switch to ON.
Turn the LOCAL/REMOTE toggle switch to REMOTE.
Initiate Ethernet I/P communication from the host.
See FAULT RESET to clear any fault.
Set the requested estat voltage level on input word 2 bits 0-7.
The estats will be energized when ENABLE(input work 1 bit 0) goes hi if OK TO START(output work 1 bit 2) is on.
Voltage feedback can be read from output word 4 bits 0-7.
Current feedback can be read from output word 4 bits 8-15.
The set voltage and enable may be changed at will.

7.2 CURRENT MODE

See SETUP to set the ethernet I/P address as desired.
Turn the power supply rocker switch to ON.
Turn the LOCAL/REMOTE toggle switch to REMOTE.
Initiate Ethernet I/P communication from the host.
See FAULT RESET to clear any fault.
Set CURRENT MODE(input word 1 bit 2).
Set the requested estat voltage ceiling on input word 2 bits 0-7.
Set the requested estat current level on input word 2 bits 8-15.
The estats will be energized when ENABLE(input work 1 bit 0) goes hi if OK TO START(output work 1 bit 2) is on.
Voltage feedback can be read from output word 4 bits 0-7.
Current feedback can be read from output word 4 bits 8-15.
The set voltage and enable may be changed at will.

7.3 FAULT RESET

Clear the opportunity that caused the fault.
Read the fault bits(input word 2 bits 6-15)
Reset the ENABLE(input work 1 bit 0).
Set FAULT RESET(input word 1 bit 1)
Reset FAULT RESET(input word 1 bit 1)

8.0 FAULTS & WARNINGS

8.1 FAULTS

COMMUNICATION FAULT

The power supply had achieved an Ethernet I/P connection and then lost it or out of range data was sent to the estat power supply.

HARDWARE FAULT

The power supply has detected a fatal error.

LOW VOLTAGE FAULT

In current mode, the power supply has detected a feedback voltage lower than KV LIMIT LO.

DV/DT FAULT

In current mode with DX/DT enabled, the measured rate of voltage rise over time has exceeded the DV/DT limit.

DI/DT FAULT

In voltage mode with DX/DT enabled, the measured rate of current rise over time has exceeded the DV/DT limit.

MINIMUM OUTPUT FAULT

The power supply detects an actual voltage or current greater then zero with no command voltage.

MAXAMUM OUTPUT FAULT

The power supply has attained the maximum command voltage and the setpoint current or voltage cannot be attained.

KV LIMIT FAULT

The measured feedback voltage of the cascade has exceeded the KV LIMIT HI setting.

CURRENT LIMIT FAULT

The measured feedback current of the cascade has exceeded the uA LIMIT HI setting.

VOLTAGE CABLE FAULT

The power supply has a voltage feedback between 0 and 4mA from the cascade which should always be from 4mA to 20mA.

CURRENT CABLE FAULT

The power supply has a current feedback between 0 and 4mA from the cascade which should always be from 4mA to 20mA.

8.2 WARNINGS

OVER CURRENT WARNING

The measured feedback current of the cascade is approaching the uA LIMIT HI setting.

OVER VOLTAGE WARNING

The measured feedback voltage of the cascade is approaching the KV LIMIT HI setting.

UNDER VOLTAGE WARNING

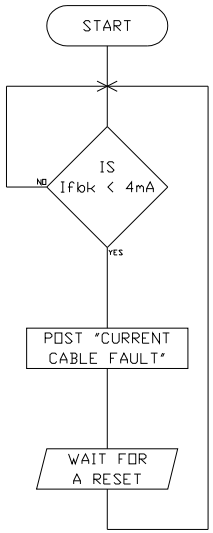
In current mode, the power supply has detected a feedback voltage approaching the KV LIMIT LO setting.

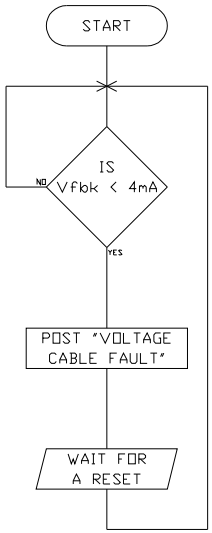
9.0 TROUBLESHOOTING

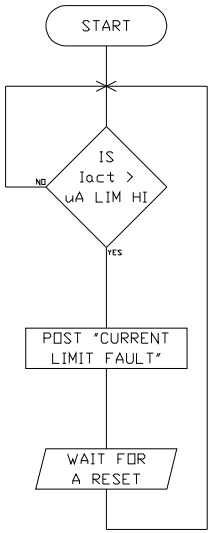
ALARM #	ALARM DESC.	CAUSE	REMEDY
PNT1-949	ESTAT Over uA warning	While operating in Voltage mode the current draw is within 10% of the limit.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-950	ESTAT Over KV warning	The actual Voltage is within 10% of the internal safety limit.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-951	ESTAT Under KV warning	While operating in current mode, the load is so great that the voltage is within 110% of the low threshold.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-955	ESTAT H/W fault	A serious internal fault has occurred, or the High Voltage was enable while a Fault existed.	Verify the voltage was not enabled during a fault and replace the power supply.
PNT1-956	ESTAT Comm. fault	One of the parameters was sent to the power supply out of the expected range.	Review the process setup and verify parameters are used within their range limits.
PNT1-957	ESTAT Low KV fault	While operating in current mode, the applicator draws so much current that the power supply was not able to attain a minimal KV value.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-958	ESTAT DV/DT fault	While operating in Voltage mode with DX/DT enabled, the rate of voltage rise over time exceeded the DV/DT setpoint.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-959	ESTAT DI/DT fault	While operating in Voltage mode with DX/DT enabled, the rate of current rise over time exceeded the DI/DT setpoint.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-960	ESTAT Min. output fault	Either Voltage or Current feedback has been detected with the minimum output of the power supply.	Check cable(s) between the power supply and cascade, replace the cascade.
PNT1-961	ESTAT Max. output fault	Either Voltage or Current feedback was not able to reach the setpoint before reaching the maximum output of the power supply.	Check cable(s) between the power supply and cascade, replace the cascade.
PNT1-962	ESTAT Over KV fault	The KV feedback from the cascade has exceeded the internal safety limit or the parameter KV limit.	Review the application to verify the limit is set correctly. Clean applicator and adjust the path as needed.
PNT1-963	ESTAT Over uA fault	The KV feedback from the cascade has exceeded the parameter uA limit.	Review the application to verify the limit is set correctly. Clean applicator and adjust the path as needed.
PNT1-964	ESTAT Cable fault	Either a short circuit or open circuit has been detected with the voltage or current feedback circuit from the cascade to the power supply.	Check the cable(s) from the power supply to the cascade to verify insulation has not been compromised.

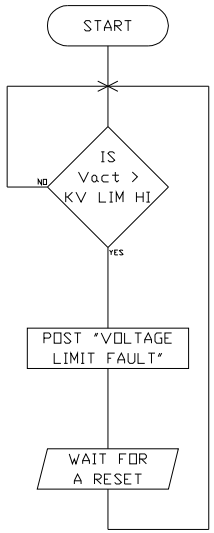
10.0 CONTROL ALGORYTHM

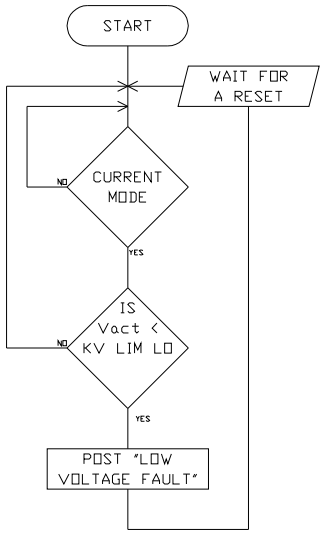
10.1 FAULTS

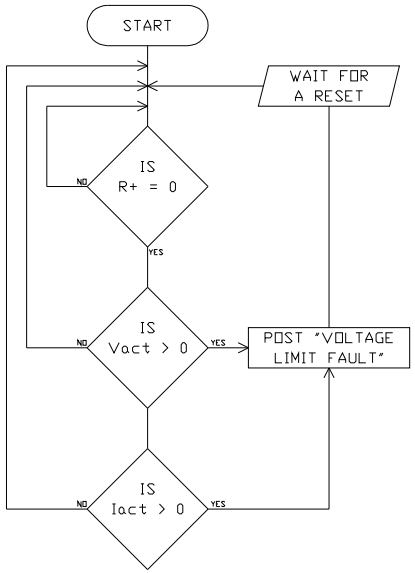


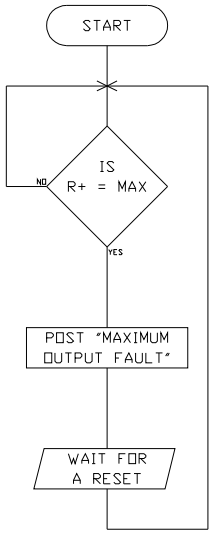


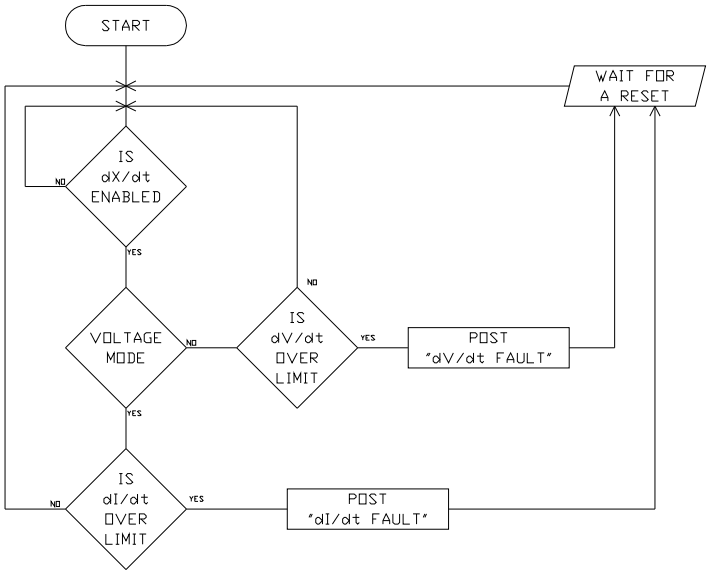












10.2 VOLTAGE AND CURRENT CONTROL