



**Field Controller  
(Current Based Regulator)  
Type: SP90/95**

## **WARNINGS**

### **WARNING**

Earth fault protection / detection devices must not be used with this equipment as the sole protection against earth faults or accidental touching or shock. The DC component in the fault may not be adequately detected by the fault detection systems and could be hazardous to personal safety.

### **WARNING**

Thyristor based convertors are able to cause disturbances to the supply network. These convertors typically do not include any radio interference, or harmonic filters. It is advisable to consider these points when planning plant power distribution, or the installation of these convertors in a sensitive electrical environment.

### **WARNING**

Earth fault protection / detection devices must not be used with this equipment as the sole protection against earth faults or accidental touching or shock. The DC component in the fault may not be adequately detected by the fault detection systems and could be hazardous to personal safety.

### **WARNING**

Electronic units are in principle not fail safe therefore it is the users to remember this and take the necessary precautions in the use and responsibility of installation of this equipment that suitable protection measures are taken to ensure that in the event of a failure that the machinery is brought to a safe condition. This is especially important where personnel are involved with moving machinery and it is recommended that electronic independent type safety circuits are installed.

**VOLTAGE TAPS:**

**SELECT CORRECT VOLTAGE TAP;**

**SELECT THE CORRECT VOLTAGE TAP ON THE BOTTOM PCB JUST ABOVE THE GLASS FUSE TO SUIT YOUR CONTROL VOLTAGE**

**SUPPLY - 220 OR 380 V AC.**

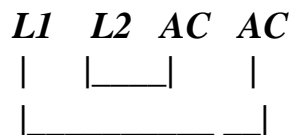
**FAILURE TO DO THIS COULD RESULT IN DAMAGE TO THE UNIT.**

**SUPPLY VOLTAGE PHASE RELATIONSHIPS:**

**COMMON SUPPLY TO THE CONTROL ELECTRONICS AND THYRISTOR BRIDGE;**

**LINK L1 to the second AC terminal from left**

**LINK L2 to the adjacent AC terminal**



**INDEPENDENT SUPPLIES;**

**MUST HAVE THE SAME PHASE RELATIONSHIP AS ABOVE i.e. L2 MUST BE IN PHASE WITH THE ADJACENT AC SUPPLY and L1 WITH THE SECOND AC SUPPLY.**

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## SECTION 1

### INTRODUCTION:

The SP-FR-V1 field regulator is designed for the control of a DC Motor field, this can in conjunction with the main Armature regulator produce a constant Kw or Hp characteristic. It is also suitable for applications where it is necessary to regulate the current of the field whether by manual systems or automatic control, i.e. manual pot or multiple motor speed-balancing when the armatures are common and it is necessary to vary individual motor speeds. This regulator is a current based closed loop control system, the electronics are galvanically isolated on both the thyristor firing circuits and the current feedback network, only the armature voltage from the main drive is a high impedance feedback. (This is only used in the constant Kw mode or as is commonly termed „Armature spillover“.)

Unique features include the actual current indication by led bar graph, dip switch selection of the current ranges, armature voltage ranges, and mode of operation.

The unit features field loss detection, multiple input voltage, and independent voltage input to the thyristor bridge for non standard applications.

Other important considerations included the ability to supply the DC current for the field from either a fully controlled bridge or a half controlled bridge with free-wheeling current and the current display will still included any and all the free-wheeling component of the DC current.

The field regulator is also designed to operate in the constant tension mode for winders when used in conjunction with the Speedtek Diameter calculator. The Diameter calculator will reference the Field Regulator and control the field current according to the diameter change, and with a set armature current, achieve constant tension, the build up in this type of application is obviously dependant on the motor field range.

## SECTION 2

### SPECIFICATIONS:

Supply voltage	: 220/240 or 380/400 V AC. 50Hz
Supply voltage main	: Up to 380 V AC (Thyristor bridge.)
Output voltage	: 180 or 310 V DC dependent on input voltages)
Output current	: 3 unit sizes - 7.5 Amps or 15 Amps or 25 Amps by Special order.
Enclosure	: IP 00 (Open / kit)
Ambient Temperature	: 0 - 40 C
Altitude	: 1000m
Footprint	: 7.5 Amp 225mm wide, 185mm high, 120mm deep 15 Amp 235mm wide, 185mm high, 130mm deep

### APPLICATIONS:

Automatic Field Weakening  
Constant Current Field Regulator  
Variable Field Current Regulator  
Combined Field Current Control (by input to the Aux. Summing)

### INDICATIONS:

Run Led  
Minimum Field current Led  
Maximum Field current Led  
Field loss Led and potential free c/o contact  
Field Current by 10 segment Led bar graph

### TEST POINTS:

<b>TP 2</b>	Current amp out to comparator.
<b>TP 3</b>	Ramp signal to comparator.
<b>TP 4</b>	Armature voltage feedback signal.
<b>TP 5</b>	Current amp ref.
<b>Pin 7 U2</b>	Reference ramp output
<b>IC 2 Pin 1 + 3</b>	Pulse transformer firing signal
<b>Cathode D17</b>	Inhibit line - H = off L = on

### **DERATINGS:**

Current values listed are based on a maximum ambient of 40 degrees C at a maximum altitude of 1500 meters ASL

At higher temperatures than 40 degrees C de-rate at 1,5% per Degree C

At higher altitudes than 2000m de-rate 1% per 100 meters.

**PROTECTIVE MEASURES: dvdt:** The regulator has both resistor / capacitor networks and Mov's on across the supply and output and Mov's across each thyristor / diode in the power bridge to limit dvdt across the semiconductors to safe values.

#### **Fuses:**

On the smaller unit mains supply ultra rapid semiconductor fuses are fitted to the PCB. On the larger units these fuses are not included and need to be fitted externally on the supply. Refer to the factory for these ratings (typically 25 or 32 amps for the 15 amp unit and 45 or 63 amps on the larger unit.) **Field current:**

The field current is monitored and by use of the Field loss relay a minimum field current or under current can be detected and indicated by loss of the F/L relay contact. This should be interlocked into the primary Drive controls so that the main Drive is never started with a Field current below a safe motor / application value.

#### **Electronics:**

The transformer feeding the electronics is protected by a 630 Ma glass fuse fitted to the PCB.

### **HIGH INDUCTIVE APPLICATIONS:**

In applications where the energy stored in the motor is exceptionally high it is advisable to use the 2 pulse regulators with freewheeling diode current capability however if fast dynamic response is required and it is necessary to install a 4 pulse regulator then a burden resistor of suitable value must be installed across the field. Please refer to the factory for assistance in this regard.

### **COOLING:**

#### **Mounting:**

The unit must be mounted vertically i.e. the cooling fins must be vertical. There must be sufficient clear area around the unit for free air circulation typically 75 to 100 mm free space above and below the unit. The ventilated space should be typically about 10 cubic meters, should this space / area is smaller, then it is recommended that a force flow of air be obtained by fitting a fan to the panel. The air flow direction should coincide with the cooling fin direction. The volumes required are typically 75 m<sup>3</sup> for the 7.5 Amp unit and 160 m<sup>3</sup> for the 15 Amp unit. Refer to the factory for assistance in this regard. (Units that are not being run to their full current values will not require the full cooling air flows.)

### SECTION 3

#### TERMINAL DESCRIPTION:

##### **Bottom PCB / Main Power PCB ;**

<b>A+ and A-</b>	Armature voltage from the main drive max. 500v DC
<b>L1 + L2</b>	Control voltage for the electronics - 220 or 380 v AC
<b>AC + AC</b>	Thyristor Bridge supply up to 380 v AC
<b>F- and F+</b>	Field voltage
<b>NC, com, NO</b>	Field loss relay contacts - potential free

##### **Top PCB / Electronic PCB**

<b>Aux</b>	Input to aux summing point
<b>+V</b>	+15 v rail
<b>0V</b>	Zero volt rail
<b>-V</b>	-15 v rail
<b>I=</b>	Current output for external 1 Ma meter if required
<b>+10</b>	+ V Ref output to external pot
<b>Min</b>	Minimum side of external pot
<b>Ref</b>	Wiper from external pot or external reference
<b>0V and Start</b>	Start by contact closure - (Stop by opening contact)

#### DIP SWITCH DESCRIPTION:

<b>5 + 8</b>	Field current range
<b>1</b>	+ 4 Armature voltage range
<b>2</b>	Armature voltage rectifier for bi-directional drives
<b>3</b>	For external operation from a pot
<b>6</b>	To force minimum field during setup
<b>7</b>	For internal ref. for spill over applications

##### **Field Current Ranges**

<b>5 + 8 off</b>	+/- 2 amps
<b>5 off 8 on</b>	+/- 5 amps
<b>5 on 8 off</b>	+/- 8 amps
<b>5 on 8 on</b>	+/- 15 amps

The bar graph indication will be an approximate indication of the field current value with full indication according to the selected range from the dip switches.

##### **Armature Voltage Ranges**

<b>1 off 4 off</b>	+/- 75 - 150 volts armature
<b>1 on 4 off</b>	+/- 150 - 300 volts armature
<b>1 off 4 on</b>	+/- 300 - 450 volts armature
<b>1 on 4 on</b>	+ 450 volts armature



### **Armature Voltage Rectification**

Dip switch 2 is used in applications where it is required that the main drive armature voltage polarity reverses, as in 4 quadrant drives, and that the field regulator operating in the spillover mode must weaken the field in both armature voltage polarities, then the armature voltage signal is fed through a precision rectifier before being used in the summing circuits. In the event that it is not required that the field weakens in one direction of the armature then by switching Sw. 2 off, the field regulator will only respond to one armature polarity, however in applications where this feature is not required then with Sw. 2 on then the field regulator is not armature voltage polarity conscious and A+ and A- have no polarity meaning.

### **TRIM POT DESCRIPTIONS:**

<b>UP + DOWN</b>	The rate of change of the field current when operating by manual pot <b>or</b> the rate of rise of the field current when operating as a constant field and in the spill-over mode at the Initial switch on - UP pot only here!
<b>A/V</b>	The point at which the field will begin to weaken when operating in the spill-over mode
<b>MIN</b>	Minimum field when operating on a manual pot mode
<b>STAB I.</b>	Field current stability
<b>MAX I.</b>	Maximum field current - in any mode
<b>MIN I.</b>	Minimum field current - in any mode
<b>F/L</b>	Field loss relay setting

## SECTION 4

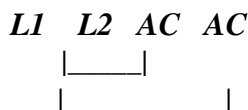
### SETTING UP PROCEDURES:

#### SELECT CORRECT VOLTAGE TAP ;

**SELECT THE CORRECT VOLTAGE TAP ON THE BOTTOM PCB JUST ABOVE THE GLASS FUSE TO SUIT YOUR CONTROL VOLTAGE SUPPLY - 220 OR 380 V AC. FAILURE TO DO THIS COULD RESULT IN DAMAGE TO THE UNIT.**

**COMMON SUPPLY TO THE CONTROL ELECTRONICS AND THYRISTOR BRIDGE;**

*LINK L1 to the second AC terminal from left  
LINK L2 to the adjacent AC terminal*



**INDEPENDENT SUPPLIES;**

**MUST HAVE THE SAME PHASE RELATIONSHIP AS ABOVE i.e.**

**L2 MUST BE IN PASE WITH THE ADJACENT AC SUPPLY and L1 WITH THE SECOND AC SUPPLY.**

### TRIM POT SETTINGS:

Prior to primary start up set the trim pot as follows

UP	50%
DOWN	50%
A/V	50%
MIN	0%
STAB I.	50%
MAX I.	50%
MIN I.	90%
F/L	10%

### VARIABLE FIELD CONTROL BY POT ;

**Refer to connection diagrams for connections.**

Set A/V pot fully CCW. Select desired current ranges by Sw. 5 and 8.

Disconnect pot wiper.

Start the field regulator

Sw. 7 ON - adjust Max I for rated field current (use a DC Current meter on the field to read field current) Max I led must be on.

Sw. 7 OFF

Sw. 6 ON and set field current to about 20 % below minimum field current. Min I led must be on.

Set F/L so that the field-loss relay to just energise - at this stage playing with the Min I pot up and down will clearly show the F/L action and the sensing level. This level should be at least 20 % below the minimum field setting to prevent nuisance trips when operating.

Set required minimum field current.

By alternating the two switches it will also be possible to assess the field current stability and make the necessary adjustment to prevent “over shoot” or “under shoot” on the field current.

Sw. 7 Off and Sw. 6 off.

Switch Sw. 3 on.

Reconnect pot wiper and check control from the pot.

Set Min. Pot so as to coincide with the pot zero and prevent no dead band at the bottom of the pot.

In applications where the required field max. Current is well below the unit max current category it might also be necessary to adjust the A/V pot to prevent a dead band at the top of the pot.

### **CONSTANT FIELD CONTROL:**

**Refer to connection diagrams for the relevant connections.**

Select the current range dip switches

Start the unit

Sw. 7 on and set for rated Field current with Max I. Max I led must be on.

Set F/L to clearly operate i.e. fall out when the field current is set 20 - 30% below rated field value, by using Max I to vary the field. Set Max I for rated field current.

### **FIELD SPILLOVER CONTROL:**

**A TACHO MUST BE FITTED TO THE MOTOR AND THE MAIN DRIVE MUST RUN ON TACHO FEEDBACK FOR THIS TYPE OF OPERATION.**

**Refer to connection diagrams for the relevant connections.**

Select relevant current range on switches 5 and 8

Select relevant spill-over voltage ranges on switches 1 and 4

Select armature rectifier if needed on switch 2

Start the unit

Set maximum field – Sw. 7 on - set max field current - the Max I led must be on

Set F/L – Sw. 7 off Sw. 6 on set 20% below minimum field current, the Min I led must be on, and set F/L relay to just energise, check operation and adjust as necessary by using Min I pot to vary field up and down.

Set Min I pot for required minimum field current

Alternate with Sw. 6 and Sw. 7 to check field current from min to max and adjust Stab I. pot for best stability. If problems are encountered setting the field stability read section on “additional field stability.”

Sw. 7 on and Sw. 6 off, and Set A/V fully CW. The Max I led must be on.

Field current should now be at full rated value. Start the main drive and slowly speed up to rated armature voltage / spill-over point.

If at any stage the field already starts to weaken prior to this voltage check the selected armature voltage range Switches no. 1 and 4 if necessary go one step up in the arm voltage range selection. At full rated armature voltage or the spill-over point, do not increase drive speed any further. Now slowly decrease A/V pot until the field current just starts to drop or the Max I led just starts to flicker or dim.

Now slowly increase the main drive speed and the field current will start dropping while the armature voltage remains constant. The Stab I pot could be adjusted if necessary at this point to achieve a stable field current. Slowly increase the main drive speed and the field should decrease accordingly. Set the desired main drive maximum speed, the field minimum current Led should also come on as it normally coincides at this point. Should the last part of the speed increase show a early minimum field led and an increase in armature voltage then the rated minimum field setting is to high and the set up procedure must be started again - starting with setting for a lower minimum field.

## SECTION 5

### ADDITIONAL FIELD CURRENT STABILITY:

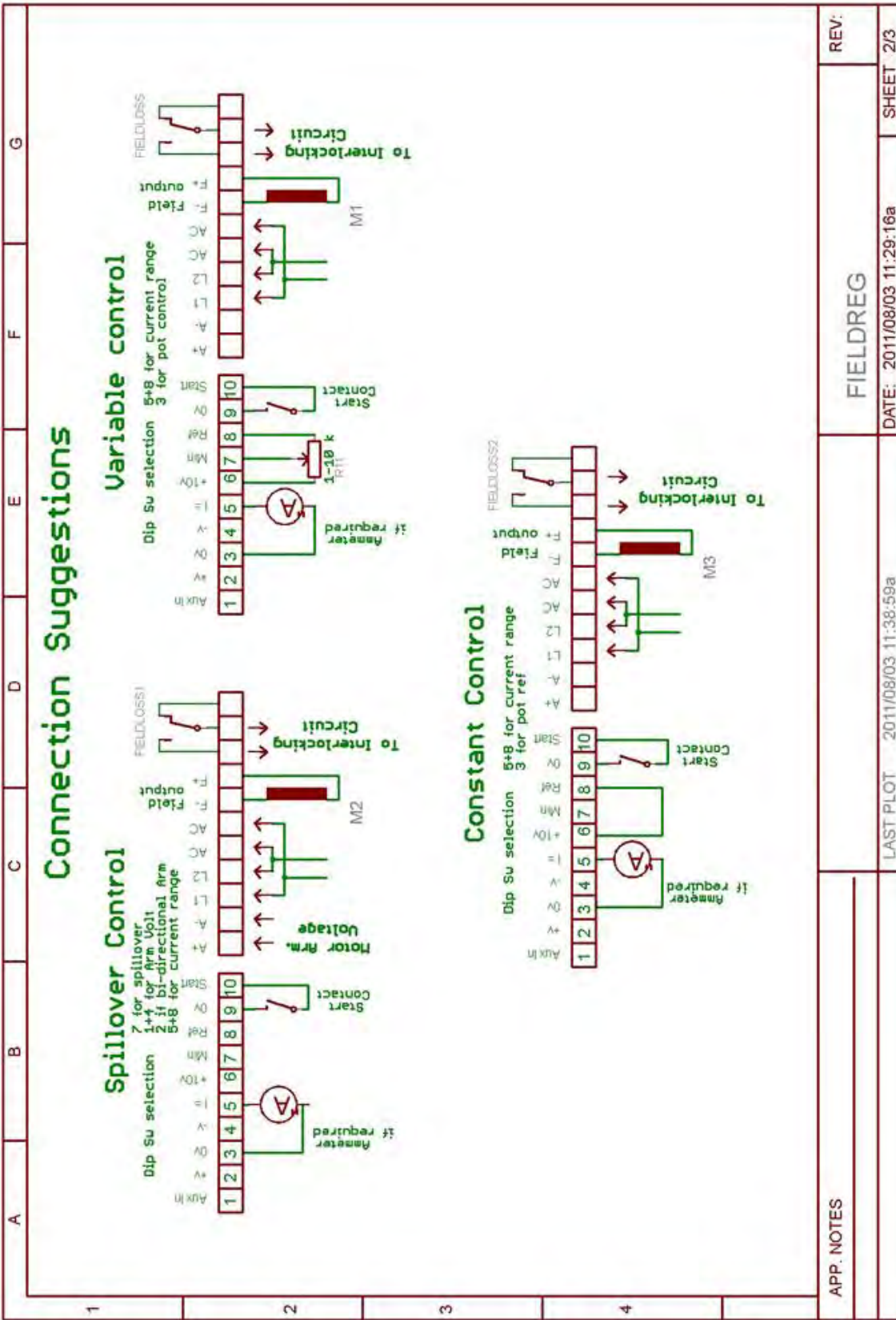
Provision has been made for difficult installations that require additional stability on the field current controls at the solder posts TP 1 and TP 2 for the current amplifier and TP 5 and TP 6 for the voltage summing amplifier.

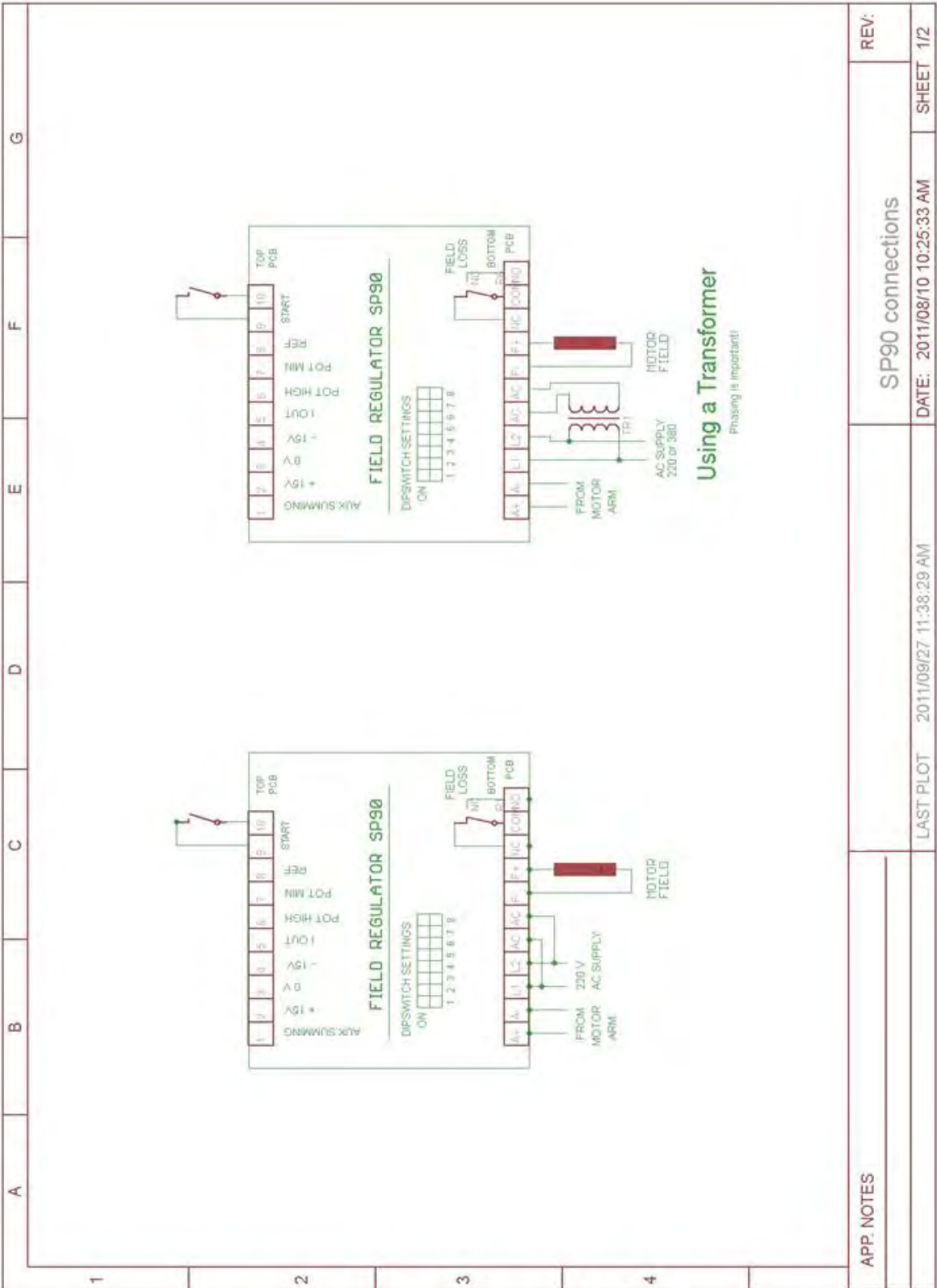
Typically adding a 1 meg resistor to TP 5 and TP 6 and 2.2 meg to TP 1 and TP 2.

If these values are added to these points then it will be necessary to apply the set up procedure again. It is possible that the “Arm. Voltage knee” will now have a flatter profile, this will require the setting of the point at which weakening occurs at a lower value sufficient to achieve a fully weakened field by the time the armature voltage reaches the motor rated value. (Then the field reduction will occur over a 30 to 50 volt armature increase, instead of possibly only 5-10 volts armature.) This should not make any noticeable difference to the motor performance or it’s rated torque outputs.

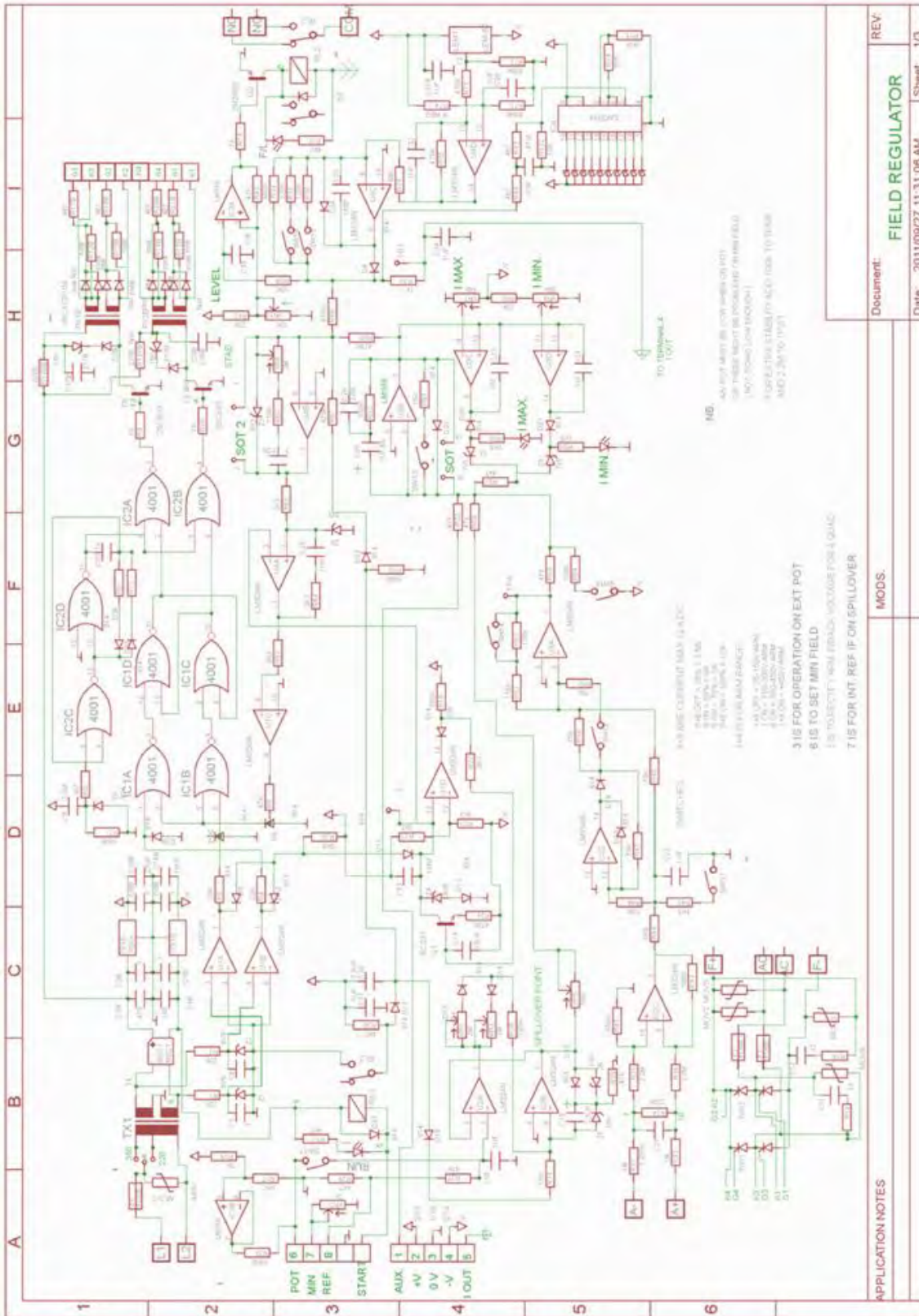
### AUXILIARY SUMMING INPUT:

The Aux summing input is a direct access to the A/V summing amplifier circuit and in the non spill-over mode this amplifier has a limited gain (with Sw3. closed), therefore any input to this point becomes a desired current value. Both polarities are acceptable and a negative will decrease and a positive will increase the desired current value and can be used for both boosting a set field or weaken a set field in start-up or economy mode operations. However no additional input to the Aux summing can force the Field current above or below the set Max I or Min I values. Please refer to the factory for further assistance in this regard.









NO. ADJUSTMENT OF CURRENT ON POT  
 ON THESE POINTS BE POSITIVE (MIN FIELD)  
 (NOT NEGATIVE) (MAX FIELD)  
 # FOR ELECTRIC START (7) ACC. POS. TO TRAIL  
 AND 2-34 TO 1991

4-9 MAX CURRENT MAX RANGE  
 1-4-50T + 0.5A 1.5A  
 2-7-50T + 0.5A 1.5A  
 3-4-50T + 0.5A 1.5A  
 4-4-50T + 0.5A 1.5A  
 5-4-50T + 0.5A 1.5A

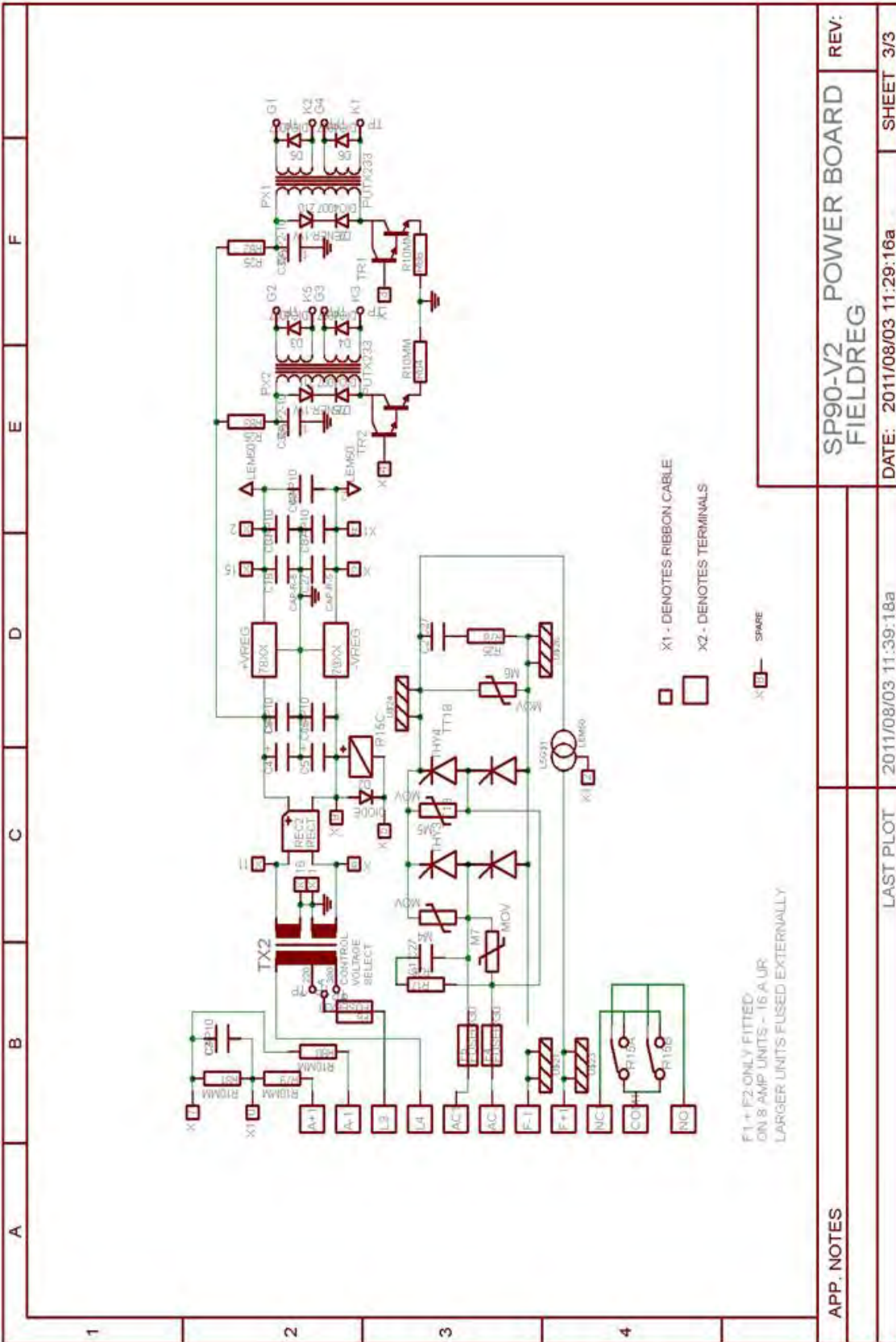
3 IS FOR OPERATION ON EXT POT  
 8 IS TO SET MIN FIELD  
 1 IS TO SELECT 1-4-50T POS. 4-50T  
 7 IS FOR INT. REF. IF ON SPILLOVER

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MODS.

APPLICATION NOTES







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