



Stalex III

Unit R:9
Terex
Bucyrus purple
CAT "killed truck"

Euelid
Hitachi

Wisedn
Liebhers

Letauner
Wabco
Dresser
KDC
Komatsu

WPTU™

Card Serial #

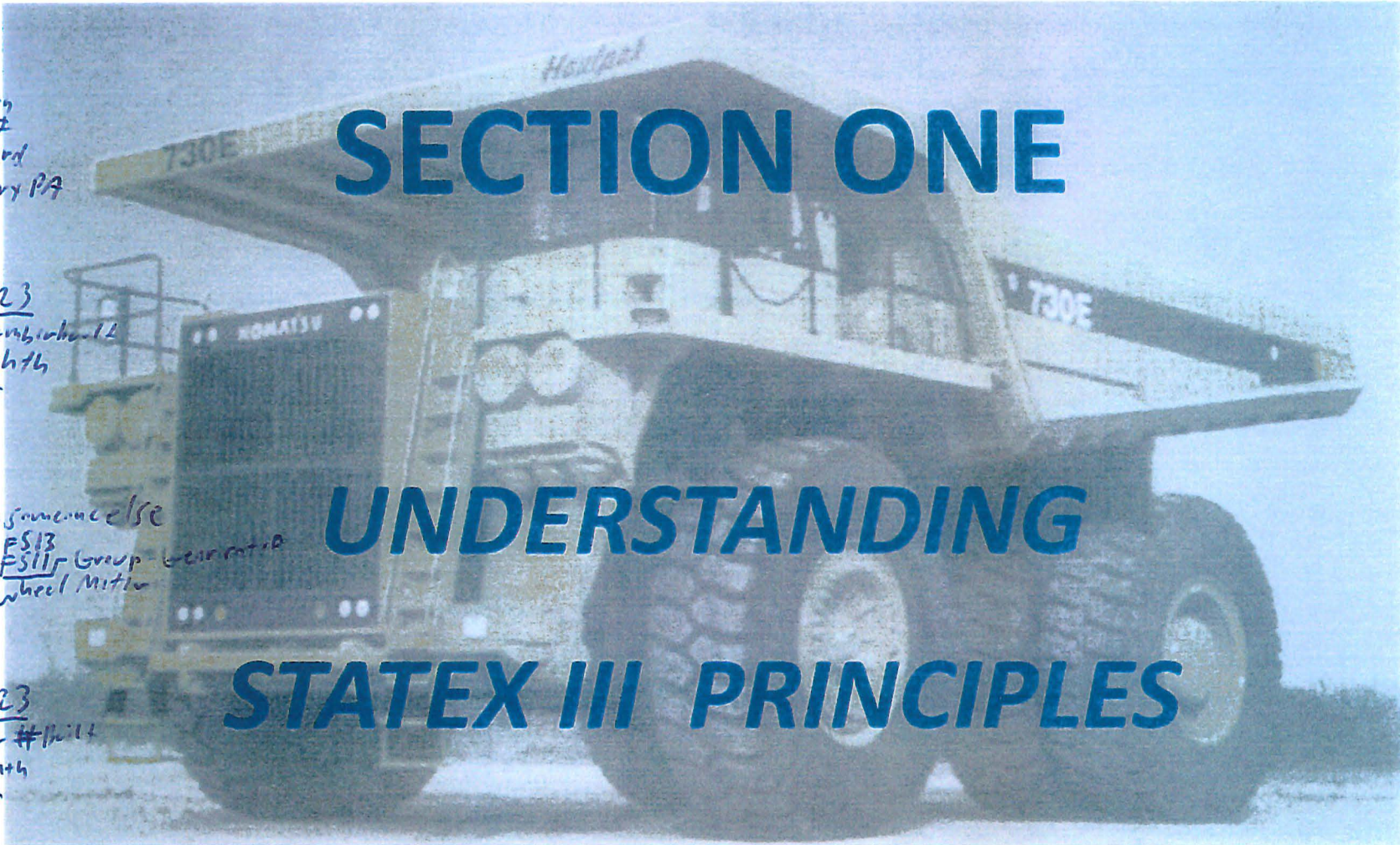
7FB10281
Revision
Card #
8x11 Card
GE Gray PA

FB180200123
month
year

EM panel

AI - Built by someone else
FS13
FS11 Group - generator
56E787 wheel motor
rotating

W991200123
L # built
month
year



SECTION ONE

UNDERSTANDING

STATEX III PRINCIPLES



CPU cards

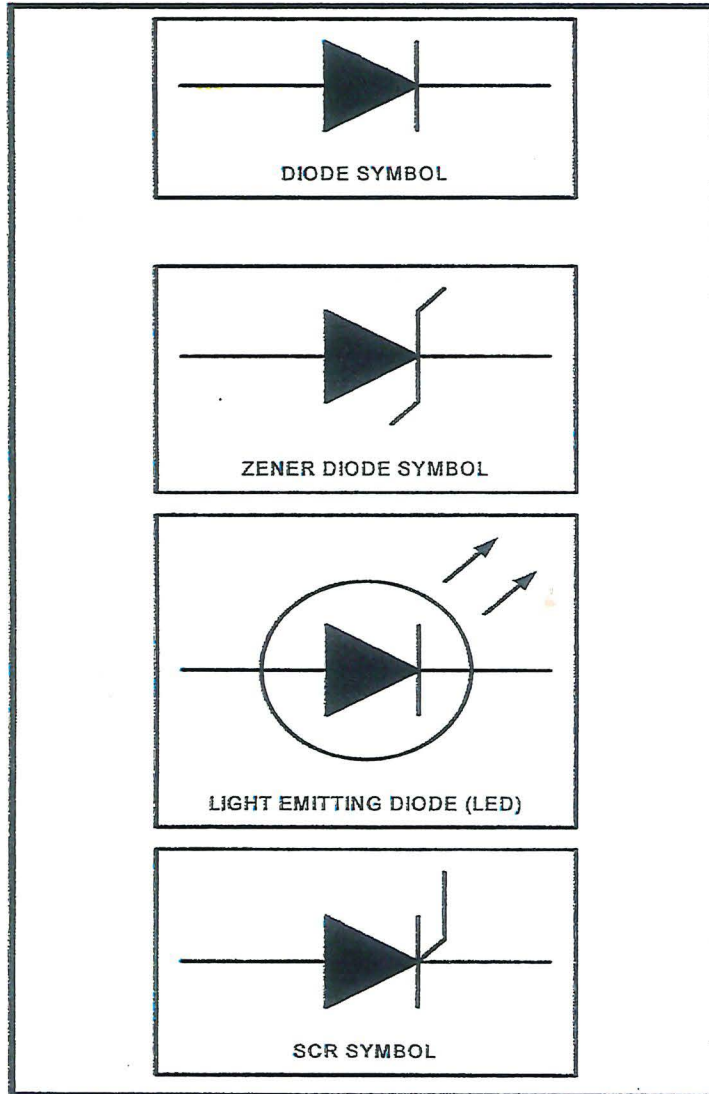
no 121 16MHz
Jung 144 25MHz
174
187 120MHz

Ar D... 1001

2
GE Transportation
Mining

STATEX 3-1992

189 optime



Diode

Electrical one way device – will conduct when “forward biased” only

Zener Diode

Electrical two way device – one way as per diode and can be used to pass current in “reversed biased” direction based on level of reverse bias voltage.

Light Emitting Diode

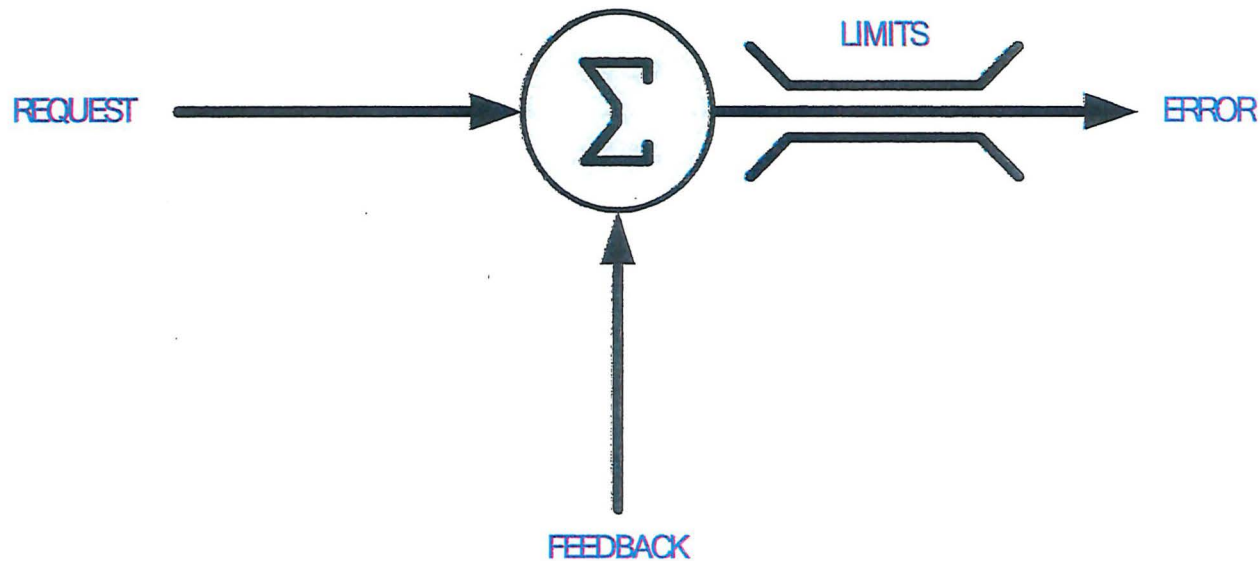
Electrical one way device - used for indication purposes on cards, etc.

Silicon Controlled Rectifier (SCR)

Electrical one way device – will conduct in forward biased direction only when gate signal applied.

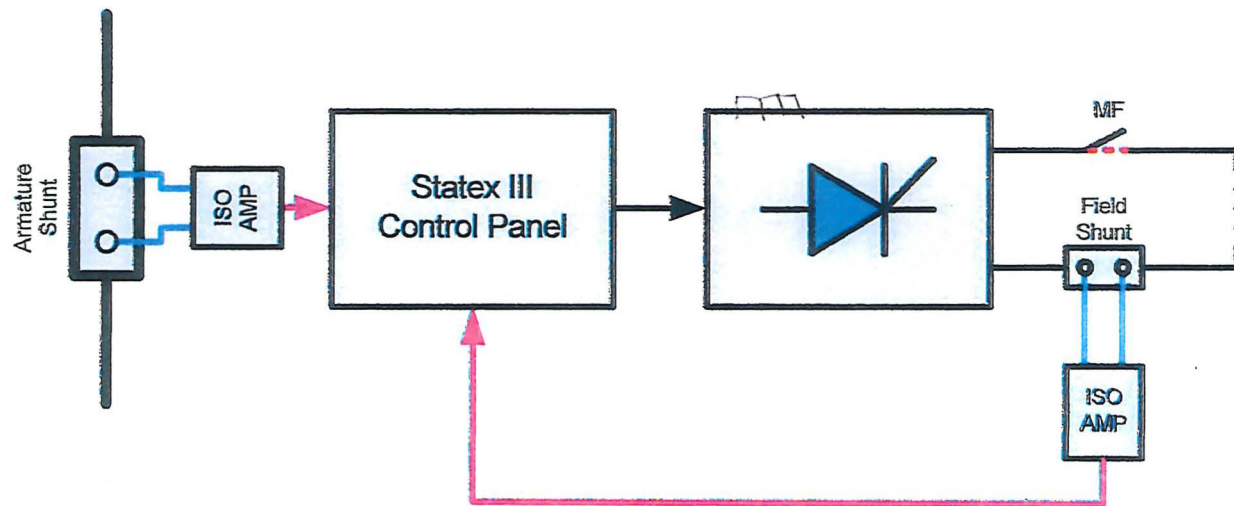
CONTROL LOOP

- Many electrical control systems use the Request – Feedback – Error system
- Request compared with feedback to produce error signal which is generally used to turn “on or off” a controlling device.
- Limits prevent system exceeding rated values.



Control Loop – Motor Field Current in Propel – Basic Overview

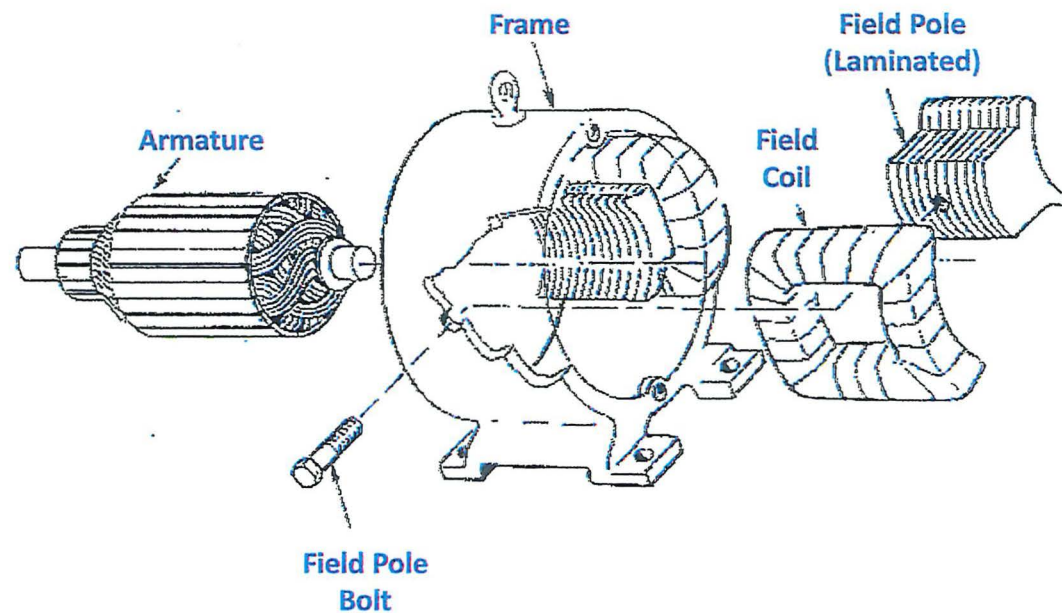
- Within Statex we use the Request – Feedback – Error system
- An Example below shows how the Motor Field Current is controlled in Propel.
- A request for Motor Field current in Propulsion is based on Wheelmotor Armature Current. Armature current feedback enters control system and is compared with Motor Field Current feedback which would initially be low if the truck had just gone into propulsion.
- As a result error would be high and the firing pulses to the exciter would turn on the SCR's to develop current in motor field.
- As motor field current increases the difference between “request and feedback” will decrease and the error will reduce also lowering the firing to the exciter.



DC Motor Principles

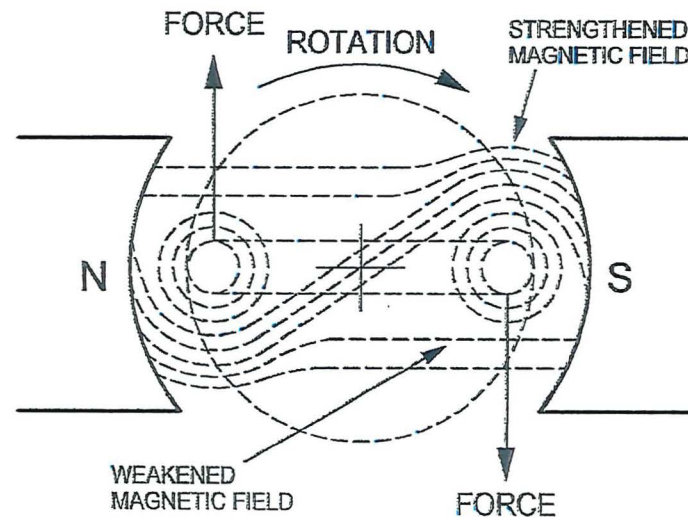
Generally a DC motor consists of:

- Frame
- Laminated Field Pole
- Field Coil
- Armature



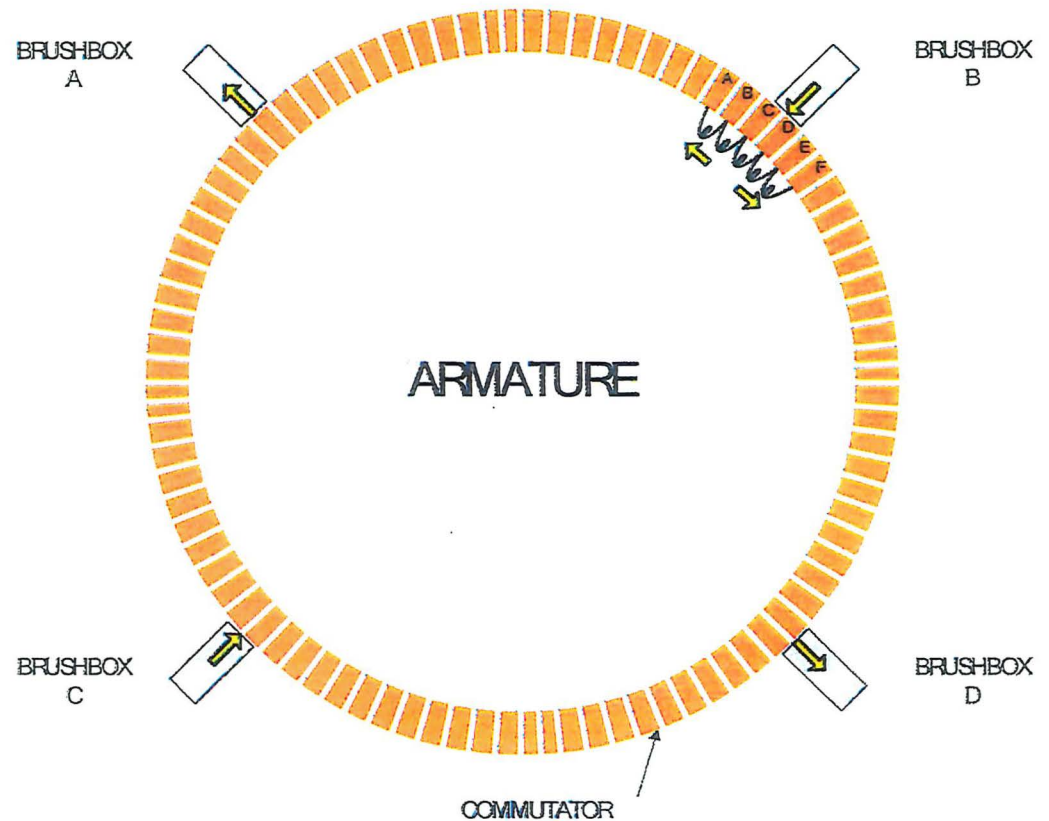
DC Motor Principles

- The basic principle of operation of a DC motor uses the principle of magnetism. In the case of a DC motor the magnetism is produced by an electric current.
- When electrical energy is applied to a DC machine, current flows in the armature conductors and produces a magnetic field that affects the main magnetic field.
- The two magnetic fields tend to neutralize each other on one side of the conductor, giving a weakened field, while the main field is strengthened on the other side.
- The resulting magnetic field produces a force that acts on the conductors as indicated.



COMMUTATION

- Is the successful reversal of current in an individual armature winding as it passes from one side of the brush to the other.
- Current enters the brush box and splits in each direction as shown right.
- This different direction in current creates different magnetic polarities in the respective windings in the armature.
- These polarities react with field circuit flux (magnetic) to cause rotation.
- This magnetic relationship needs to be maintained to cause rotation to continue.

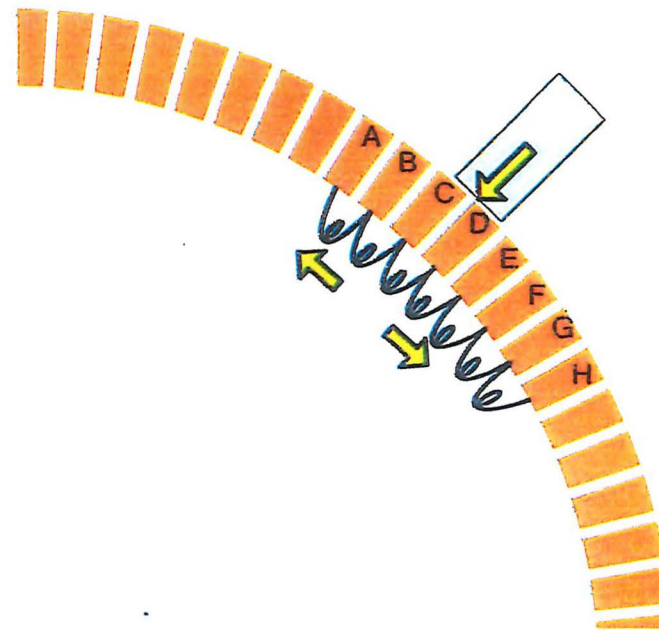


COMMUTATION

–The following is a summary of the respective current flows:

- » Winding A-B Right to Left
- » Winding B-C Right to Left
- » Winding C-D Shorted – Zero
- » Winding D-E Left to Right
- » Winding E-F Left to Right

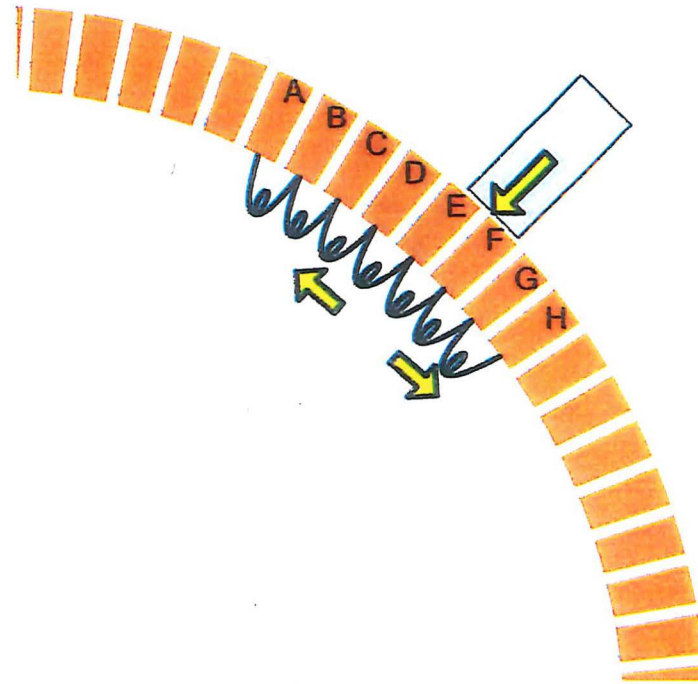
–The magnetic field around the windings between segments A and C will be the opposite polarity to that of the windings between D and F



BRUSHBOX

COMMUTATION

- As the armature rotates in an anticlockwise direction, windings D to E move from one side of the brush to the other.
- As the brush shorts out windings D to E the current that was flowing Left to Right will fall to zero.
- As the segments pass the opposite side of the brush the current rises in the opposite polarity providing the magnetic field to continue the motion of rotation.
- This is the process of commutation.



BRUSHBOX

MOTOR SPEED

- The speed of a DC motor is determined by the applied voltage and field strength.
- The motor will accelerate until the back EMF (the voltage *GENERATED* by having windings rotating in a magnetic field) equals the applied EMF.
- At this point the current flow into the motor will be very low (cannot be zero as this would result in zero torque and as a result the motor would slow down).
- Weakening the field on a DC motor will reduce the back EMF generated and as a result armature current will be drawn from the supply.
- This will create torque in the motor and the armature speed will increase until the back EMF equals the applied EMF.

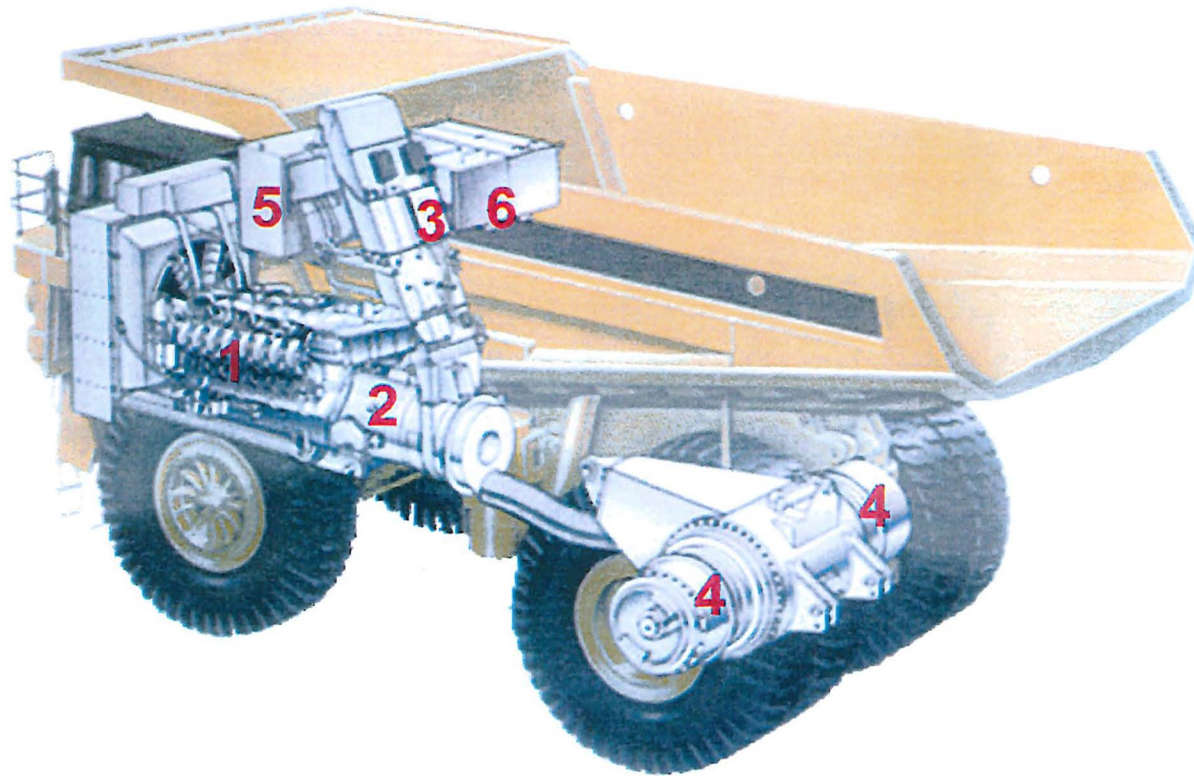
STATEX III PRINCIPLES

MAJOR COMPONENTS

1. Engine
2. Alternator
3. Rectifier
4. Motors
5. Control (Microprocessor)
6. Grid Box

COMPONENT PURPOSE

1. Develops mechanical energy
2. Converts Mech Energy to AC Elec Energy
3. Converts AC Elec Energy to DC Elec Energy
4. Convert DC electrical energy to mechanical energy
5. Multiple Components - Interfaces Program logic with real world
6. Converts Electrical Energy to Heat



AFSE - Alternator field static exciter

Main Circuits

Armature Circuit (2 parts – propel and retard)

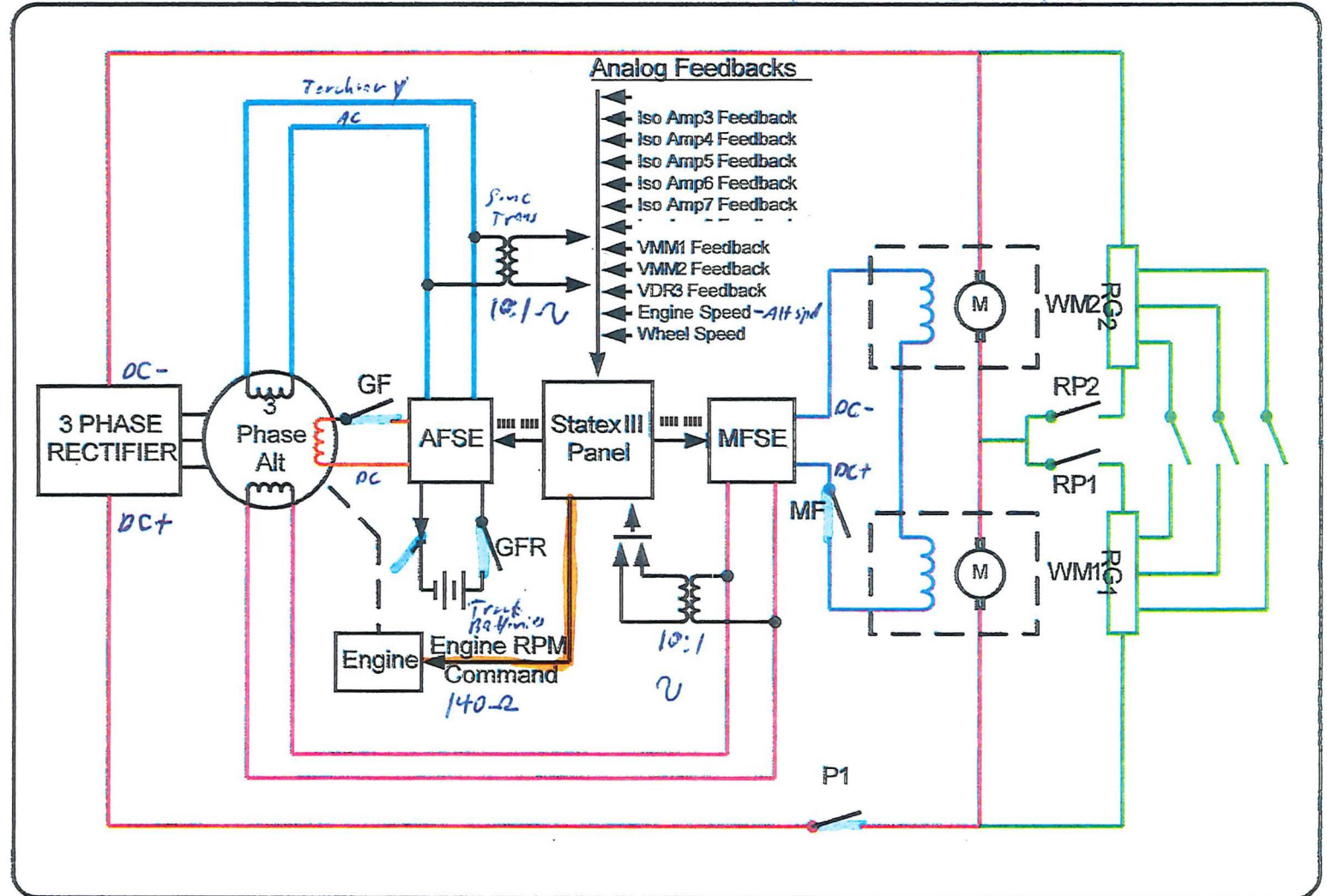
Motor Field Circuit

Alternator Field Circuit

Battery Boost Circuit

Motor Field Tertiary Circuit

Alternator Field Tertiary Circuit



— statex sends frequency signal to engine ecu (pedal position error)

SECTION TWO

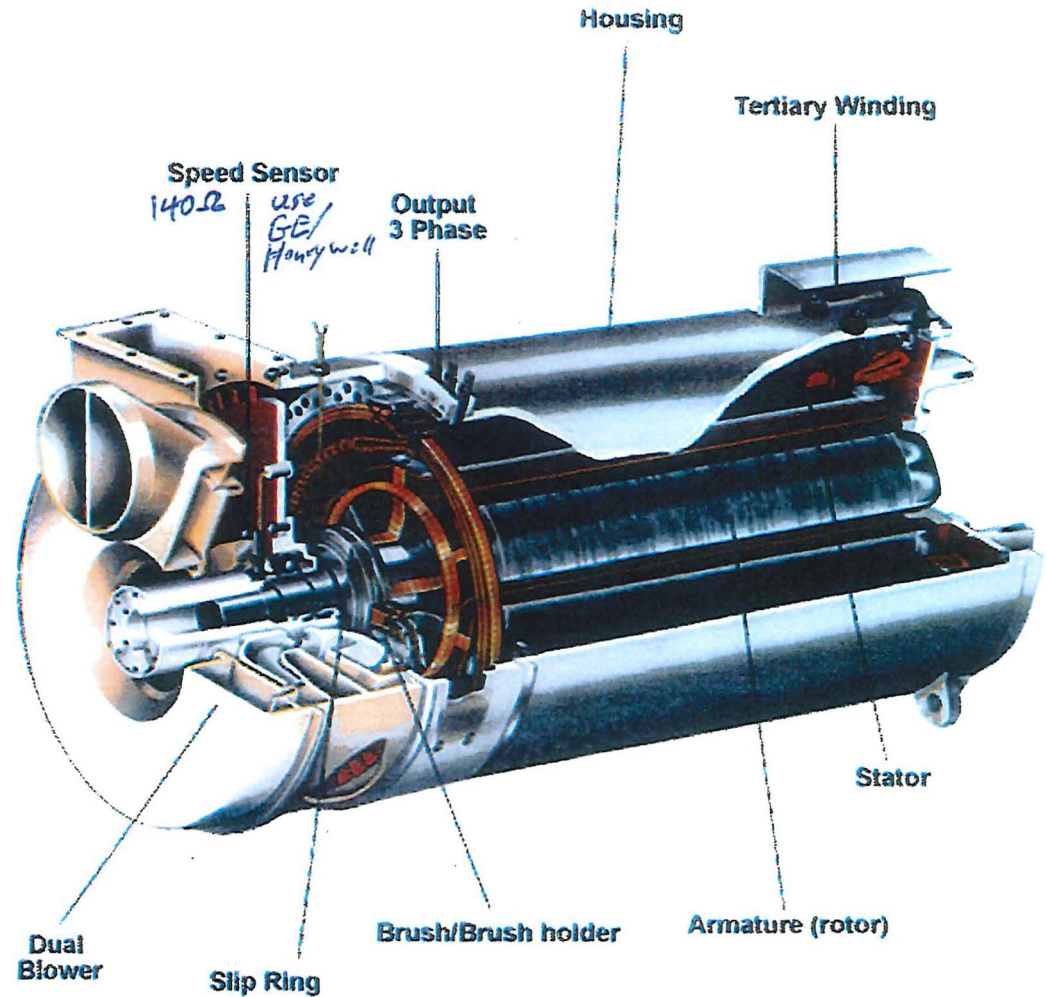
SYSTEM COMPONENTS

SYSTEM COMPONENTS 5GT A26

*AC Trucks
2500 hrs swap slip ring polarity*

MAIN ALTERNATOR

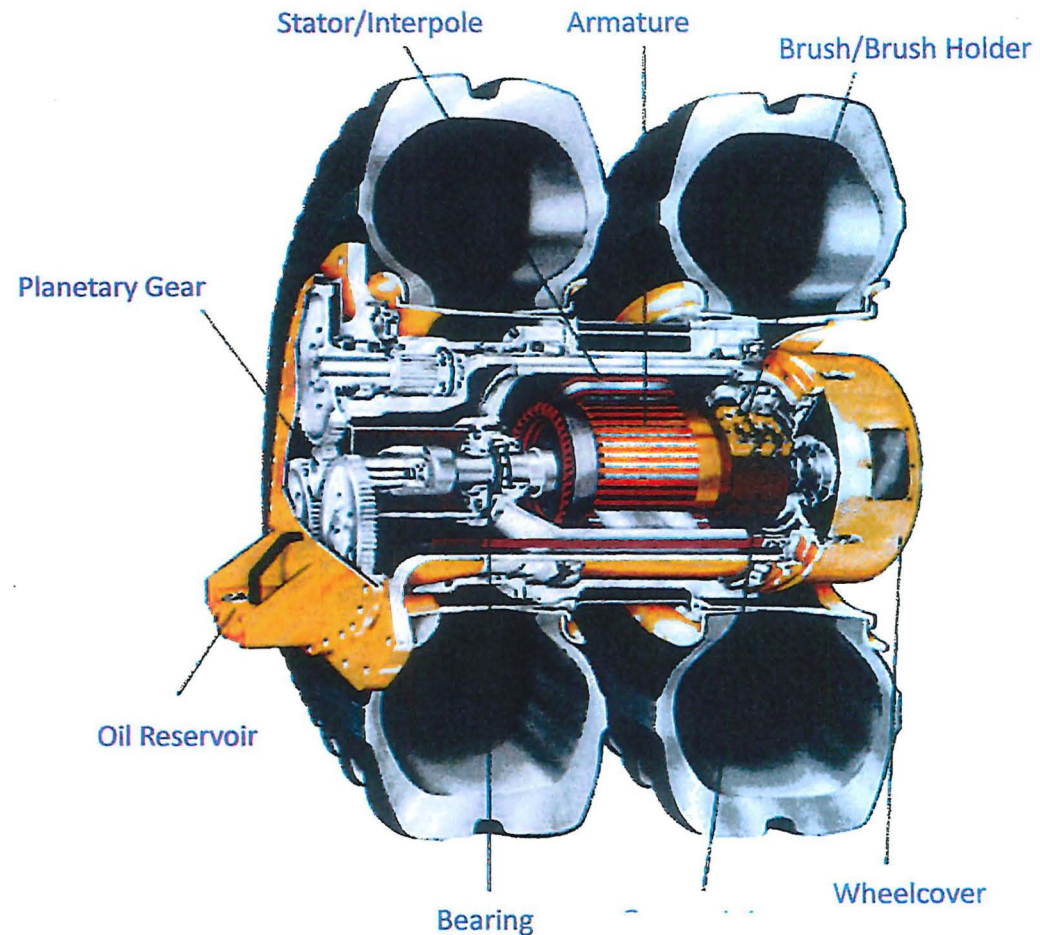
- Traction Alternator is a three phase, Y connected, AC generator.
- Intergrated blower for wheelmotors and control group.
- Tertiary windings for supply to AFSE & MFSE.
- Wound rotor used to vary output from alternator by varying rotor current.



*5GT A26 A1
F4*

WHEEL MOTORS

- The wheelmotor is a force ventilated DC motor that converts electrical energy to mechanical energy.
- Armature drives through sun pinion into planetary gears that in turn drive hub.
- Planetary gears run in oil bath – wheel bearings are greased.
- Brushboxes and brushes provide for the electrical transfer of current into and out of the commutator / armature.



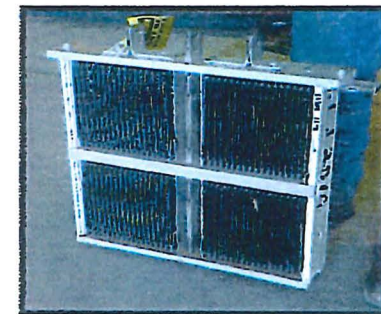
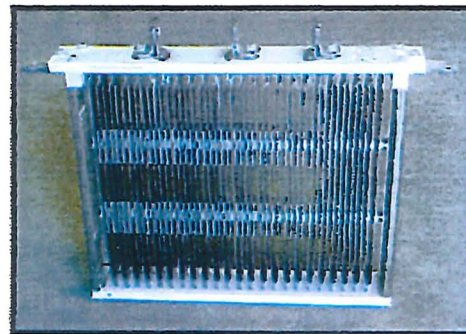
SYSTEM COMPONENTS

17EA20H120
123
108

17EA33D420
0306
J
NEW

GRID BOX

- The retarding grid box converts the electrical energy generated by the wheelmotors in retarding into heat.
- The grid box assembly can consist of 12,14,18 & 20 grid element configurations.
- The grids are cooled by one or two grid blowers that are connected in parallel with some of the grid resistance.
- Ensure different styled grids are not mixed as this can create air flow issues

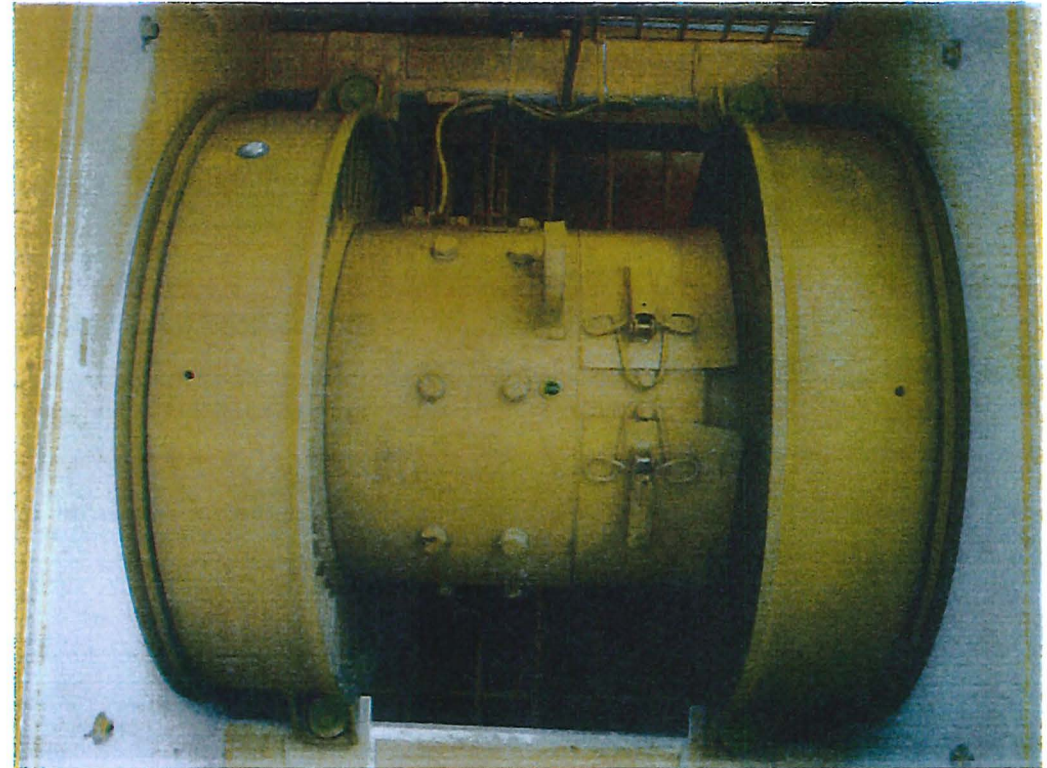


SYSTEM COMPONENTS

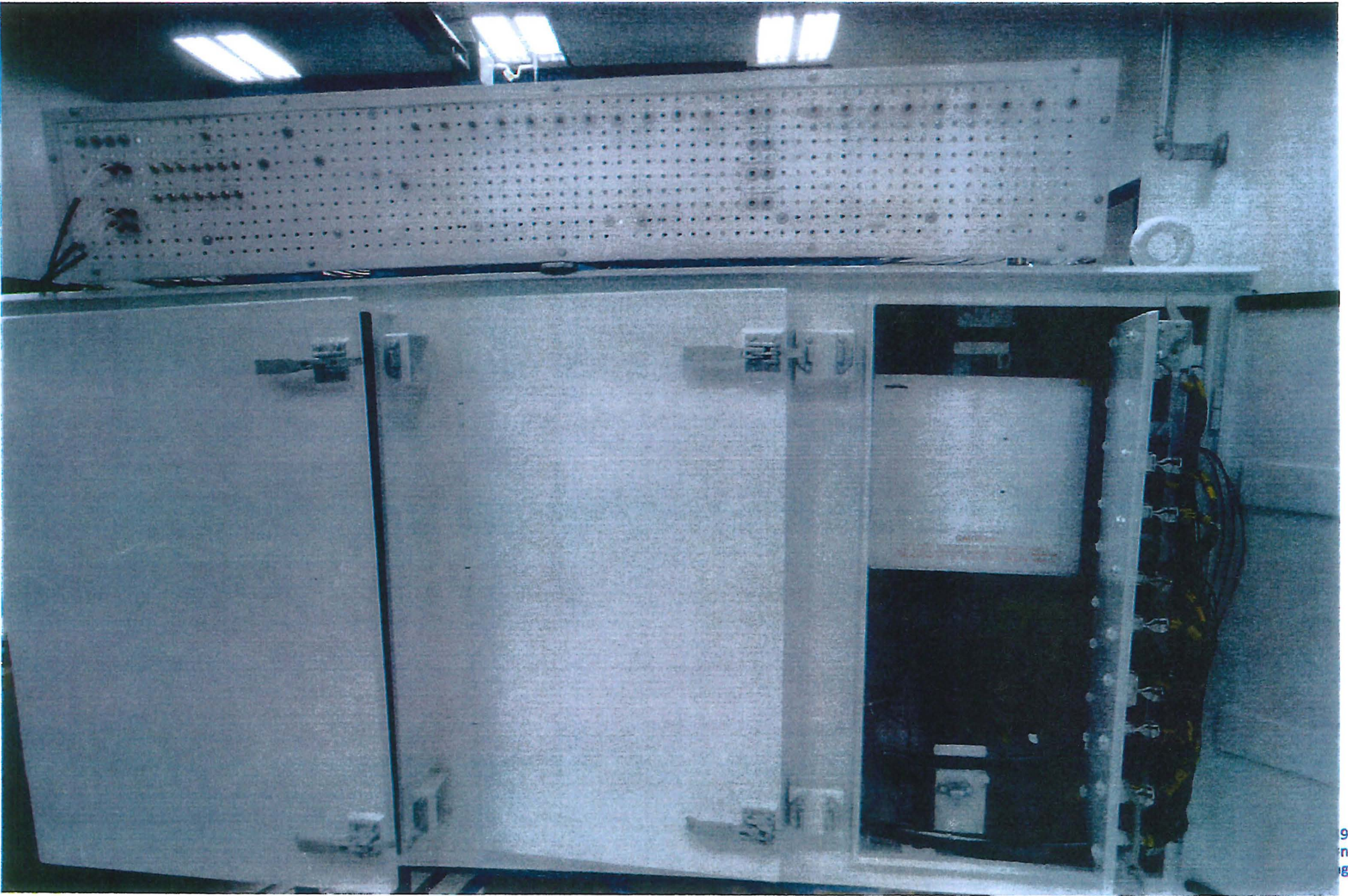
56Y19L6 4 mount
 L5 4 mount no grounding brush
 L1 3 mounts
 A3 3 mount - smaller

GRID BLOWER

- The Grid Blower is used to cool the retarding grids during retard.
- The motor is a series DC motor that is connected across a portion of the retard grids and the speed of the motor will be dependant on the voltage applied to the motor.
- There are two fan assemblies, one at either end of the blower assembly which blow away from the blower assembly.
- Care needs to be taken if driving truck on one wheelmotor – ensure grid blower is still in circuit.
- In-rush current

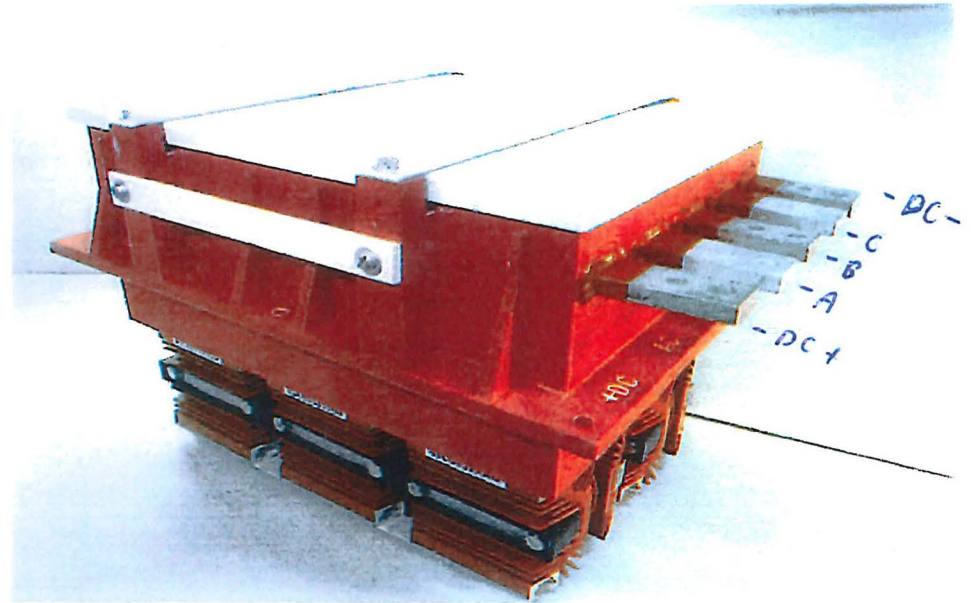


61 - Blower Motor 1
 62 - Blower Motor 2
 check grid bank 2



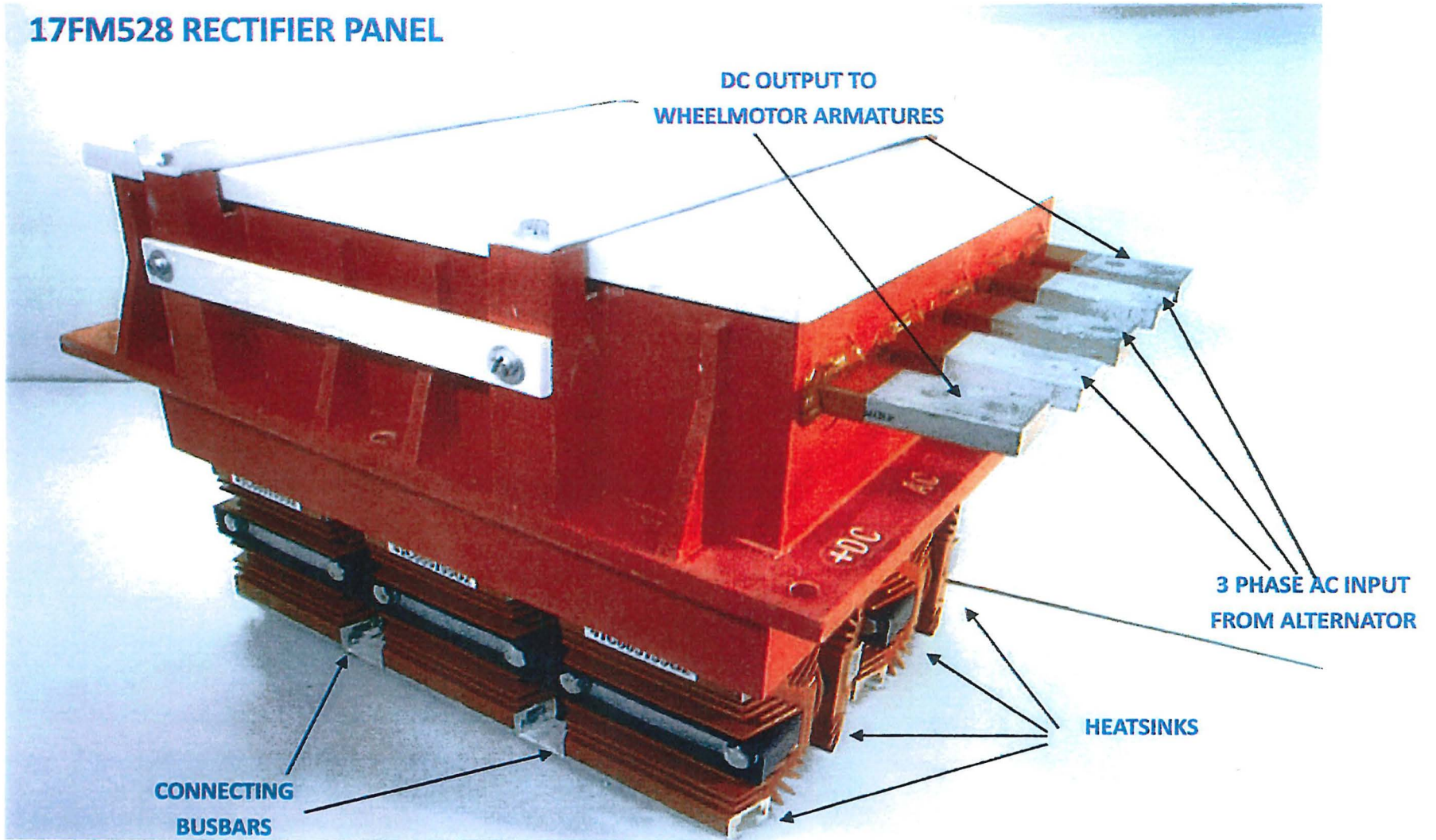
17FM528 RECTIFIER PANEL

- Main Rectifier converts AC Electrical Energy to DC Electrical Energy
- Rectifier is a Three Phase Full Wave Bridge rectifier assembly.
- Consists of 6 diodes/heat sink assemblies.
- Not recommended to change diode but rather complete diode/heatsink assembly.
- Can be checked by testing for a short circuit from the DC+ and DC- to any of the three phase connections.



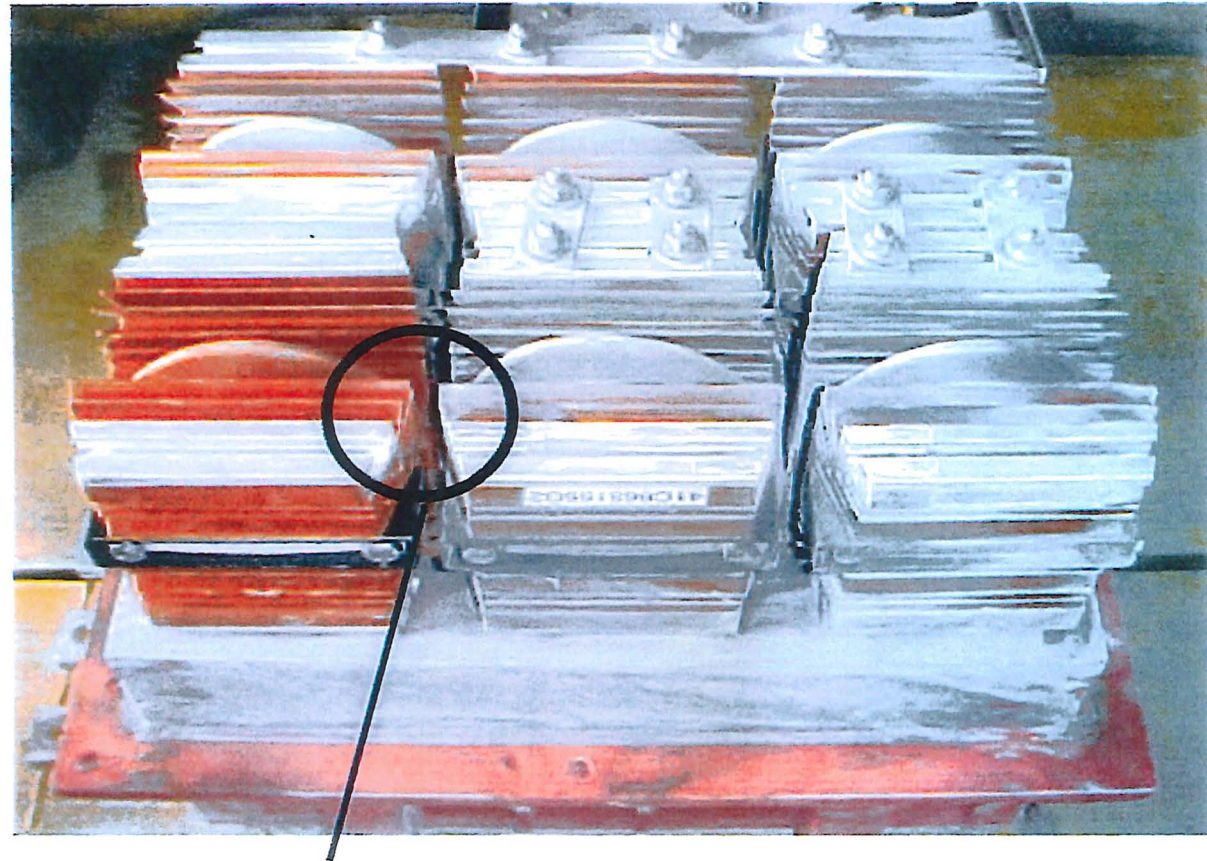
SYSTEM COMPONENTS

17FM528 RECTIFIER PANEL



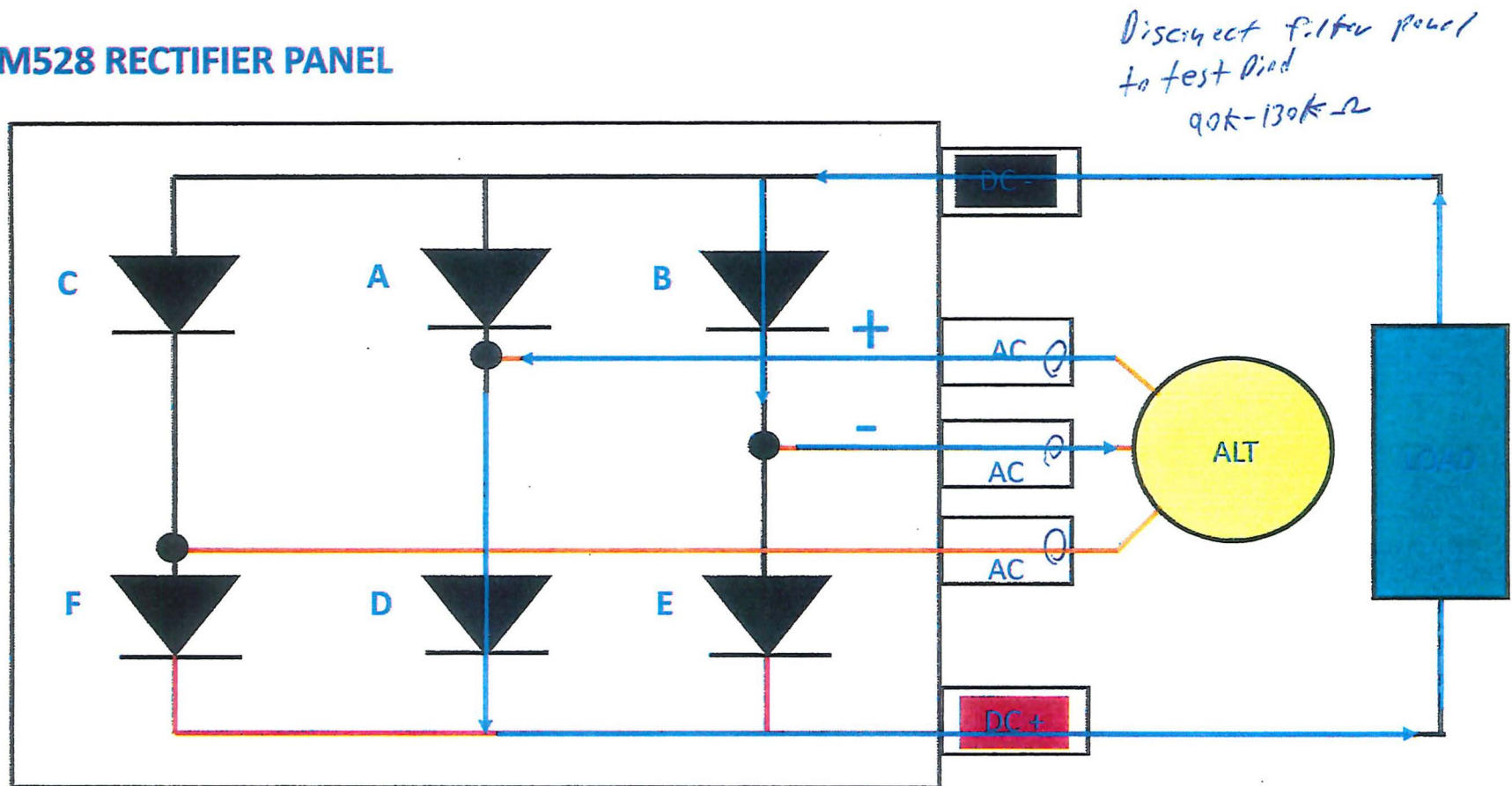
17FM528 RECTIFIER PANEL HEATSINK ASSY 41C665155G*

code 45-1 senses ripple
shorted Diode
check filter panel

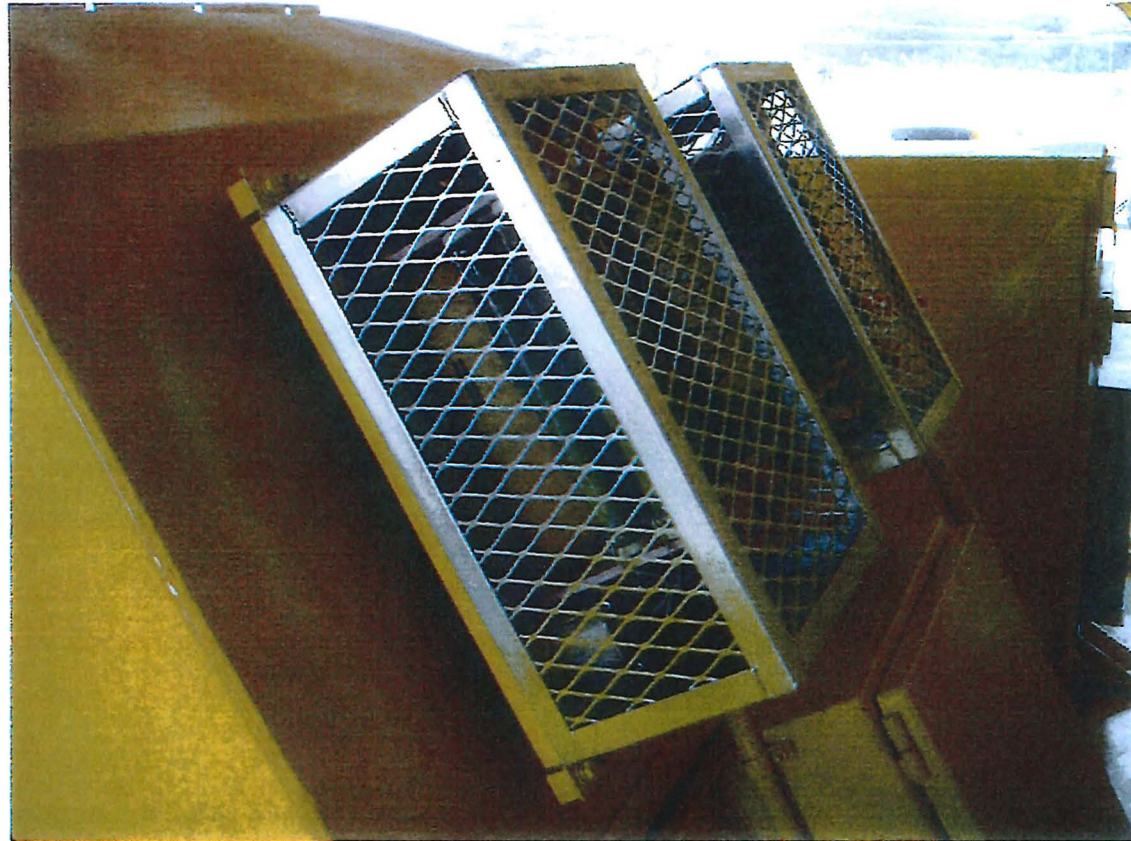


- MAINTAIN GAP BETWEEN HEATSINKS BETWEEN 10-12MM
- OBSERVE CORRECT POLARITY OF HEATSINKS DURING REPLACEMENT
- ENSURE BUSBAR LINKS ARE PLACED IN CORRECT POSITIONS AND TIGHTENED

17FM528 RECTIFIER PANEL



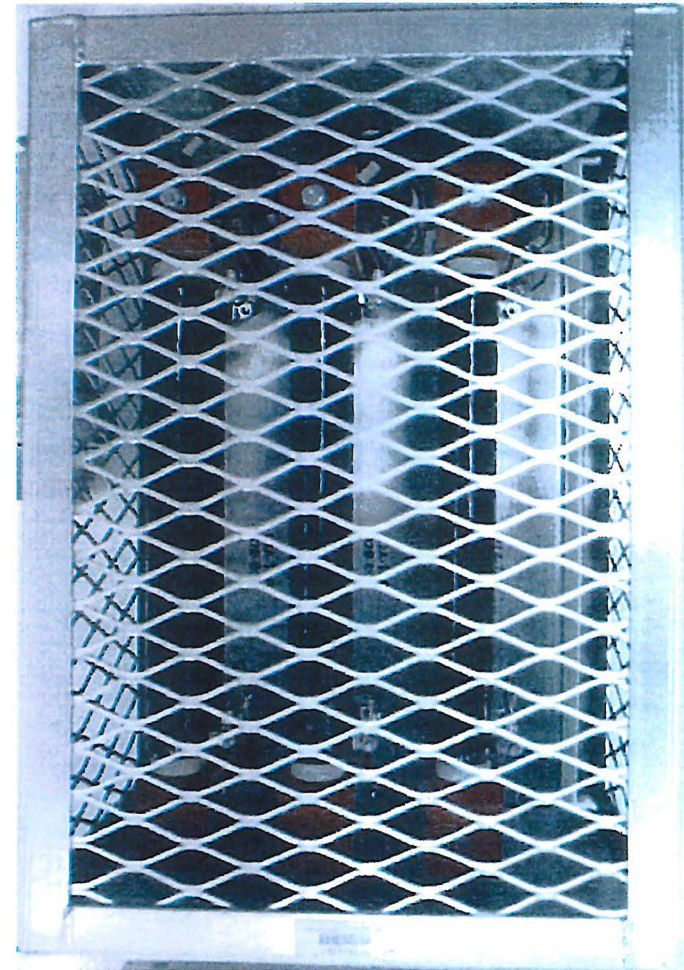
17FM460 FILTER PANEL



17FM460 FILTER PANEL

- Filter Panel used to filter out noise from the AC supply produced by the Main Alternator.
- Simple RC (Resistor/Capacitor) network construction.
- Protects the main rectifier diodes by filtering out any transient high voltage spikes.
- Disconnect main alternator connections and one leg of filter circuit to test with multimeter,

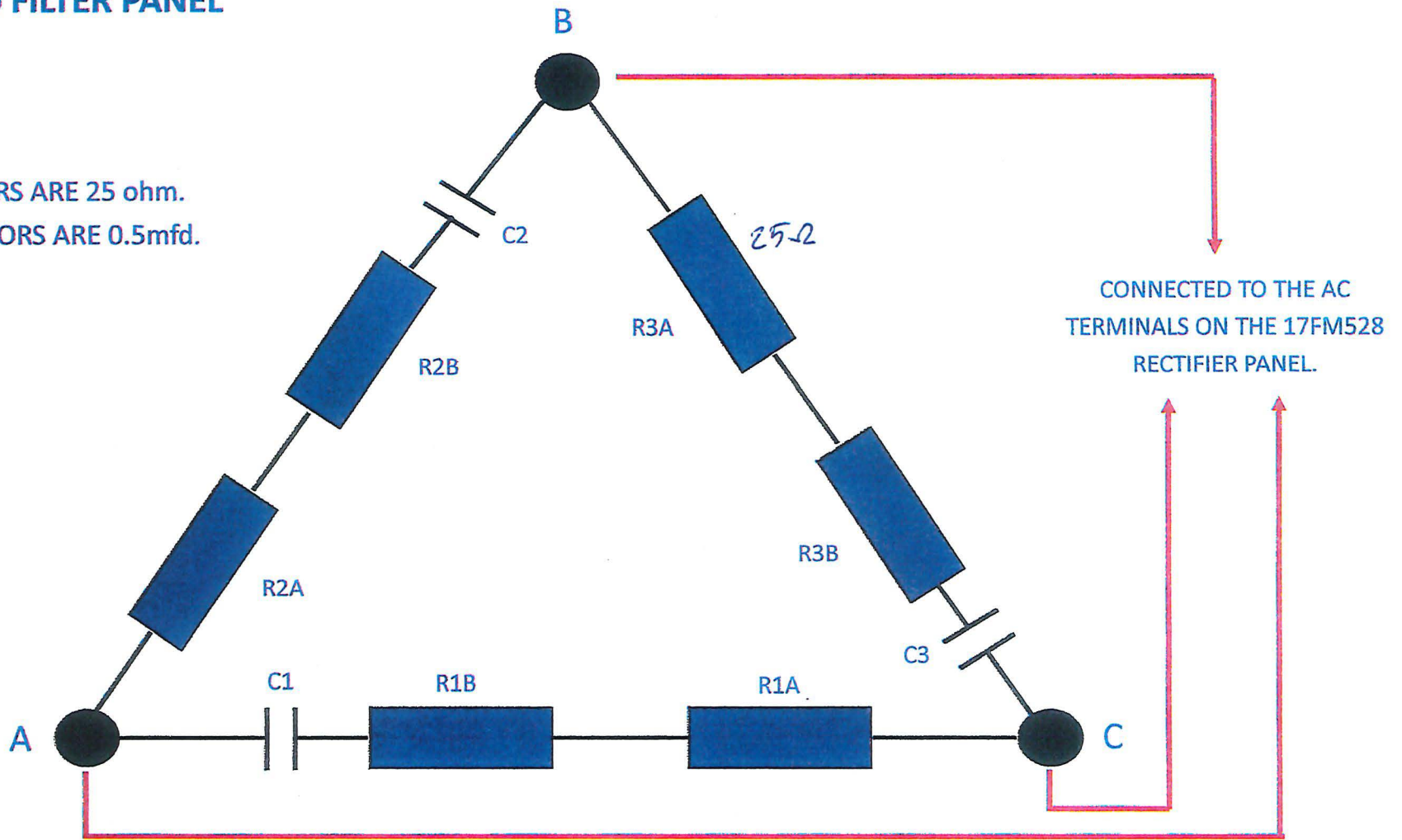
*If bad em cause: Alt. sliprings wear faster
wheel motor to flash*



SYSTEM COMPONENTS

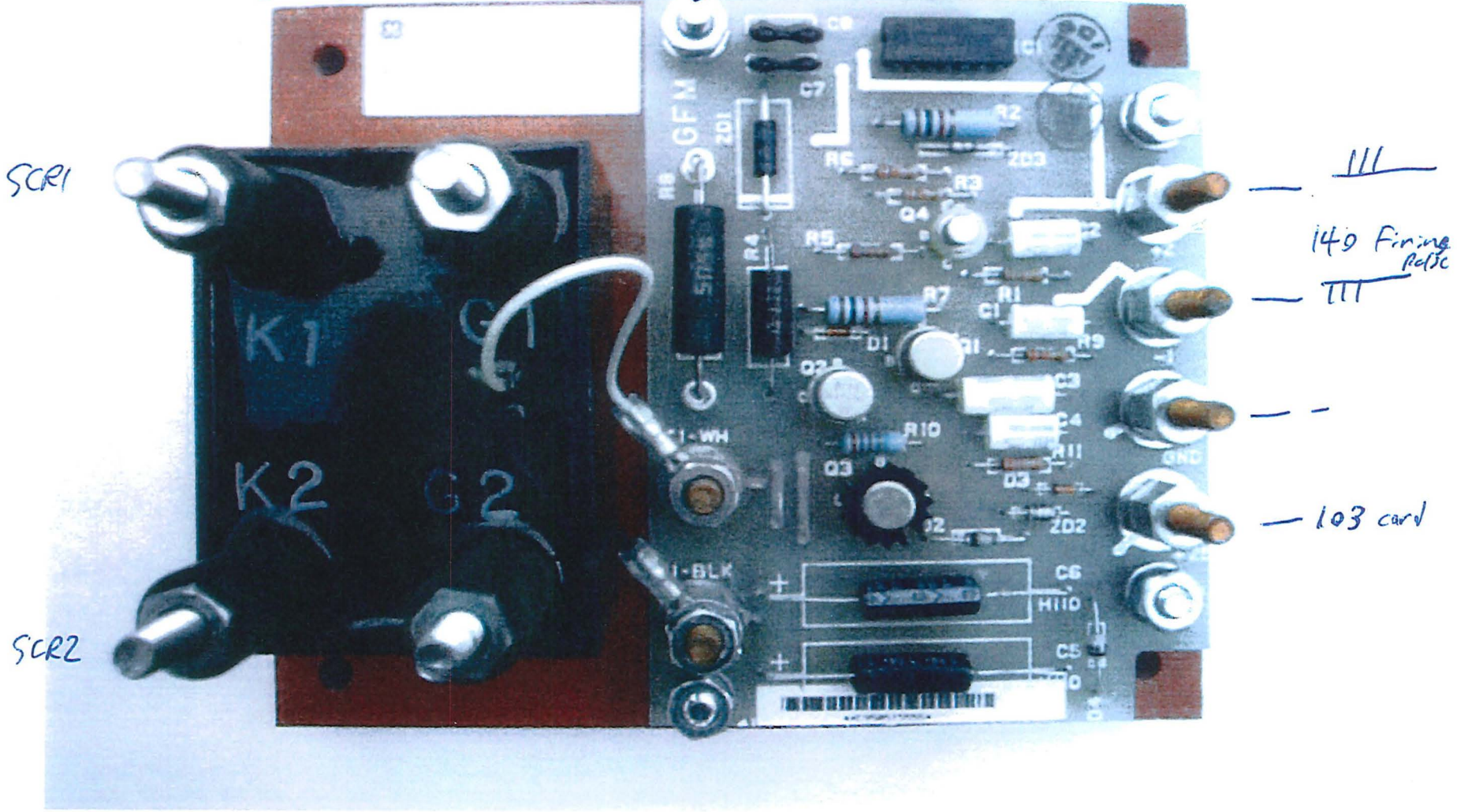
17FM460 FILTER PANEL

NOTE:
ALL RESISTORS ARE 25 ohm.
ALL CAPACITORS ARE 0.5mfd.



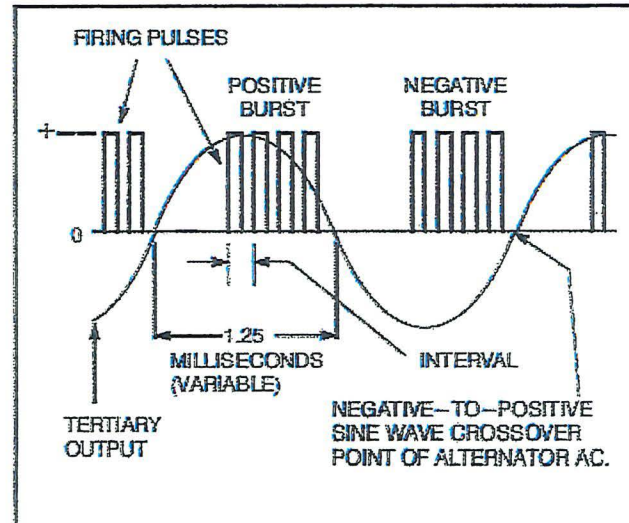
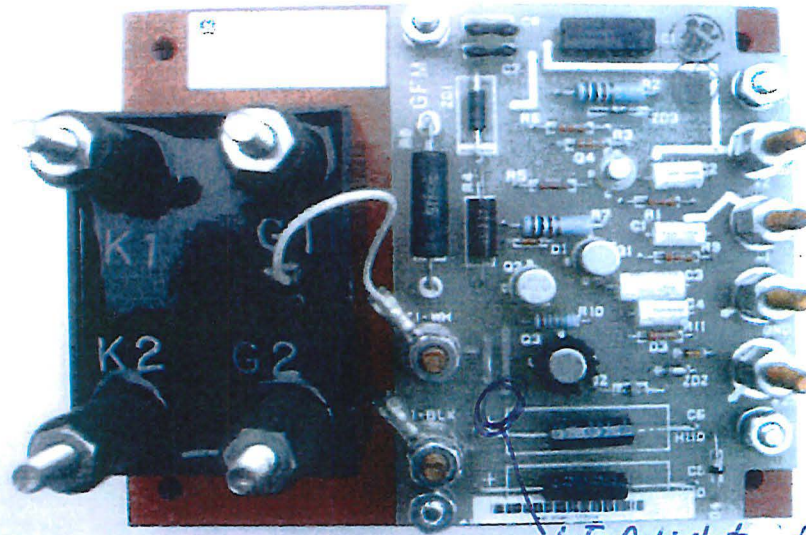
SYSTEM COMPONENTS

17FM415 MODULE (complete GFM) *Gate Firing Module*

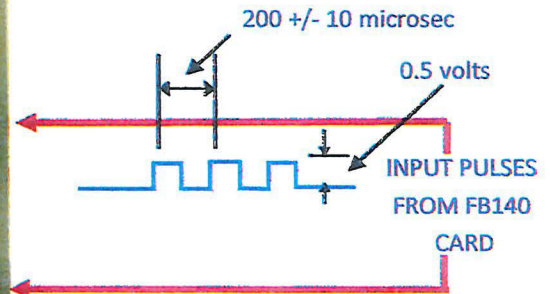
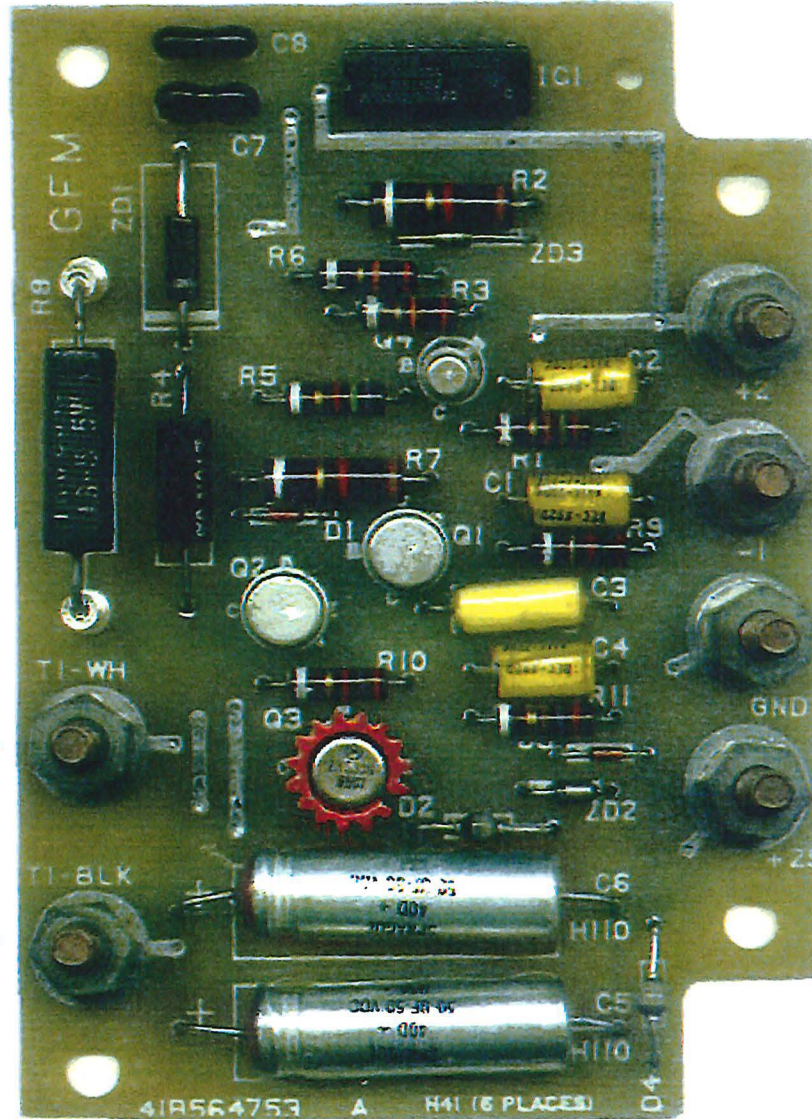


GATE FIRING MODULE (GFM)

- Gate Firing Module takes the firing pulses from the Statex FL275 panel and doubles the amplitude of the pulses to send to the pulse transformer.
- An LED module (not shown) indicates the presence of firing pulses to the Pulse Transformer.
- Check for +24V at terminals +25 and GND.
- Check for AC millivolts at +2 & -1 terminals if LED not lit.

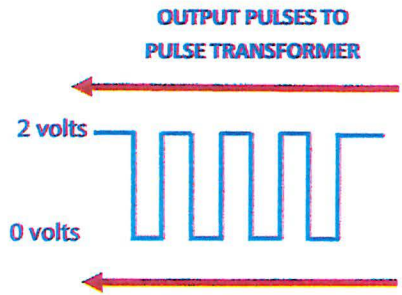


GFM MODULE



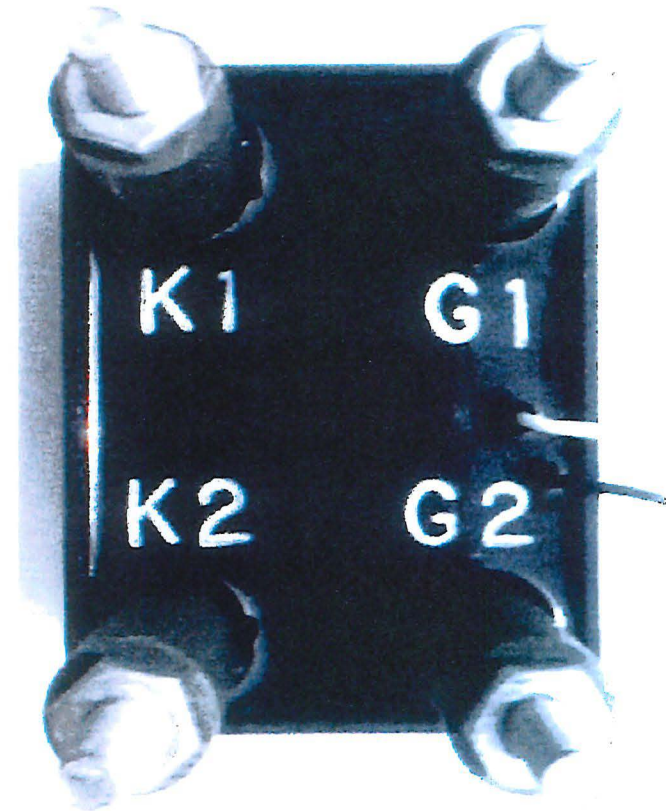
COMMON

24v Digital output from FB10 card



PULSE TRANSFORMERS

- The Pulse Transformer takes the single output pulse from the GFM and converts the signal into two identical pulses for each of the Static Exciter SCR's.
- Can check for Open Gated SCR by checking resistance between G1 and K1 or G2 and K2.
- Normal gate resistance should be 10 to 30 ohms.
- An open circuit gate connections will show as a 100 ohms.

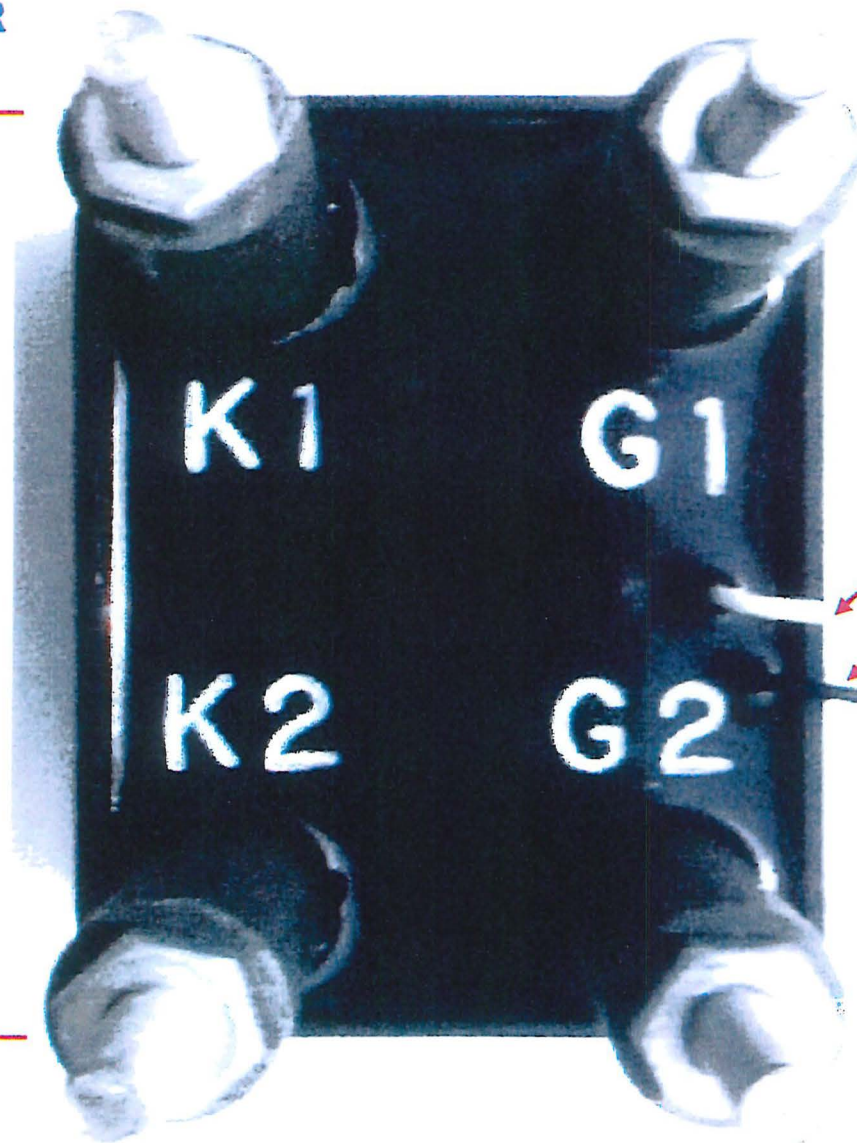


SYSTEM COMPONENTS

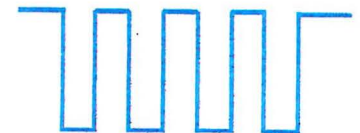
PULSE TRANSFORMER

TO CATHODE
OF SCR1

TO GATE
OF SCR1



PULSES FROM GFM
MODULE GO TO
WHITE & BLACK
LEADS



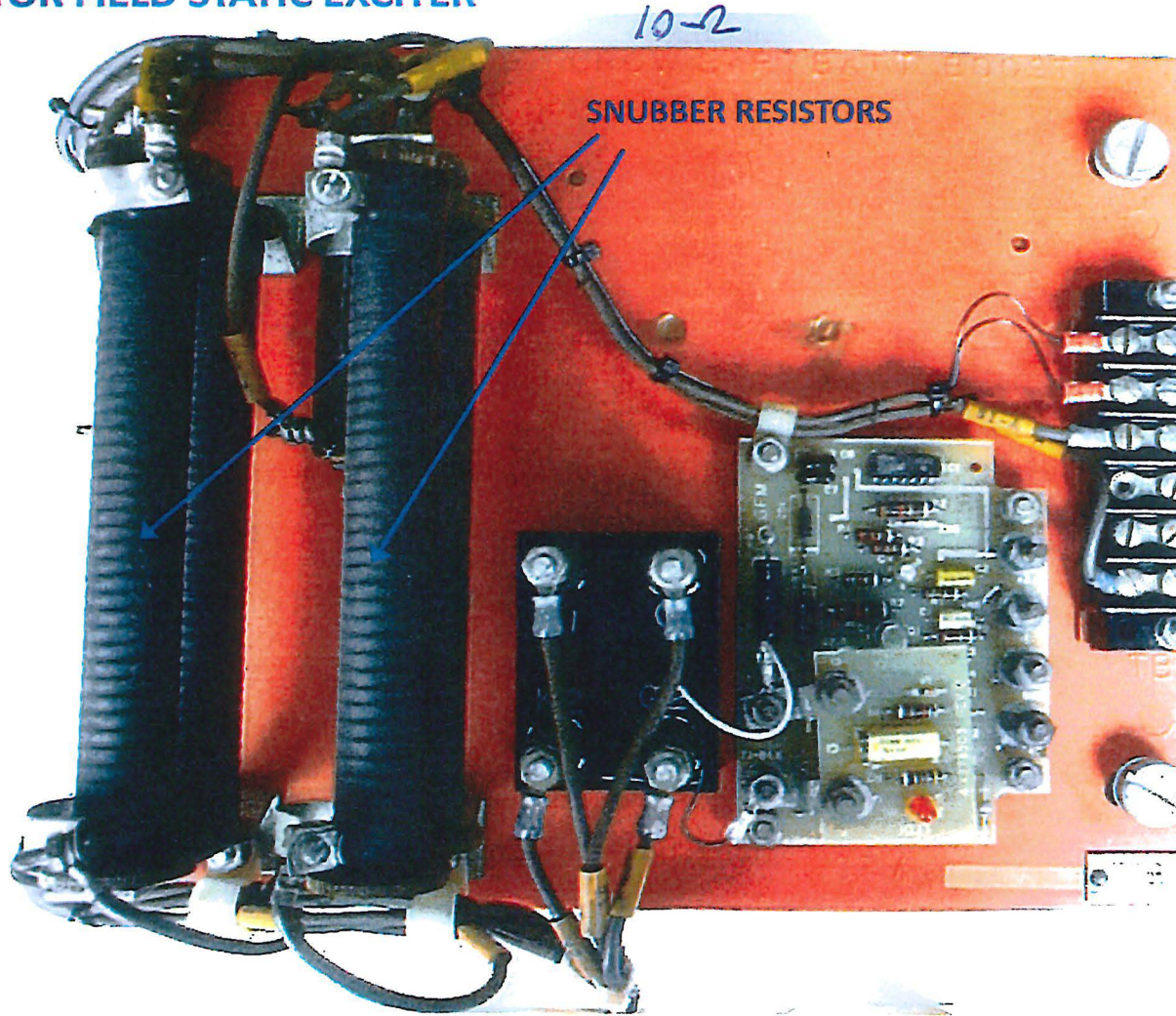
TO CATHODE
OF SCR2

TO GATE
OF SCR2



SYSTEM COMPONENTS

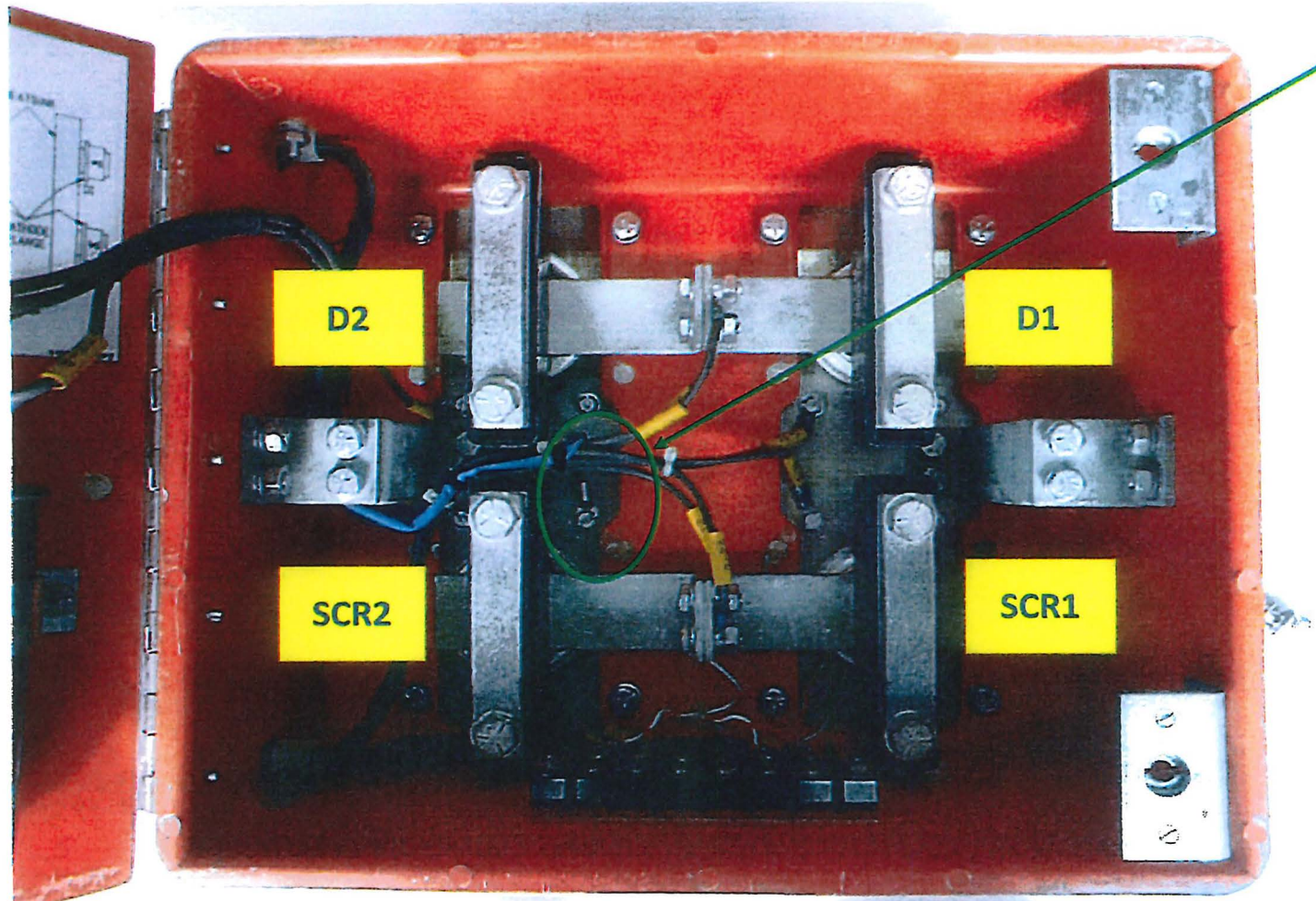
17FM467 MOTOR FIELD STATIC EXCITER



10-2
SNUBBER RESISTORS

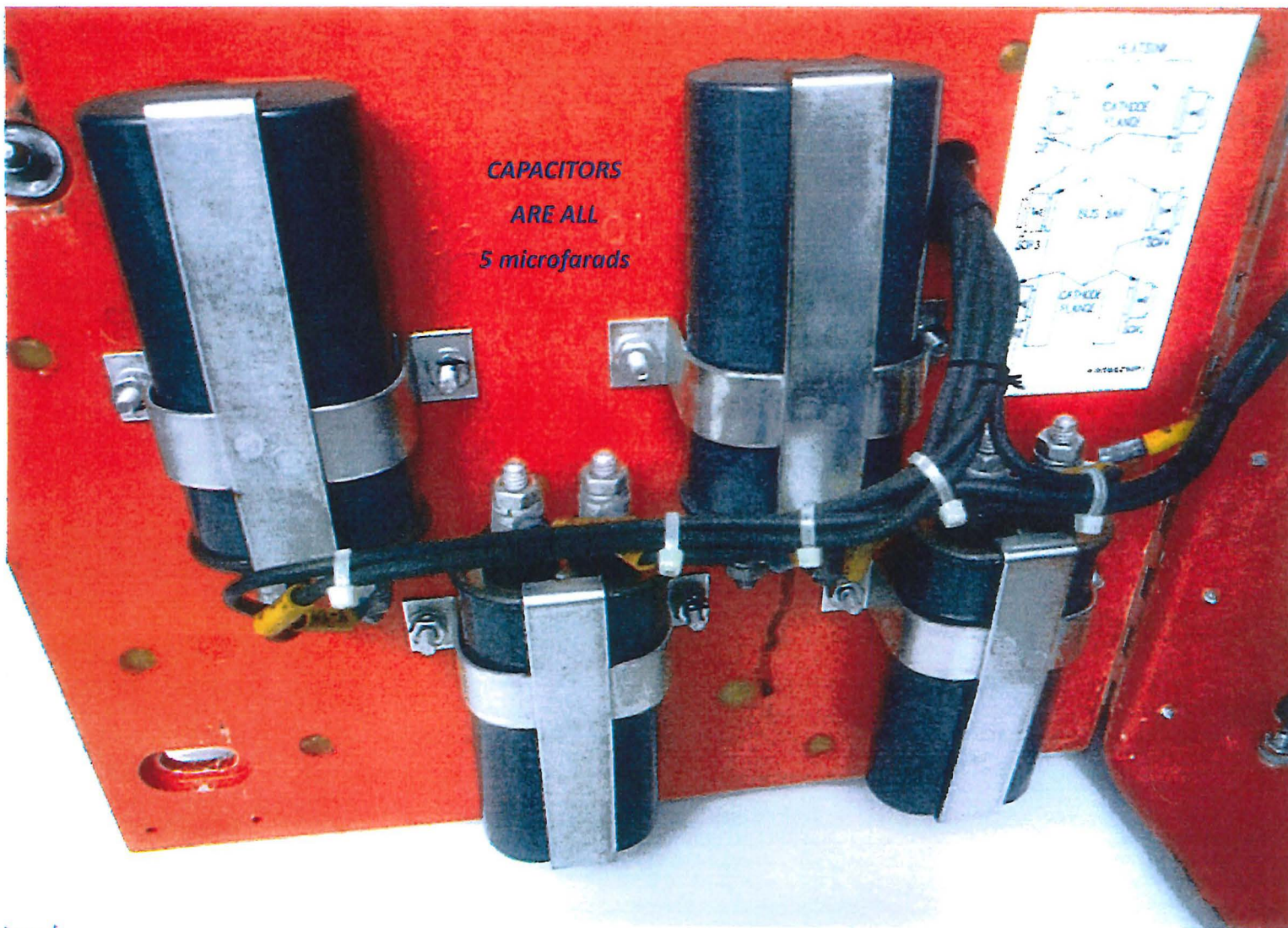
TEMP SENSOR

17FM467 DIODE/SCR LAYOUT



Temp
Sensor

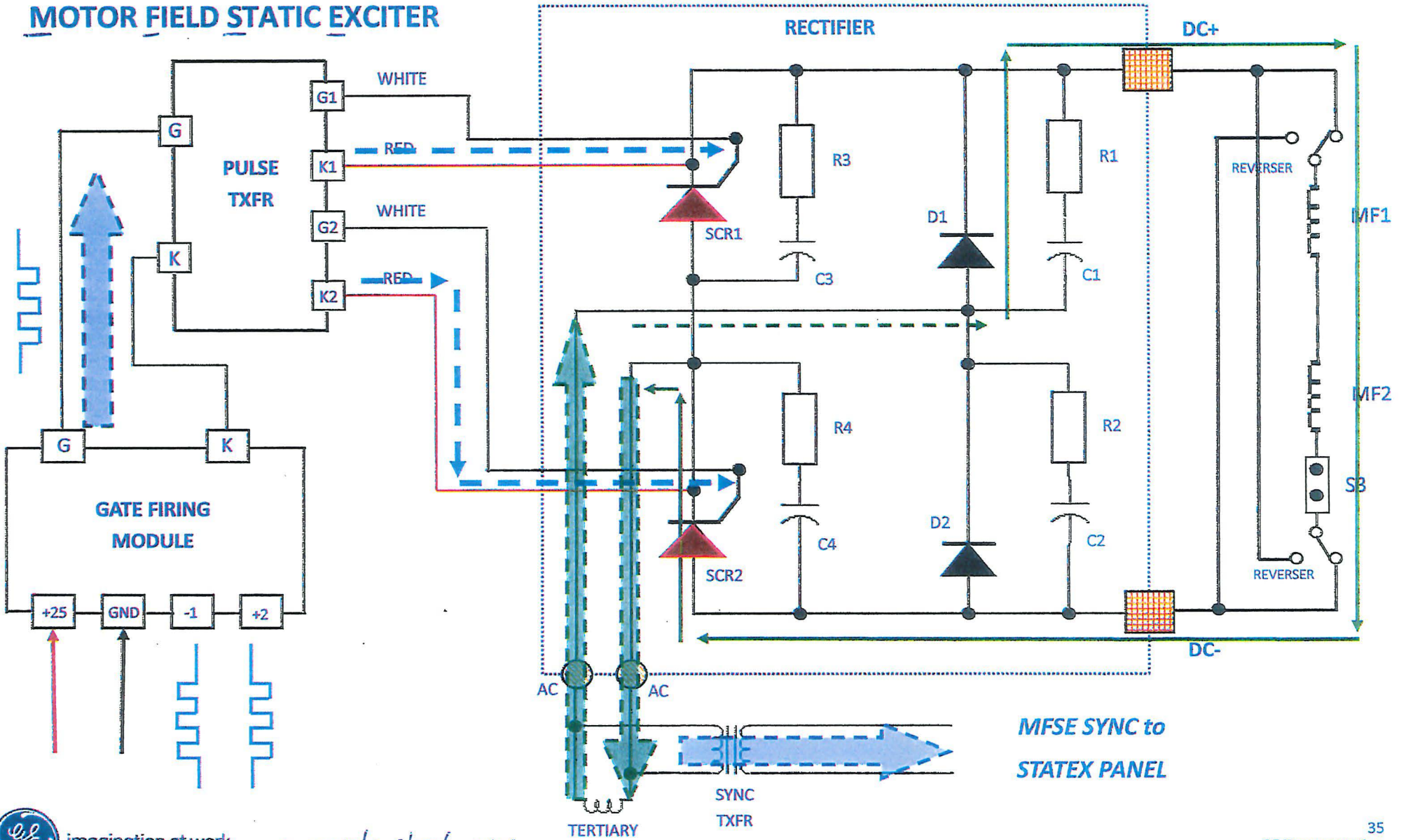
17FM467 SNUBBER CAPACITORS LAYOUT



SYSTEM COMPONENTS

MFSE

MOTOR FIELD STATIC EXCITER



MFSE SYNC to
STATEX PANEL



No propel - check sync transformer

SYSTEM COMPONENTS

17FM466 ALTERNATOR FIELD STATIC EXCITER . AFSE

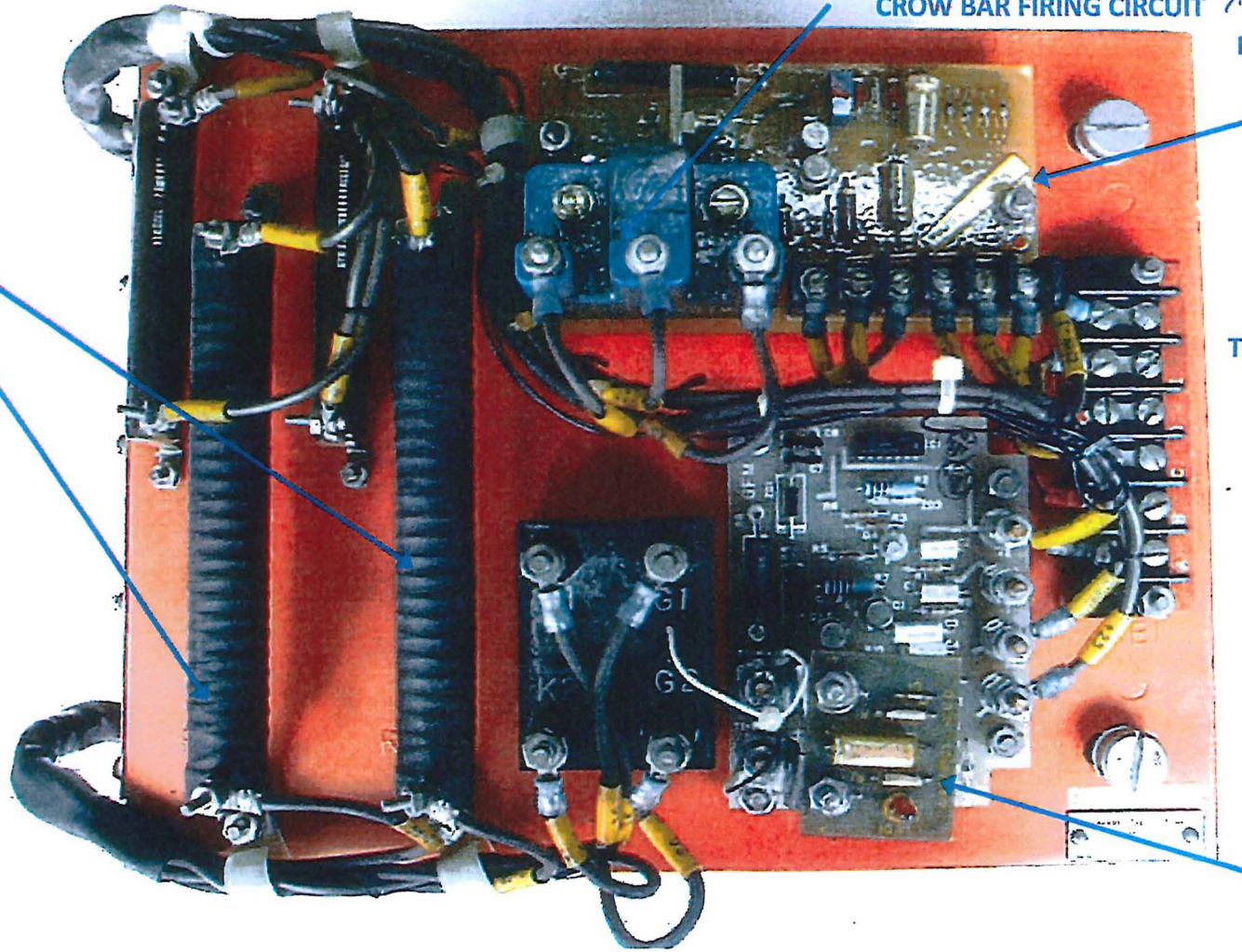
If blows - Alternator shorted
CROW BAR FIRING CIRCUIT 79-170V on Alt Field

SNUBBER
RESISTORS

BATTERY BOOST
MODULE

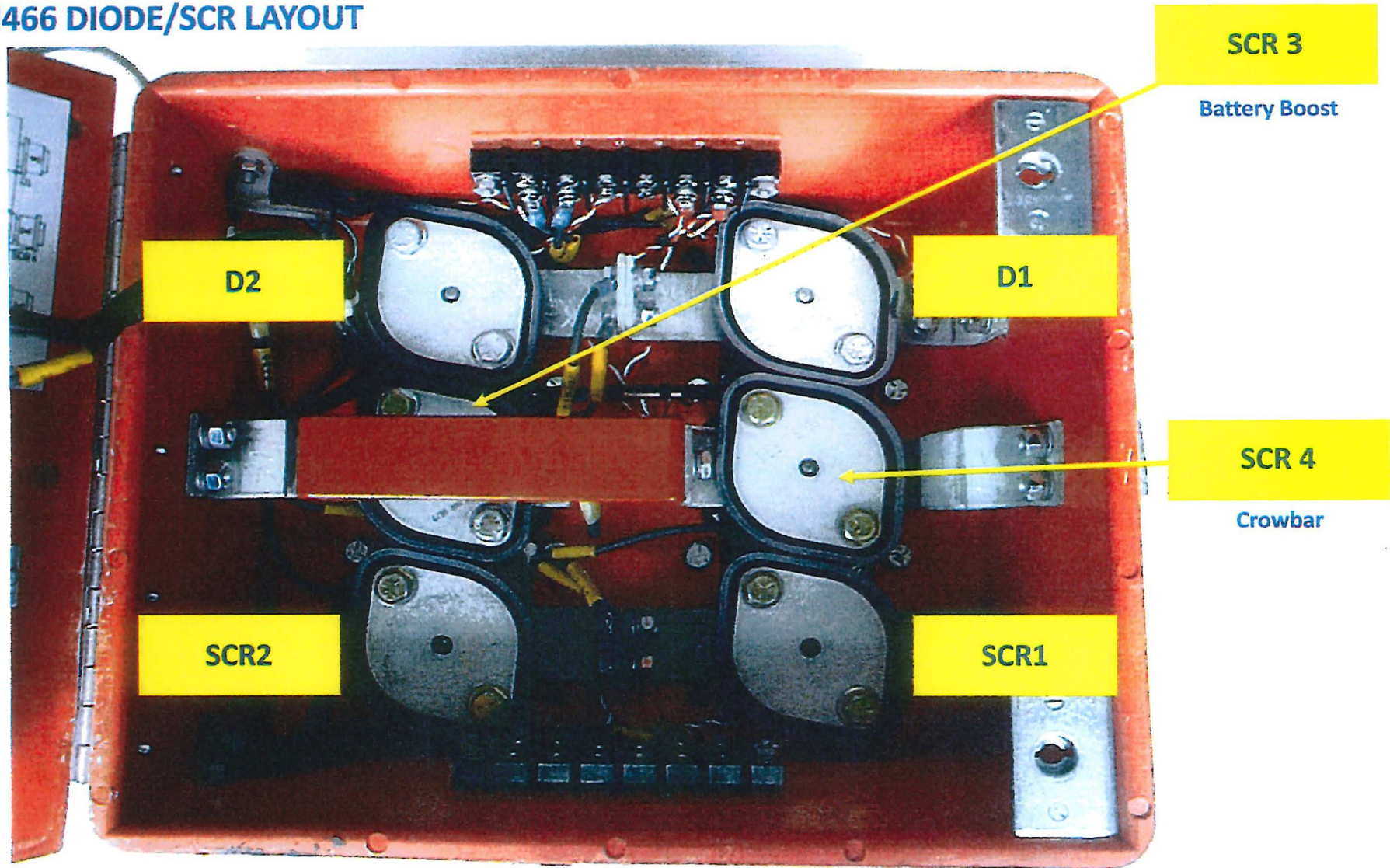
TEMP SENDER

LED MODULE



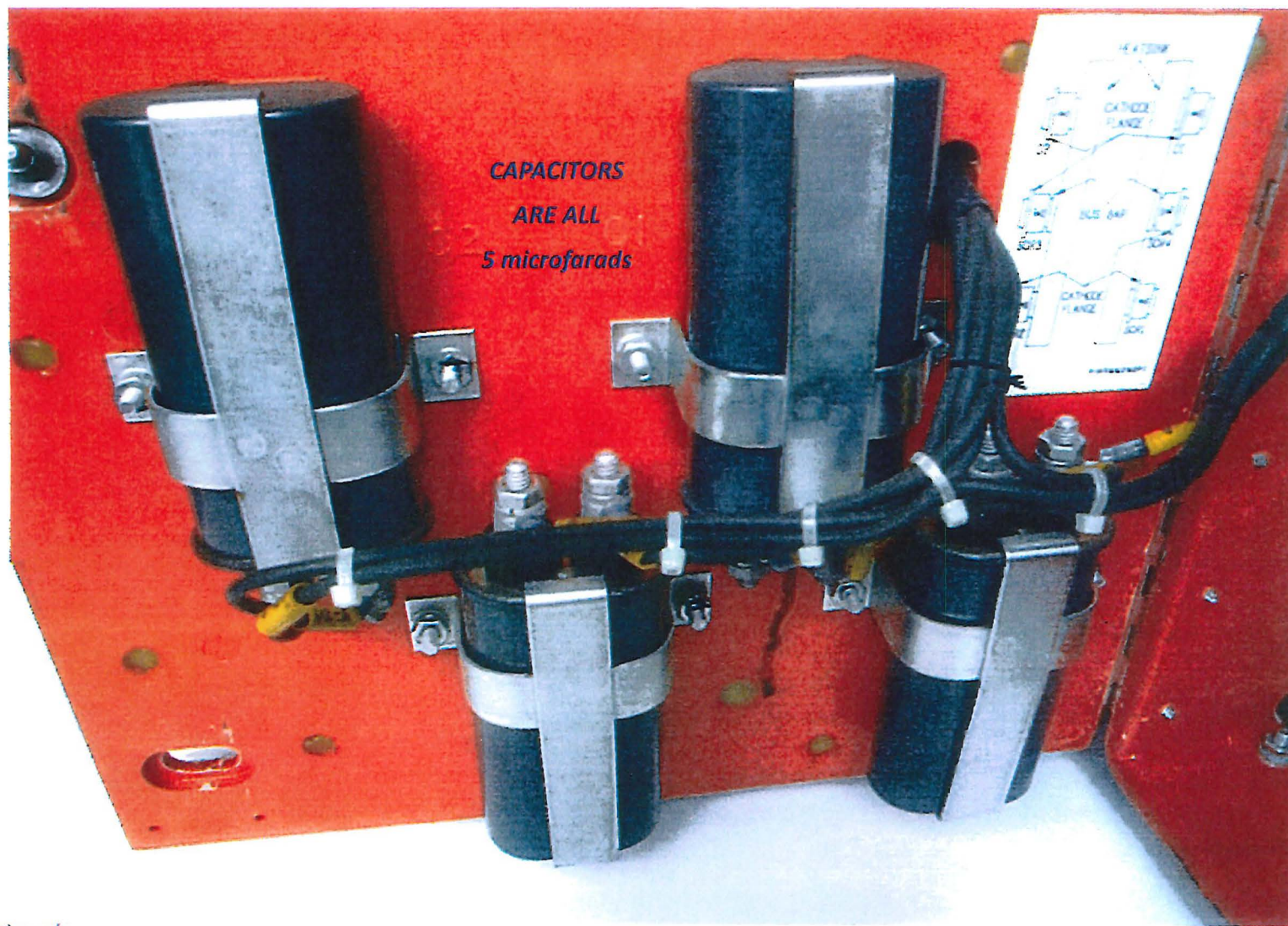
SYSTEM COMPONENTS

17FM466 DIODE/SCR LAYOUT

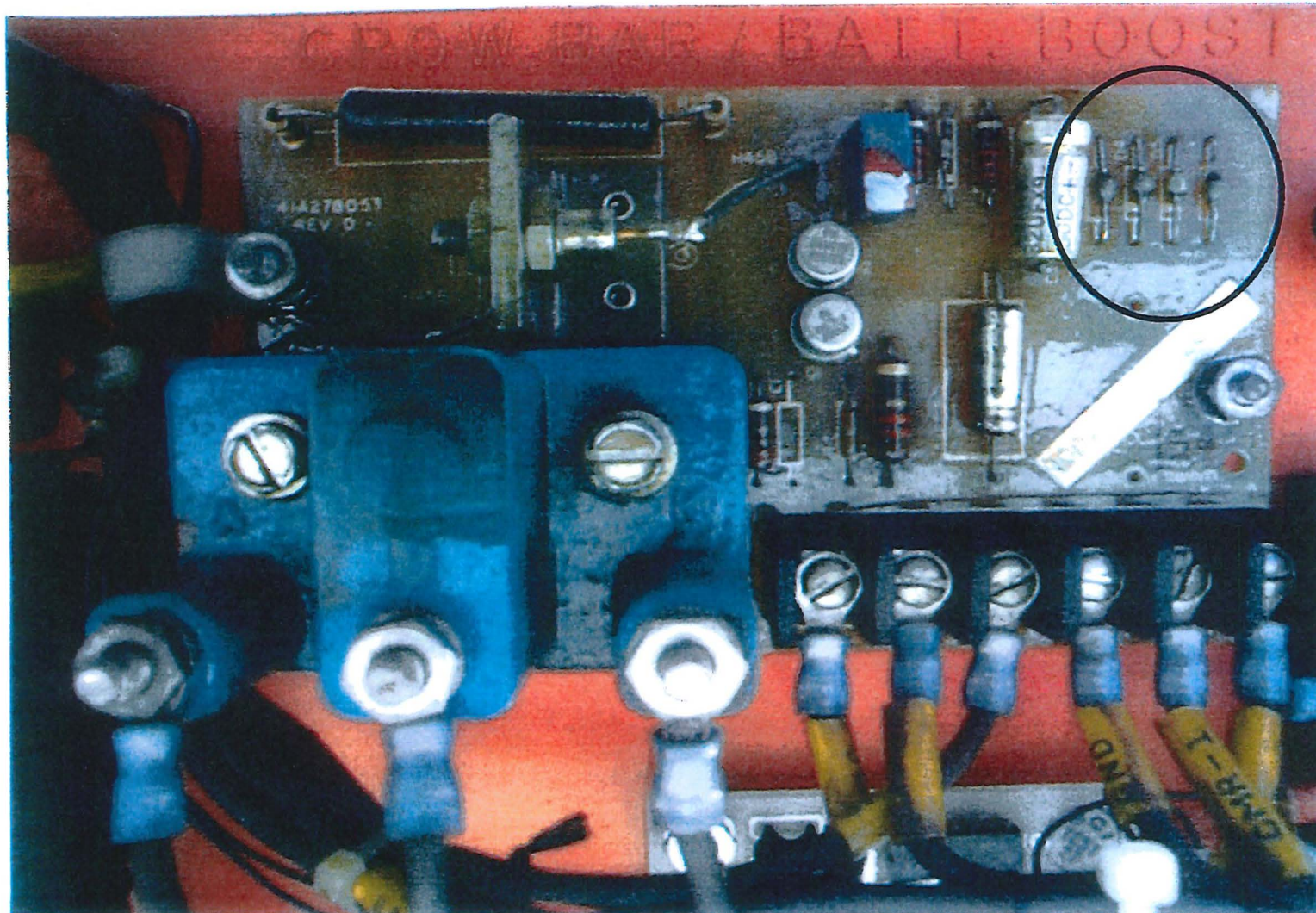


SYSTEM COMPONENTS

17FM466 SNUBBER CAPACITORS LAYOUT



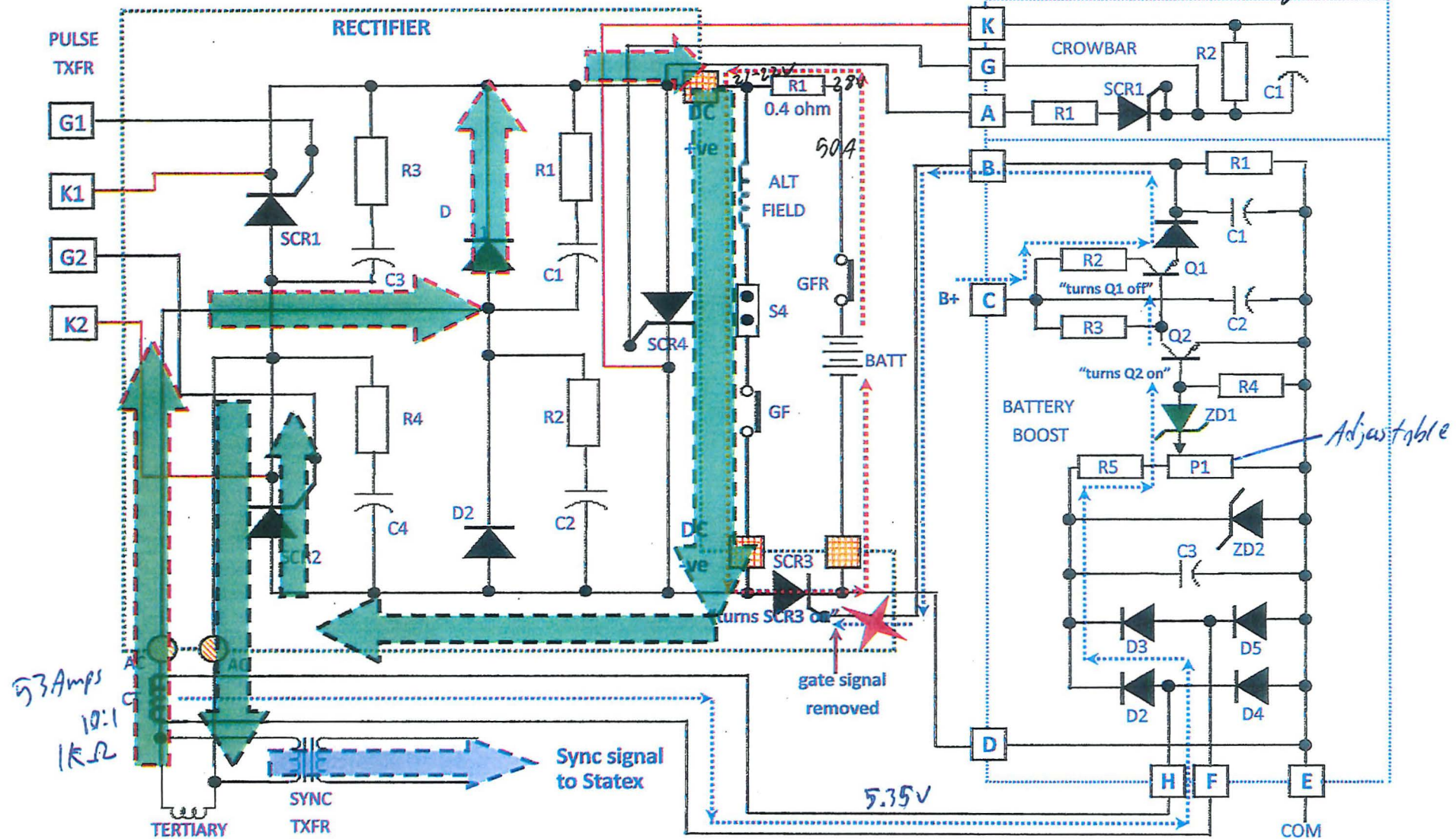
CROWBAR/BATTERY BOOST MODULE



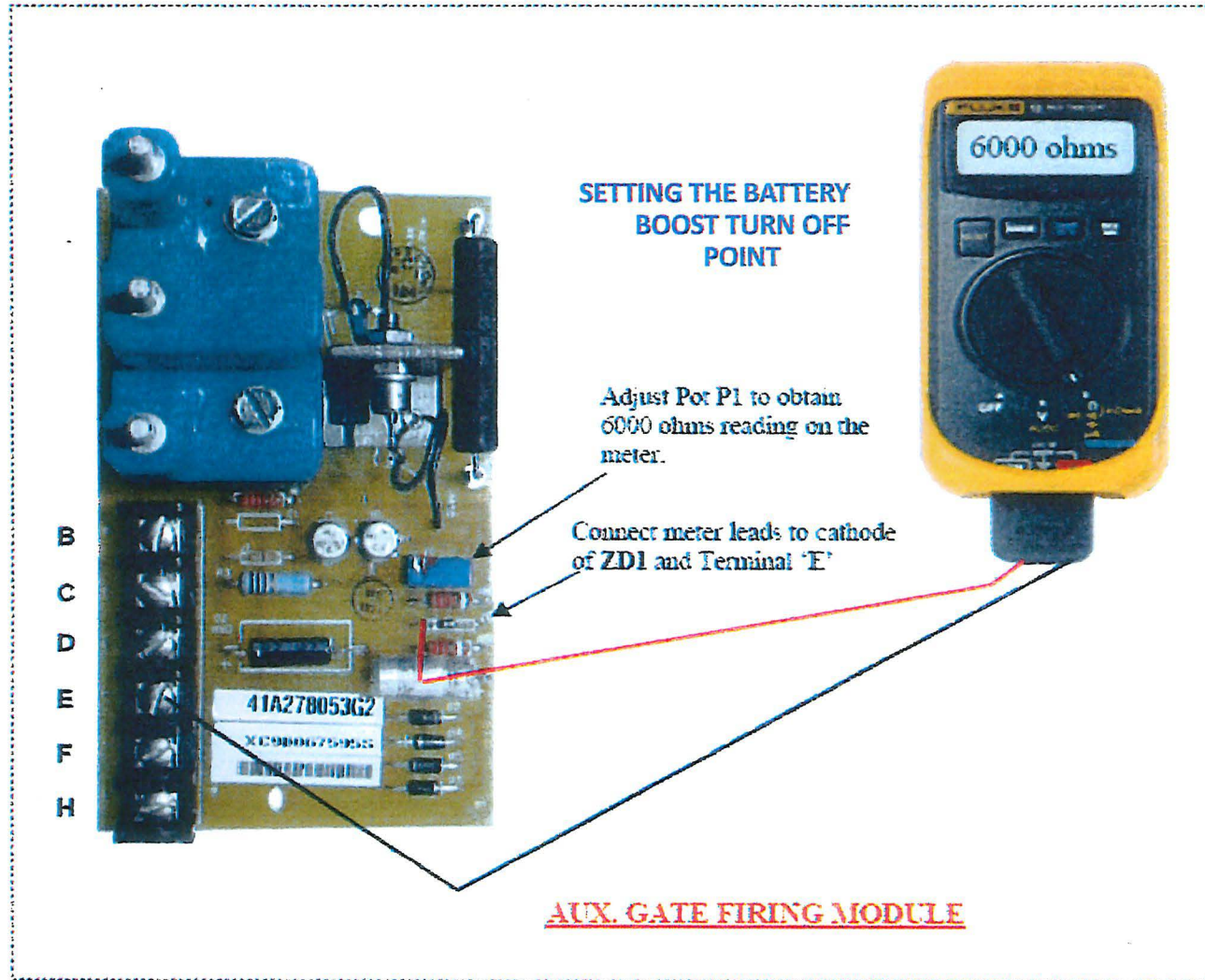
GE recommends that all GFM modules with this type of diode be replaced.

SYSTEM COMPONENTS

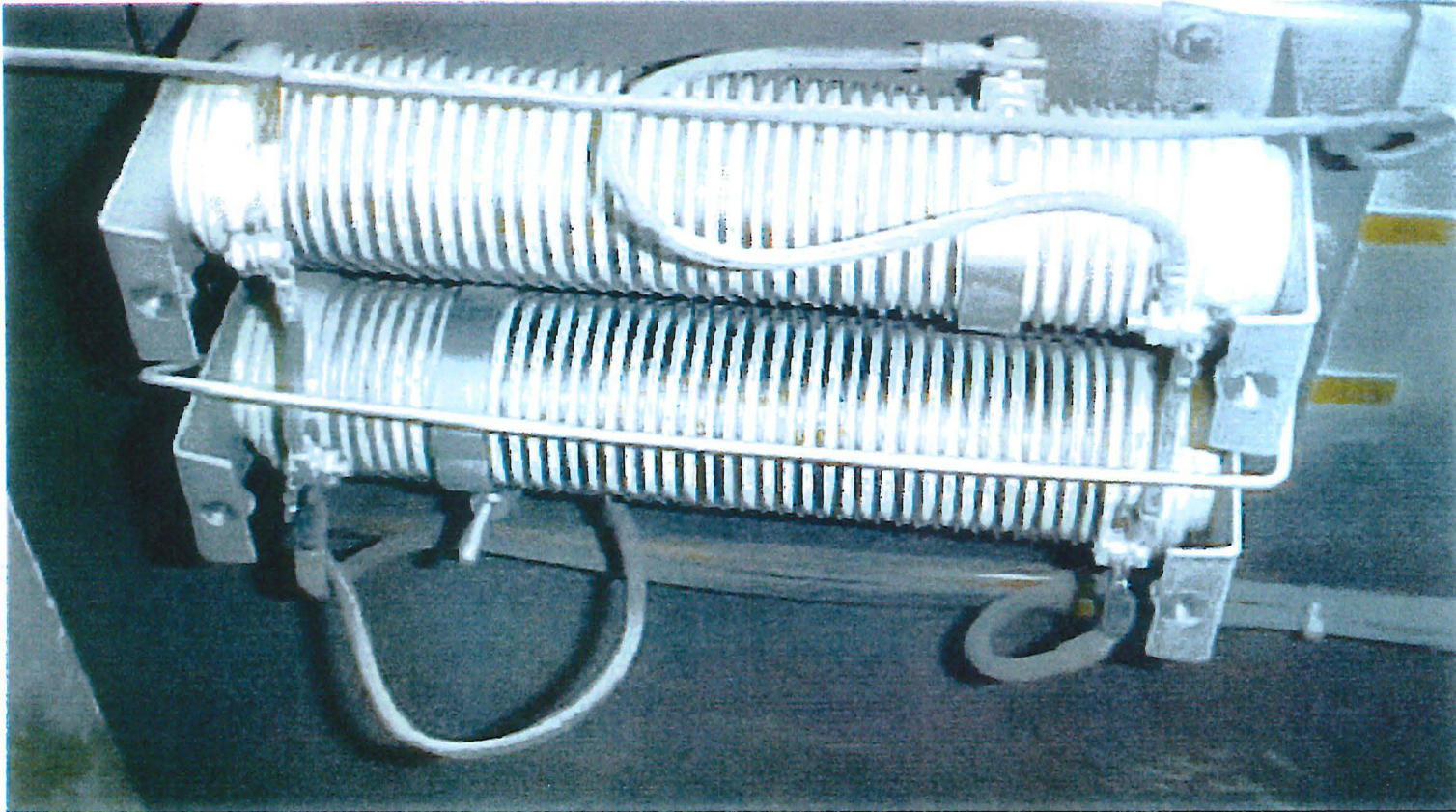
17FM466 AFSE - BATTERY BOOST FUNCTION



CROWBAR/BATTERY BOOST MODULE



RESISTOR R1 (0.4 OHMS)

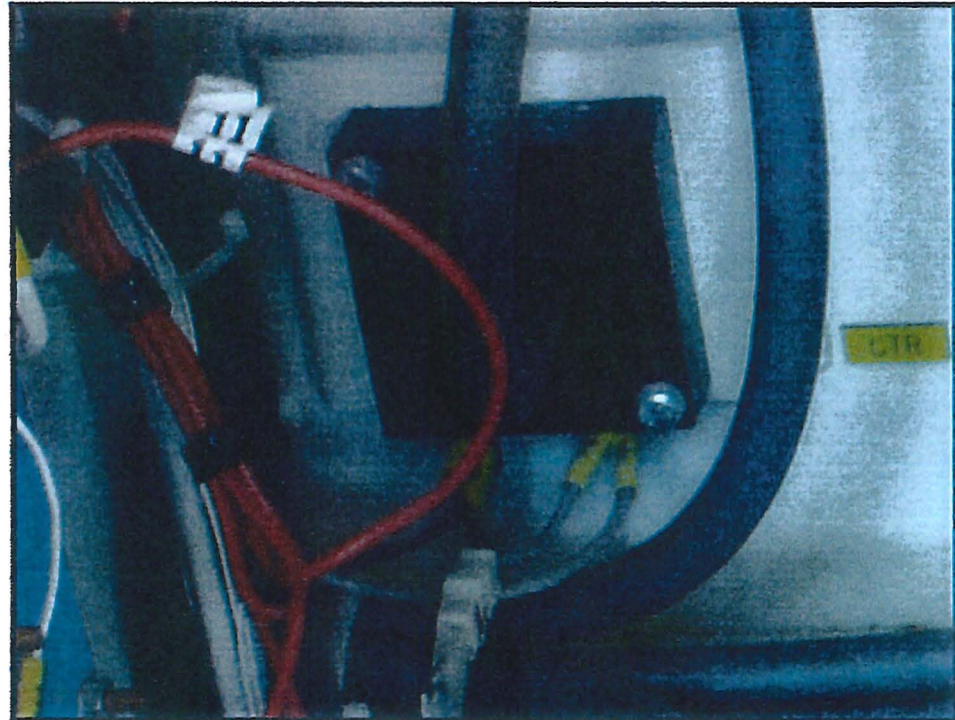


Limits Battery Boost Current (approx 40 amps)

Note: 2 resistors in Parallel formation

CURRENT TRANSFORMER

- Current transformer CT is used to monitor AFSE Tertiary input current level.
- This signal is fed back to the Battery Boost card and is used for controlling the gate circuit of SCR3 in the Battery Boost circuit .
- Burden resistor attached to limit dangerous voltage buildup if card circuit goes open



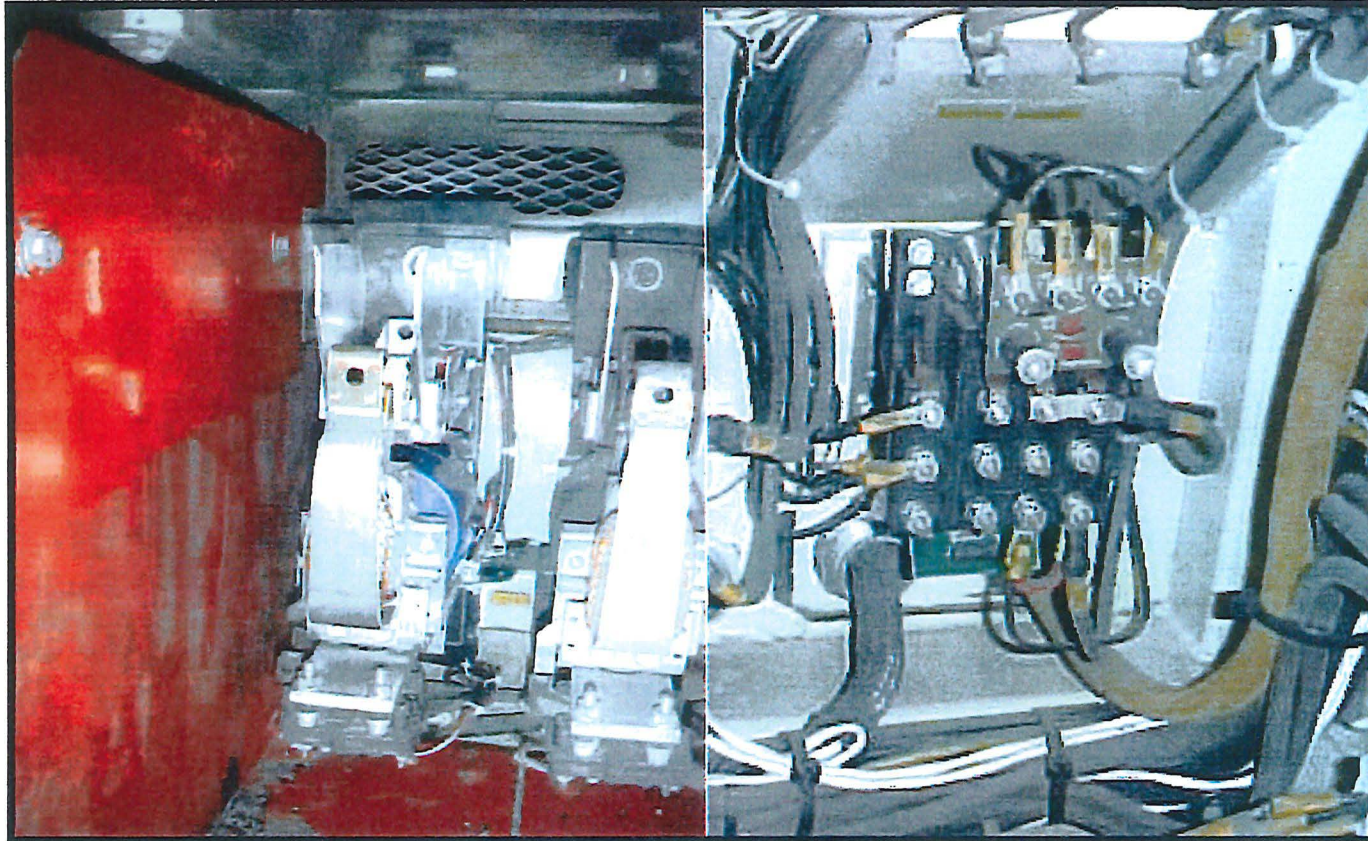
SYSTEM COMPONENTS

GF and GFR

17CM53A10

Excluding Arc chute

17LV66J

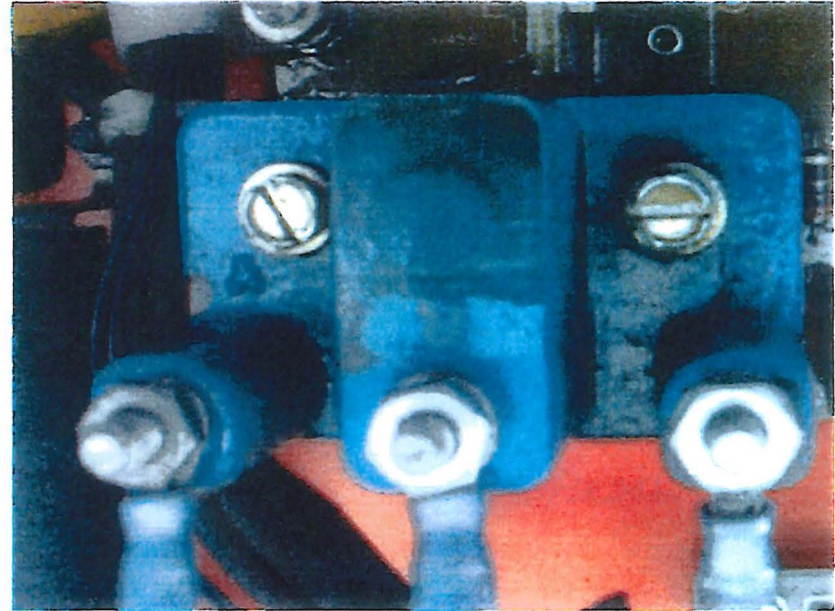


CONTACTORS IN THE BATTERY BOOST CIRCUIT

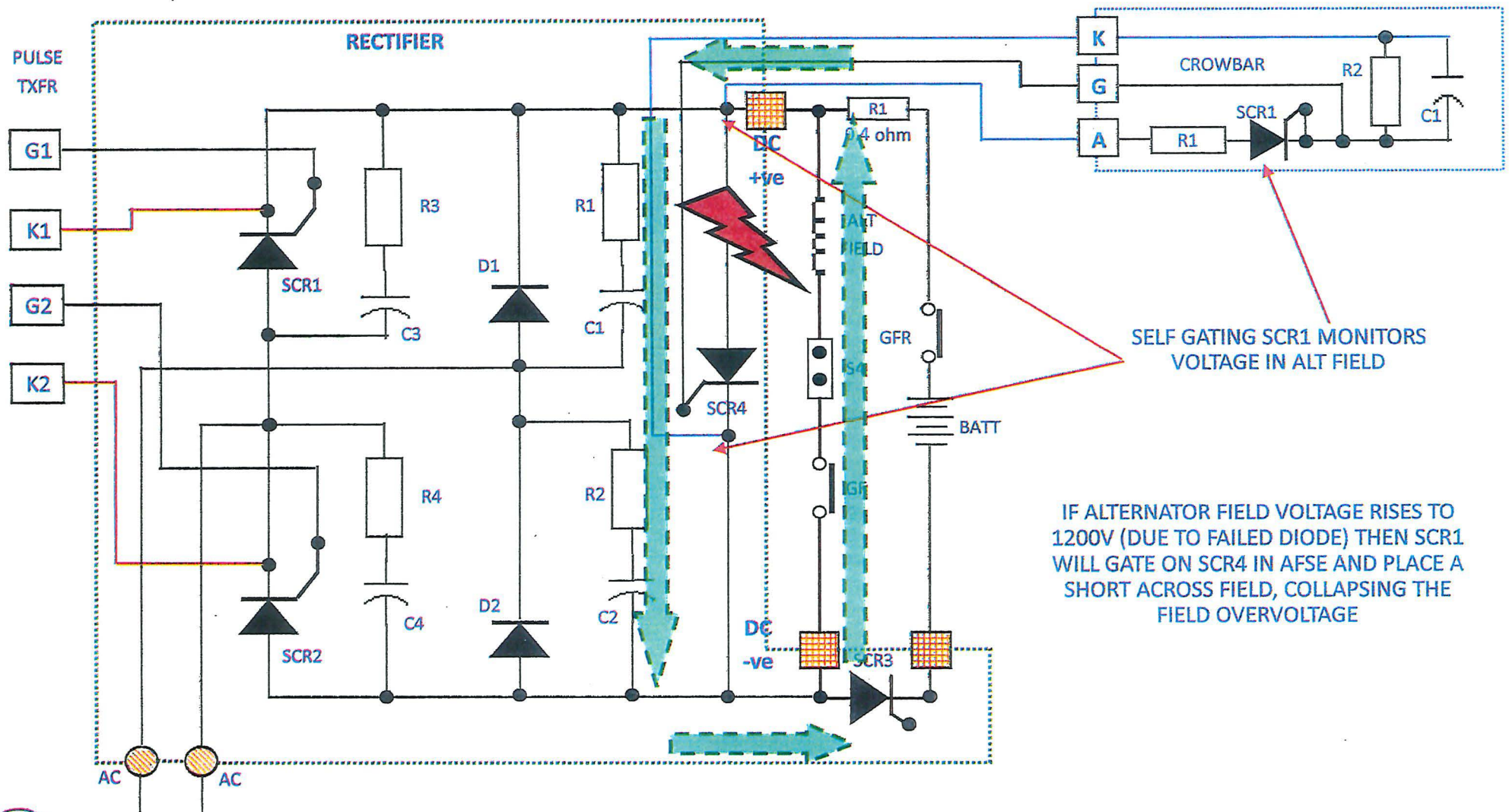
NOTE – GF may be a CM55

17FM466 AFSE – CROWBAR

- The Crowbar portion of the battery boost card is designed to provide the control to SCR4 inside the AFSE to protect the Alternator field from excessive voltage spikes which might damage the field.
- Will turn on SCR4 if a voltage spike exceeds 1200V.



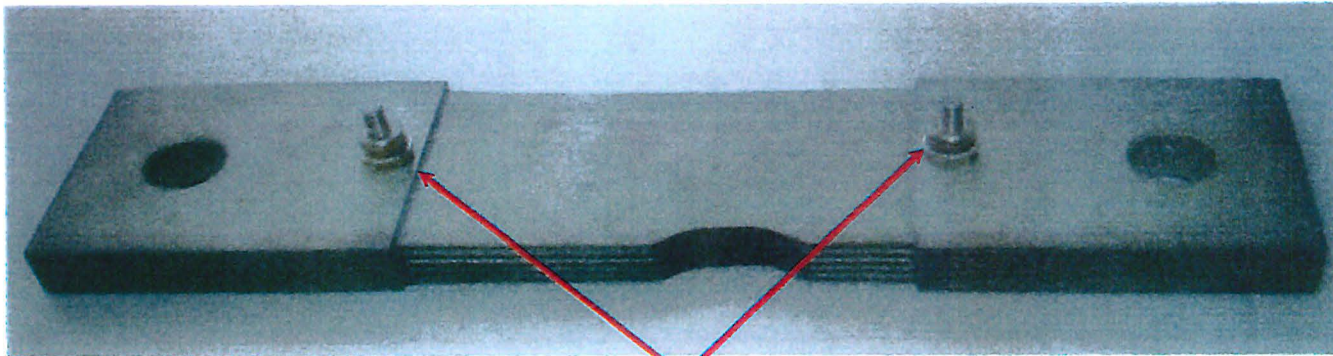
17FM466 AFSE – CROWBAR FUNCTION



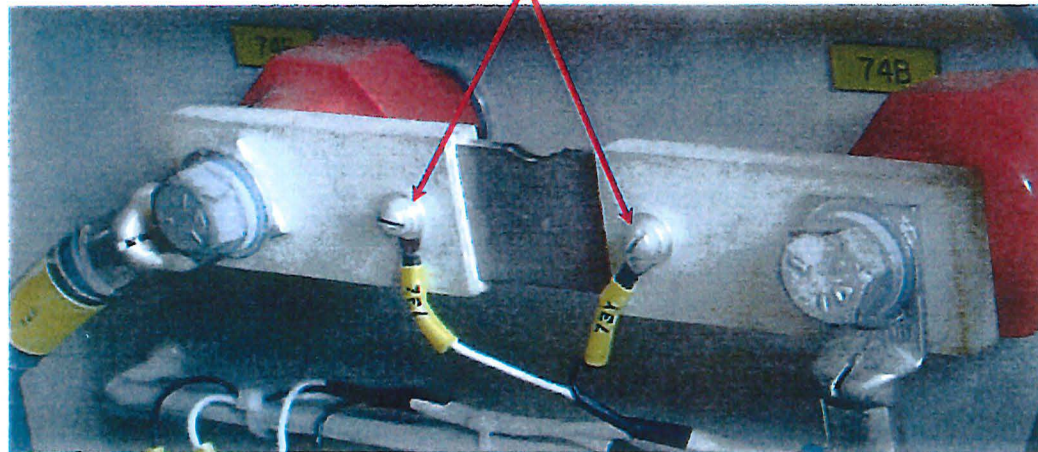
SYSTEM COMPONENTS

SHUNTS 1000/400A to 100mV

10:1 motor
4:1 rest

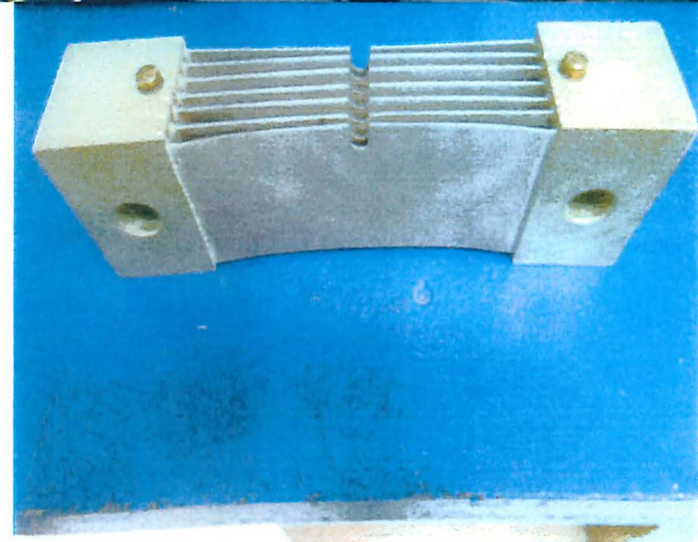
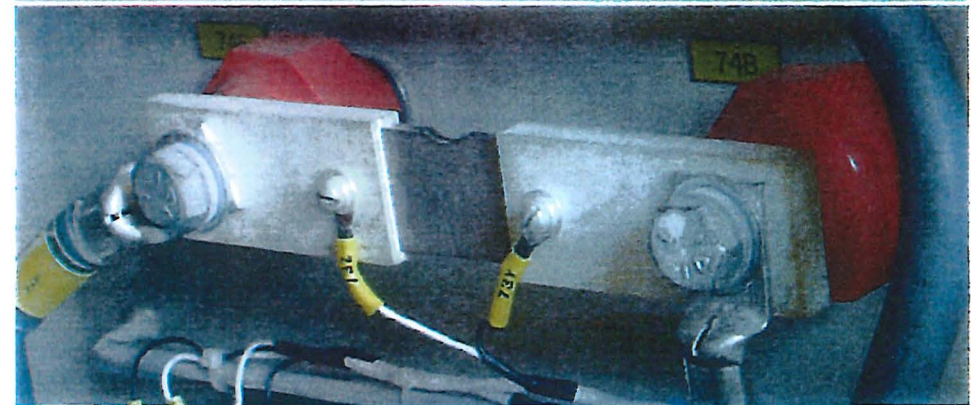
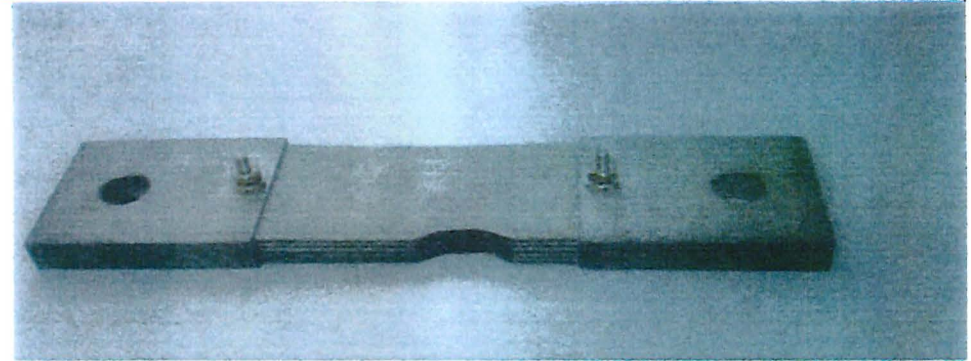


100mv out



SHUNTS 1000/400A to 100mV

- The shunts used in the Statex III system provide a millivolt signal proportional to the current flowing through them.
- Armature current shunts are calibrated to provide a feedback signal of 100mv for each 1000 amps flowing through them.
- Newer style shunts provide a feedback signal of 200mv for each 2000 amps flowing through them.
- All field shunts are calibrated for a feedback signal of 100mv for each 400A flowing through them.



SYSTEM COMPONENTS

17FM394 CURRENT ISOLATION AMPLIFIER

140
DC VOLTAGE OUTPUT
(SHOULD BE 10 TIMES
THE INPUT SIGNAL)

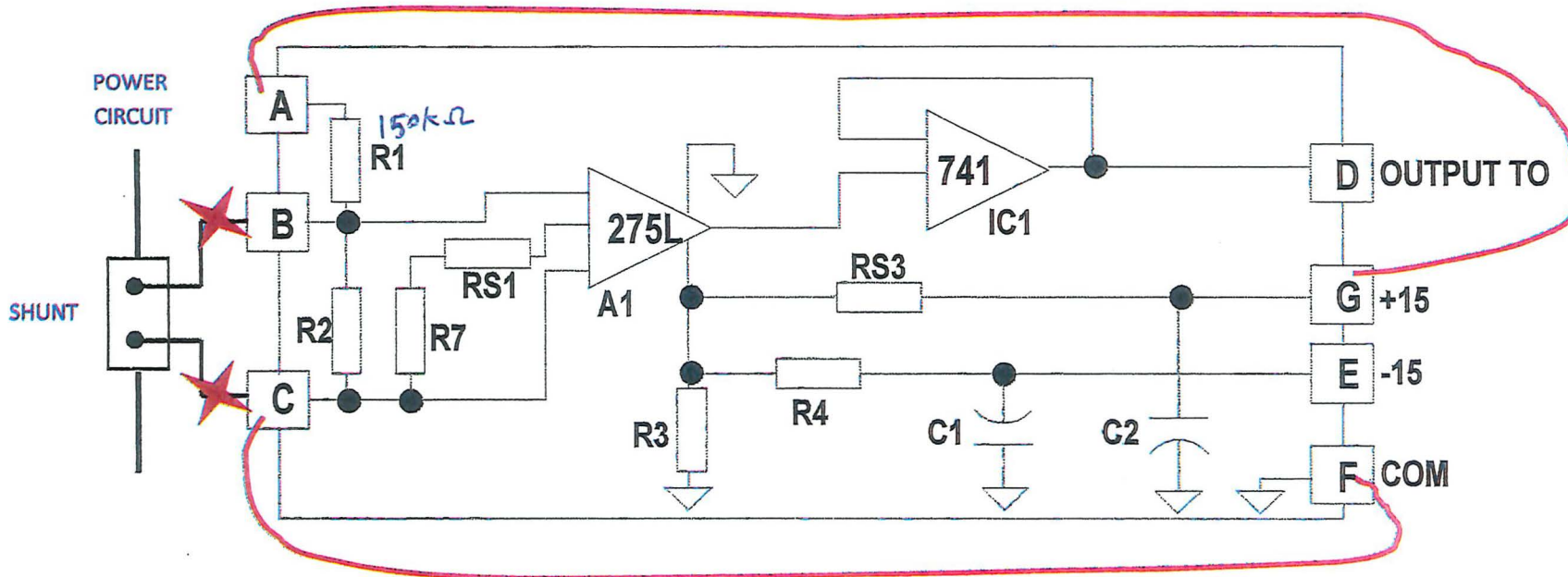
POWER SUPPLY INPUTS
AND COMMON FROM
FB100 CARD

USED FOR TESTING
PURPOSES ONLY

DC mV INPUT FROM SHUNT



17FM394 CURRENT ISOLATION AMPLIFIER



TO TEST ON THE TRUCK, CARRY OUT THE FOLLOWING:

1. DISCONNECT INPUT WIRES AT TERMINALS 'B' & 'C'
2. CONNECT JUMPER FROM TERMINAL 'G' TO TERMINAL 'A'
3. CONNECT JUMPER FROM TERMINAL 'F' TO TERMINAL 'C'
4. CHECK THAT TERMINAL 'B' TO 'C' READS 100mV,
5. READ 1.00 volts +/- 0.05 volts AT TERMINAL 'D' TO TERMINAL 'F'

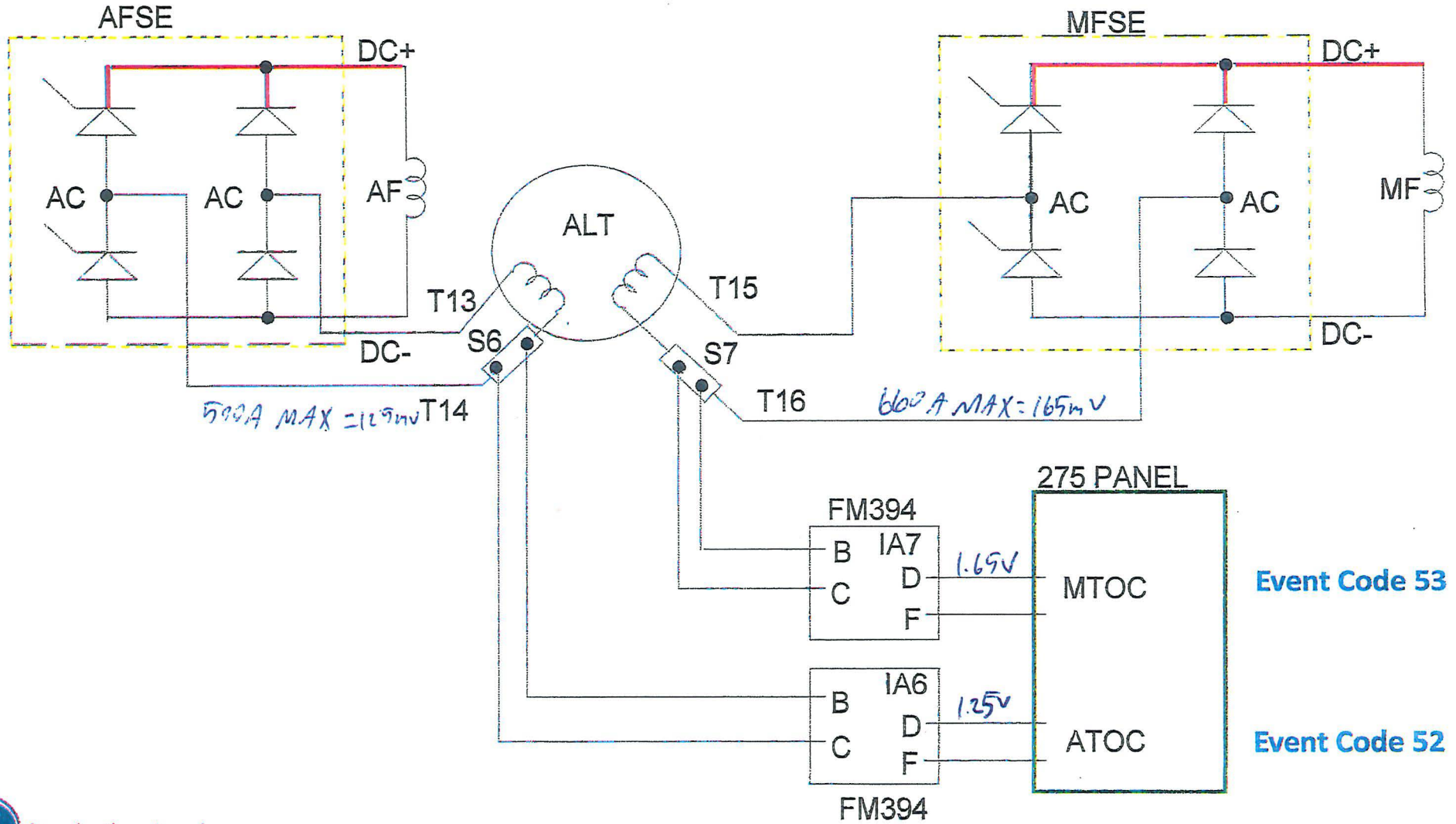
NOTE – J Model ISO-AMPS

Recommended to test with a milli-volt source

Importance

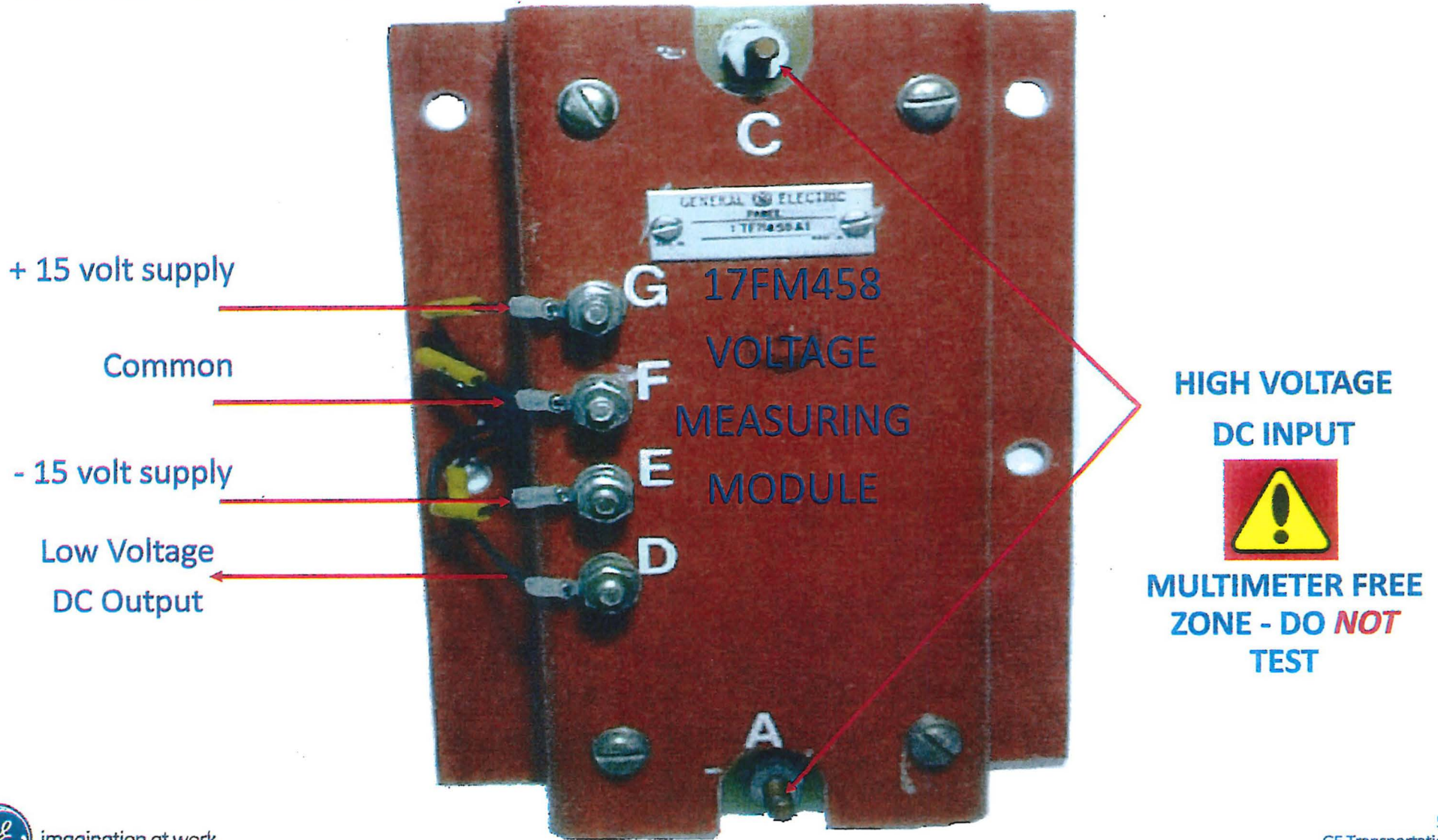
S4
 S3
 S1/S2
 S6/S7 trip levels only (omit cause surges)

TERTIARY PROTECTION SYSTEM




SYSTEM COMPONENTS

17FM458 VOLTAGE MEASURING MODULE



**HIGH VOLTAGE
DC INPUT**



**MULTIMETER FREE
ZONE - DO NOT
TEST**

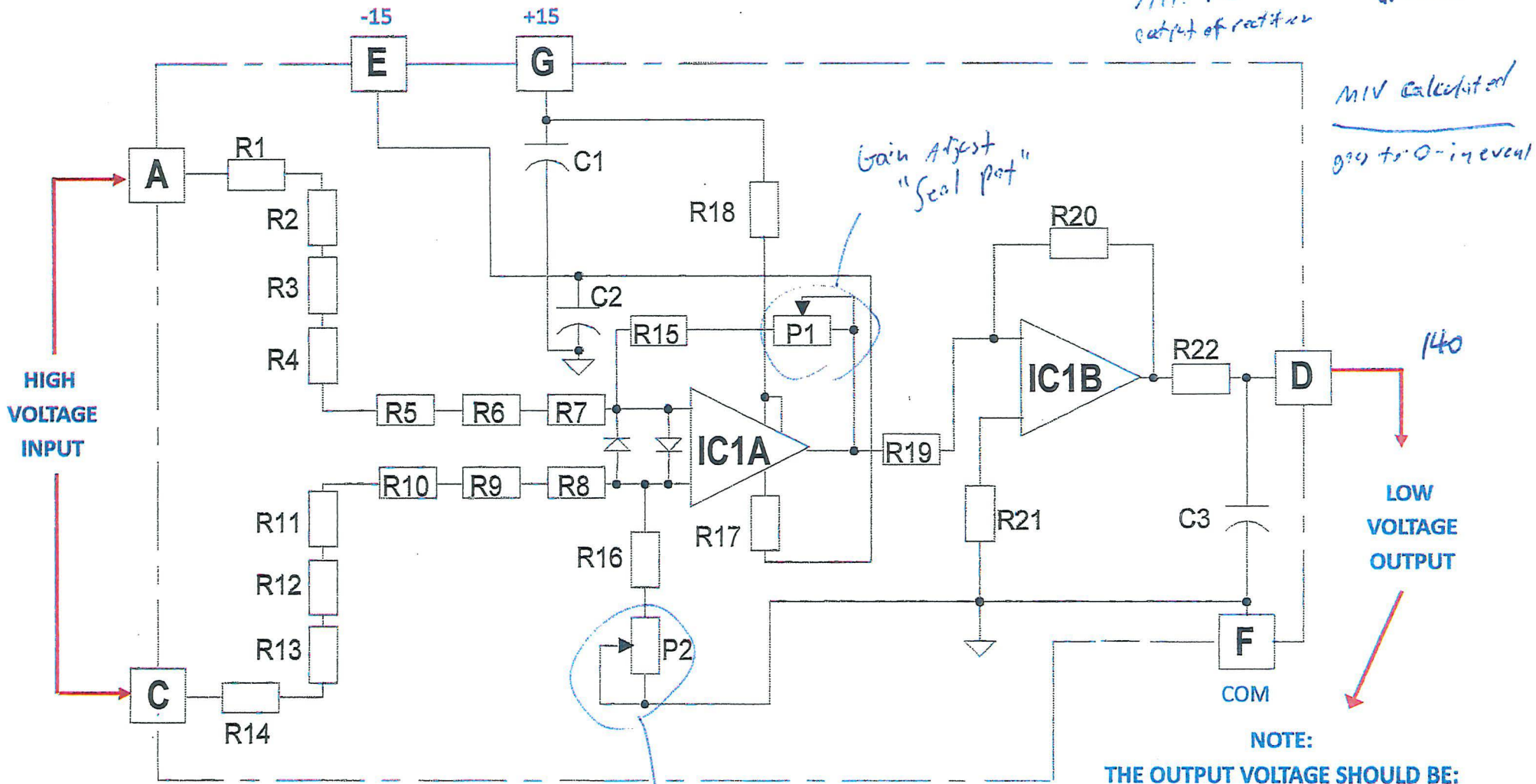
SYSTEM COMPONENTS

17FM458 VOLTAGE MEASURING MODULE

ratio
1:200

VMM1
Alt. DC
output of rectifier

VMM2
wheel meter?



MIV calculated
goes to 0-in event

Zero Adjust
"Seal pot"

NOTE:
THE OUTPUT VOLTAGE SHOULD BE:
INPUT VOLTAGE/200

Statex III

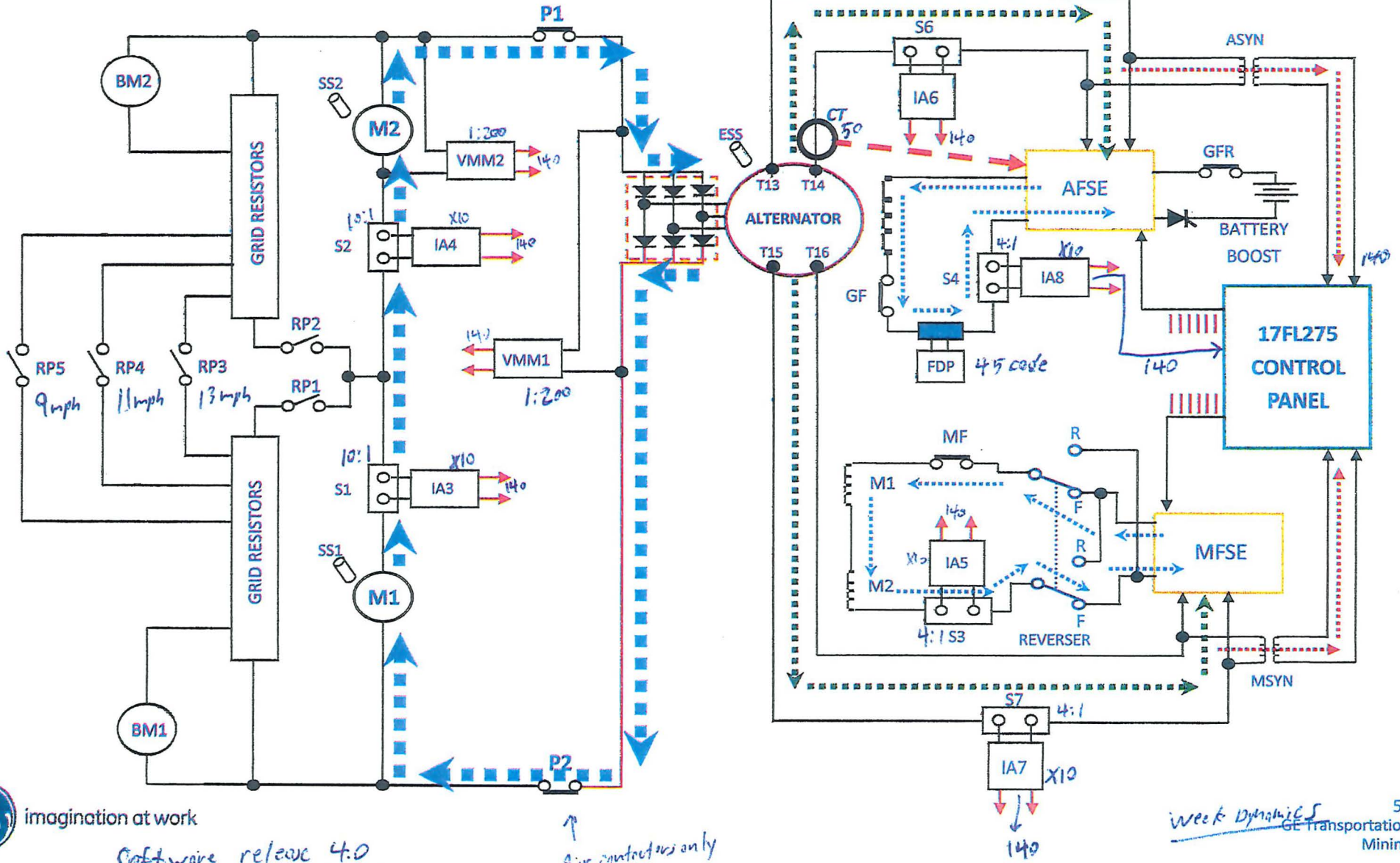
Engine idle will increase with high temp. reading

SYSTEM FUNCTIONALITY

140 V
Speed sensor 3
Engine speed sensor
All the same

WPTU™
600RPM
For tests

STATEX III MAIN POWER COMPONENTS (PROPEL)



Software release 4.0
60-RP Bounce

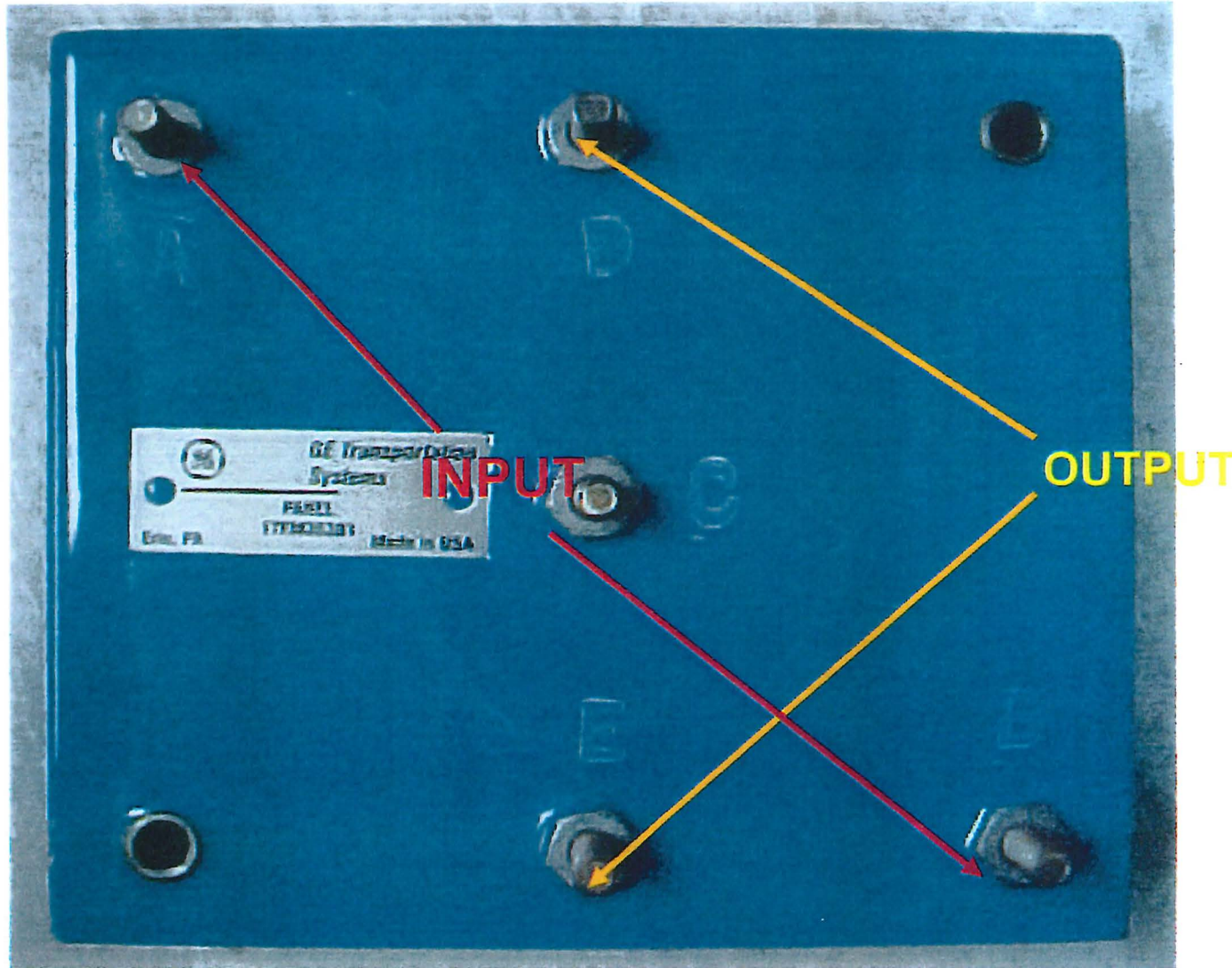
Air contractors only

Week Dynamics
GE Transportation Mining

SYSTEM COMPONENTS

17FM363 VOLTAGE DIVIDER RESISTOR (VDR)

10:1

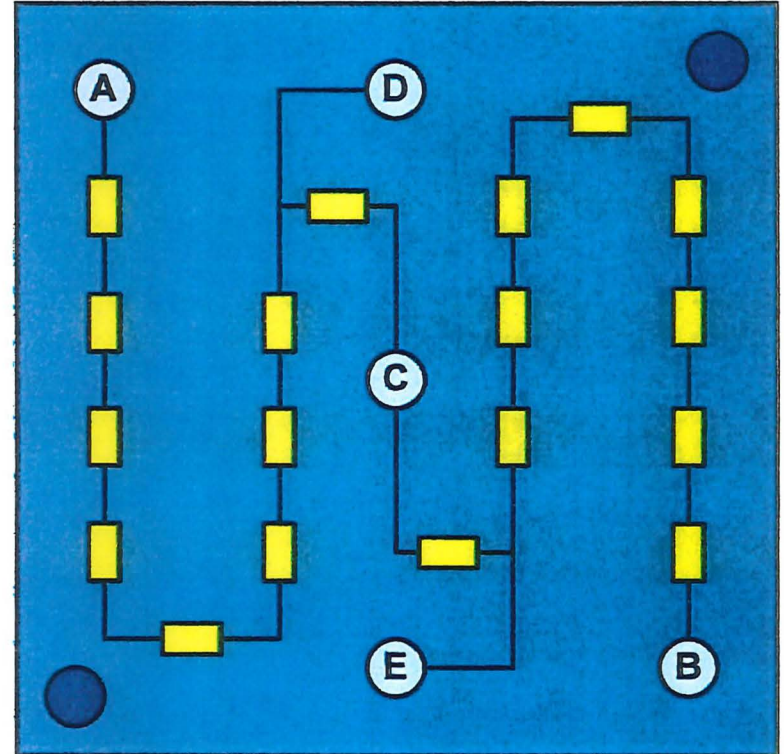


VOLTAGE DIVIDER RESISTOR

Used for alternator field voltage feedback and within the ground fault system

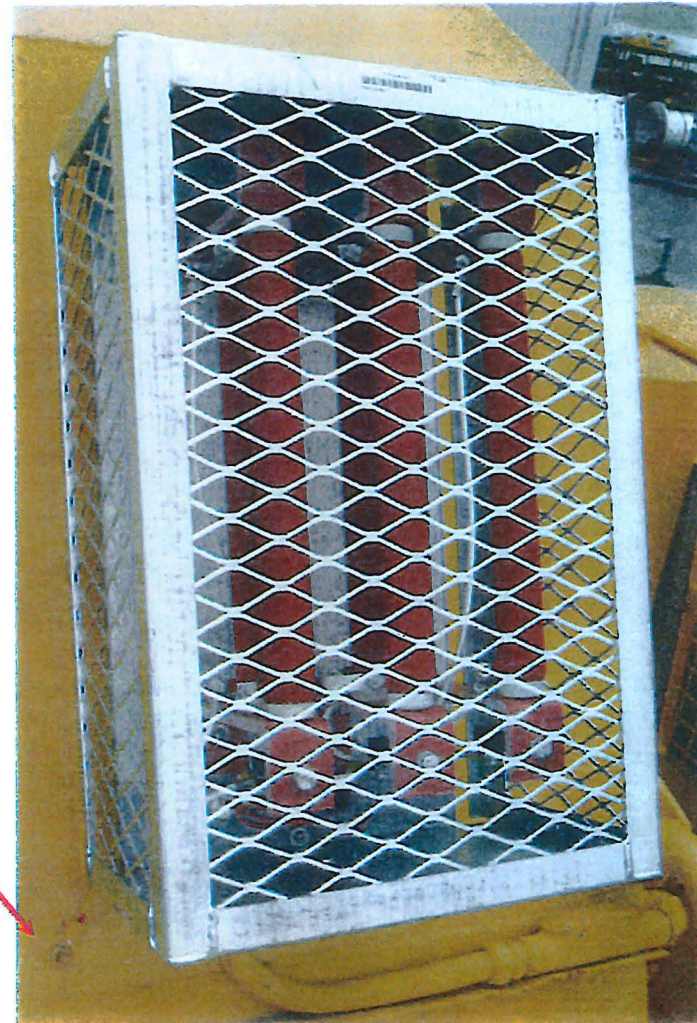
Resistance between terminals A and B is 180k Ohms

The resistance across terminals C to E should be 10K

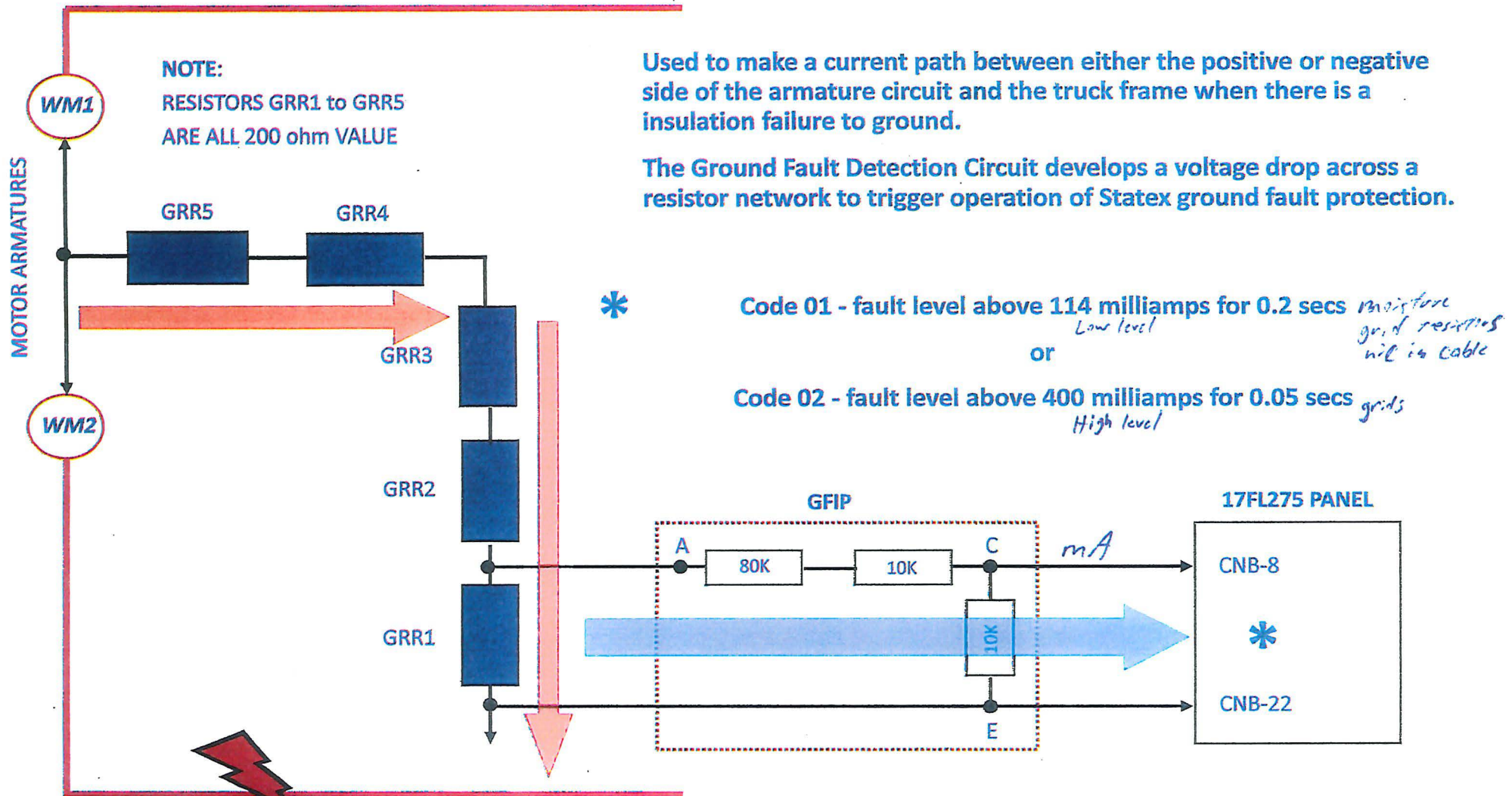


17FM494 GROUND FAULT RESISTOR PANEL

- The 17FM494 Ground Fault Detection panel (GRR) is used to detect power circuit grounds.
- It is simply a voltage divider network used to develop a voltage drop across GRR1 proportional to the ground current flow.
- Generally earthed under panel.

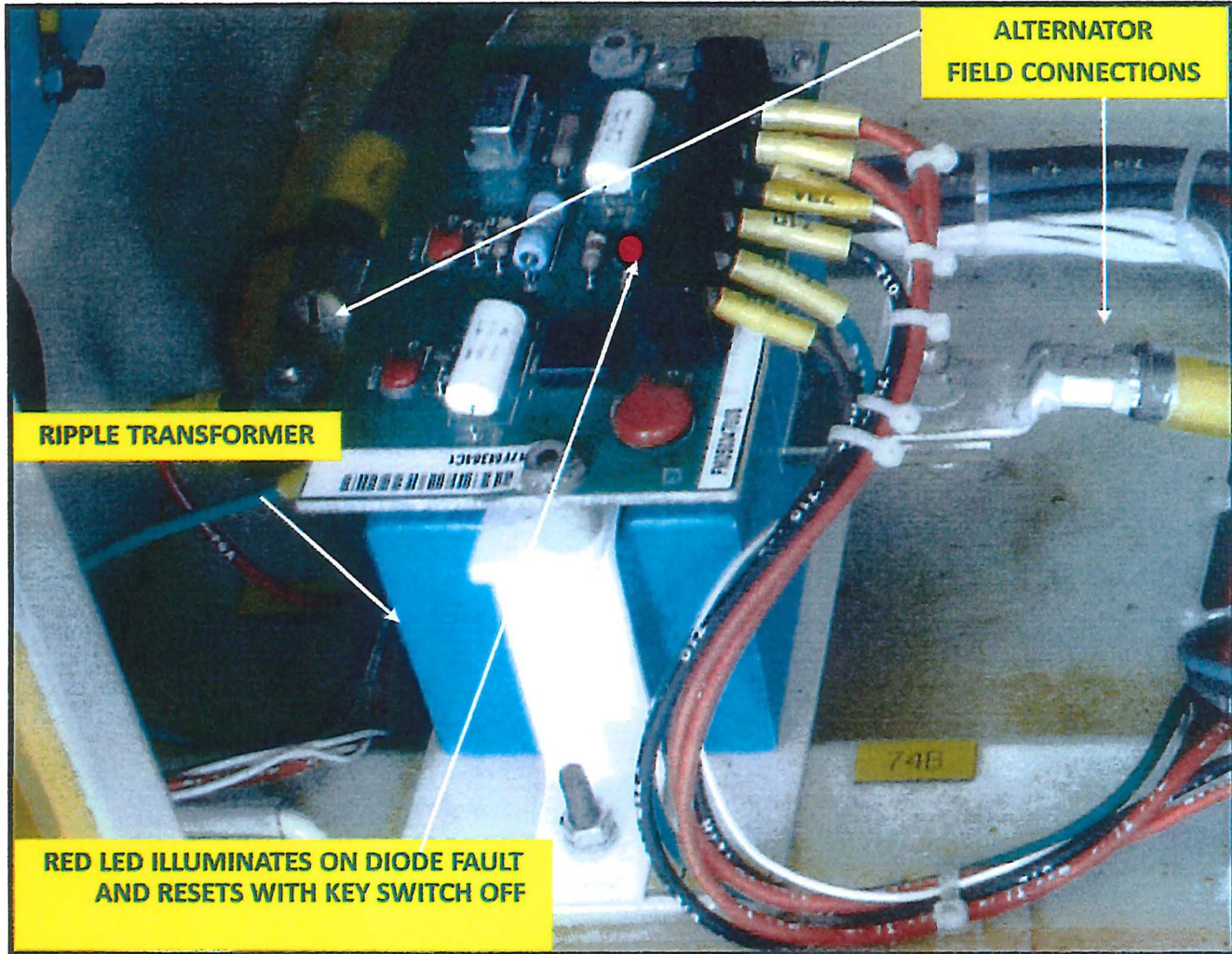


GROUND FAULT DETECTION CIRCUIT



SYSTEM COMPONENTS

17FM384 FAULT DETECTION PANEL



detect, ripples

*45- failed Diode
cycle power*

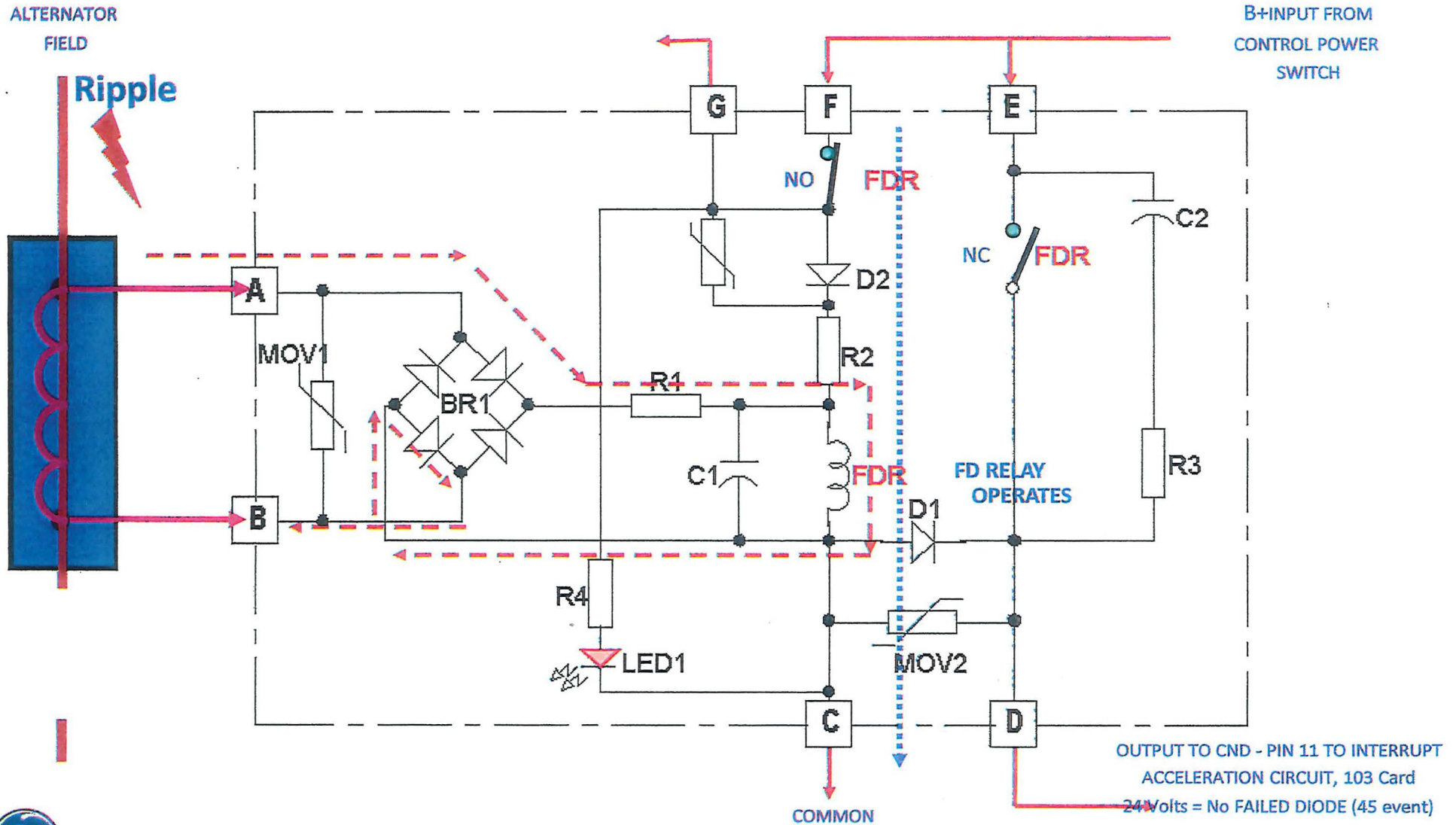
RIPPLE TRANSFORMER

**ALTERNATOR
FIELD CONNECTIONS**

**RED LED ILLUMINATES ON DIODE FAULT
AND RESETS WITH KEY SWITCH OFF**

SYSTEM COMPONENTS

17FM384 FAULT DETECTION PANEL



*79-engine shutdown
code
fix problem - it will run*

*only event
"need" to cycle power*

Dump Body Override / Hill start switch

17FM384 FAULT DETECTION PANEL

FAULTS THAT CAN TRIP THE FDP

- Failed Diode in the Main Rectifier
- Wheel Motor Flashover
- Failed Diode or SCR in either Static Exciters
- Loose Connection in any power circuit
- Any alternator field irregularities

*01 - First time - reset with DBO
2nd time in hr - reset with panel
3rd time in hr - laptop*

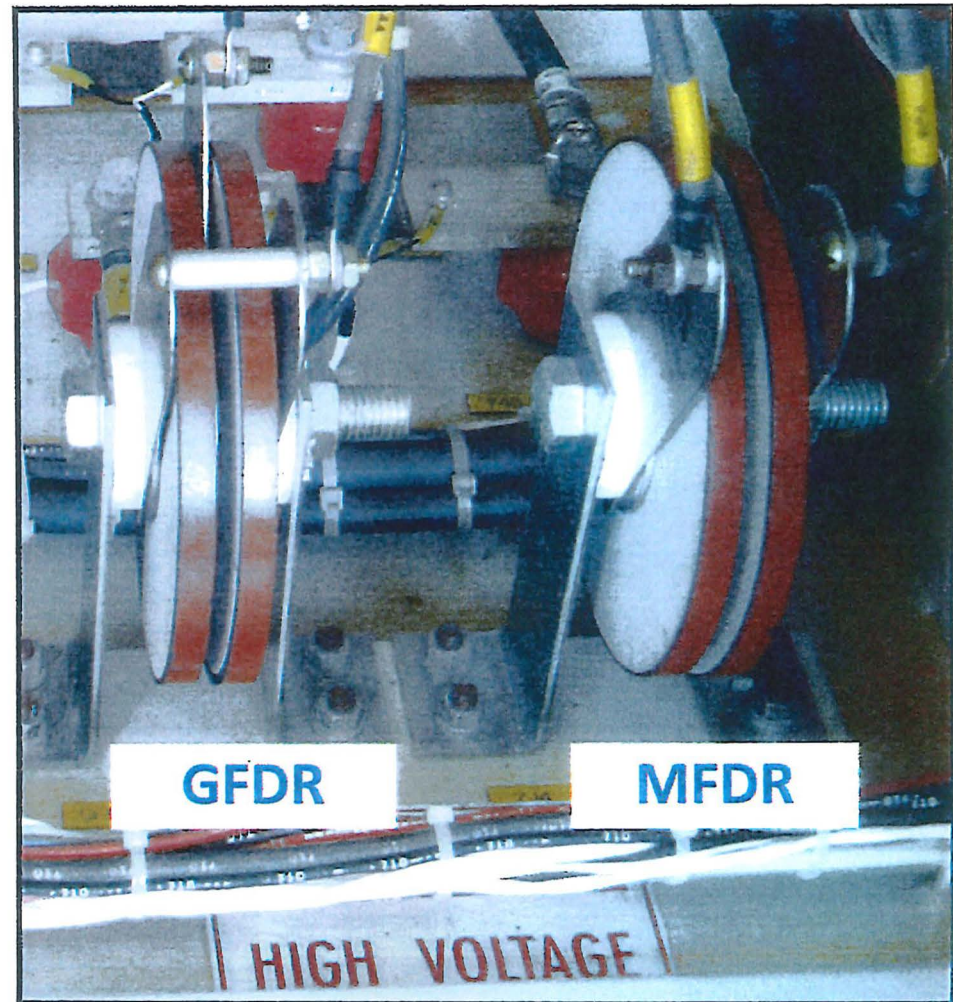
1199 faults storage

*4.2-1-12 | Frame non restrictive code
51 Frame on restrictive code
room for 30 51 events
Download events at PM - then delete*

Discharge resistor

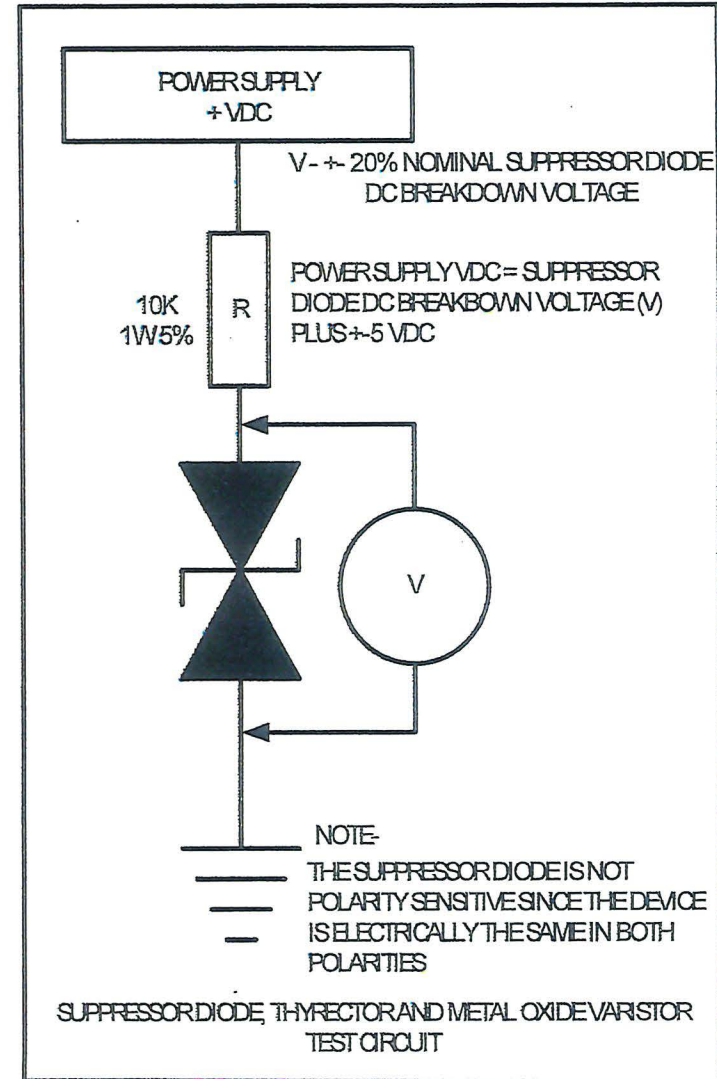
GFDR/MFDR THYRITES

- GFDR & MFDR are permanently connected across the Alternator and Motor Fields and are used to remove any self induced spikes produced by a collapsing magnetic field each time the MF or GF contactor opens.
- Part Number of Both - 41A259026P2
- GFDR rated at 275V
- MFDR rated at 550V
- Different voltage rating achieved by changing bridge configurations.



GFDR/MFDR THYRITES

- A faulty GFDR has the potential to cause Failed Diode trips in the Statex III system.
- The figure right shows one method for testing the Thyrite.
- Basically a variable voltage is applied to the thyrite and a multimeter is used to check at what voltage the device “breaks down” and conducts.



SPEED SENSORS

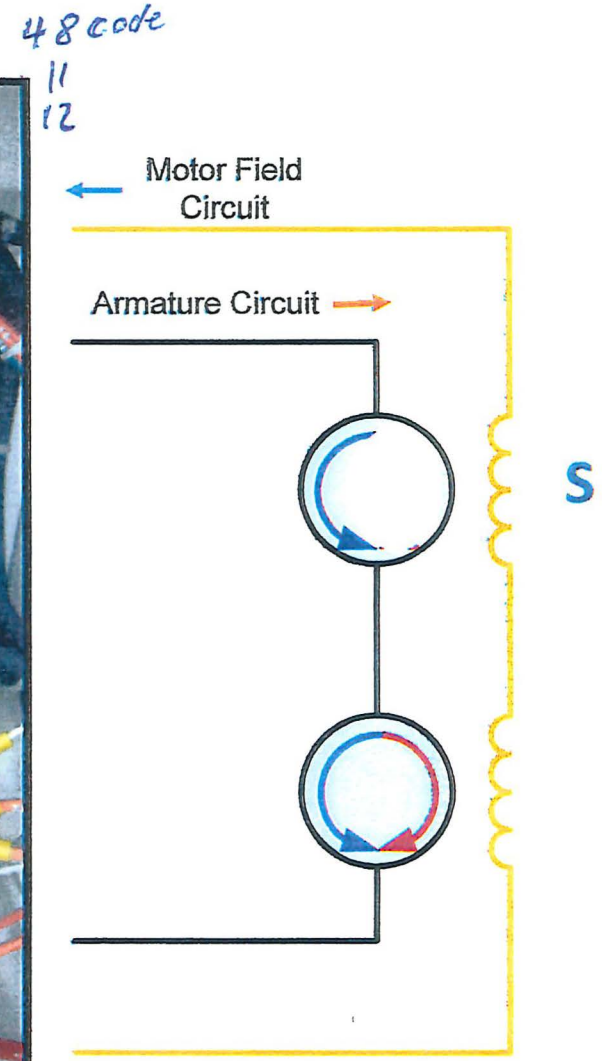
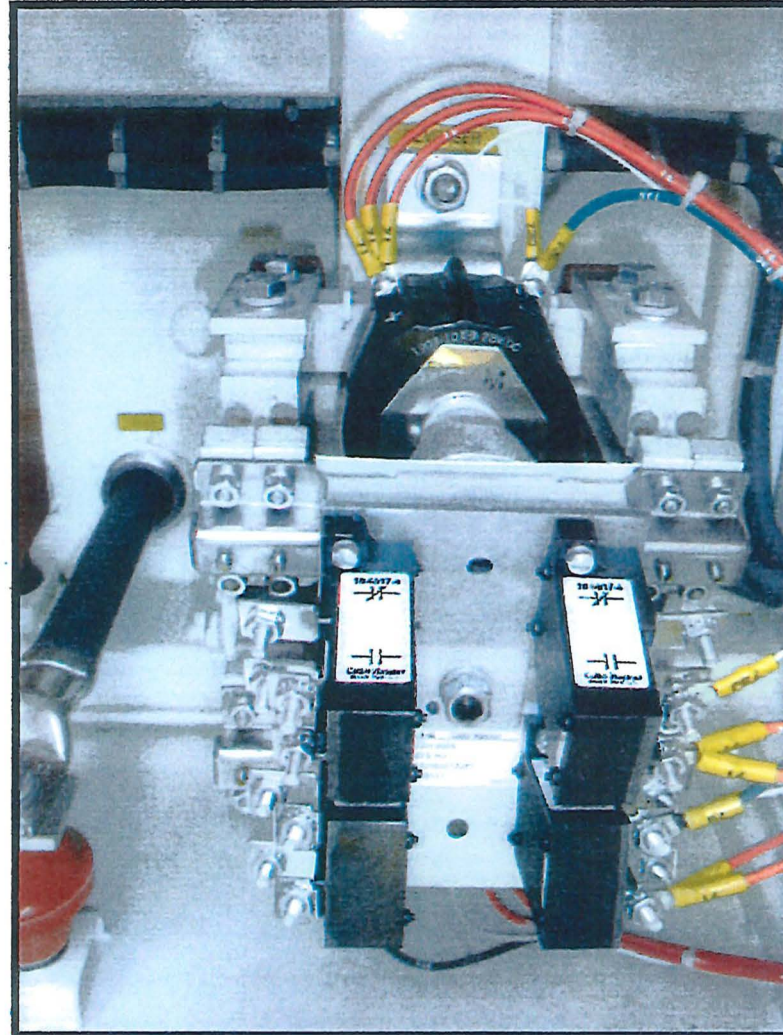
- Speed Sensors provide feedback signals to the control system.
- These signals are proportional to the speed of the Motorized Wheels and engine.
- Speed sensor signals are generated by passing gear teeth through the magnetic field of a permanent magnet, situated in closed proximity to a rotating gear.
- Produce approximately 3 – 9VAC
- To adjust turn sensor by hand until sensor head touches gear then back out $\frac{1}{2}$ to $\frac{3}{4}$ of a turn and tighten locknut.

140 Ω



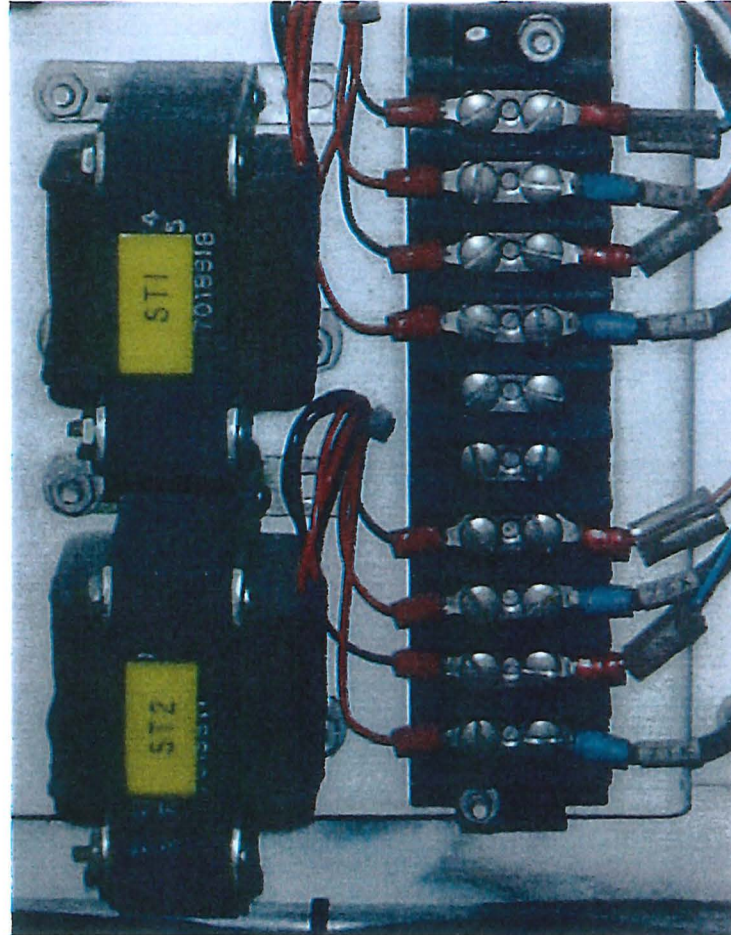
REVERSER

- The function of the reverser is to change the direction of current flow in the motor field circuit which will change the direction of movement of the truck.
- Only changes when truck speed below 3MPH and MF open.

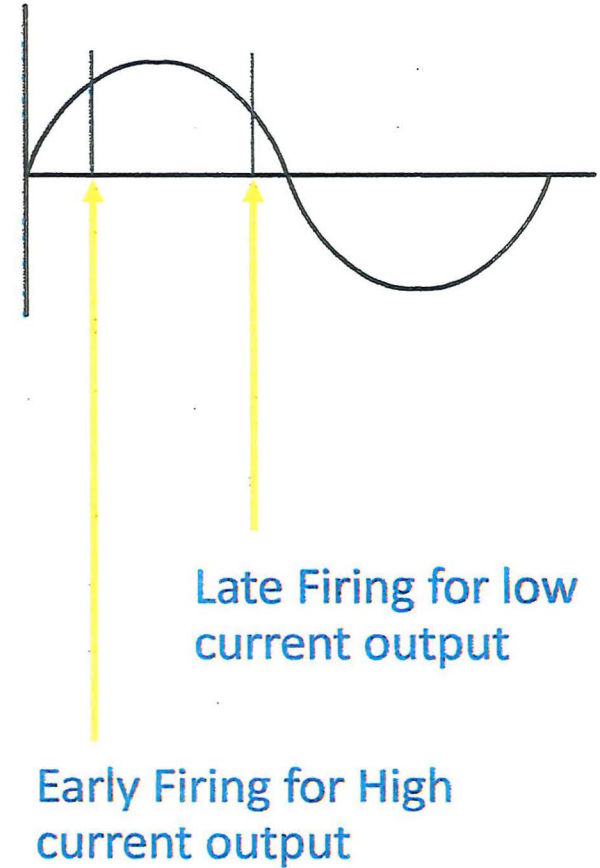


SYNCHRONISATION TRANSFORMERS

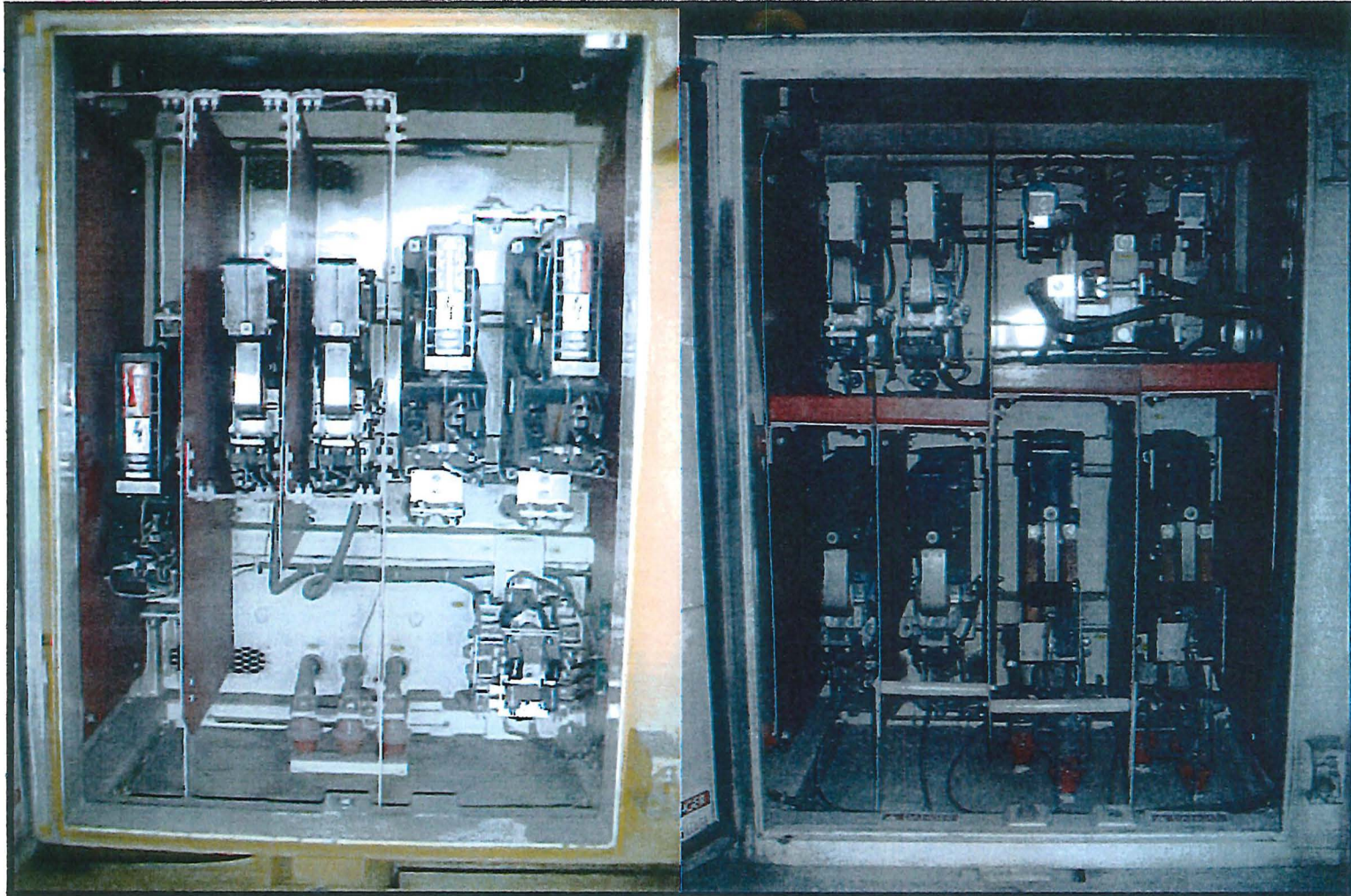
- Used as part of the control system to ensure firing pulses are sent to AFSE and MFSE when the AC supply to them is in the positive ½ cycle as well as the negative ½ cycle.



AC to AFSE/MFSE



POWER CONTACTORS

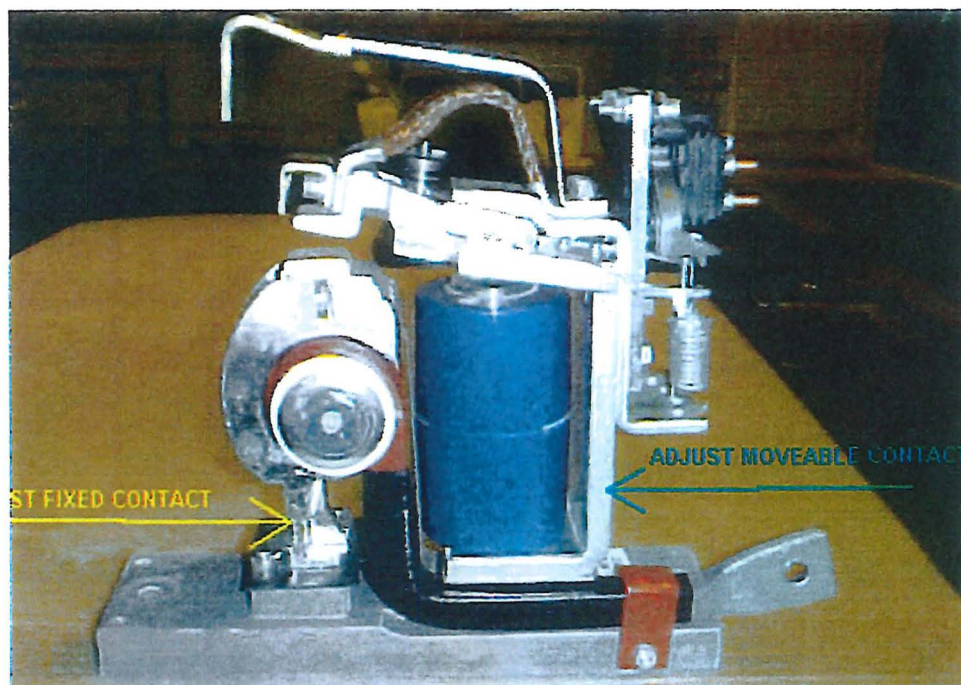


AIRLESS CONTACTOR ASSEMBLY

AIR CONTACTOR ARRANGEMENT

CONTACTORS

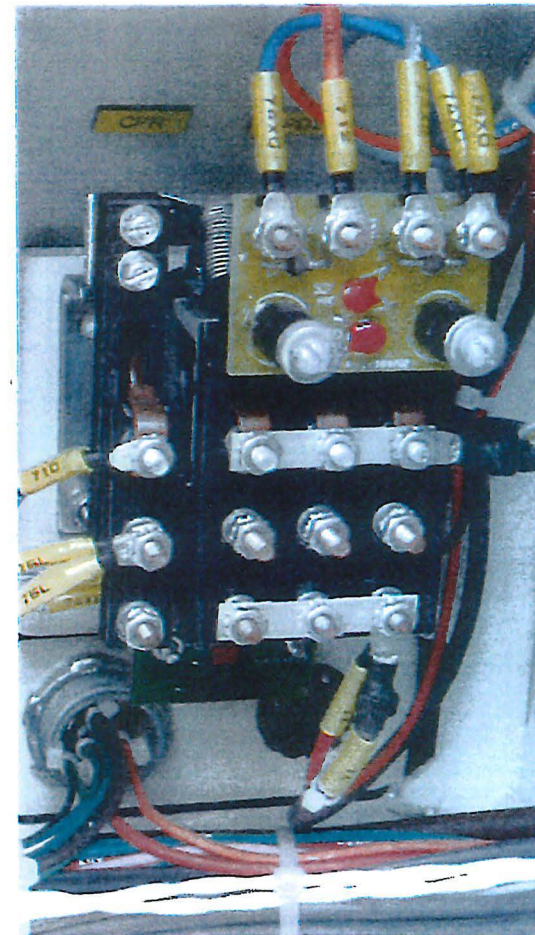
- Multiple items to maintain:
 - Spring Pressure on Contact Tips
 - Spring tension holding contactor open
 - Contact tip alignment.
 - Contact condition.
 - Aux Feedback Adjustment.
 - Pivot Condition.



60-1
60-2

CONTROL POWER RELAY

- CPR is used to provide 24V power supply to the Statex III control system and other associated truck components.
- The relay is usually supplied from the OEM key switch but is latched up for approximately two seconds after the key switch has been turned off via a latch circuit in the Statex III system.
- The control power relay is identical to GFR however some OEMS do utilize alternative wiring configurations.

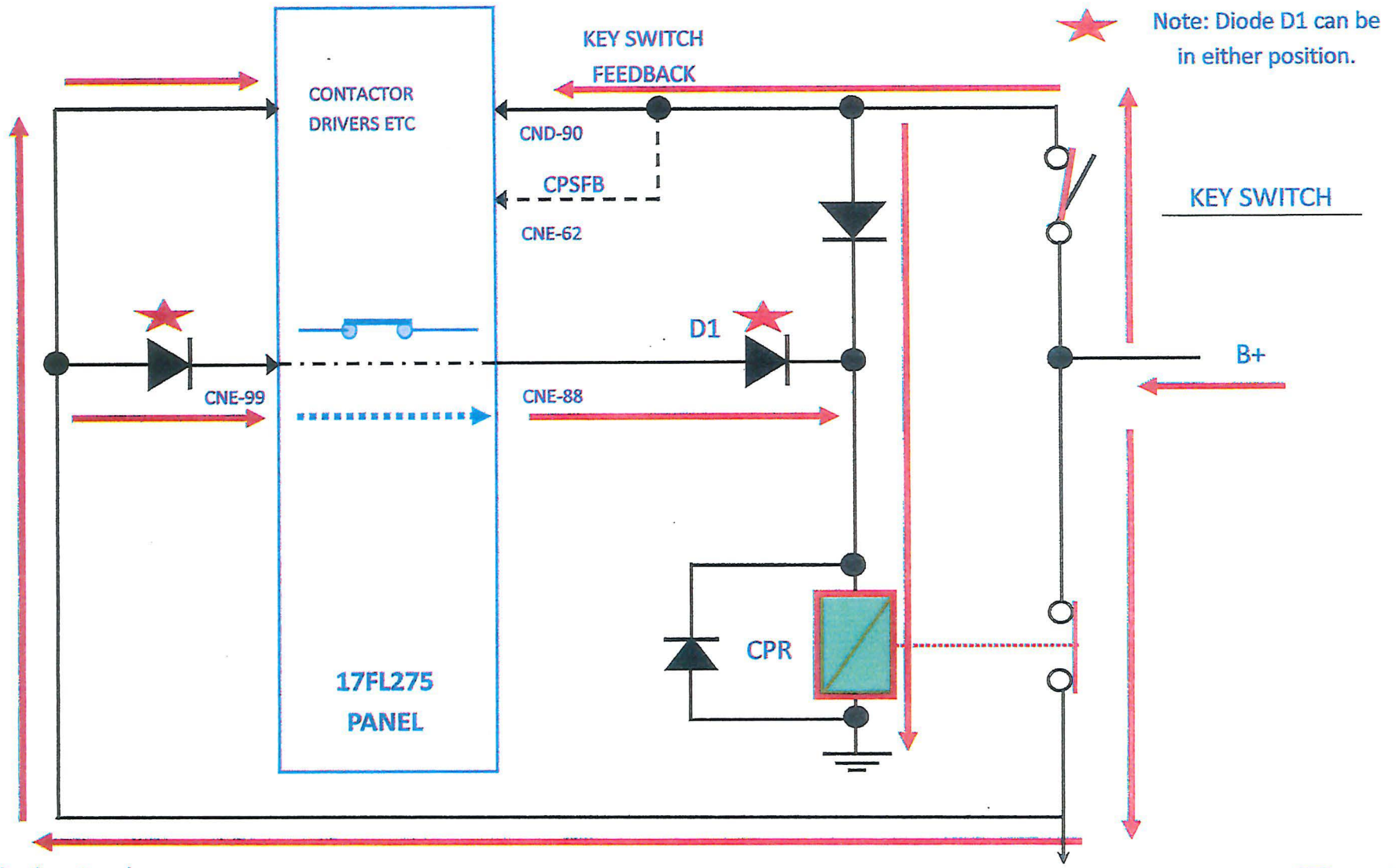


*Control power went shut off
← Bad diod*

SYSTEM COMPONENTS

"Latch"

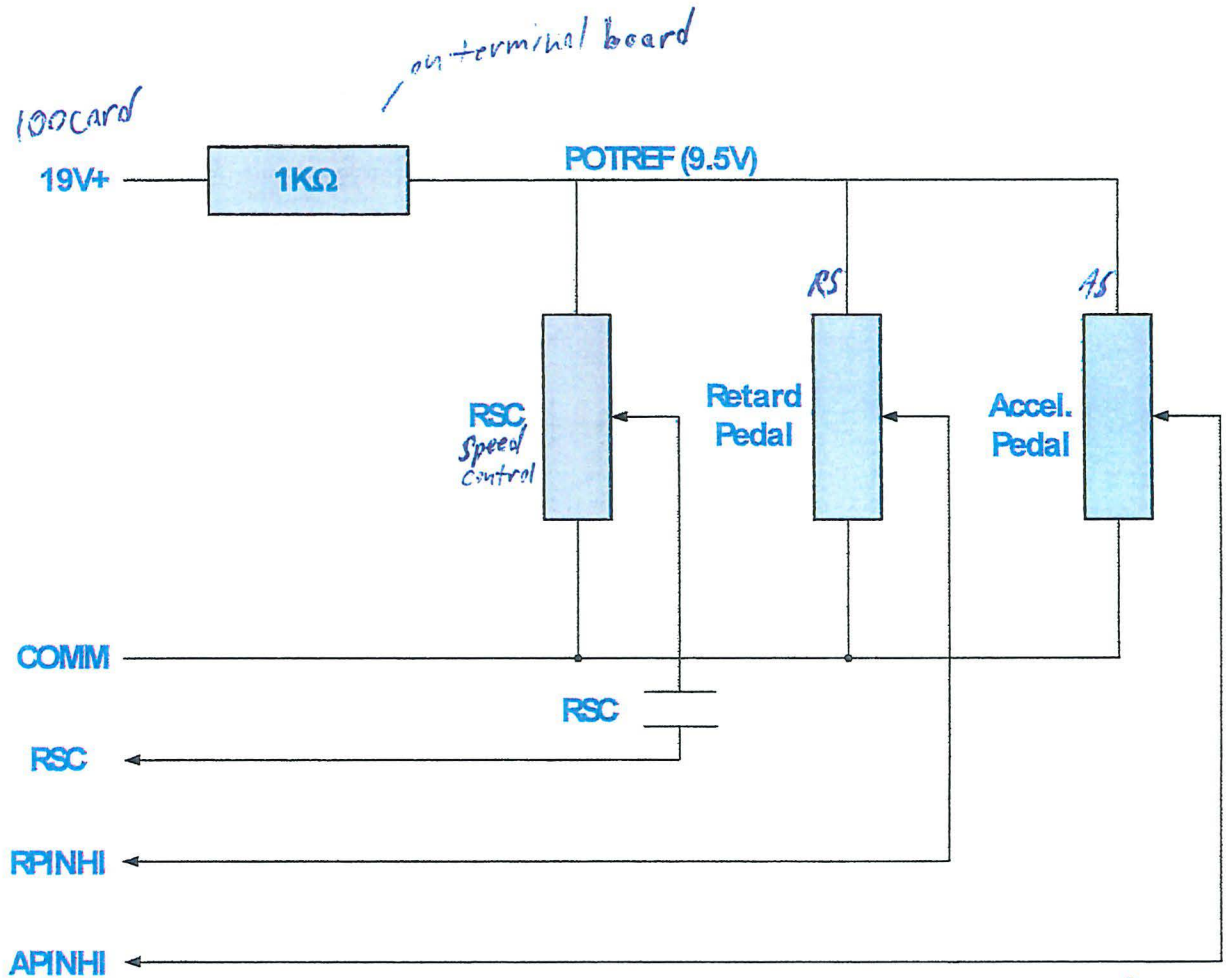
CONTROL POWER RELAY



Energized over 3 mph

FOOTPEDALS

- Footpedals and RSC potentiometers are used to provide variable operator request signals to the Statex III control system.
- They are supplied from the 19V output of the FB100 card and routed to the pedals/RSC via a dropping resistor.
- This creates a basic voltage divider circuit supplying the variable resistors with approximately 9-10V

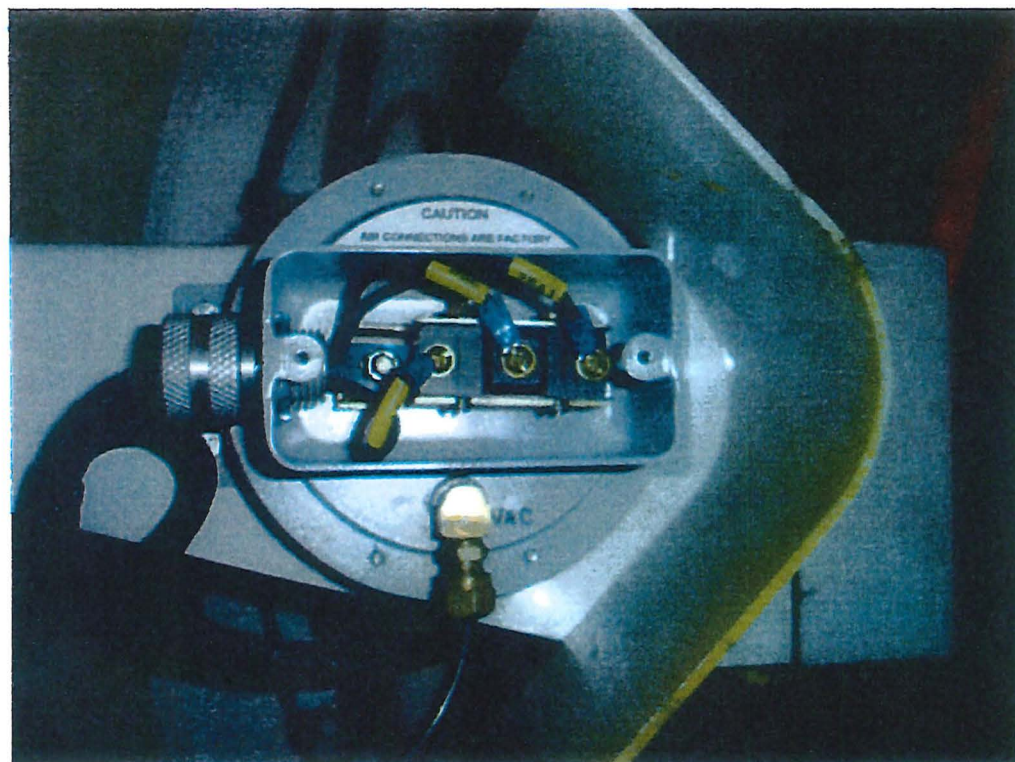


Retard Pedal is precedence over Accel.

BLOWER PRESSURE SWITCH

- The axlebox pressure switch located in the axlebox. When correctly adjusted, detects loss of cooling air pressure from the main alternator blower to the wheel motors.
- When engine rpm is approximately 1100rpm for Fuel Saver trucks, or greater than 1500rpm for Non-Fuel Saver trucks, the blower pressure switch should be activated.

time delay 10sec



63-1 event

63-2 bad sensor



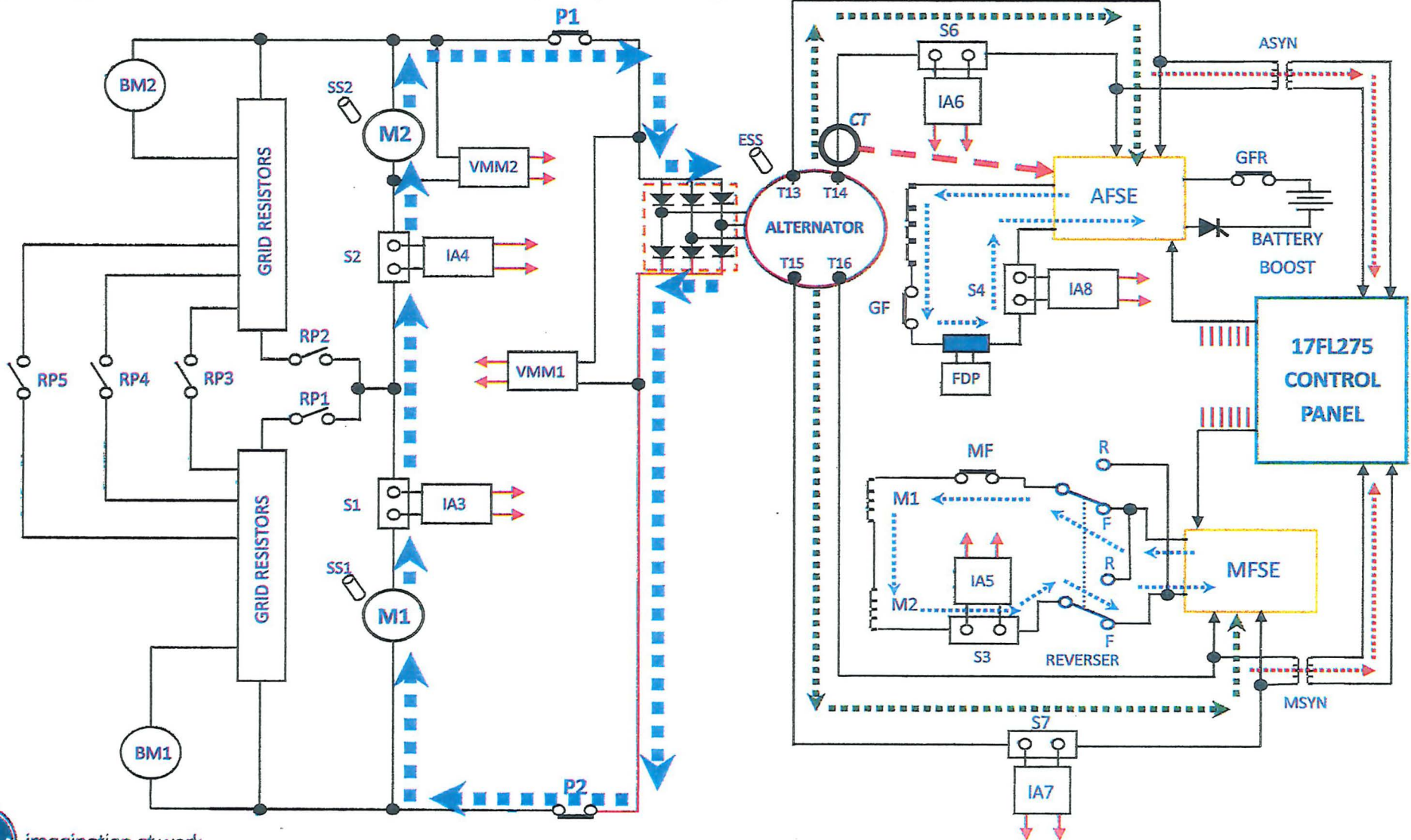
SECTION THREE

SYSTEM FUNCTIONALITY

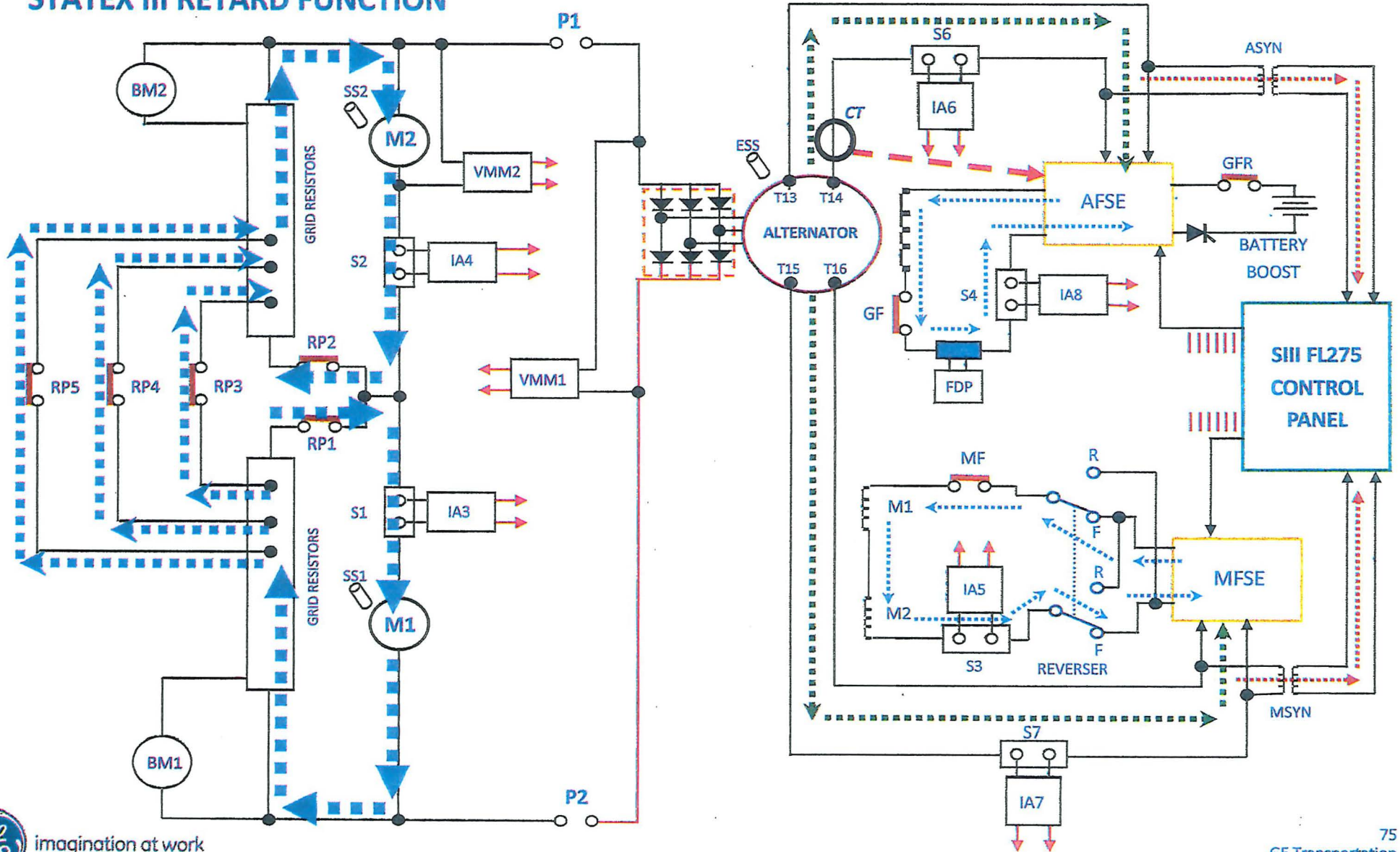
SECTION THREE

SYSTEM FUNCTIONALITY

STATEX III MAIN POWER COMPONENTS (PROPEL)



STATEX III RETARD FUNCTION



PROPEL

Sequencing

- AFSE, Battery Boost, MFSE
- P1 /P2
- MF
- GF
- GFR

Control

- 40 Amp Battery Boost Current.
- AFSE Tertiary Voltage occurs
- Sync transformer provides information feedback of AC to AFSE back to control panel.
- Firing Pulses AFSE GFM.
- Current from AFSE starts to flow in alternator field circuit.
- CT sees Tertiary Current & turns off Battery Boost (Alternator now Self Excited)
- Voltage output from DC RECTIFIER = ARMATURE CURRENT.
- High Current until Armature spins @ low Voltage.
- Armature Current is Command for Motor Field.
- Already have MFSE Tertiary Voltage.
- MF CMD = Firing Pulses to MFSE GFM.
- Current from MFSE starts to flow in Motor field circuit.
- **FIELD AMPS + ARMATURE AMPS = TORQUE.**



RETARD

- AFSE , Battery Boost, MFSE
- RP1 /RP2
- MF
- GF
- GFR

Control

- 40 Amp Battery Boost Current.
- AFSE Tertiary Voltage occurs.
- Sync transformer provides information feedback of AC to AFSE back to control panel.
- Firing Pulses AFSE GFM.
- Current from AFSE starts to flow in alternator field circuit.
- CT sees Tertiary Current & turns off Battery Boost (Alternator now Self Excited).
- AF-CMD – Regulates Alt Field current to set Alt Output Voltage to 1350 volts.
- Already have MFSE Tertiary Voltage.
- Firing Pulses to MFSE GATE FIRING MODULE.
- Motor Field Current flows through wheel motor fields.
- Motor now a Generator.
- ARMATURE Current flows in Grids.
- ARM AMPS results from Motor Field Current & Speed to a max of 1320/1390/1450 Amps.
- MF CMD = Request – Feedback.



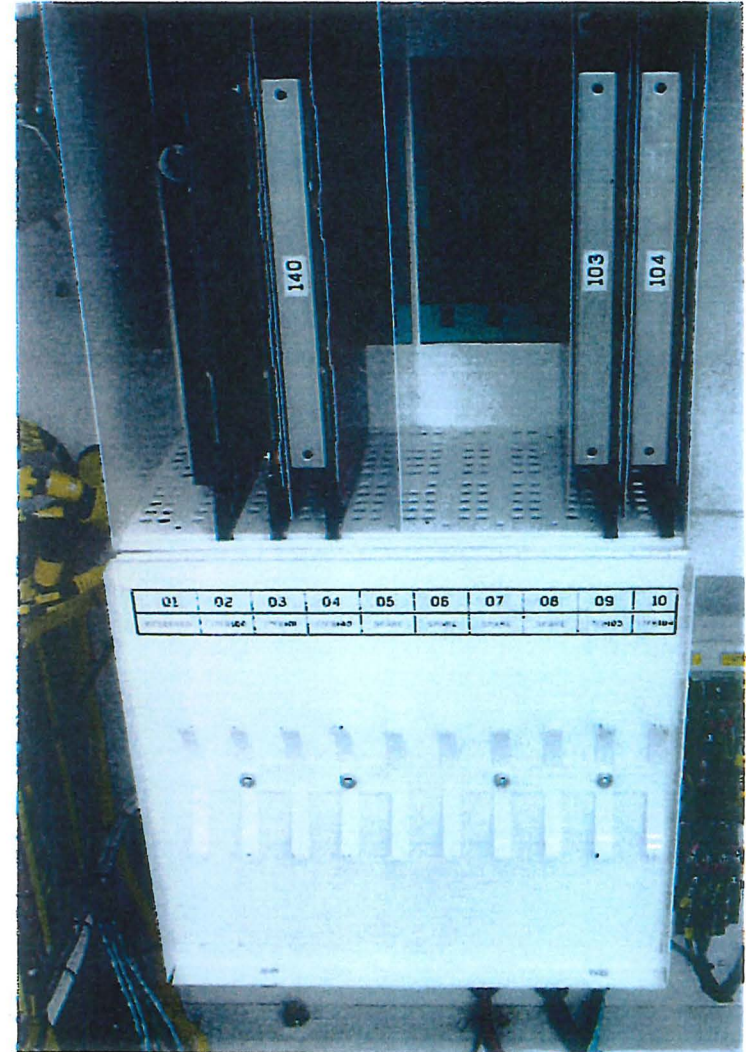
SECTION FOUR

MICROPROCESSOR

CONTROL

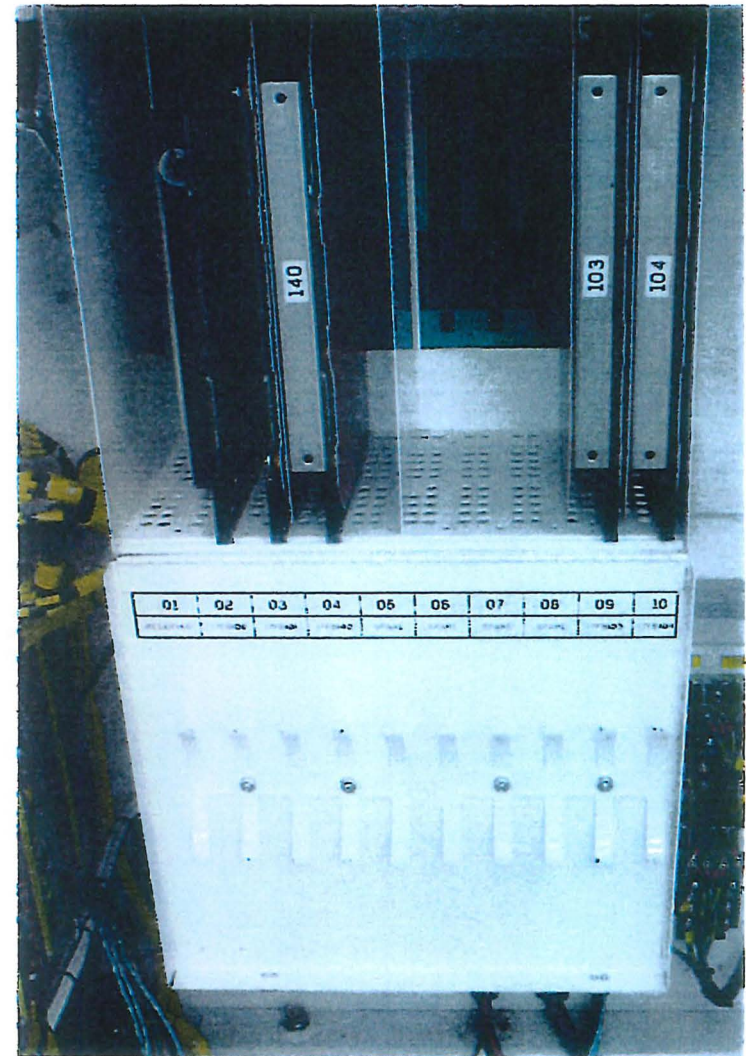
FL275 PANEL SIMPLIFIED

- The FL275 Panel is the heart of the Control System.
- Panel has five input connectors of which 4 are used at this time which are: CNA, CNB, CND & CNE.
- The backplane contains receptacles for card connectors (210 Pin) and these connections are wrapped not soldered.
- The card complement of the FL275 panel consists of the following five cards.
 - 17FB100 - Power Supply
 - 17FB101/144/174- Central Processing Unit
 - 17FB102/140 - Analog Input/Output
 - 17FB103 - Digital Input/Output
 - 17FB104 - Digital Input/Output



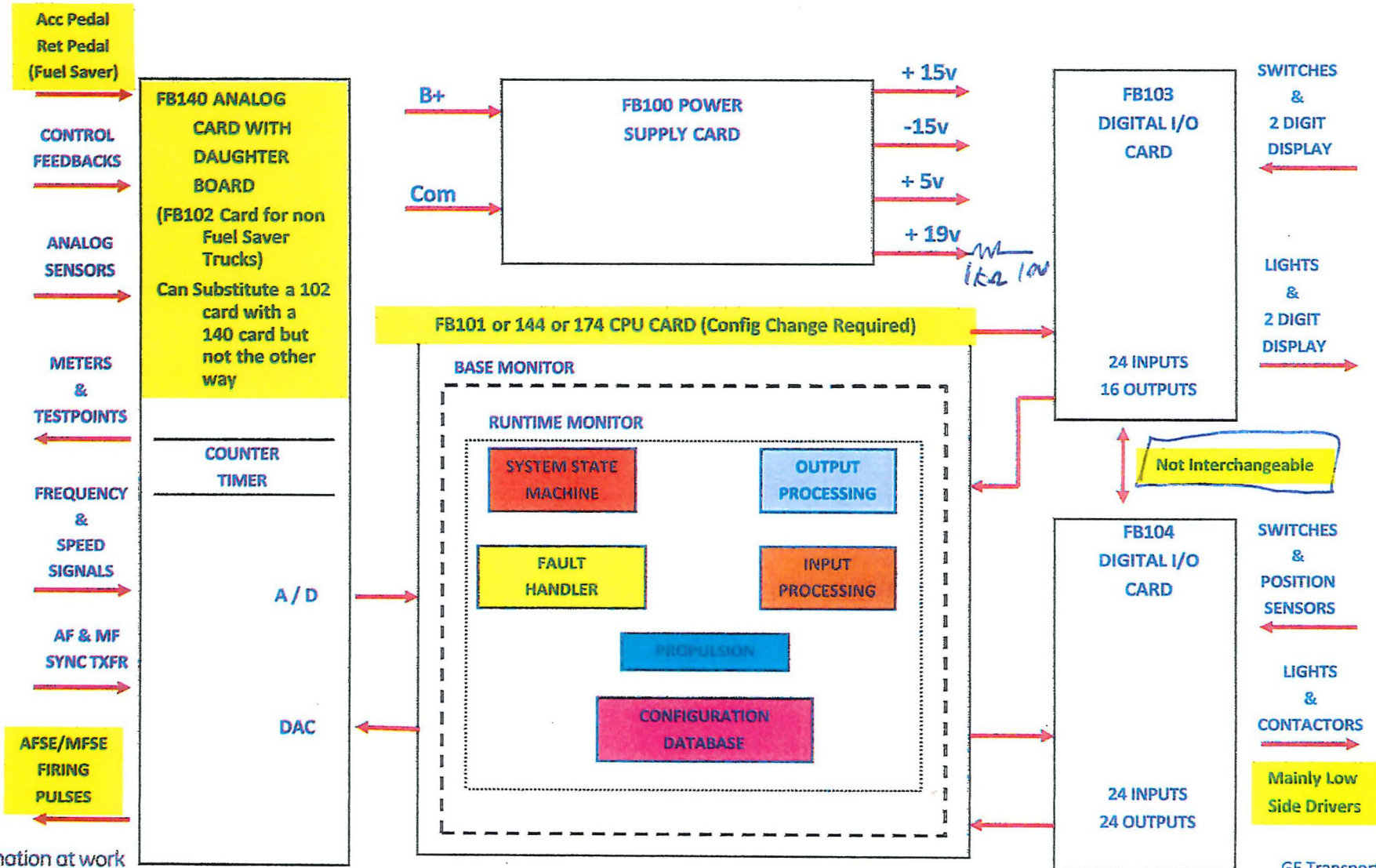
FL275 PANEL SIMPLIFIED

- The FL275 Panel receives inputs from the various digital and analog feedbacks to the panel from multiple field devices that allow us to monitor the various voltages, currents speeds, etc of the control system.
- The Panel:
 - Provides propulsion and retarding control
 - Provides maximum speed control including overspeed.
 - Provides data to the Diagnostic Display Panel
 - Multiple other functions such as park brake solenoid control, retard light control, etc.



MICROPROCESSOR CONTROL

FL 275 PANEL SIMPLIFIED

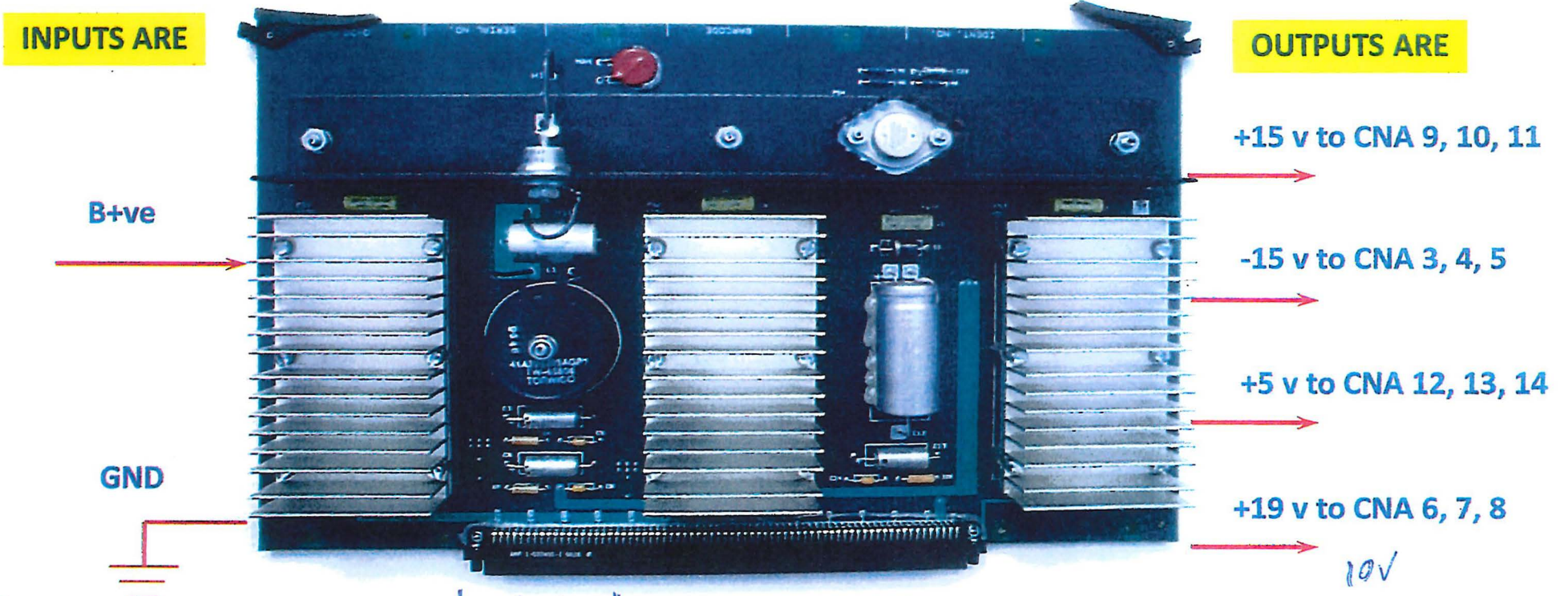


144 share configuration files

MICROPROCESSOR CONTROL

POWER SUPPLY CARD.

- Some supplies produced by this card leave the panel and appear on field devices (ie + & - 15V, 19V) however some stay internal to the FL275 Panel (ie +5V)



1 19V 1
 90 Battery low
 91 Battery high
 Loss when 19V-chests down

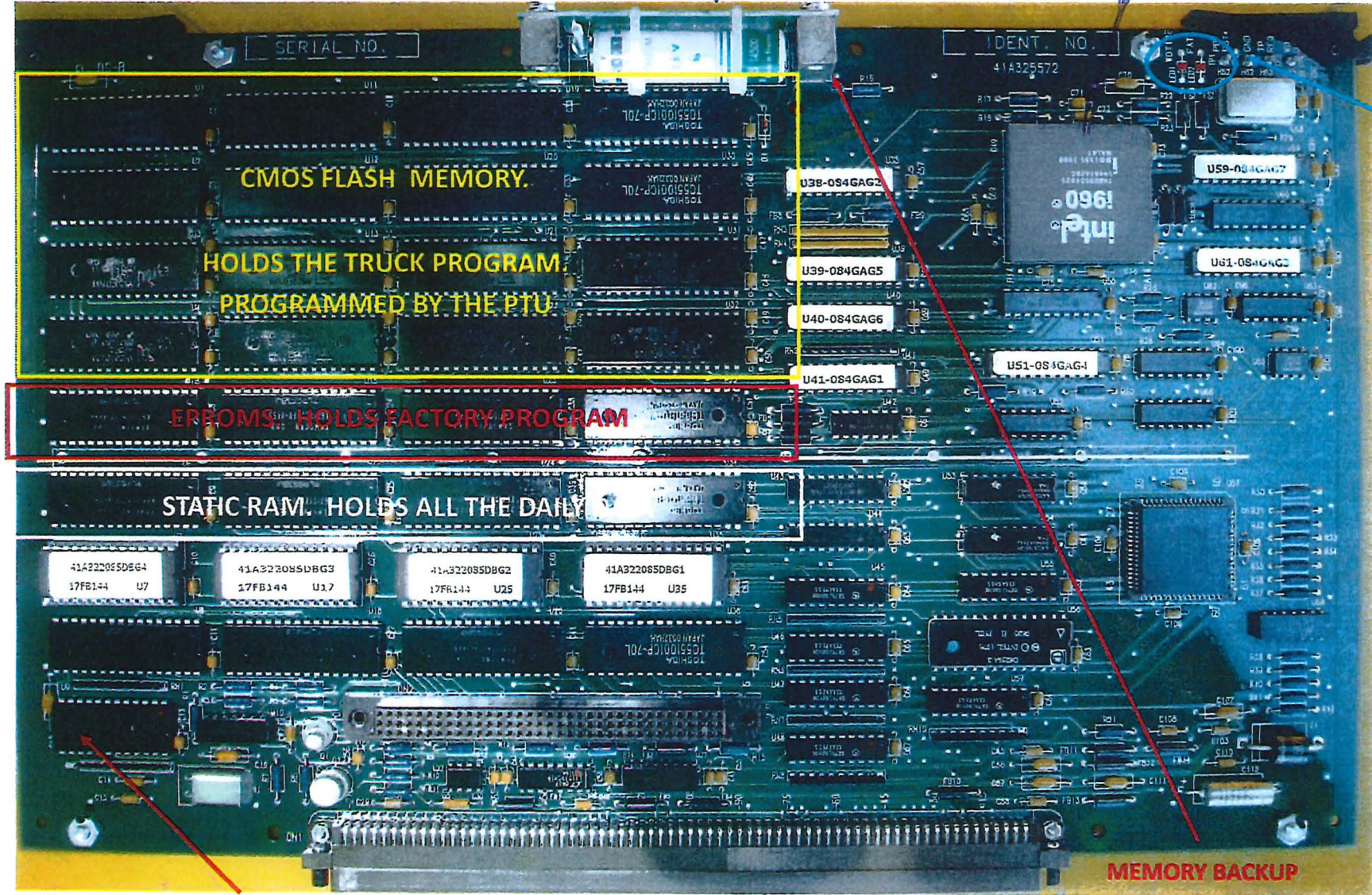
140 monitors battery voltage

MICROPROCESSOR CONTROL

17FB144 CPU CARD

holds col. Battery 3.6V very important

CPU chip 25MHz



LED
If flashing card has failed

ERROMS: HOLDS FACTORY PROGRAM

STATIC RAM. HOLDS ALL THE DAILY

MEMORY BACKUP

REALTIME CLOCK

BATTERY



imagination at work

MICROPROCESSOR CONTROL

17FB101/144/174 CPU CARD

+5V +15V -15V GND

Must be programmed

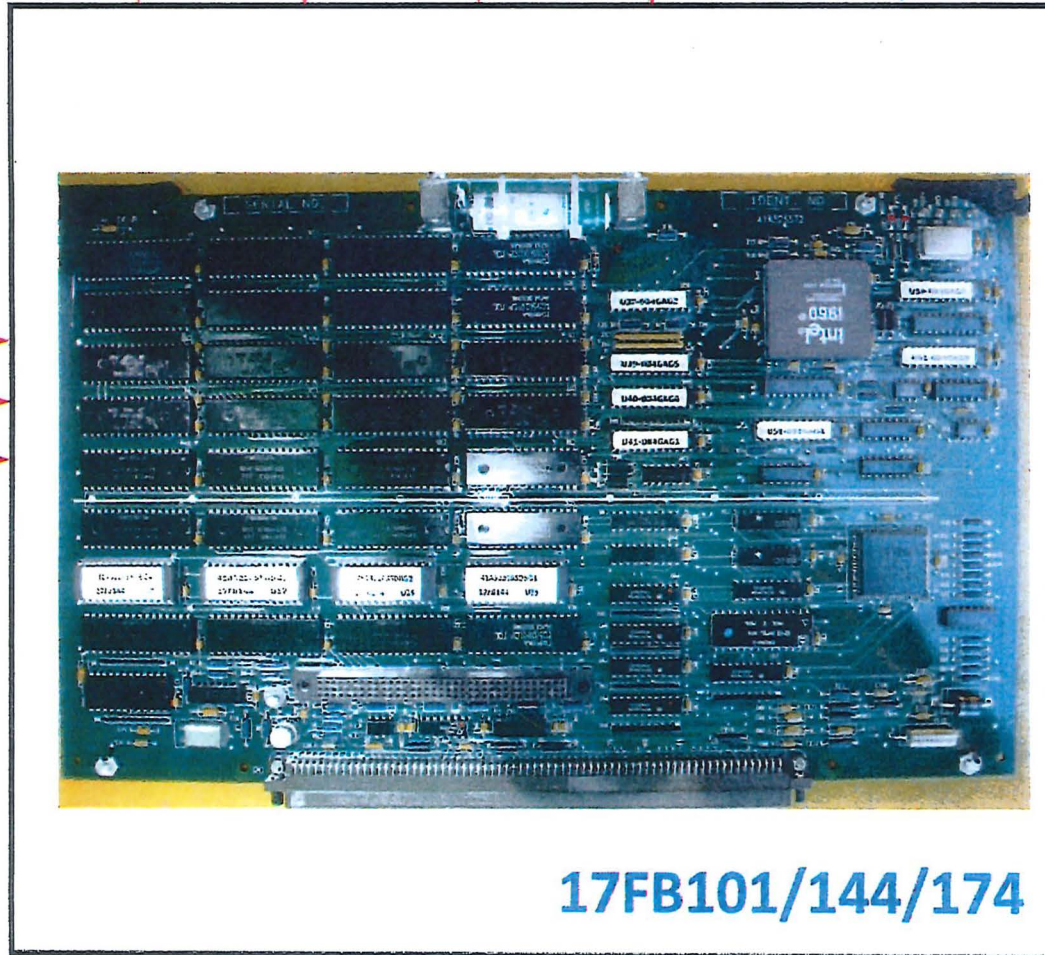
INPUTS FROM
OTHER 275
PANEL CARDS

OUTPUTS TO
OTHER 275 PANEL
CARDS

10-20K

102/140
103
104

102/140
103
104

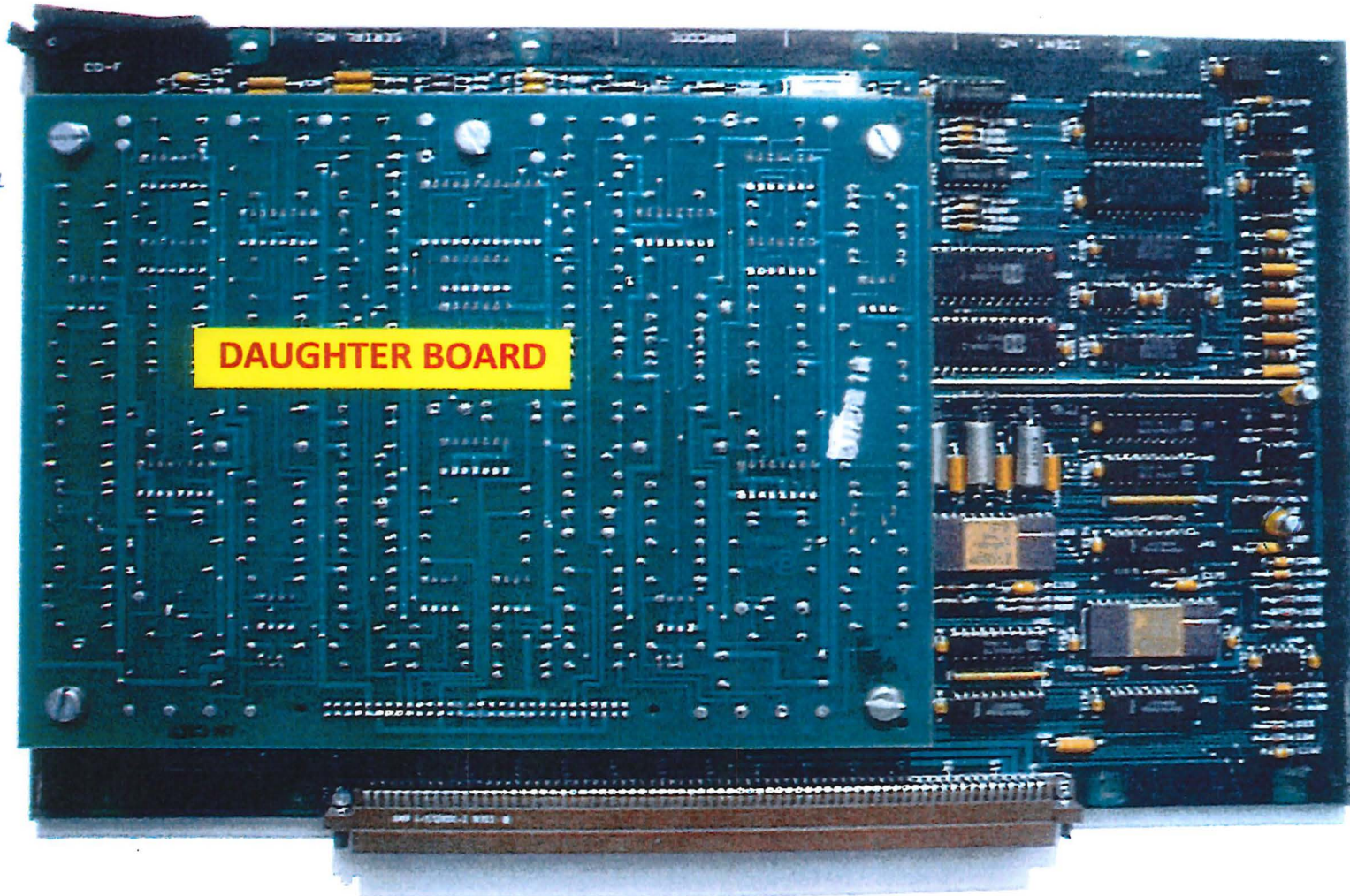


17FB101/144/174

MICROPROCESSOR CONTROL

17FB140 Analog I/O Card was 102

Sink from input



5V transistor
wire 916
596

17FB140 ANALOG I/O CARD

INPUTS

- VMM1 - AOUTVOLT
- VDR3 - ALTFLDVOLT
- S1 IA3 - M1 AMPS
- S2 IA4 - M2 AMPS
- VMM2 - M2 VOLT
- S3 IA5 - MF AMPS
- Pedal - RPINHI
- Pedal - APINHI
- IOV - POTREF
- Set retard speed - SRS (RSC)
- S4 IA8 - ALTFAMPS
- S7 IA7 - MTOC
- S6 IA6 - ATOC
- Motor temp low - M1TS
- " - M2TS
- AFSE TEMP
- MFSE TEMP
- ALT INTAKE TEMP
- not used alot - COOLT
- COOLP
- CRANKP
- OILP
- Speed sensor - M1 & M2 SPDIN
- Engine speed sens. - ESS
- MA from ground fault - FAULT
- SPARE

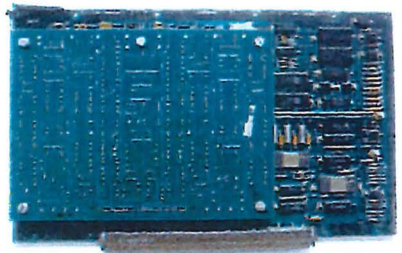
- B+
- +5V
- +15V
- 15V
- GND
- ASYN
- MSYN

OUTPUTS

- PULSES TO MFSE
- |||
- PULSES TO AFSE
- ENGRPMCMD
- Hz 115 Hz - idle
- 320 Hz - 1400 RPM
- 9V - 916, 556 Drec #5
- ~~MOTS~~
- Motor
- Temp
- Sensor Gauge
- ~~TRKSPD~~
- ~~ENGRPMA~~
- ~~BRKBLK~~

DAUGHTER BOARD

+10 - -10
ALT FLD CALL
MOT FLD CALL



INTERFACE CARD FOR ANALOG SIGNAL CONDITIONING

Very Important

"AFTER Card replacement" **17FB140**

Start track
Watch laptop
Retard pedal - All the way
Good:
Alt volts stable 1290-1310V
Bad: volts all over 1190-1420V
Alt Field 120A "Good"

17FB140B1 (use these)
Some bad cards flushed wheel motors

A1
A2
A3

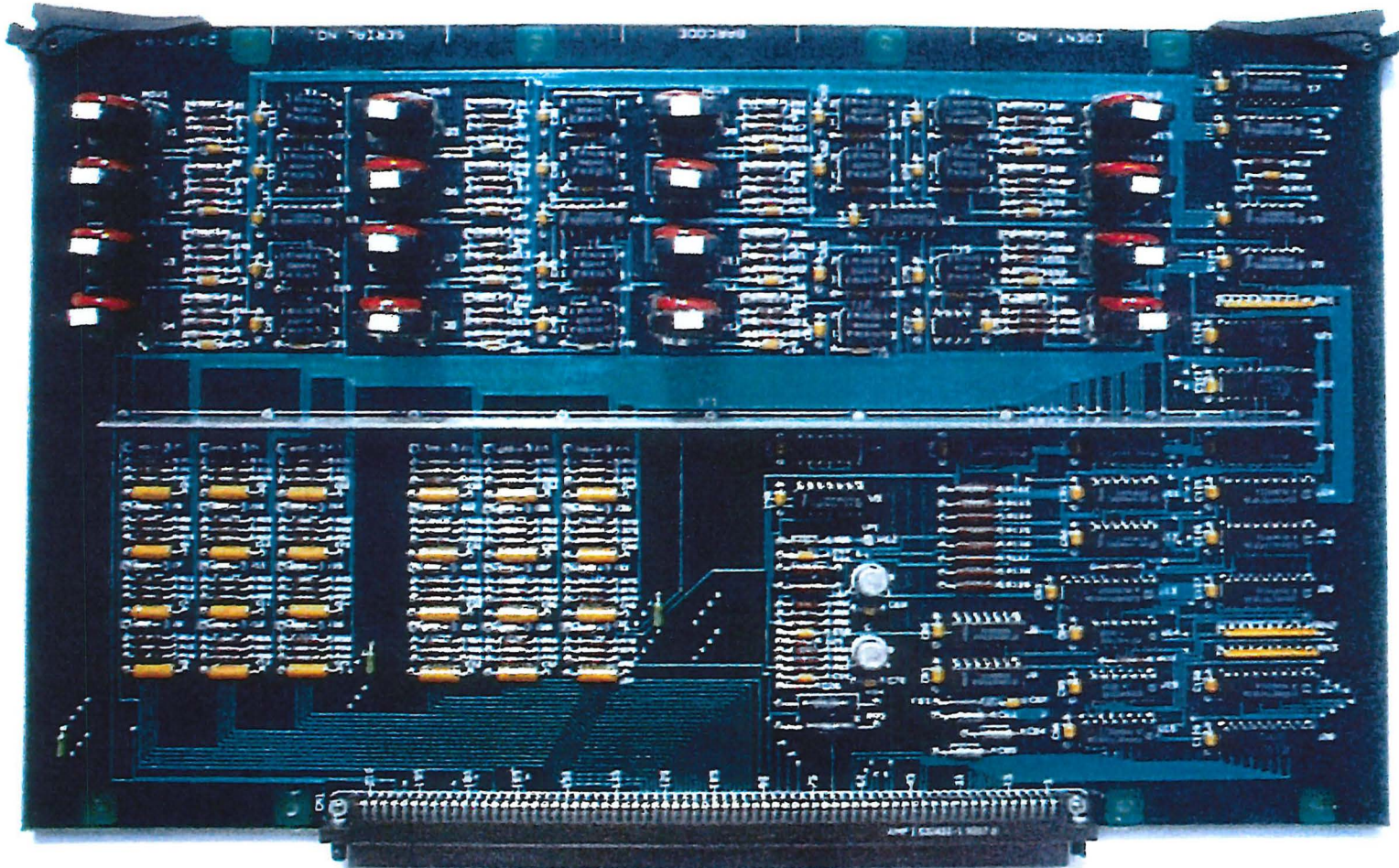


DCPS B11 - FB140

MICROPROCESSOR CONTROL

17FB103 Digital I/O Card

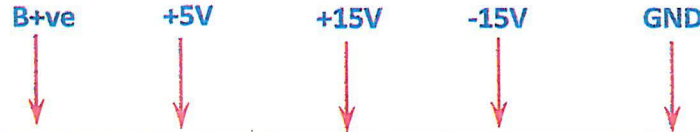
16 channels



MICROPROCESSOR CONTROL

controls 2 digit display

17FB103 DIGITAL I/O CARD

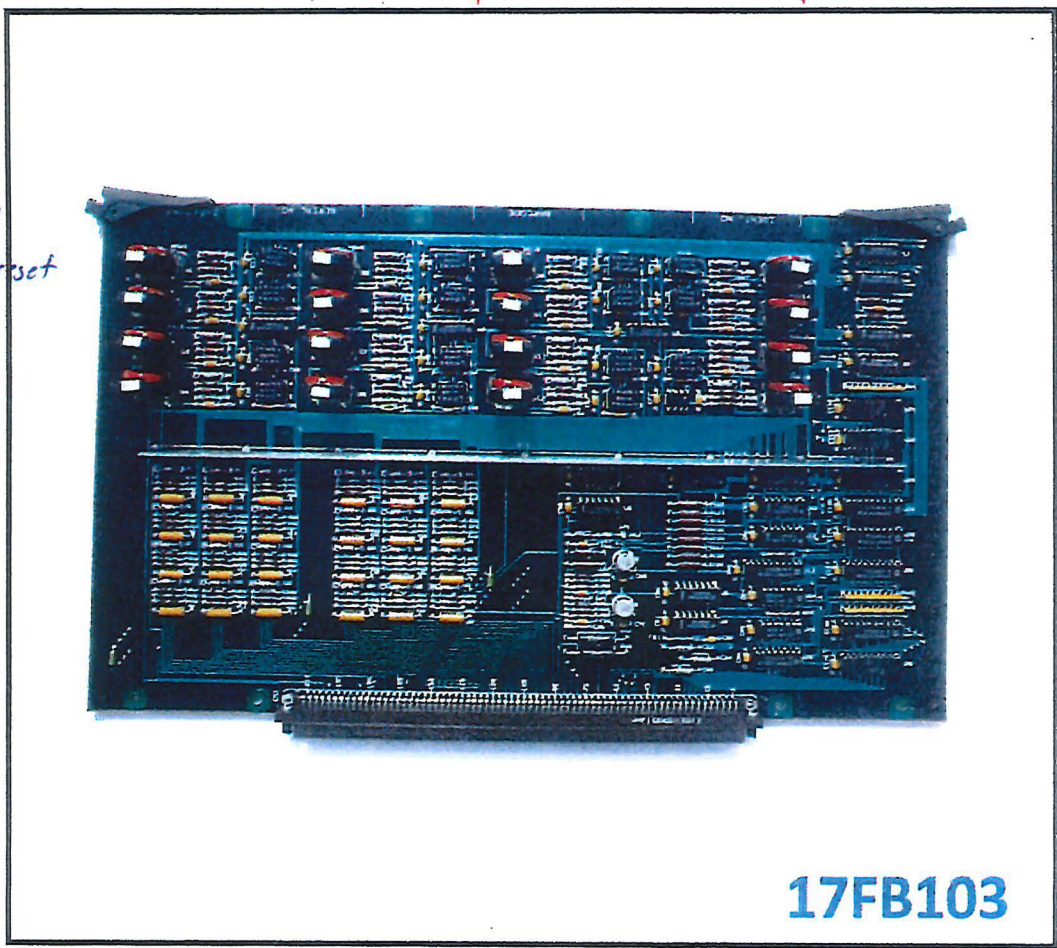


OUTPUTS

- AFSE +27V
- BFLT LT Blower fault light
- FDL Failed dead light
- GNDFLT ground fault light
- DIS low idle solenoid
- MFSE +25
- OS over speed light
- SYSFLT System fault light
- TS Throttle
- RETARD LT light
- PKBRKSOL
*park brake solenoid
← @ 3 mph*

INPUTS

- 200 ← FIRST SEARCH
- LAST SEARCH
- LOCAL RESET
- ACCINHI/APS *air press. switch*
- Blower pressure switch BPS
- ump body override DOS *Hill start/soft reset*
- ump body up switch DUMP BS
- engine shut down ENGSD *74 event*
- engine service ENGSVC *78 event yellow*
- fault detection FAIL DIODE 45
- FORIN
- LDLESW
- 2 speed over speed LDWT
- NEUTRAL
- REVIN
- retard speed control RSC

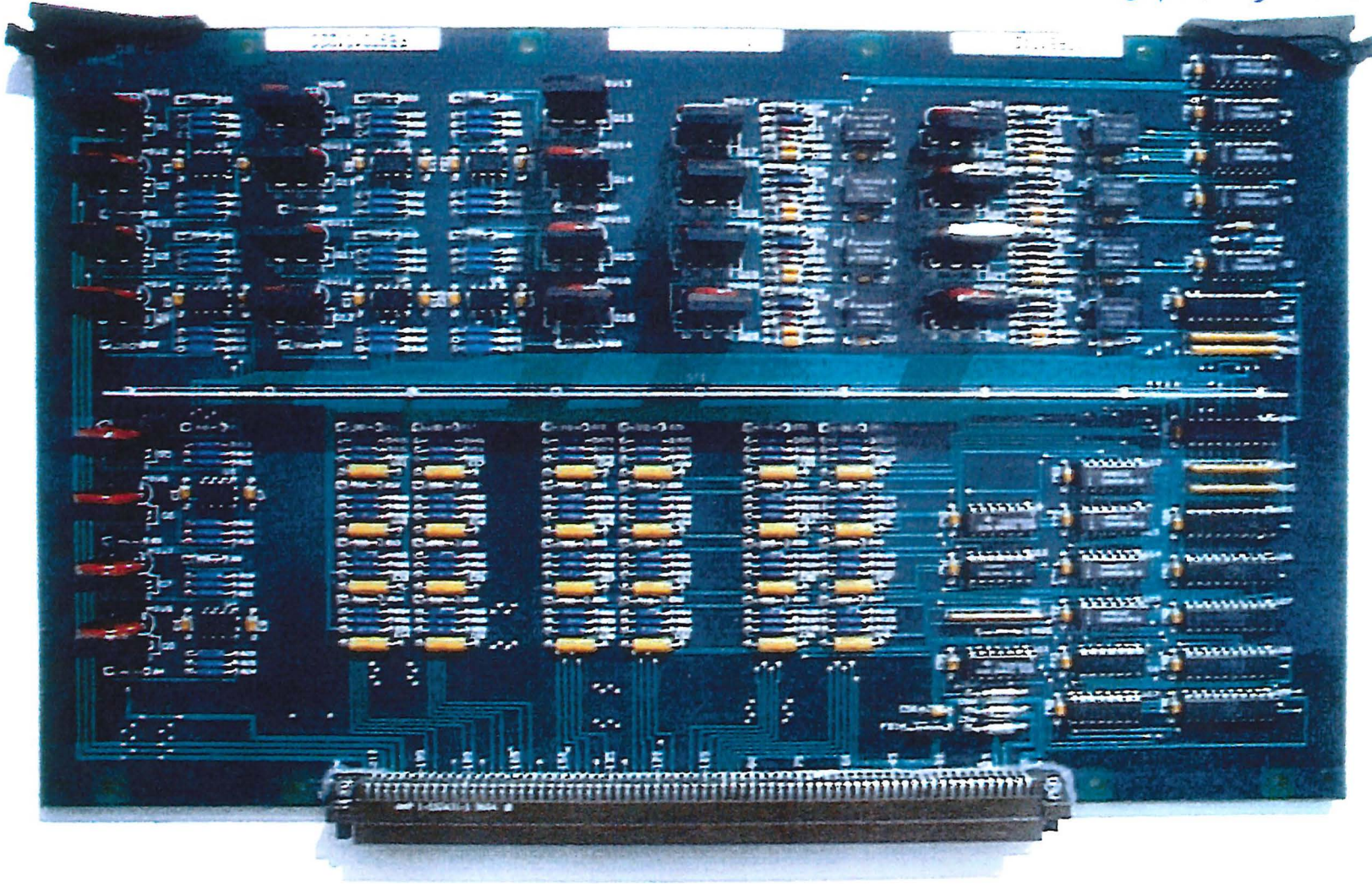


17FB103

MICROPROCESSOR CONTROL

17FB104 Digital I/O Card

24 channels - contactor work



GE 787-GTA26

AAVVEE

intructo

WPTU™

Statex III

MICROPROCESSOR CONTROL

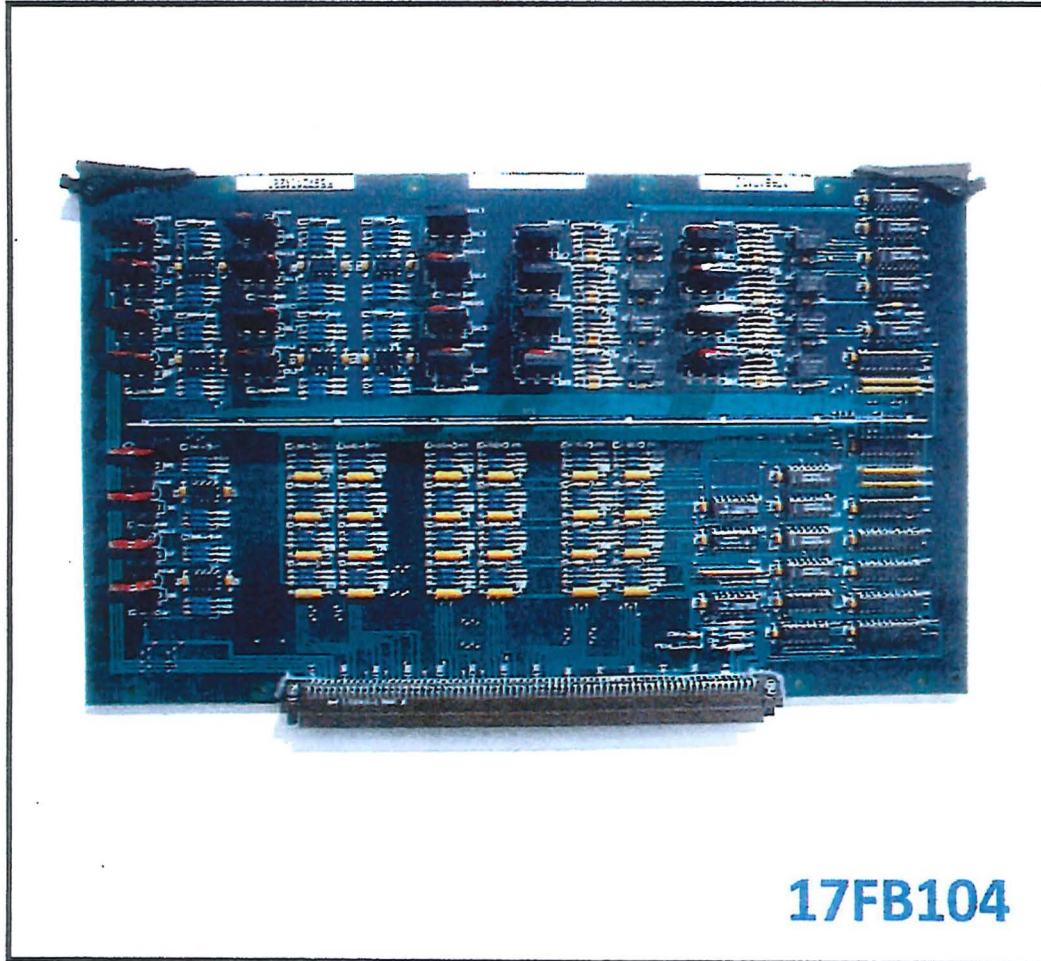
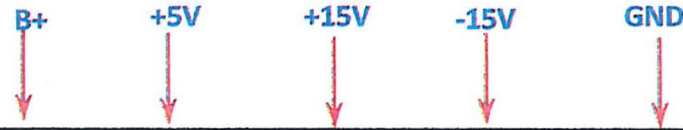
trud

17FB104 DIGITAL I/O CARD

INPUTS

- CPRFB
- FORFB
- GFFB
- GFRFB
- MFFB
- P1FB
- ~~P2FB~~
- REVF
- RP1FB
- RP2FB
- RP3FB
- RP4FB
- RP5FB
- RP6FB
- RP7FB
- RP8FB
- RP9FB

control power
Forward
Generator
Generator
Motor



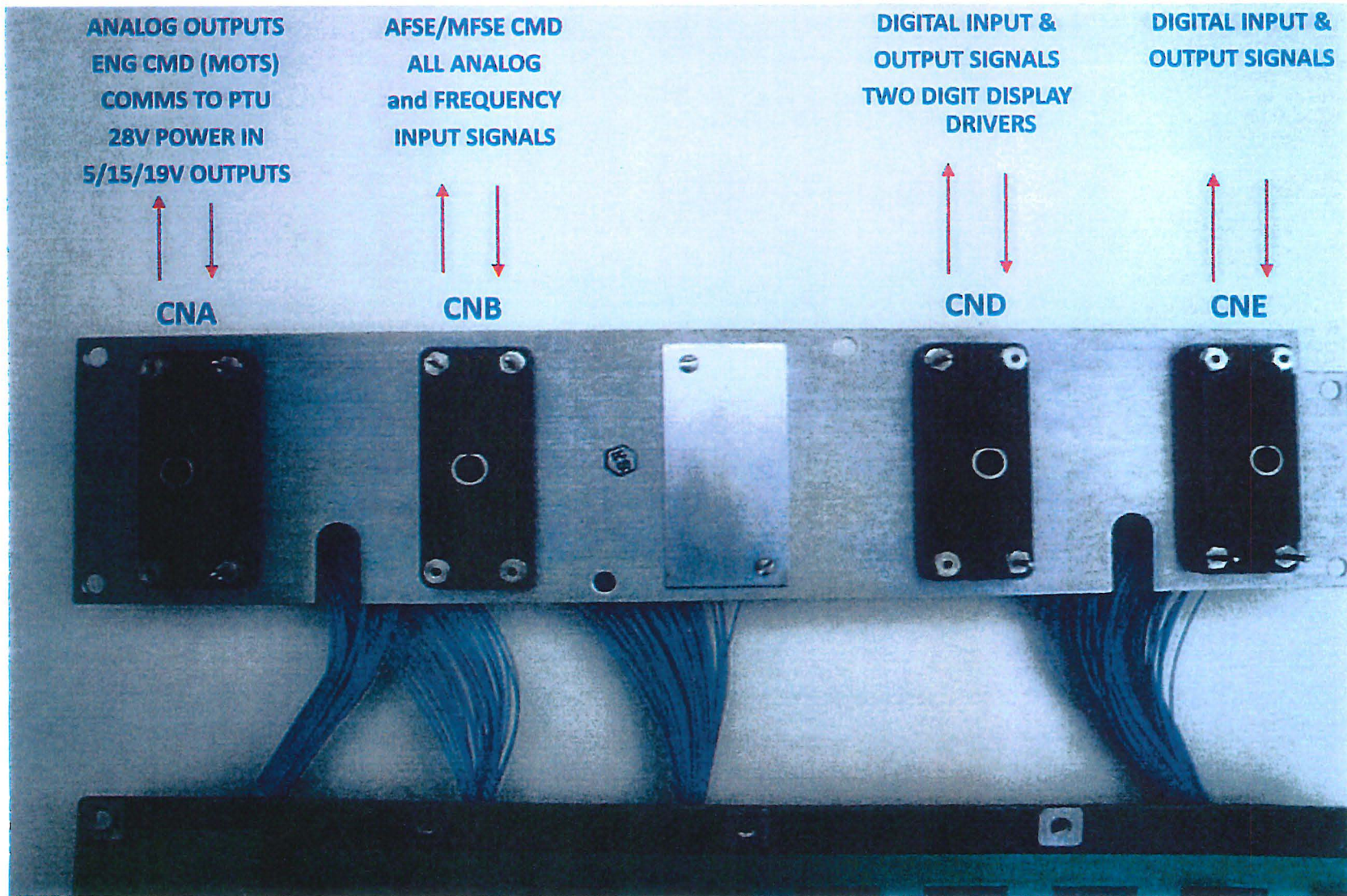
17FB104

TB21C Ground Buss

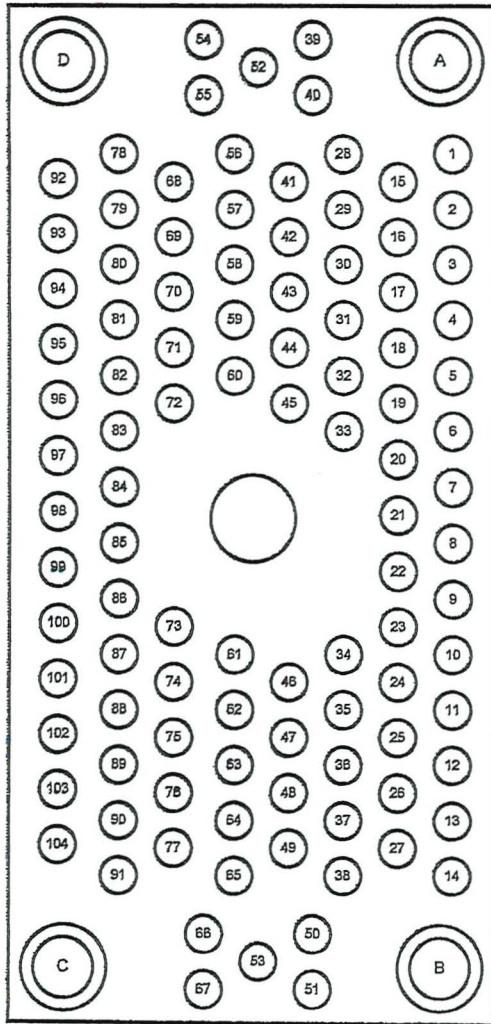
OUTPUTS

- CPRL
- ENGSDNLT *engine shut down*
- ENGSRVLT *engine service*
- FOR *Forward*
- GF *Generator field*
- GFR
- MOTL
- MF *motor field*
- P1
- P2
- REV
- RP1
- RP2
- RP3
- RP4
- RP5
- RP6
- RP7
- RP8
- RP9
- OEMSPDEVENT

17FL275 PANEL CN CONNECTORS



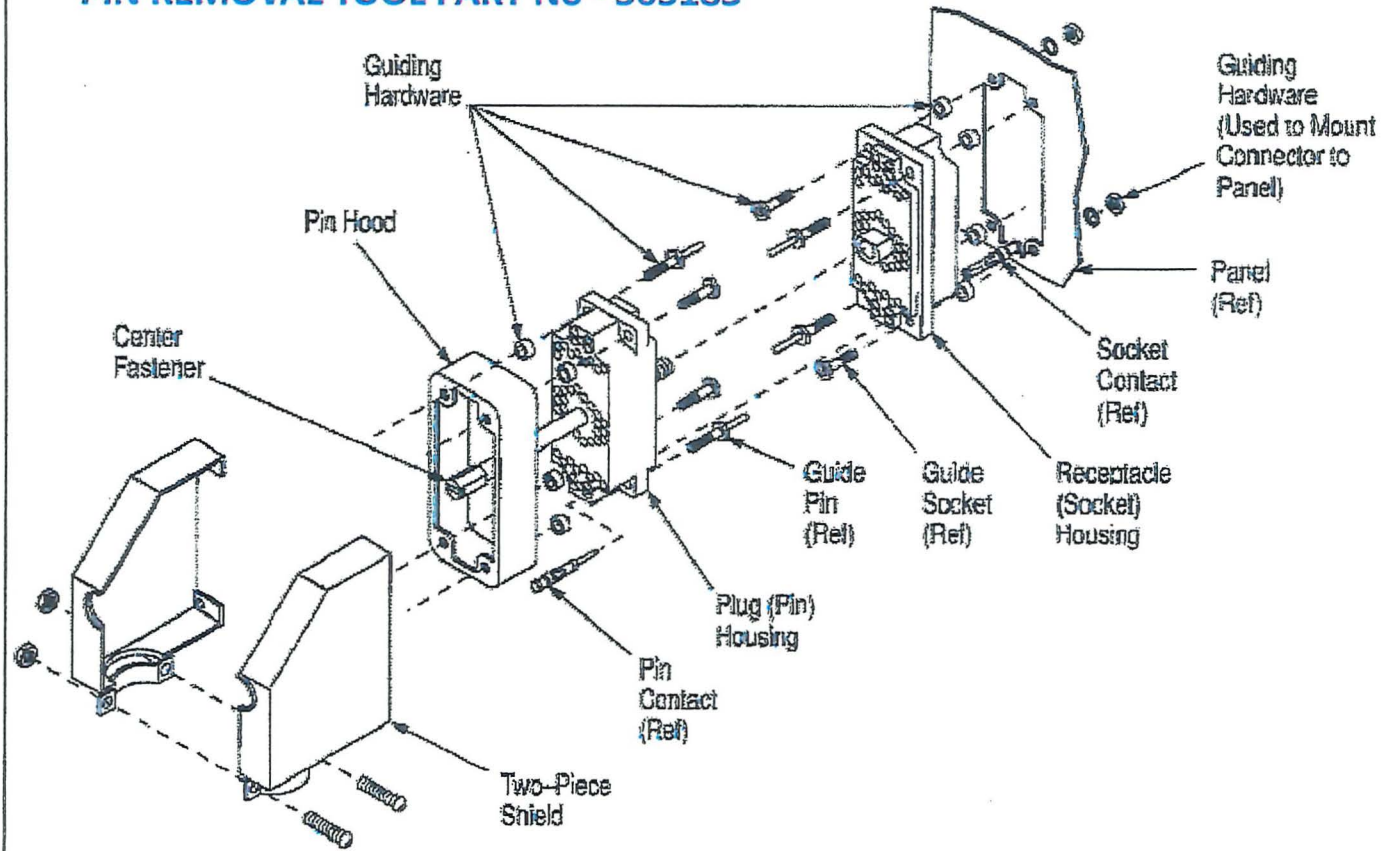
17FL275 PANEL CN CONNECTORS



AMPHENOL

M Type CONNECTORS - 104 pin / socket configuration

PIN REMOVAL TOOL PART No - 305183



PROPULSION SUMMARY

- Engine RPM is monitored by a speed sensor mounted in the main alternator.
- Speed sensor feeds back to the FB140 card which conditions signal and sends to CPU (FB101/144).
- This signal is used to create a HP Level Request signal that is compared to system limits (Speed, Voltage, HP, Current etc).
- The FL275 panel then produces firing pulses synchronised to the tertiary output to send to the AFSE GFM based on the HP level Request.
- The GFM processes the control signals and send to the Pulse Transformer.
- Pulse Transformer sends signal to the AFSE SCR's.
- Armature current feedback is returned to the FL275 Panel and these signals are used to create the Motor Field Reference signal. This signal represents amount of field current required for a given armature current.
- Motor Field Reference signal is then compared with actual field current and a Motor Field Propel Reference signal is produced.
- The FL275 panel then produces firing pulses synchronised to the tertiary output to send to the MFSE GFM based on the Motor Field Propel Reference .
- The GFM processes the control signals and send to the Pulse Transformer.
- Pulse Transformer sends signal to the MFSE SCR's.

RETARD SUMMARY

- Retard pedal is depressed to initiate retard.
- A DC signal proportional to pedal position is supplied to the FL275 panel. This is the Retard Reference signal.
- Retard Reference is then compared with the Speed Taper Curve and from this a Retard Request signal is produced.
- The Retard Request signal is then summed with a signal representing Motor Armature Amps and a resultant Motor Field Retard Reference signal is produced.
- The FL275 panel then produces firing pulses synchronised to the tertiary output to send to the MFSE GFM based on the Motor Field Retard Reference .
- The GFM processes the control signals and send to the Pulse Transformer.
- Pulse Transformer sends signal to the MFSE SCR's.

FL 275 PANEL INPUTS (ANALOG)

<u>SIGNAL NAME</u>	<u>DESCRIPTION</u>	<u>ORIGIN</u>
ALTOUVOLTS	ALTERNATOR OUTPUT VOLTS	VMM1
ALTFLDVOLTS	ALTERNATOR FIELD VOLTS	VDR3
M1 AMPS	MOTOR 1 (LH) ARMATURE CURRENT	Shunt 1 via IA3
M2 AMPS	MOTOR 2 (RH) ARMATURE CURRENT	Shunt 2 via IA4
M2 VOLTS	MOTOR 2 VOLTAGE	VMM2
MFAMPS	MOTOR FIELD CURRENT	Shunt 3 via IA5
RPINHI	RETARD PEDAL INPUT HIGH	Retard pedal potentiometer
APINHI	ACCELERATOR PEDAL INPUT HIGH	Accel pedal potentiometer
POTREF	POTENTIOMETER REFERENCE VOLTAGE	Potentiometer Power Supply
SRS	SELECTED RETARD SETTING	RSC Rheostat
ALTFLD AMPS	ALTERNATOR FIELD CURRENT	Shunt 4 via IA8
MTOC	MOTOR TERTIARY OVERCURRENT	Shunt 7 via IA7
ATOC	ALTERNATOR TERTIARY OVERCURRENT	Shunt 6 via IA6
M1TS	MOTOR 1 (LH) TEMPERATURE SENSOR	Temp Sensor in Motor 1
M2TS	MOTOR 2 (RH) TEMPERATURE SENSOR	Temp Sensor in Motor 2
AFSE TEMP	AFSE TEMPERATURE SENSOR	Temp Sensor in AFSE
MFSE TEMP	MFSE TEMPERATURE SENSOR	Temp Sensor in MFSE
ALTINTAKE TEMP	ALTERNATOR COOLING AIR AMBIENT TEMP.	Temperature Panel on Alternator
UNDEFIN 1	UNDEFINED 1. - FUTURE USE. - SPARE	
UNDEFIN 2	UNDEFINED 2. - FUTURE USE. - SPARE	
OILP	ENGINE OIL PRESSURE - OPTIONAL	ENGINE MOUNTED SENSOR (Not used)
COOLP	ENGINE COOLANT PRESSURE - OPTIONAL	ENGINE MOUNTED SENSOR (Not used)
COOLT	ENGINE COOLANT TEMPERATURE - OPTIONAL	ENGINE MOUNTED SENSOR (Not used)
CRANKP	ENGINE CRANKCASE PRESSURE - OPTIONAL	ENGINE MOUNTED SENSOR (Not used)
FAULT	GROUND FAULT SENSING	GFIP

MICROPROCESSOR CONTROL

FL 275 PANEL INPUTS (FREQUENCY)

<u>SIGNAL NAME</u>	<u>DESCRIPTION</u>	<u>ORIGIN</u>
M1 SPDIN	MOTOR 1 SPEED INPUT	MOTOR 1 SPEED SENSOR
M2 SPDIN	MOTOR 2 SPEED INPUT	MOTOR 2 SPEED SENSOR
ESS	ENGINE SPEED SENSOR	SPEED SENSOR IN ALTERNATOR

MICROPROCESSOR CONTROL

FL 275 PANEL INPUTS (DIGITAL)

<u>SIGNAL NAME</u>	<u>DESCRIPTION</u>	<u>ORIGIN</u>
AS	ACCELERATOR SWITCH	FB101 - MICROSWITCH ON PEDAL. FB144 - >15% ON FOOTPEDAL.
RS	RETARD SWITCH	FB101 - MICROSWITCH ON PEDAL & %.
MFFB	MOTOR FIELD CONTACTOR FEEDBACK	INTERLOCK ON MF CONTACTOR.
GFFB	ALTERNATOR FIELD CONTACTOR FEEDBACK	INTERLOCK ON GF CONTACTOR.
GFRFB	ALTERNATOR FIELD RELAY FEEDBACK	CONTACTS ON GFR RELAY.
P1FB	POWER CONTACTOR 1 FEEDBACK	INTERLOCK ON P1 CONTACTOR
RP1FB to RP9FB	RETARD CONTACTORS FEEDBACK	INTERLOCKS ON RP1 to RP9.
FORIN	FORWARD INPUT. REQUESTING FORWARD	SELECTOR SW IN OPERATORS CAB.
REVIN	REVERSE INPUT. REQUESTING REVERSE	SELECTOR SW IN OPERATORS CAB.
FORFB	FORWARD FEEDBACK	REVERSER INTERLOCK CONTACTS.
REVFB	REVERSE FEEDBACK	REVERSER INTERLOCK CONTACTS.
BPS	BLOWER PRESSURE SWITCH	PRESSURE SWITCH IN AXLE BOX.
RSC	RETARD SPEED CONTROL	RSC SWITCH IN OPERATORS CAB.
IDLESW	IDLE SWITCH. REQUESTS 1650RPM	HI/LO IDLE SW. IN OPERATORS CAB.
FAILDIODE	FAILED DIODE DETECTION	FAULT DETECTION PANEL. 17FM384.
LDWT	LOAD WEIGHT. LOADED TRUCK/2SOS	OEM WEIGH SYSTEM or LOAD CELL.
CPSFB	CONTROL POWER SWITCH FEEDBACK	CONTROL POWER SWITCH.
DOS	DUMP OVERRIDE SWITCH	DOS SWITCH IN OPERATORS CAB.
DUMPBS	DUMP BODY SWITCH. BODY UP or DOWN	PROXIMITY or LIMIT SWITCH.
ACCINHI	ACCELERATE INHIBIT	OEM DEPENDENT.
ENGSDWN	ENGINE SHUTDOWN	ENGINE OEM CONTROL MODULE.
ENGSERV	ENGINE SERVICE	ENGINE OEM CONTROL MODULE.
SERVBRKSW	SERVICE BRAKE SWITCH	OEM DEPENDENT.
PKBRKSW	PARK BRAKE SWITCH	SWITCH IN OPERATORS CAB.
SNAPSHOT	ALSO KNOWN AS "DATASTORE" MANUALLY RECORDS EVENT CODE "98".	SWITCH IN OPERATORS CAB.



MICROPROCESSOR CONTROL


FL 275 PANEL INPUTS (DIGITAL)

<u>SIGNAL NAME</u>	<u>DESCRIPTION</u>	<u>ORIGIN</u>
AS	ACCELERATOR SWITCH	FB101 - MICROSWITCH ON PEDAL. FB144 - >15% ON FOOTPEDAL.
RS	RETARD SWITCH	FB101 - MICROSWITCH ON PEDAL & %.
MFFB	MOTOR FIELD CONTACTOR FEEDBACK	INTERLOCK ON MF CONTACTOR.
GFFB	ALTERNATOR FIELD CONTACTOR FEEDBACK	INTERLOCK ON GF CONTACTOR.
GFRFB	ALTERNATOR FIELD RELAY FEEDBACK	CONTACTS ON GFR RELAY.
P1FB	POWER CONTACTOR 1 FEEDBACK	INTERLOCK ON P1 CONTACTOR
RP1FB to RP9FB	RETARD CONTACTORS FEEDBACK	INTERLOCKS ON RP1 to RP9.
FORIN	FORWARD INPUT. REQUESTING FORWARD	SELECTOR SW IN OPERATORS CAB.
REVIN	REVERSE INPUT. REQUESTING REVERSE	SELECTOR SW IN OPERATORS CAB.
FORFB	FORWARD FEEDBACK	REVERSER INTERLOCK CONTACTS.
REVFB	REVERSE FEEDBACK	REVERSER INTERLOCK CONTACTS.
BPS	BLOWER PRESSURE SWITCH	PRESSURE SWITCH IN AXLE BOX.
RSC	RETARD SPEED CONTROL	RSC SWITCH IN OPERATORS CAB.
IDLESW	IDLE SWITCH. REQUESTS 1650RPM	HI/LO IDLE SW. IN OPERATORS CAB.
FAILDIODE	FAILED DIODE DETECTION	FAULT DETECTION PANEL. 17FM384.
LDWT	LOAD WEIGHT. LOADED TRUCK/2SOS	OEM WEIGH SYSTEM or LOAD CELL.
CPSFB	CONTROL POWER SWITCH FEEDBACK	CONTROL POWER SWITCH.
DOS	DUMP OVERRIDE SWITCH	DOS SWITCH IN OPERATORS CAB.
DUMPBS	DUMP BODY SWITCH. BODY UP or DOWN	PROXIMITY or LIMIT SWITCH.
ACCINHI	ACCELERATE INHIBIT	OEM DEPENDENT.
ENGSDWN	ENGINE SHUTDOWN	ENGINE OEM CONTROL MODULE.
ENGSERV	ENGINE SERVICE	ENGINE OEM CONTROL MODULE.
SERVBRKSW	SERVICE BRAKE SWITCH	OEM DEPENDENT.
PKBRKSW	PARK BRAKE SWITCH	SWITCH IN OPERATORS CAB.
SNAPSHOT	ALSO KNOWN AS "DATASTORE" MANUALLY RECORDS EVENT CODE "98".	SWITCH IN OPERATORS CAB.



MICROPROCESSOR CONTROL

FL 275 PANEL OUTPUTS (ANALOG)

<u>SIGNAL NAME</u>	<u>DESCRIPTION</u>	<u>ORIGIN</u>
ENGRPM	ENGINE RPM-0 to 10v. SCALED TEST POINT. DOESNT DRIVE DASH METER	FB140 CARD via ENGINE SPEED SENSOR.
TRKSPD	TRUCK SPEED. AS ABOVE	AS PER THE ABOVE.
AFSEFP	AFSE FIRING PULSES	FB140 CARD.
MFSEFP	MFSE FIRING PULSES	FB140 CARD.
BRKBLV	BRAKE BLENDING VALVE-FUTURE USE	
ENGRPM CMD	ENGINE RPM COMMAND (FUEL SAVER ONLY). VARIABLE FREQUENCY SIGNAL TO ENGINE CONTROL MODULE. 580 RPM = 115.90 Hz 1900 RPM = 379.80 Hz FREQUENCY x 5.0004 = ENG RPM REQUEST.	FB140 CARD 
MOTS	WHELMOTOR TEMPERATURE - PROGRAMMABLE TEST POINTS	FB140 CARD

MICROPROCESSOR CONTROL

FL 275 PANEL OUTPUTS (DIGITAL)

SIGNAL NAME	DESCRIPTION	ORIGIN
AFSE	AFSE ENABLE. +24VDC = ENABLE TO GFM +25 TERMINAL	FB103 CARD
MFSE	MFSE ENABLE. (AS ABOVE)	FB103 CARD
BLWFLTLT	BLOWER FAULT LIGHT	FB103 CARD
CPRL	CONTROL POWER RELAY LATCH - HOLDS CONTROL POWER RELAY IN AT >2mph EVEN IF CONTROL POWER OFF.	FB104 CARD
FOR	FORWARD - TO REVERSER FORWARD COIL.	FB104 CARD
REV	REVERSE - TO REVERSER REVERSE COIL.	FB104 CARD
MF	MOTOR FIELD CONTACTOR COIL DRIVER	FB104 CARD
P1	P1 CONTACTOR COIL DRIVER	FB104 CARD.
P11	P1 SLAVE CONTACTOR COIL DRIVER - PARALLELED WITH P1(AIRLESS TRUCKS)	FB104 CARD
P2	P2 CONTACTOR COIL DRIVER (240 ton AIR OPERATED TRUCKS ONLY (GTA26).	FB104 CARD
P22	AS PER P11 ABOVE.	FB104 CARD
GF	ALTERNATOR FIELD CONTACTOR COIL DRIVER	FB104 CARD
GFR	ALTERNATOR FIELD RELAY COIL DRIVER	FB104 CARD
RP1 - RP9	RETARD POWER CONTACTORS COIL DRIVERS	FB104 CARD
GNDFLT	GROUND FAULT LIGHT DRIVER	FB103 CARD
SYSFLT	SYSTEM FAULT LIGHT DRIVER	FB103 CARD
TS and LIS	THROTTLE & LO IDLE SOLENOID DRIVERS	FB103 CARD
RETARDCABLT	RETARD LIGHT DRIVER	FB103 CARD
OSLT	OVERSPEED LIGHT DRIVER	FB103 CARD
ENGSDNLT	ENGINE SHUTDOWN LIGHT DRIVER	FB104 CARD
ENGSRVLT	ENGINE SERVICE LIGHT DRIVER	FB104 CARD
FAILDIODELT	FAILED DIODE LIGHT DRIVER	FB103 CARD
MOTLT	WHEELMOTOR OVERTEMPERATURE LIGHT	FB104 CARD
OEMSPDEVENT	OEM SPEED EVENT (OPTIONAL USE) - PROGRAMMABLE SPEED RELATED OUTPUT. USED FOR AUX. STEERING PUMP ETC.	FB104 CARD
	PARK BRAKE SOLENOID DRIVER	FB103 CARD

SOFTWARE

PTU Program (LAPTOP)

- The PTU program is used to view truck data when the truck is operating.
- The PTU program provides the communication link to the CPU to download OBJ and CFG files and upload stat and event data.
- Note: The laptop OS is critical to the operation of the PTU program. The wPTU program is Windows XP compatible.

System Regulation

- The micro processor is located on the CPU (144) card. Certain operating parameters can be changed to adjust the truck with the PTU.
- In addition to controlling the propulsion and retard circuits the software restricts the control system from specific transitions under certain conditions. Eg the system will not allow a direction change without the truck passing through the “nomo” or no motion state.
- The software does allow transition among the three retard states, being normal retard, retard speed control and overspeed. This is because once the contactors energise in retard no other contactor changes are necessary.
- Note: The term nomo occurs when truck speed is less than 0.5 kph

SOFTWARE

BASE MONITORING PROGRAM

- The base Monitor Program performs functions for the system, including power-up tests on the CPU card.
- This software is programmed on four EPROM chips at the factory and installed on the CPU card.

OBJECTIVE CODE

- The Runtime Monitor Program (OBJ) is used to control common truck functions. It is downloaded to Flash (Electrically Erasable Read Only Memory) chips on the CPU card from OBJ files stored on the Laptop(PTU) hard drive..
- At power up the Flash Memory is then copied to the RAM chips on the FB144 CPU card.

This software

- Controls contactors, relays, lights, solenoids and firing pulses etc...
- Monitors truck running parameters and stores event/fault data.
- Communicates with the laptop(PTU) to display operating parameters and event/fault data.

SOFTWARE

CONFIGURATION SOFTWARE (CFG)

- The configuration program is used to set values which are specific to the truck such as engine, alternator, motorised wheel configuration, retard current limits, speed taper, power reference and control stability constants.

Why is it needed?

- There are a number of different truck configurations such as different gear ratios, engine/alternator configurations and retard packages so the configuration file must be able to be modified to suit.
- These changes are done through the config utility of the wPTU Program.

SOFTWARE

EVENTS

- The event panel provides a variety of operational and fault codes for certain system events. These codes are appropriately called event codes.
- The diagnostic system on the CPU card stores up to 500 events. If more occur after the storage is full, the system will remove the oldest event to make room for the newest event.
- Stored events can only be removed from the system using the PTU unless they have been removed when new events occur after the storage is full.

SOFTWARE

FRAMES

- The system also collects “frames”. Frames contain actual truck data and is in relation to date and time. The time between each frame capture is set by the PTU in increments of 0.012* seconds.
- Frames are collected as a record of system function at the time of the event.
- * (The default increment is 0.204 secs and is adjustable using the PTU)

WINDOWS

- Some events may also have frame windows which is a collection of 51 frames.
- The 51 frames consist of 40 frames before the event, 1 at the event occurrence, and 10 frames after the event.
- The system will save each event window for the first 30 events that are qualified to have windows.
- They will be saved until the event is erased.
- After 30 windows are stored, no more windows can be stored.

SOFTWARE

DECAY TIME

- “How long events are held in memory” (time in seconds)
- Decay time is associated with Lock limit, where the time within the number of lock limits is monitored.
- The timer and counter are reset at the end of the decay time.

LOCK LIMIT

- “Maximum number of resets allowed before reset is disabled” (within decay time)
- The number of faults which can occur before the “DOS” (Dump Override Switch) will no longer reset the fault.
- For example, a failed diode (Event Code 45:00) has a lock limit of 1.
- Each time this fault occurs, a no acceleration restriction is placed on the propulsion system.
- The “DOS” will not reset this fault. The RESET button on the 2 digit display must be pressed first, then the “DOS” can be pressed to clear the fault.

SOFTWARE

ACCEPT LIMIT

- “Limit on maximum number of events which may be recorded and stored”
- When the limit of a given event is exceeded, the oldest event of this type recorded without a window (51 frames) will be replaced with the new event.
- If a window is associated with any event, it will not be overwritten.
- The system does not allow events with windows (51 frames) to be overwritten.
- If the oldest event has a window (51 frames), the oldest non-window event will be overwritten.

WINDOW LIMIT

- “Number of windows that will be captured for events of this type”
- This indicates how many windows (51 frames) will be captured for events of this description, subject to space restrictions.(30 x 51 frame events in total).
- When the window capture limit has been exceeded, only a single frame of data is saved.
- Therefore, event data should be checked and erased regularly

TWO DIGIT DISPLAY



- Indicates Up To 99 Display Codes.
- Earlier/Later Scrolling.
- Maintenance Reset.
- Most problems can be solved using this display & the Troubleshooting Guide.
- Mounted in Control Group
- Identifies a Problem by using a Fault Code.
 - (PTU must be used to identify sub codes)
 - Some events have multiple sub codes eg 32:36 (M1TS) however only a code 32 is displayed on the 2DD
 - The PTU must be used to verify the specific sub code definition.

2DD EVENTS THAT INHIBIT PROPULSION

CODE	EVENT DESCRIPTION	THINGS TO CHECK / POSSIBLE CAUSE OF EVENT
01	GROUND - LOW LEVEL	MOISTURE IN MOTORS, GRIDS, POWER CABLES.
02	GROUND - HIGH LEVEL	MOTOR FLASH, INSULATION FAILURE, BAD 140 CARD.
08	PEDAL ACCEL	INCORRECT OUTPUT VOLTAGE FROM ACCELERATOR PEDAL.
09	PEDAL RETARD	INCORRECT OUTPUT VOLTAGE FROM RETARD PEDAL.
10	GF CONTACTOR	WELDED TIPS, BLOCKED ARMATURE, DEFECTIVE COIL, POSITION
11	GFR RELAY	SENSOR OR WIRING. LOOSE WIRES OR CONNECTIONS TO COIL OR
12	MF CONTACTOR	POSITION SENSOR. MECHANICAL OBSTRUCTION THAT PREVENTS
13	P1 CONTACTOR	SMOOTH OPERATION. BAD 104 CARD.
14	P2 CONTACTOR	
17 to 25	RP1 to RP9 CONTACTORS	
26	REVERSER - FORWARD POSITION	
27	REVERSER - REVERSE POSITION	
28	FORWARD/REVERSE CALL	FORWARD & REVERSE CALLED FOR AT THE SAME TIME.
37	STARTUP	IT MAY OR MAY NOT INHIBIT PROPEL. BAD 101 CPU CARD.
45	MAIN DIODE FAULT	SHORTED DIODES, BAD FDP, BAD WIRING, BAD 103 CARD. <i>Cycle power</i>
46	MOTOR 1 OVERCURRENT	EXCESS CURRENT IN MOTOR 1 ARMATURE.
47	MOTOR 2 OVERCURRENT	EXCESS CURRENT IN MOTOR 2 ARMATURE.
48	MFLD & MARM AMPS	BAD SHUNT OR ISO-AMP, WIRES. BAD 140 CARD.
49	MOTOR FIELD OVERCURRENT	EXCESS MOTOR FIELD CURRENT.
50	MOTOR STALL	EXCESS GRADE, LOAD, R/R, BAD SPD SENSORS, IA, SHUNT, 140 CARD.
51	MOTOR SPIN	ONE MOTOR STUCK, THE OTHER SPINNING. SAME AS 50.
52	ALTERNATOR TERT. OVERCURRENT	AFSE HAS SHORTED DIODES/SCRs. ENGINE RPM IS LOW.
53	MOTOR TERT. OVERCURRENT	MFSE HAS SHORTED DIODES/SCRs. ENGINE RPM IS LOW IN RETARD.
54 to 56	+15v, -15v, +19v SUPPLIES	BATTERY VOLTS BELOW 20V. EXCESSIVE LOAD ON SUPPLY.
57	M1, M2 OPPOSITE POLARITY	BAD 140 CARD, WIRING TO SHUNTS, CABLING TO SHUNTS OR MOTORS.
59	PTU CONFIGURATION	PTU CONFIGURATION INPUTS ARE INCONSISTENT.
61	M 1 GRID FAILURE	LOSS OF RETARD GRID CIRCUIT CONTINUITY.
62	M 2 GRID FAILURE	SAME AS 61.
79	ENGINE SHUTDOWN	ENGINE PROBLEM. SHUT DOWN THE ENGINE AS SOON AS POSSIBLE. <i>Once problem is fixed, code will go away</i>

2DD EVENTS THAT DO NOT INHIBIT PROPULSION

CODE	EVENT DESCRIPTION	THINGS TO CHECK / POSSIBLE CAUSE OF EVENT
30	ANALOG OUTPUT: SUBCODE	SOFTWARE ERROR. BAD 101 OR 140 CARD.
31	FREQUENCY OUTPUT	
32	ANALOG INPUT: SUBCODE	SAME AS 30.
33	FREQUENCY INPUT	SAME AS 30. BAD SPEED SENSOR.
34	FREQUENCY HARDWARE	BAD SPEED SENSOR OR WIRING.
37	HARDWARE STARTUP: SUBCODE	BAD 101 CARD.
60	RP BOUNCE	RP CONTACTOR CLOSED IN PROPEL
63	LOW AXLE BOX PRESSURE	BAD DUCT, OPEN DOOR, BAD GASKET, BAD BPS, BAD 103 CARD.
64	MOTOR 1 EXCEEDS 220C	MOTOR HOT DUE TO LOAD, DUTY OR COOLING AIR. BAD BPS,
65	MOTOR 2 EXCEEDS 220C	WIRING, THERMAL SENSOR IN MOTOR.
66	OVERSPEED RETARDING	VEHICLE SPEED EXCEEDED OVERSPEED RETARDING LIMIT.
67	RETARD SPEED EXCEEDED	OVERSPEED OVERSHOOT
68	RETARD AMPS TOO HIGH	BAD SHUNT, ISO-AMP OR 140 CARD.
69	HORSEPOWER LOW	ENGINE IS LOW ON HORSEPOWER.
70	HORSEPOWER HIGH	ENGINE HORSEPOWER LIMIT HAS BEEN EXCEEDED.
71	ENGINE OVERSPEED	ENGINE SPEED LIMIT HAS BEEN EXCEEDED.
72	OIL PRESSURE WARNING	ENGINE PROBLEM, BAD SENSOR, BAD 140 CARD.
73	OIL PRESSURE SHUTDOWN	SAME AS 72
74	STAT LOGGING VIA CODE 74 <i>tail-fail</i>	CHECK SUBCODE FOR INCORRECT OPERATOR ACTION
75	COOL PRESSURE SHUTDOWN	SAME AS 72.
76	CRANKCASE OVERPRESSURE	SAME AS 72.
77	COOLANT TEMP HIGH	SAME AS 72.
78	ENGINE SERVICE	FROM DDEC. CHECK DDEC/ENGINE.
80	ENGINE SPEED RETARD	ENGINE LESS THAN 1100 RPM IN RETARD. CHECK ENGINE /DDEC.
81	MOTOR 1 VOLT LIMIT	MOTOR 1 IS OVERVOLTAGE.
82	MOTOR 2 VOLT LIMIT	MOTOR 2 IS OVERVOLTAGE.
83	ALT FLD SLOW DECAY	BAD SHUNT OR ISO-AMP. BAD 140 CARD.
88	LAMP	LAMP TEST IN PROGRESS. JUST AN INDICATION, NOT A REAL EVENT.
90	LOW BATTERY VOLTS	BAD CHARGER OR BATTERY.
91	HIGH BATTERY VOLTS	BAD CHARGER OR REGULATOR.
92	ENGINE SENSOR	BAD ENGINE SENSOR OR WIRING TO SENSOR.
98	DATA STORE	INDICATES THAT A DATA SNAPSHOT HAS BEEN INITIATED BY MANUAL MEANS.
99	SOFTWARE	SOFTWARE PROBLEM. RELOAD/RECONFIGURE. BAD 101 CARD.

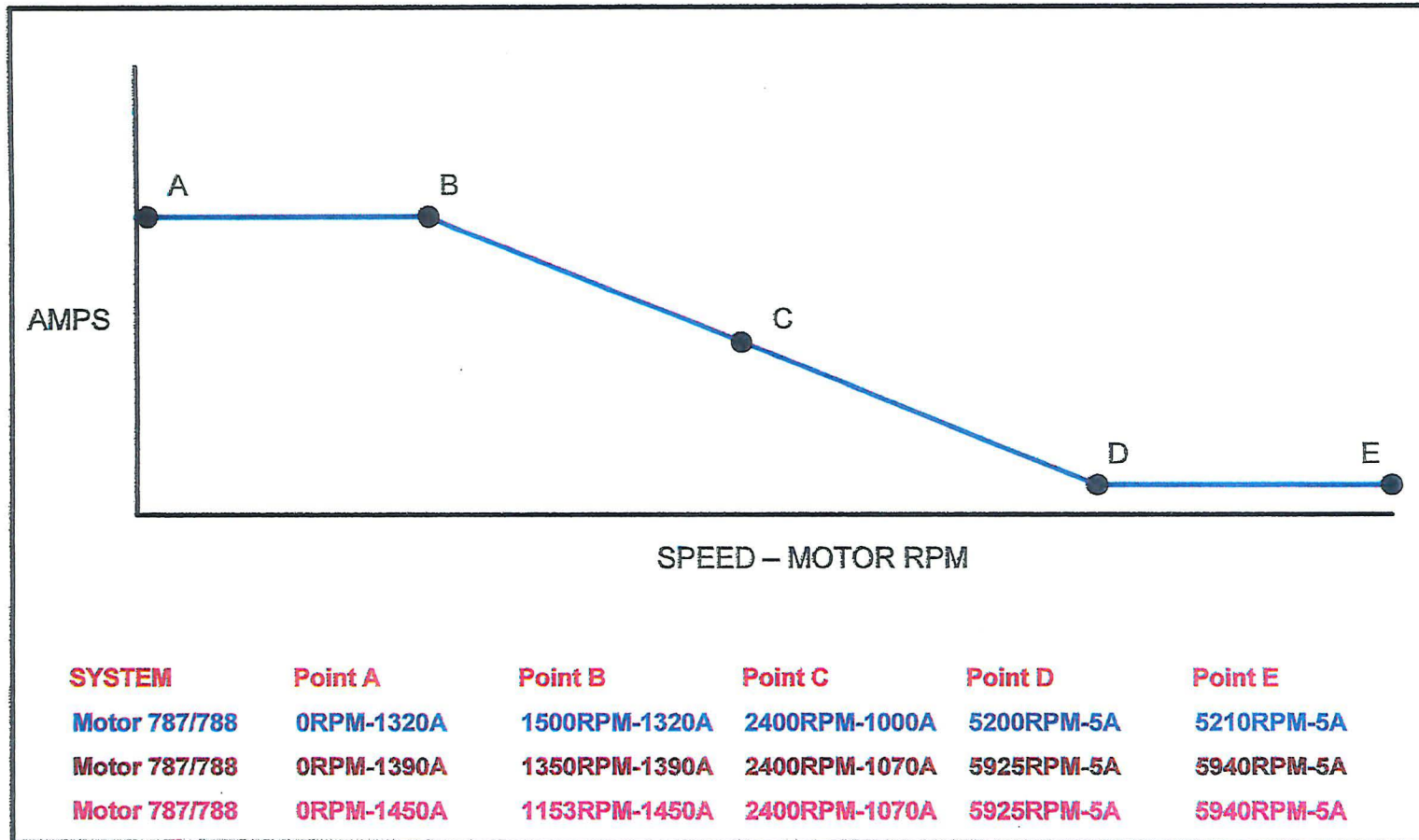
↑ gather page

2DD EVENTS THAT DO NOT INHIBIT PROPULSION

CODE	EVENT DESCRIPTION	THINGS TO CHECK / POSSIBLE CAUSE OF EVENT
30	ANALOG OUTPUT: SUBCODE	SOFTWARE ERROR. BAD 101 OR 140 CARD.
31	FREQUENCY OUTPUT	
32	ANALOG INPUT: SUBCODE	SAME AS 30.
33	FREQUENCY INPUT	SAME AS 30. BAD SPEED SENSOR.
34	FREQUENCY HARDWARE	BAD SPEED SENSOR OR WIRING.
37	HARDWARE STARTUP: SUBCODE	BAD 101 CARD.
60	RP BOUNCE	RP CONTACTOR CLOSED IN PROPEL
63	LOW AXLE BOX PRESSURE	BAD DUCT, OPEN DOOR, BAD GASKET, BAD BPS, BAD 103 CARD.
64	MOTOR 1 EXCEEDS 220C	MOTOR HOT DUE TO LOAD, DUTY OR COOLING AIR. BAD BPS,
65	MOTOR 2 EXCEEDS 220C	WIRING, THERMAL SENSOR IN MOTOR.
66	OVERSPEED RETARDING	VEHICLE SPEED EXCEEDED OVERSPEED RETARDING LIMIT.
67	RETARD SPEED EXCEEDED	OVERSPEED OVERSHOOT
68	RETARD AMPS TOO HIGH	BAD SHUNT, ISO-AMP OR 140 CARD.
69	HORSEPOWER LOW	ENGINE IS LOW ON HORSEPOWER.
70	HORSEPOWER HIGH	ENGINE HORSEPOWER LIMIT HAS BEEN EXCEEDED.
71	ENGINE OVERSPEED	ENGINE SPEED LIMIT HAS BEEN EXCEEDED.
72	OIL PRESSURE WARNING	ENGINE PROBLEM, BAD SENSOR, BAD 140 CARD.
73	OIL PRESSURE SHUTDOWN	SAME AS 72
74	STAT LOGGING VIA CODE 74	CHECK SUBCODE FOR INCORRECT OPERATOR ACTION
75	COOL PRESSURE SHUTDOWN	SAME AS 72.
76	CRANKCASE OVERPRESSURE	SAME AS 72.
77	COOLANT TEMP HIGH	SAME AS 72.
78	ENGINE SERVICE	FROM DDEC. CHECK DDEC/ENGINE.
80	ENGINE SPEED RETARD	ENGINE LESS THAN 1100 RPM IN RETARD. CHECK ENGINE /DDEC.
81	MOTOR 1 VOLT LIMIT	MOTOR 1 IS OVERVOLTAGE.
82	MOTOR 2 VOLT LIMIT	MOTOR 2 IS OVERVOLTAGE.
83	ALT FLD SLOW DECAY	BAD SHUNT OR ISO-AMP. BAD 140 CARD.
88	LAMP	LAMP TEST IN PROGRESS. JUST AN INDICATION, NOT A REAL EVENT.
90	LOW BATTERY VOLTS	BAD CHARGER OR BATTERY.
91	HIGH BATTERY VOLTS	BAD CHARGER OR REGULATOR.
92	ENGINE SENSOR	BAD ENGINE SENSOR OR WIRING TO SENSOR.
98	DATA STORE	INDICATES THAT A DATA SNAPSHOT HAS BEEN INITIATED BY MANUAL MEANS.
99	SOFTWARE	SOFTWARE PROBLEM. RELOAD/RECONFIGURE. BAD 101 CARD.

SYSTEM CONTROL – SPEED TAPER

Limits on Armature current based on Armature speed.



SPIN STALL SYSTEM

When the spin/stall option is enabled and a spin condition exists, if M1 is the higher speed wheelmotor, RP1 will close; if M2 is the higher speed wheelmotor, RP2 will close.

When the spin/stall option is DISABLED and a spin condition exists, NEITHER RP1 nor RP2 closes.

The logic for spin/stall detection is: (one wheel motor > 160 rpm while the other wheel motor < 25 rpm) AND (motor armature current > 100 amps).

If this condition is sustained for 0.5 seconds, the RP (1 or 2) contactor for the wheelmotor with higher speed will be closed.

Once closed, the RP contactor will remain closed until either 5.0 seconds after the spin condition (defined above) is no longer true or the spin condition has been sustained for 10 seconds.

If the latter is true, a NAFLT will be generated, inhibiting propulsion.

In a truck with a bad wheelmotor speed sensor (let's assume on M1), the spin condition will be detected as soon as M2 speed exceeds 160 rpm.

After 0.5 seconds, the RP2 contactor will close.

Of course, in reality, this is not truly a spin condition since wheelmotor 1 is really turning -- the system just doesn't know it.

If propel is sustained (which it would be under these conditions since the driver doesn't (yet) know there is any problem, in 10 seconds an NAFLT will be generated.

After 3 resets of the restrictive event 51 by a persistent driver, the lockout limit is reached, and the truck will be 'dead' until reset by the 2DD or a PTU.

Finally, if Spin/Stall Detection/Protection option is NOT enabled when a wheel speed sensor fails, the truck will continue to drive normally.

WHEEL SLIDE COMPENSATION

The anti-slide method of control while in retarding that is being utilized is to base retarding effort on the difference between requested wheel speed (from retard pedal position) and the actual average truck wheel speeds.

The greater the difference in speed between the requested and actual, the greater the retarding effort.

During a one wheel slide condition, the difference between requested speed and the actual average wheel speed is reduced and retarding effort is automatically cut back so that the sliding wheel can rotate again.

As the sliding wheel returns to the same speed as the other wheel motor, retarding effort is restored to the operator requested level.

This same principle applies when trying not to slide our automobiles.

We let up on the brake pedal and reduce braking effort in a skid to allow the wheels to spin again.

FEEDBACK AND REQUEST

Propel

During propel, **REQUEST** is the amount of horsepower available from the engine, based on its present speed and is scaled in units of counts, where 2000 counts represents the rated net horsepower for the given truck.

During propel, **FEEDBACK** is the total amount of horsepower being delivered by the propulsion system. It takes into account all operating regions for the wheelmotors: current limit, voltage limit, horsepower limit and speed limit.

FEEDBACK is also scaled in units of counts.

During steady state conditions, **REQUEST** and **FEEDBACK** should be equal (or nearly so). When transient load conditions exist, the difference between **REQUEST** and **FEEDBACK** cause the control system to modify the command being sent to the static exciters: if **REQUEST** exceeds **FEEDBACK**, the command sent to the AFSE is increased, whereas if **FEEDBACK** exceeds **REQUEST**, the command sent to the AFSE is decreased. (The command to the MFSE is a function of the wheelmotor armature current and varies accordingly).

FEEDBACK AND REQUEST

Retard

During retard, **REQUEST** is the highest level of retarding effort being requested as determined by: the operator via the foot pedal, truck speed (overspeed, or the retard speed control, if activated). **REQUEST** has units of amps.

During retard, **FEEDBACK** is the level of retarding effort being delivered by the propulsion system. It takes into account both motor field and armature current limits. **FEEDBACK** is also scaled in units of amps.

During steady state conditions, **REQUEST** and **FEEDBACK** should be equal (or nearly so). When transient load conditions exist, the difference between **REQUEST** and **FEEDBACK** cause the control system to modify the command being sent to the static exciters: if **REQUEST** exceeds **FEEDBACK**, the command sent to the MFSE is increased, whereas if **FEEDBACK** exceeds **REQUEST**, the command sent to the MFSE is decreased.

(The command to the AFSE is a function of the alternator output voltage and is held essentially constant).

AUTOMATIC VS MANUAL HP CONTROL

“Engine Horsepower Adjust” Figure

The number used in the “engine horsepower adjust” parameter in the “Truck Specifics Screen” of the cfg file is a unitless number.

All engines (from 1200GHP/1050NHP up to 2500GHP/2350NHP) are re-scaled in the software.

The full load NHP for an engine is always equal to 2000. Therefore, the conversion is as such:

100 engine units is equal to $100 \times 1050/2000 = 52.5$ HP for the 1200GHP engine and
100 engine adjust units is equal to $100 \times 2350/2000 = 117.5$ HP for the 2500GHP engine.

Although the adjustment range is +/- 500, a large adjustment should only be used for temporary engine testing.

AUTOMATIC VS MANUAL HP CONTROL

“Automatic Mode”

“(ie: Fixed rpm, variable horsepower)”

The preferred setting for truck operation is “Automatic Mode” This will automatically maintain engine rpm at the “engine full load rpm” figure in the “Truck Specifics Screen” of the cfg file.

In “Automatic Mode” the engine will be loaded automatically within the range of +/- 7.5% of the result of:

“full load net horsepower + or - the “engine horsepower adjust” figure in the cfg file to maintain the “engine full load rpm”.

ie: if the engine is capable of only 90% of rated net horsepower (and the “engine horsepower adjust” figure is zero), the engine rpm would drop below the “engine full load rpm” figure (ie: The engine will bog).

AUTOMATIC VS MANUAL HP CONTROL

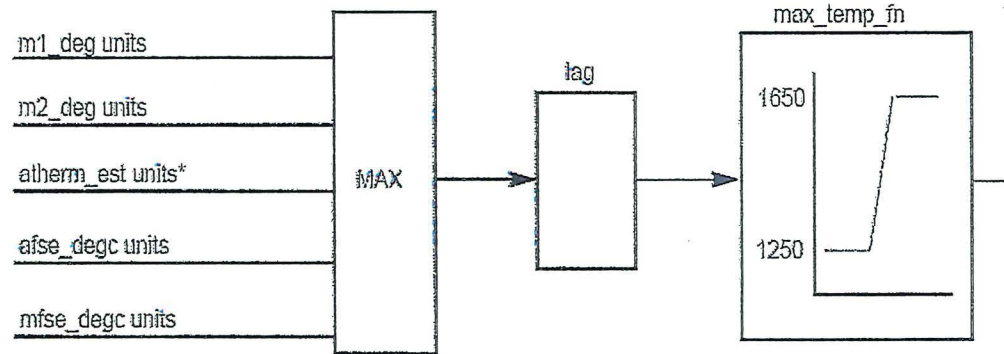
“Manual Mode”

(ie: Fixed horsepower, variable rpm) can be used to derate an underpowered engine. By using a negative “engine horsepower output adjust” figure, the Statex III system will not demand more than the full net horsepower minus the “engine horsepower output adjust” figure.

If a truck is in “Manual Mode” with a negative “engine horsepower output adjust” figure, and the available engine horsepower drops below the requested demand (due to failed injectors or similar), the engine rpm will drop, ie: The engine will bog.

FUEL SAVER 140

- The fuel saver option on Statex III trucks provides a variable engine rpm control based on several temperature inputs to reduce fuel burn rates in the engine, thus reducing costs.
- Retard RPM is adjusted based on temperature of Motors, Static Packages, etc.
- RPM in propulsion is also reduced when the truck reaches speed override and the engine load demand is low.



*Calculated temperature of alternator

