LeTourneau TECHNOLOGIES™

MINING PRODUCTS

Built On Experience. Driven By Vision.

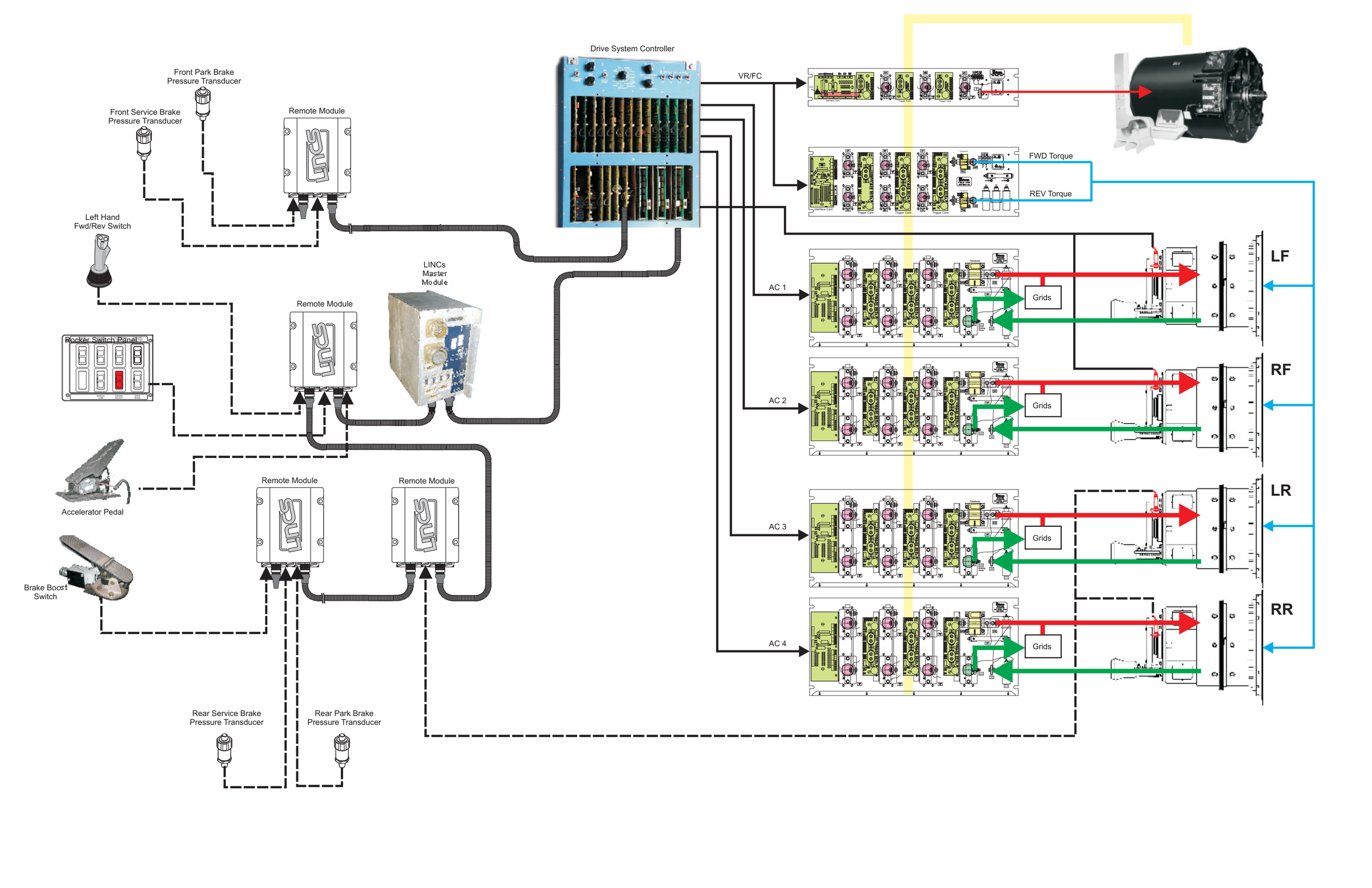
SCR Drive System

SCR PROPULSION

- Theory of Operation
- Component Description
- Circuit Description
- Troubleshooting
- Installation & Removal

THEORY OF OPERATION

NOTES:


Drive System Controller
Front Park Brake
Pressure Transducer
Front Service Brake
Pressure Transducer
Remote Module
Left Hand
Fwd/Rev Switch
LINCs
Master
Module
Remote Module
Rocker Switch Panel
Accelerator Pedal
Remote Module
Remote Module
Brake Boost
Switch
Rear Service Brake
Pressure Transducer
Rear Park Brake
Pressure Transducer
VR/FC
FWD Torque
REV Torque
AC 1
AC 2
AC 3
AC 4
Grids
Grids
Grids
Grids
LF
RF
LR
RR

NOTES:

NOTES:

Component Descriptions

Machine	Cummins	Detroit	HP	KW
L 1350	QSK45 (Tier 1) QSK50 (Tier 2)	D4000 12v	1600	1193
L 1850	QSK 60	D4000 16v	2000	1491
L 2350	QSK 60	D4000 16v	2300	1715

Tier 1 Detroit receives RPM Command from Engine Remote Module.

All others receive RPM Command from J1939 Bus.

ENGINE

L-1350 - 9B Generator

L-1850 - 12B Generator

L-2350 – 12C Generator

Temperature protected

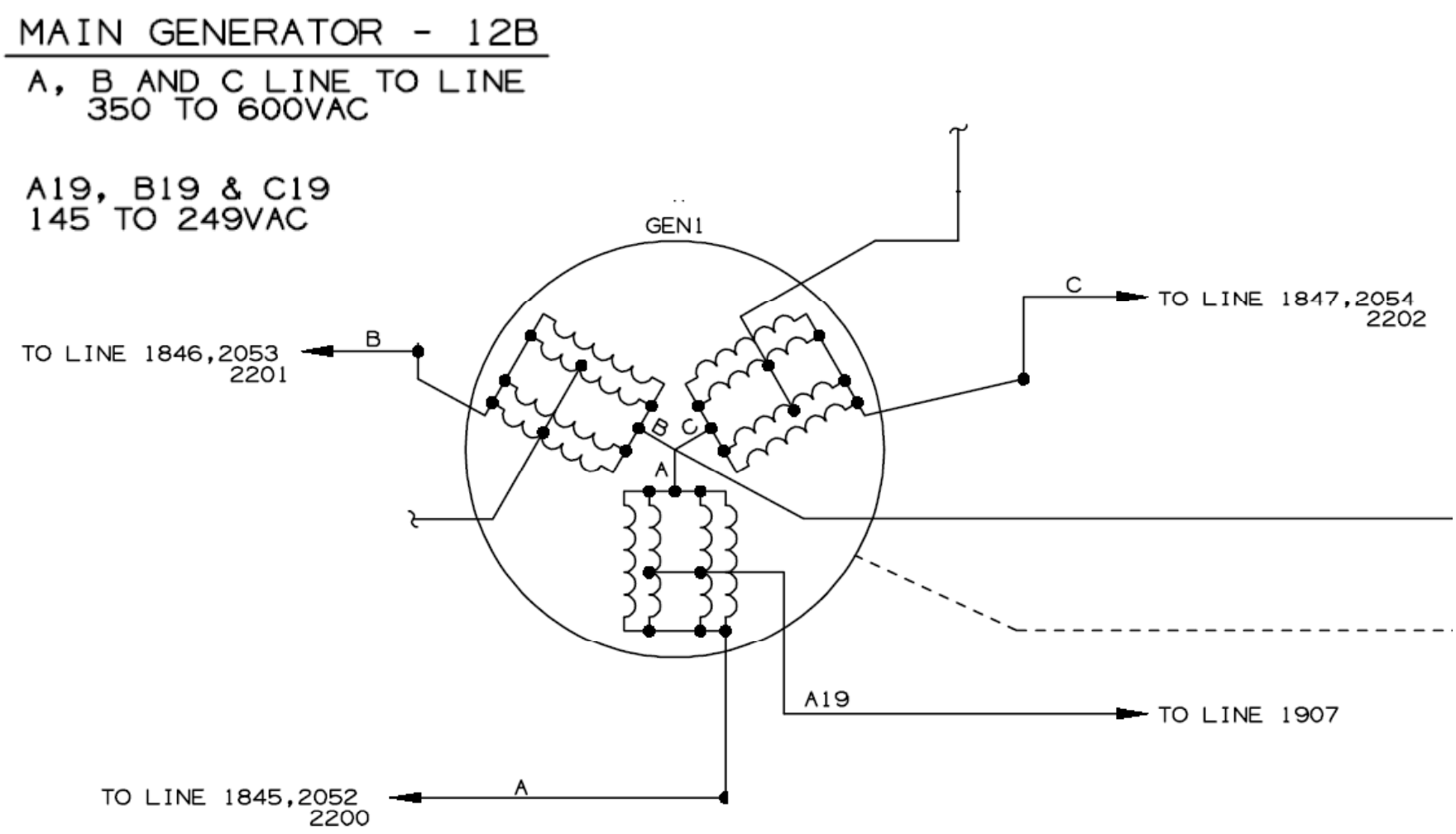
Single sealed bearing

Wye wound Generator (3 phase)

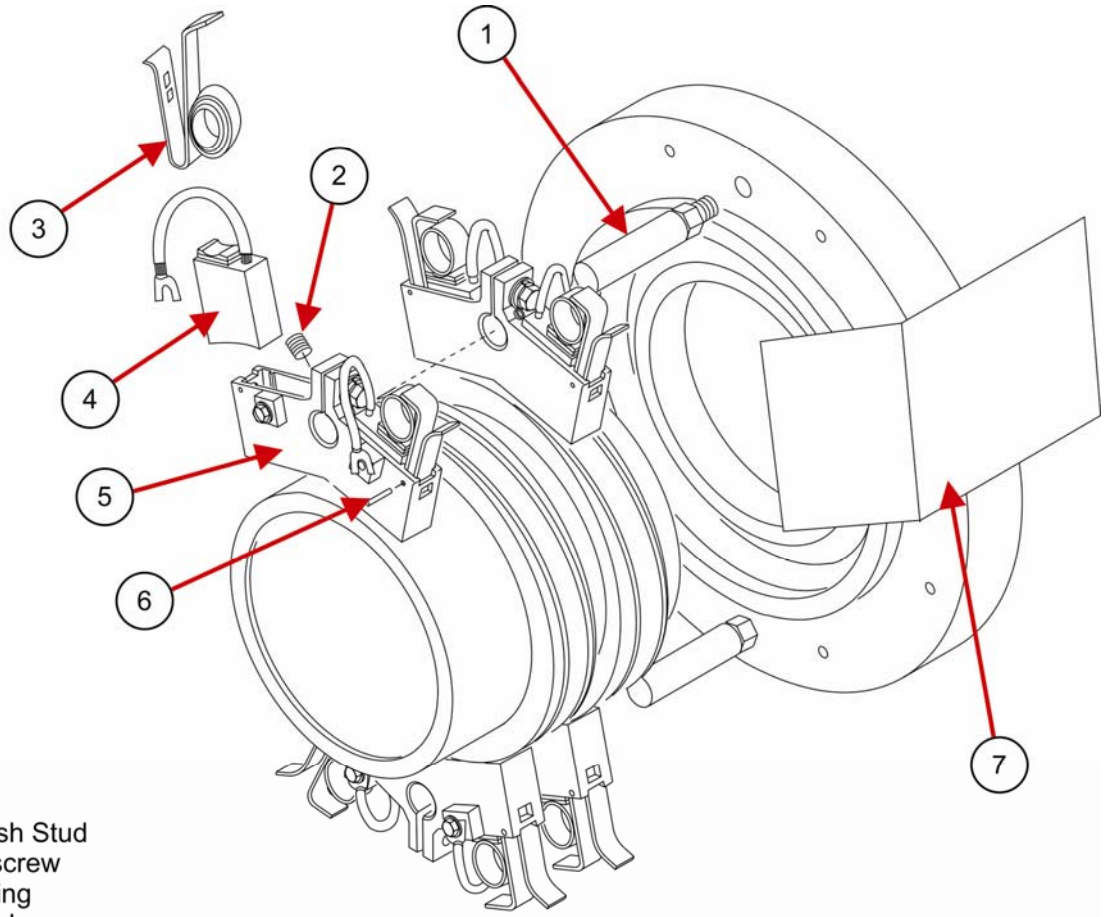
KVA for Generator

Manufactured by LeTourneau

GENERATOR

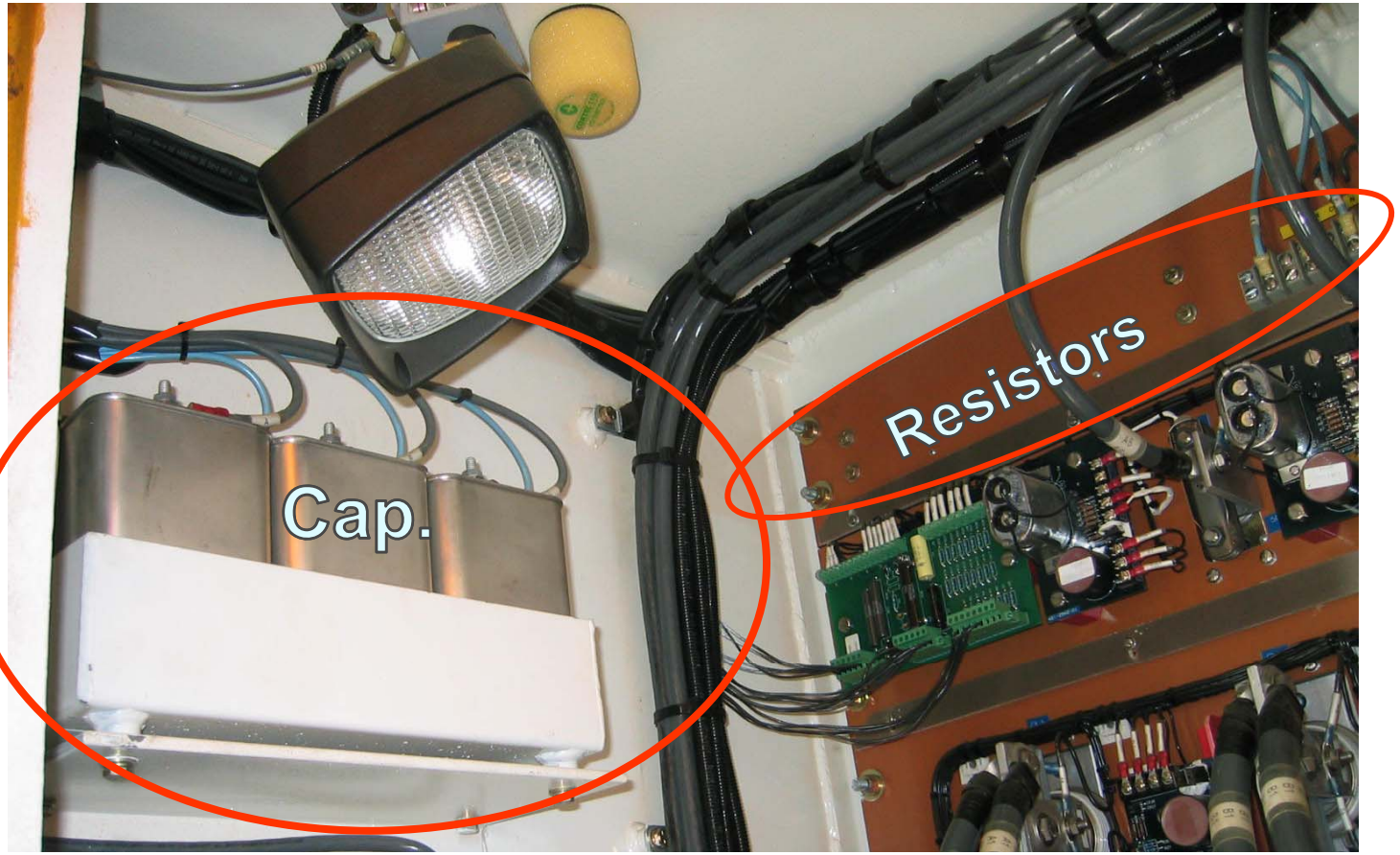

MAIN GENERATOR - 12B
A, B AND C LINE TO LINE
350 TO 600VAC
A19, B19 & C19
145 TO 249VAC
GEN1
B
TO LINE 1846,2053
2201
C
TO LINE 1847,2054
2202
A
B C
A19
TO LINE 1907
A
TO LINE 1845,2052
2200

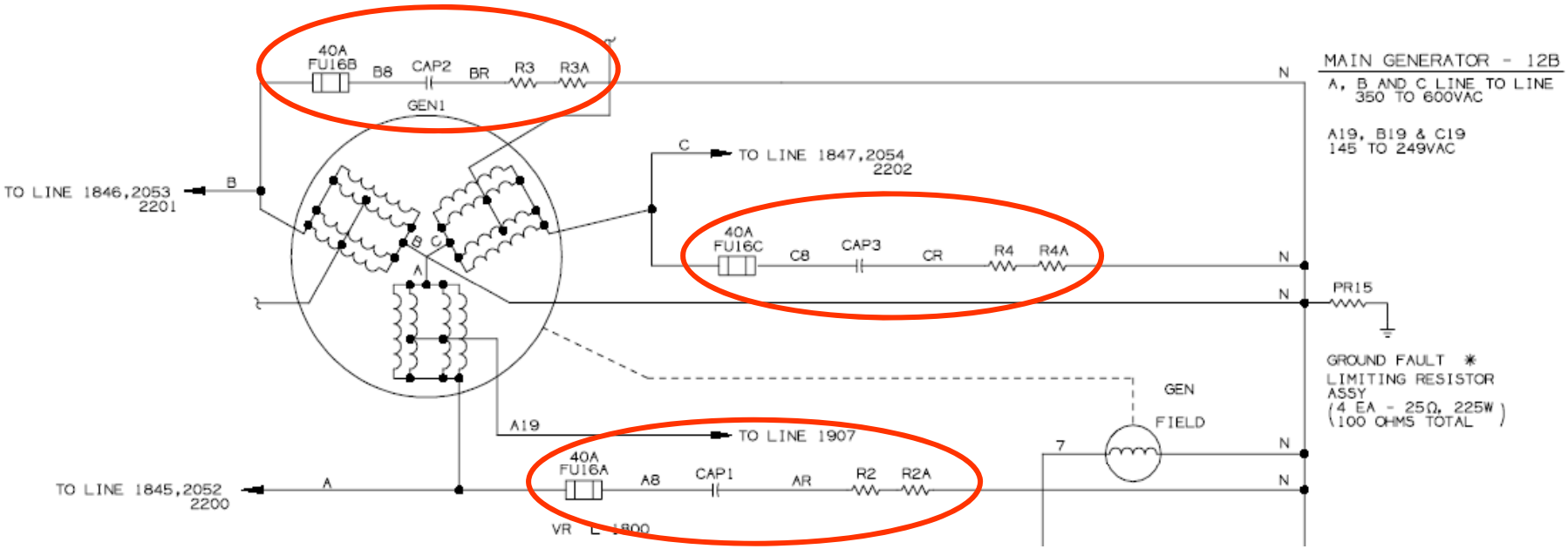
GENERATOR



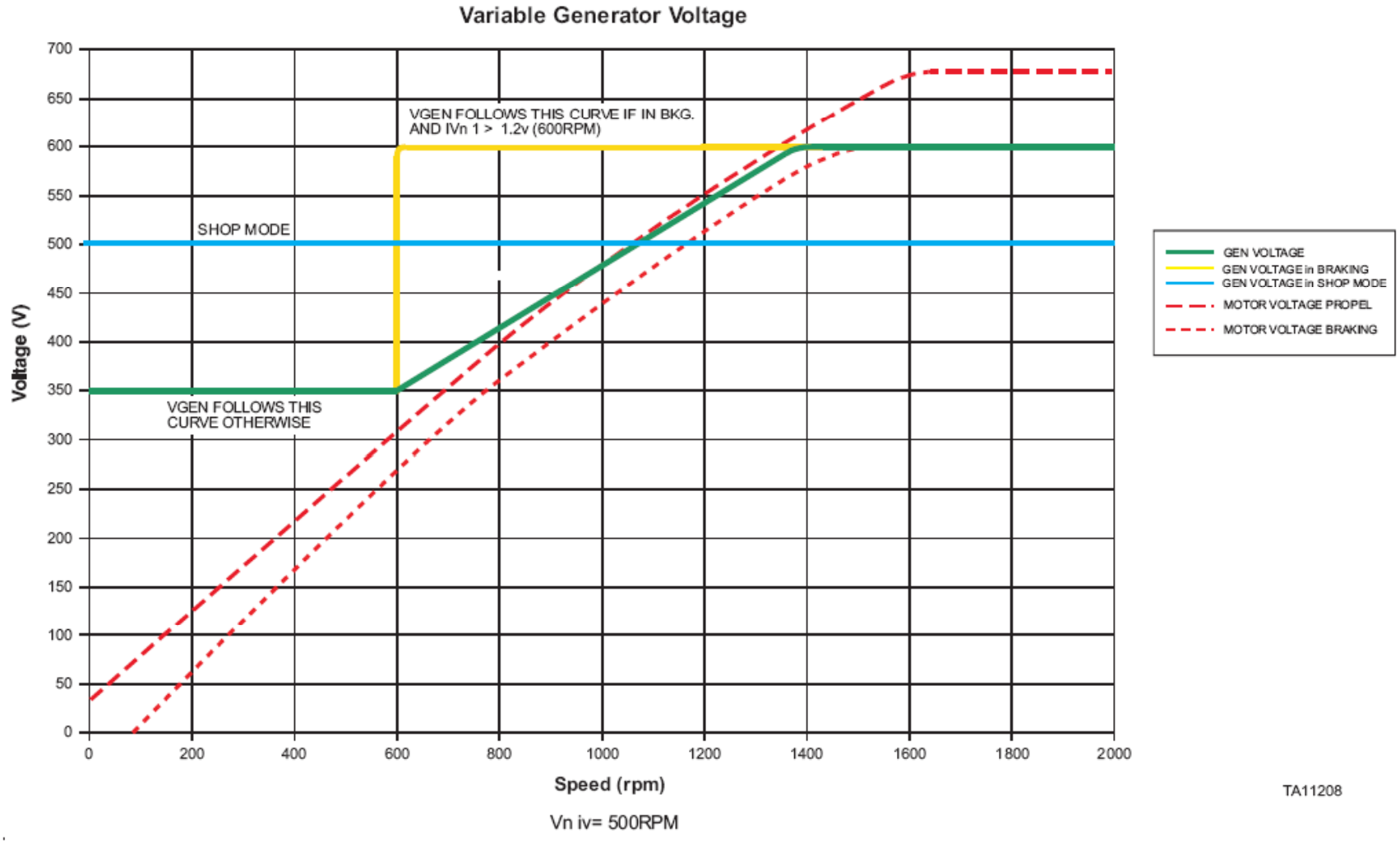
1 Brush Stud
2 setscrew
3 Spring
4 Brush
5 Brush holder assy - includes springs - DOES NOT include brushes
6 Roll pin
7 Air deflector (7 and 7B only)

BRUSHES AND SLIP RING

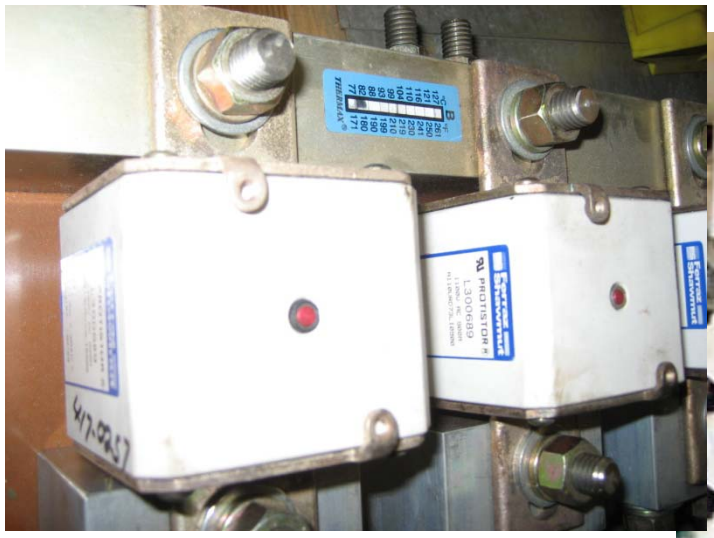

Cap.
Resistors

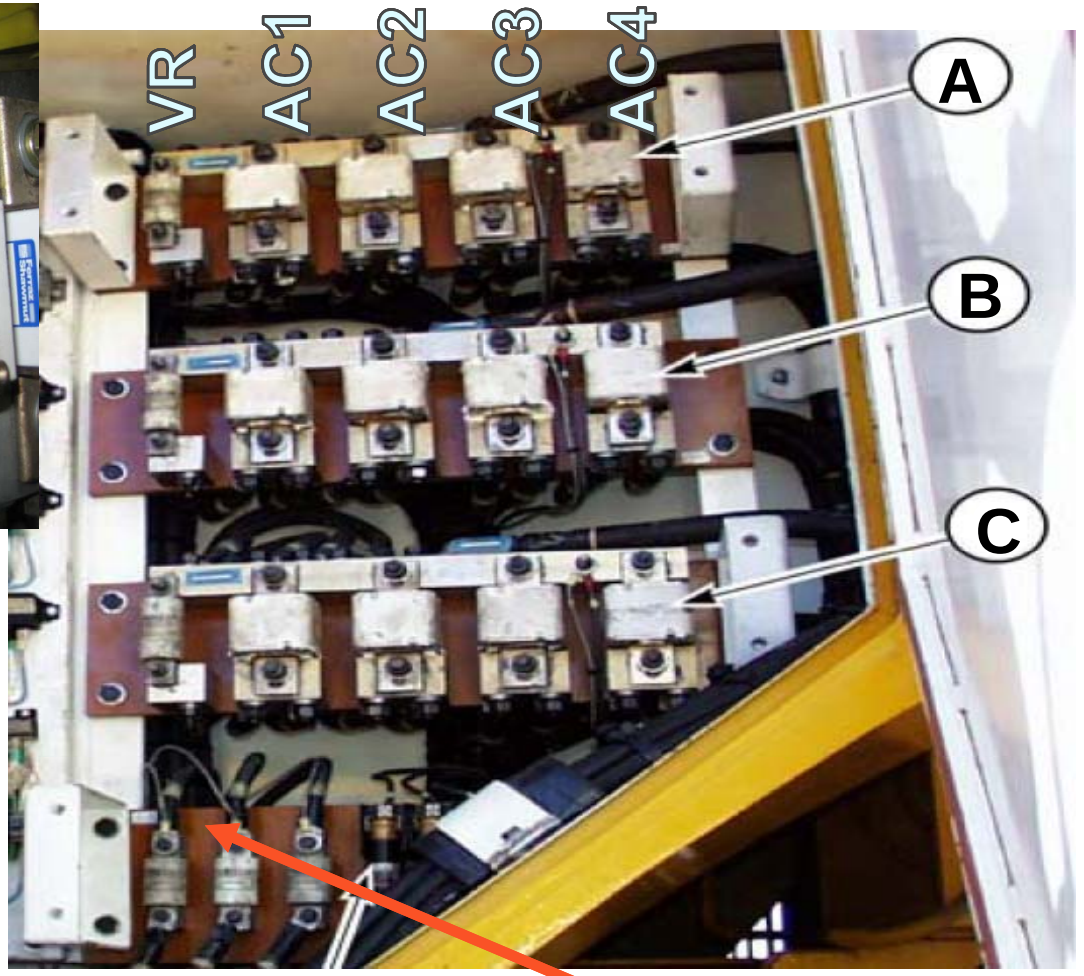


GENERATOR SUPPRESSION



GENERATOR OUTPUT





AC FUSES

TRACTION MOTOR (J2)

Component Descriptions

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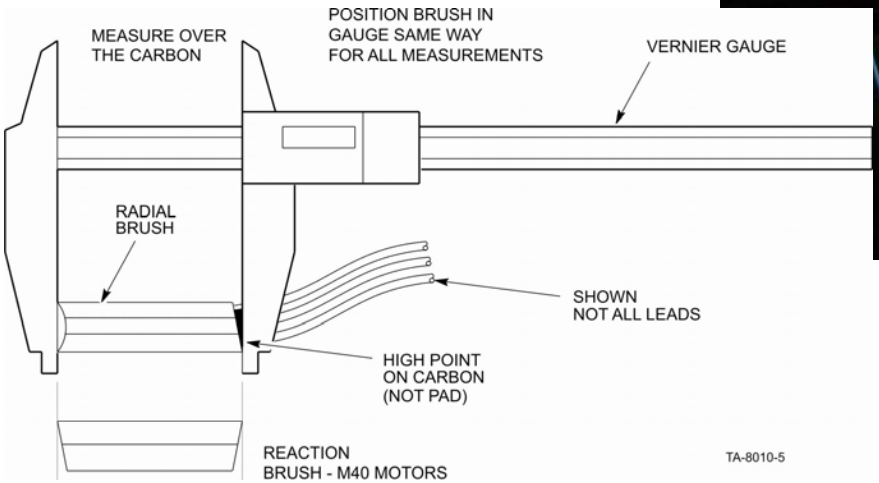
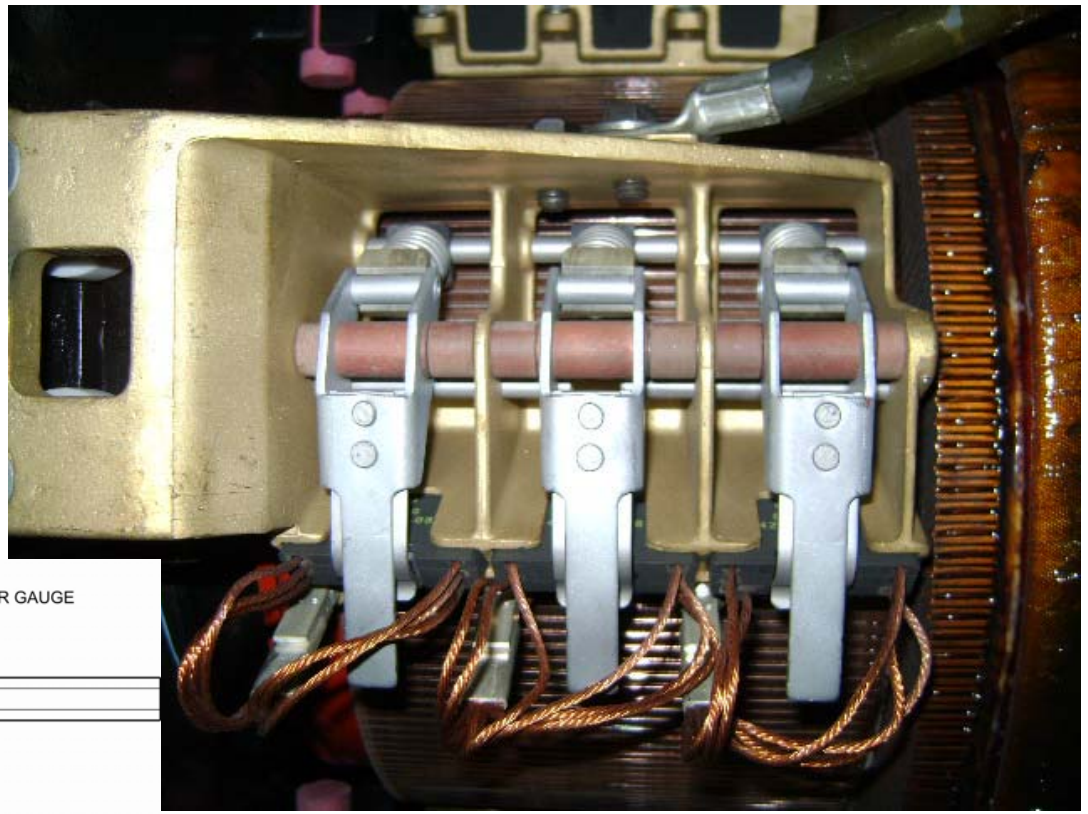
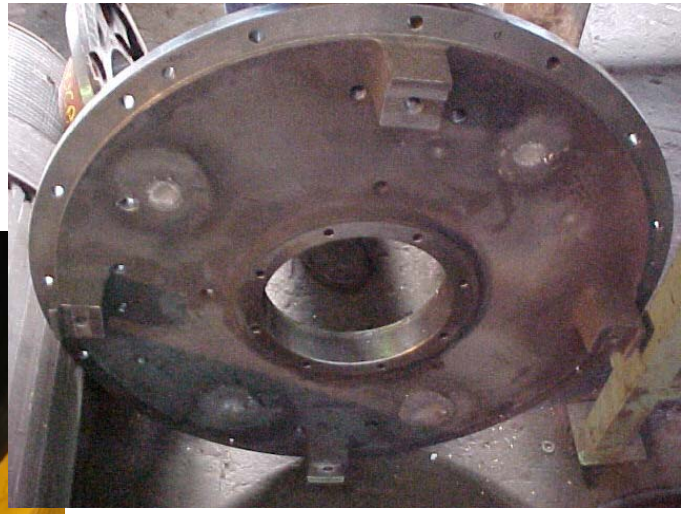




BRUSH MEASURING



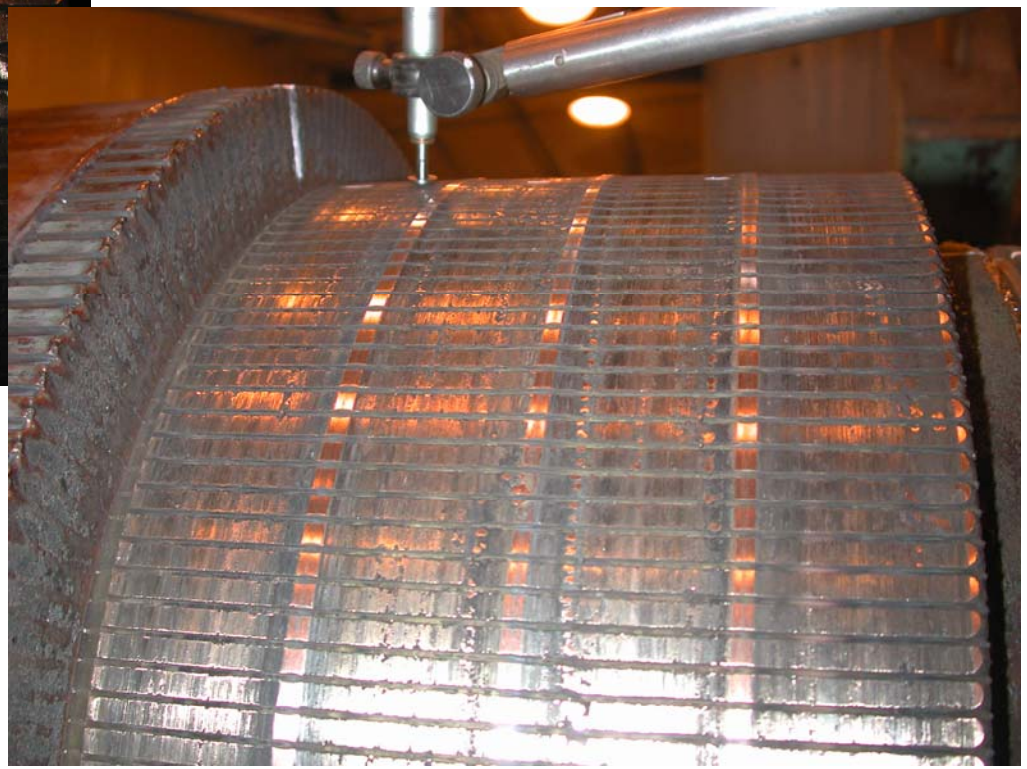
No IA feedback or MAX command

FLASHOVER [SLOW SPEED]

Rough Commutator or

Bad Springs or

Bad Commutation



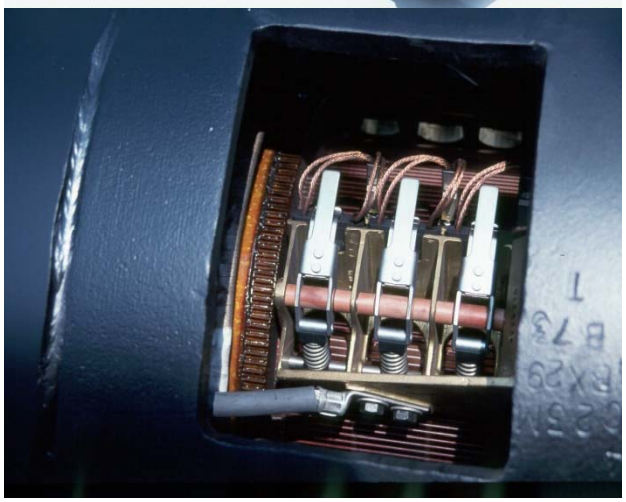
FLASHOVER [HIGH SPEED]

4 Pole DC

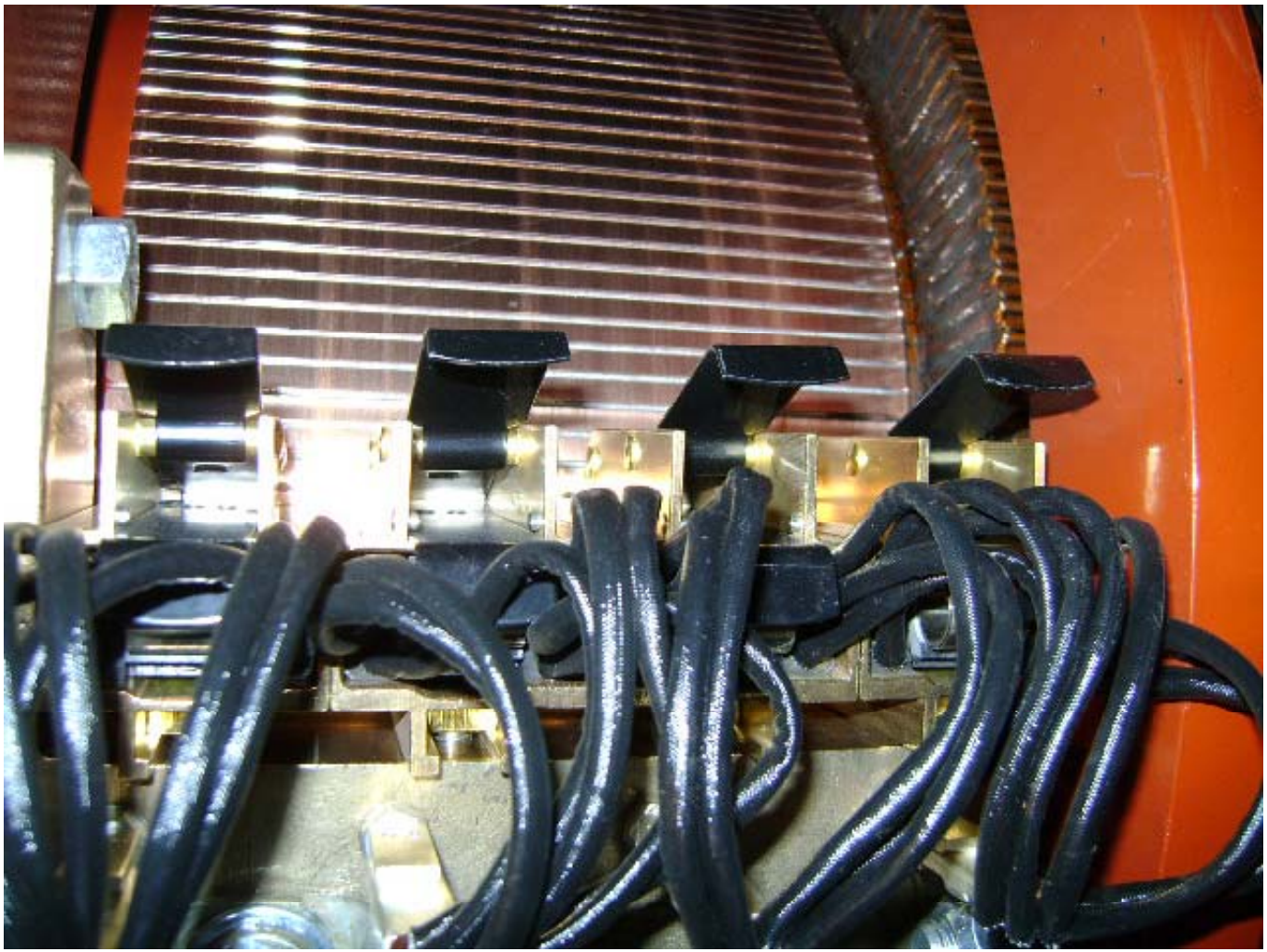
400 Hp continuous rating

Reaction brush holders

Manufactured by LeTourneau



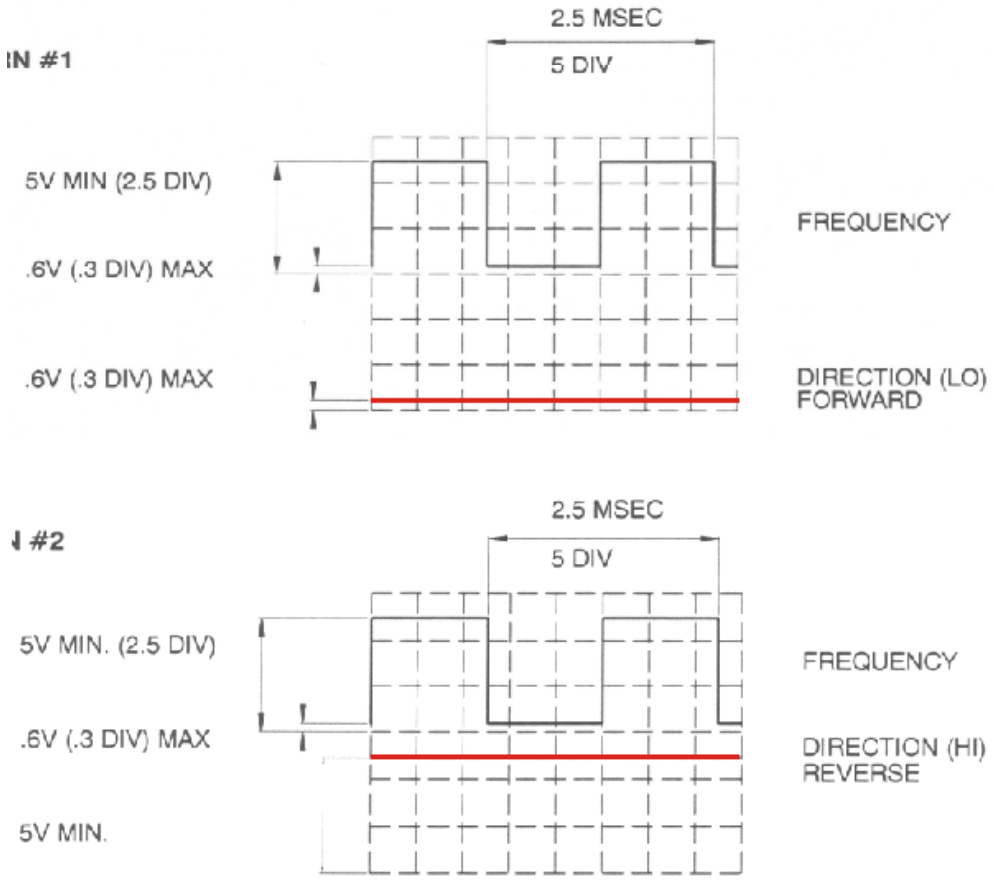
TRACTION MOTOR (M40)

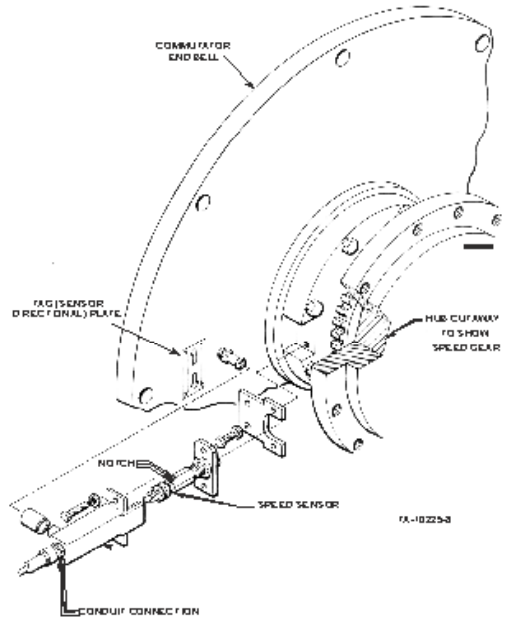


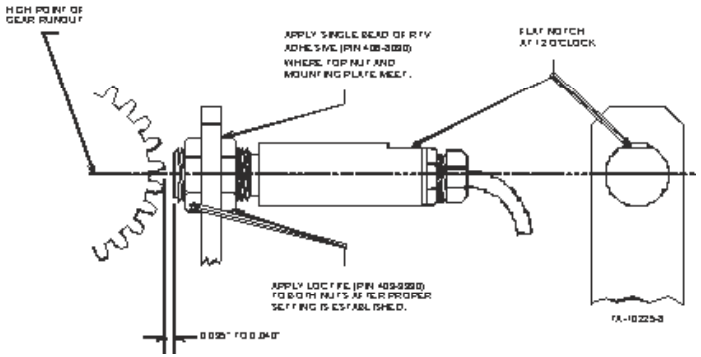
TRACTION MOTOR (M40) BRUSHES

Component Descriptions

LeTourneau Technologies, Inc.







Speed Sensor

MOTOR DC FUSES

Component Descriptions

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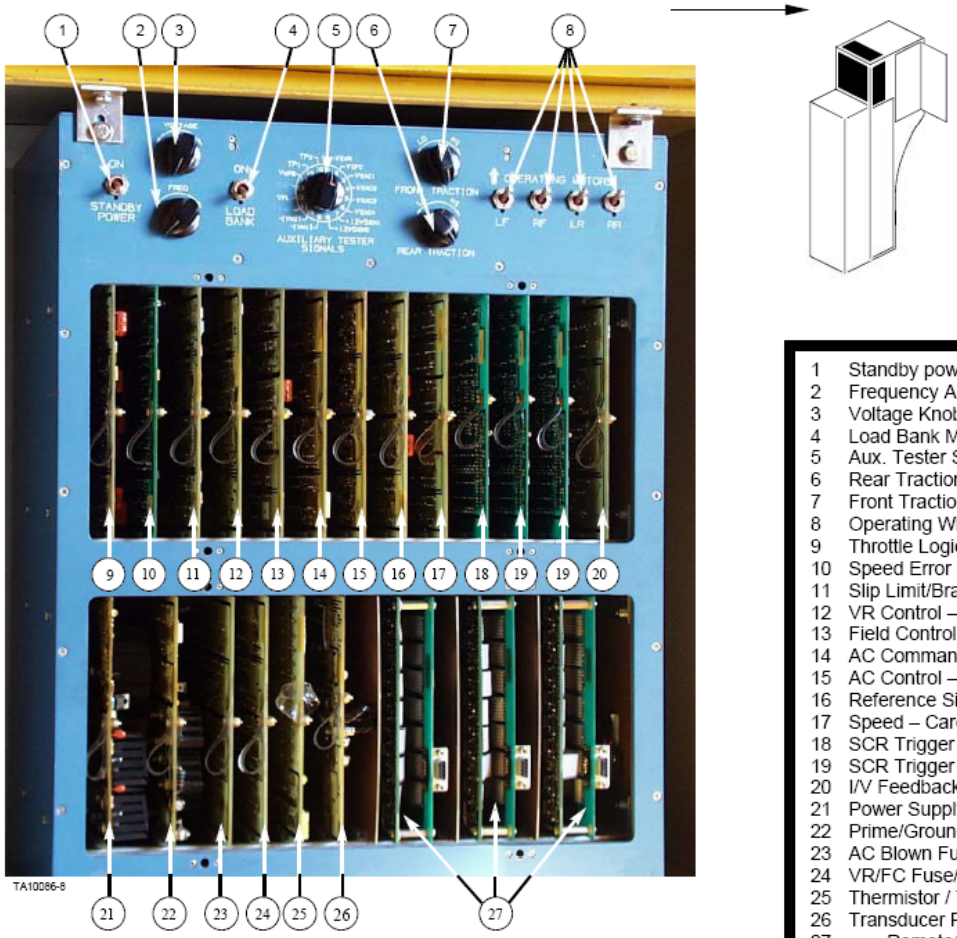


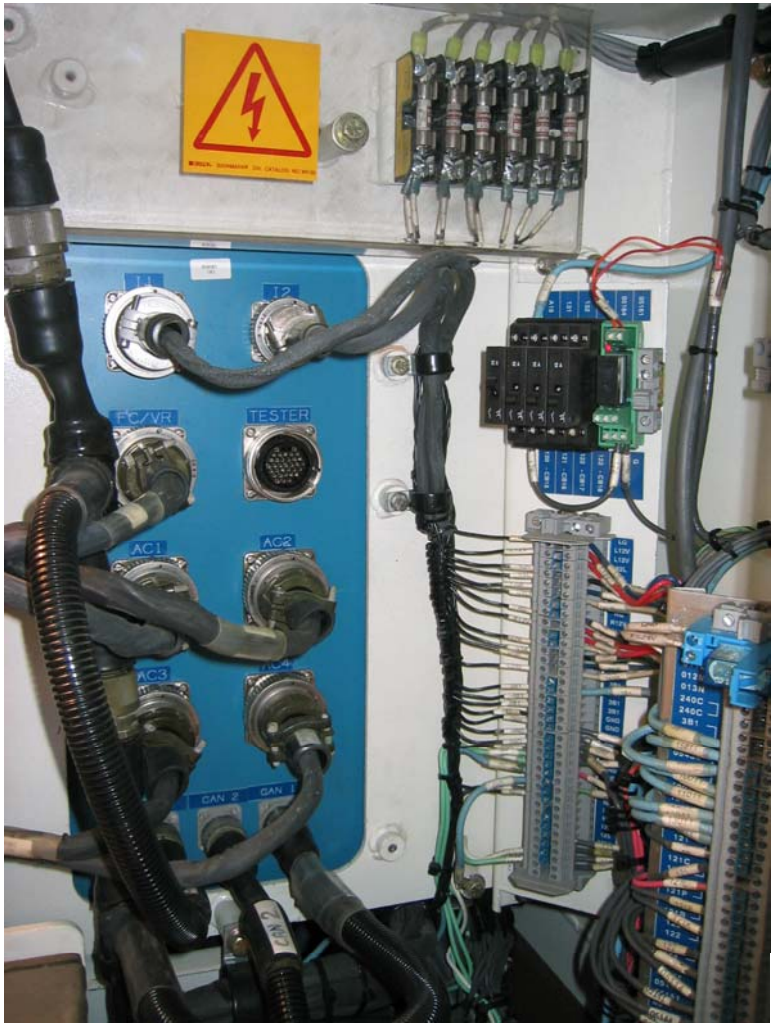
1	Standby power switch
2	Frequency Adjust
3	Voltage Knob Adjust
4	Load Bank Mode Switch
5	Aux. Tester Sig. Switch
6	Rear Traction Torque Adjust
7	Front Traction Torque adjust
8	Operating Wheel Motors Switch
9	Throttle Logic – Card C1
10	Speed Error - Card C2
11	Slip Limit/Brake Mode – Card C3
12	VR Control – Card C4
13	Field Control – Card C5
14	AC Command Limit – Card C6
15	AC Control – Card C7
16	Reference Signal – Card C8
17	Speed – Card C9
18	SCR Trigger Signal – Card C10
19	SCR Trigger Signal – Card C11
20	I/V Feedback – Card C13
21	Power Supply – Card PS
22	Prime/Ground Fault – Card C20
23	AC Blown Fuse Detector – Card C21
24	VR/FC Fuse/Braking Detector – Card C22
25	Thermistor / Temperature – Card C23
26	Transducer Power Supply – Card C24
27	Remote/Interface 1, 2, 3 – Cards RI-1,2,3

CONTROLLER

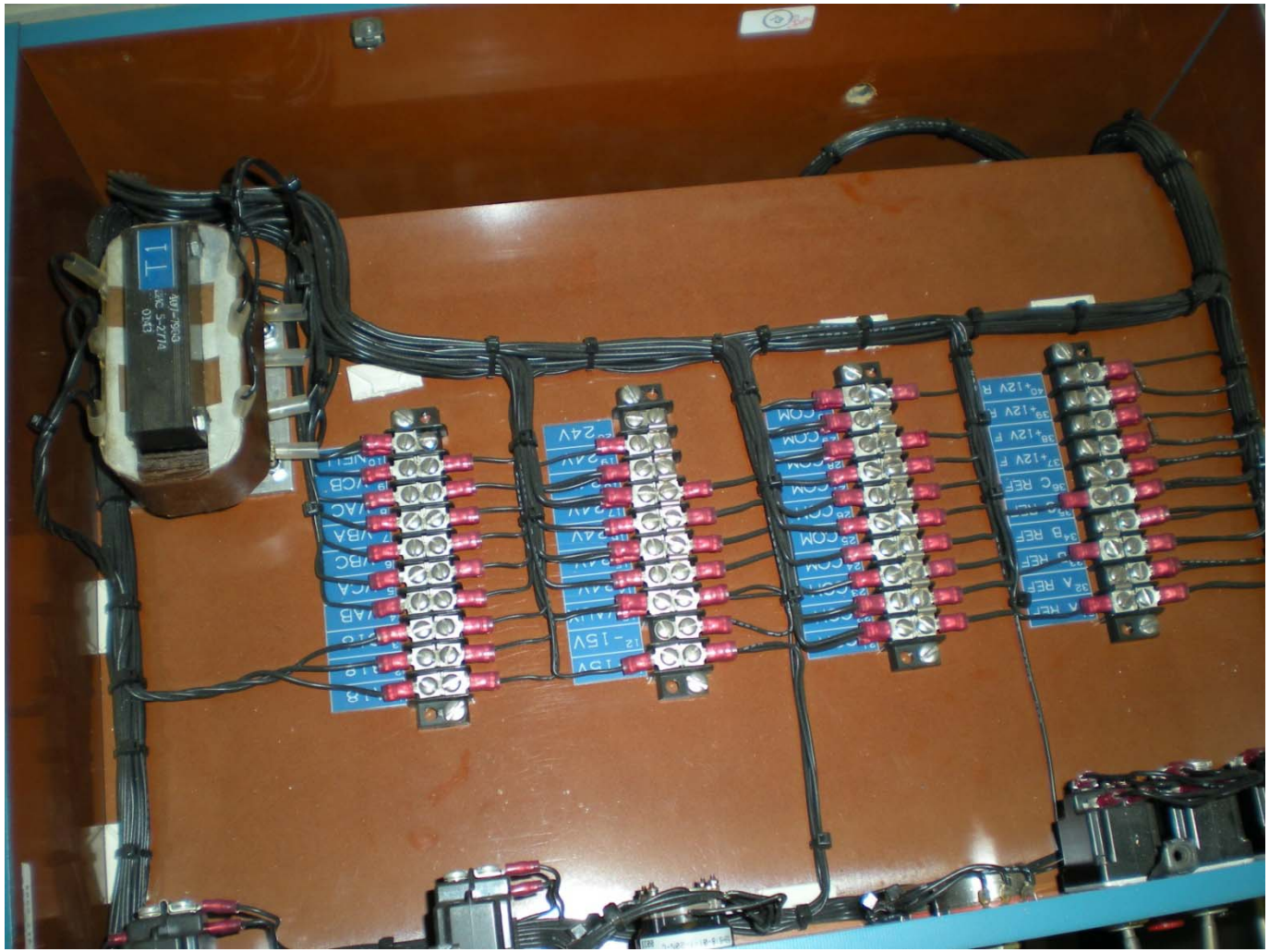
CONTROLLER

Component Descriptions

LeTourneau Technologies, Inc.



CONTROLLER [BACK]



CONTROLLER [TOP]

Component Descriptions

LeTourneau Technologies, Inc.

CARD NO.	NAME	PRIMARY FUNCTION	QTY
C1	Throttle Logic	Generates VHC, VH and VHL signals. Puts out NOT STANDBY and SLOW SPEED MODE signals.	1
C2	Speed Error	All related VA and VE signals generated. Commutation Limit signals generated.	1
C3	Slip Limit, Brake Mode	Slip Limit and Brake Mode signals generated.	1
C4	VR Control	VR Enable/Inhibit and VR CTRL signals generated. Also, VGEN, Prime Inhibit, VR Op ALM and VR/GEN Temp signals.	1
C5	Field Control	All Field Commands and Limit Curves, and FC1 & 2 OP ALM, CTRL, Enable/Inhibit signals are generated. The IF, IF Proper, IF POL and LOAD BANK MODE signals generated.	1
C6	AC Command Limit	Receives the VE command and various limit signals. Generates the VIAF & VIAR signals, and VIA (1-4) signals. Also generates the Enable and OP ALM signals for AC 1-4.	1
C7	AC Control	The VIA (1-4) signals are ramped. The AC (1-4) CTRL and Inhibit signals are generated.	1
C8	Reference Signal	The SCR reference signals (cosine sweep and endstop) are generated for proper field and armature SCR triggering.	1
C9	Speed	|VN|, VN and Speed Sensor Fail signals are generated	1
C10	SCR Trigger Signal	SCR Trigger signals are generated for the VR and FC. A picket fence oscillator operates during each trigger pulse, which is sent to the panel Trigger Card.	1
C11	SCR Trigger Signal	SCR Trigger signals are generated for the AC (1 &2) on one card and AC (3 &4) on the other. A picket fence oscillator operates during each trigger pulse, which is sent to the panel Trigger Cards.	2
C13	I/V Feedback	Motor Voltages (VM 1-4) and Armature Currents (IA 1-4) are generated. Field Current (IF), HP and HP Limit signals are generated.	1
PS	Power Supply	The 24-volt battery voltage is used to generate the ±15v and the two +12v speed sensor supplies, and the +60 volt supply for the SCR Trigger Cards located on the converter panels.	1
C20	Prime/Ground Fault	Generator priming control, and ground fault detection and shutdown logic are generated.	1
C21	AC Blown Fuse Detector	AC Fuse Proper (1-4) signals are generated. AC fuses are detected by voltage across them, and DC fuses by an open circuit motor voltage (VM 1-4) measurement.	1
C22	VR/FC Fuse and Braking Detector	VR/FC Fuse Proper signals are generated. Dynamic braking and brake failure are detected.	1
C23	Thermistor / Temperature	The panel heatsink thermistor outputs are processed to generate AC 1-4, FC and VR temperature signals. Voltages from the RI 1-3 cards that represent the Motors 1-4 and generator thermistor are processed to generate those temperature signals.	1
C24	Transducer Power Supply	The 24-volt battery voltage is used to generate ±15v supplies for the VR, FC and AC 1-4 current measuring transducers located on the converter panels. The +15v supply is also used to drive the heatsink thermistors.	1
RI 1, 2, 3	Remote/Interface 1. 2. 3	These three card assemblies connect the Master Module to the Controller via the CAN Bus. It transfers the Remote Card connections to the other Controller cards, buffers and scales signals that go between the Remote Card and the Controller, inputs the address connection, and connects the CAN bus to the Remote Module Card.	3

CONTROLLER [CARDS]

Component Descriptions

LeTourneau Technologies, Inc.

CONTROLLER [REMOTE INTERFACE CARD]

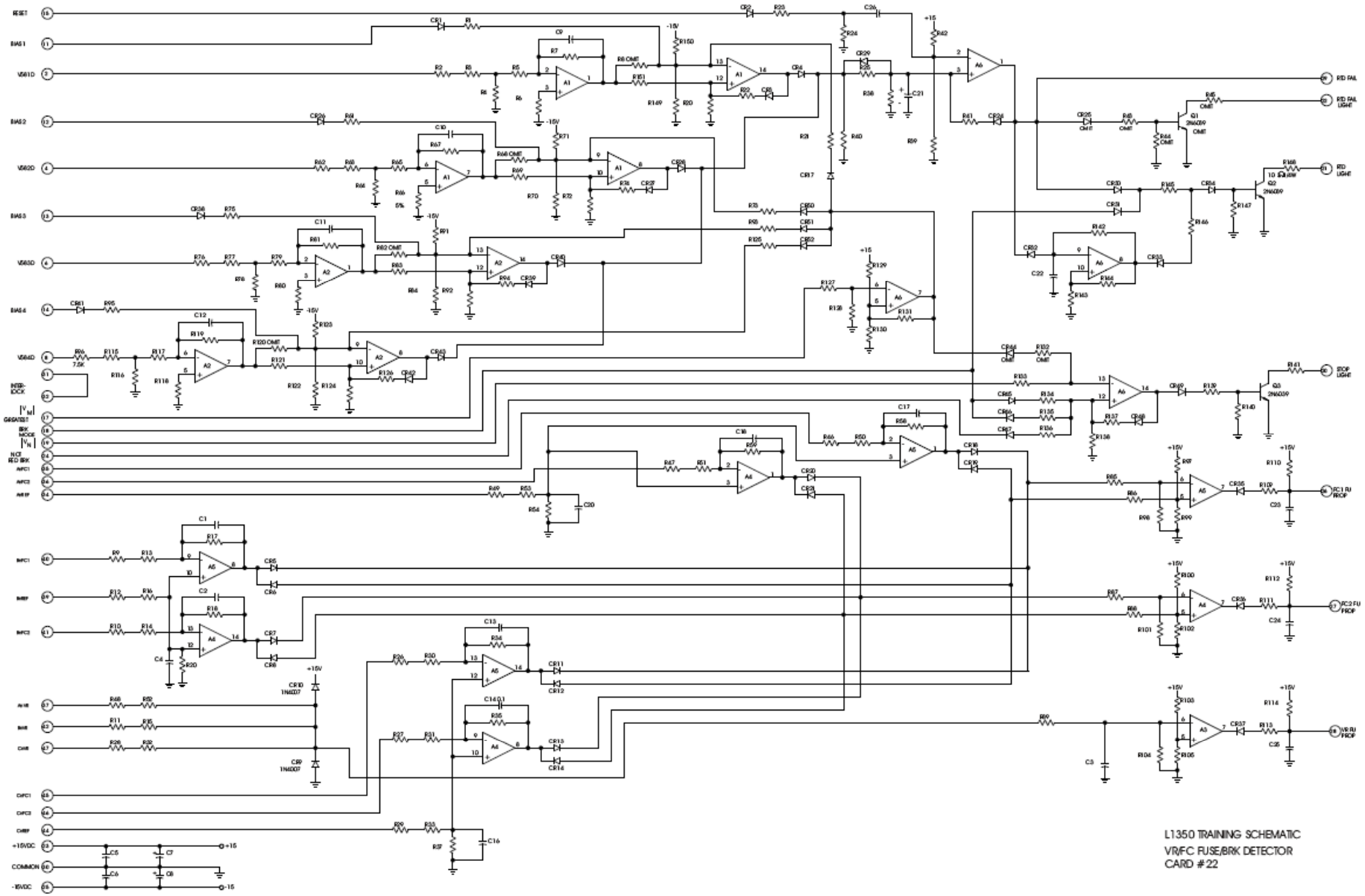
Component Descriptions

LeTourneau Technologies, Inc.

CONTROLLER [INTERCONNECT WIRING]

Component Descriptions

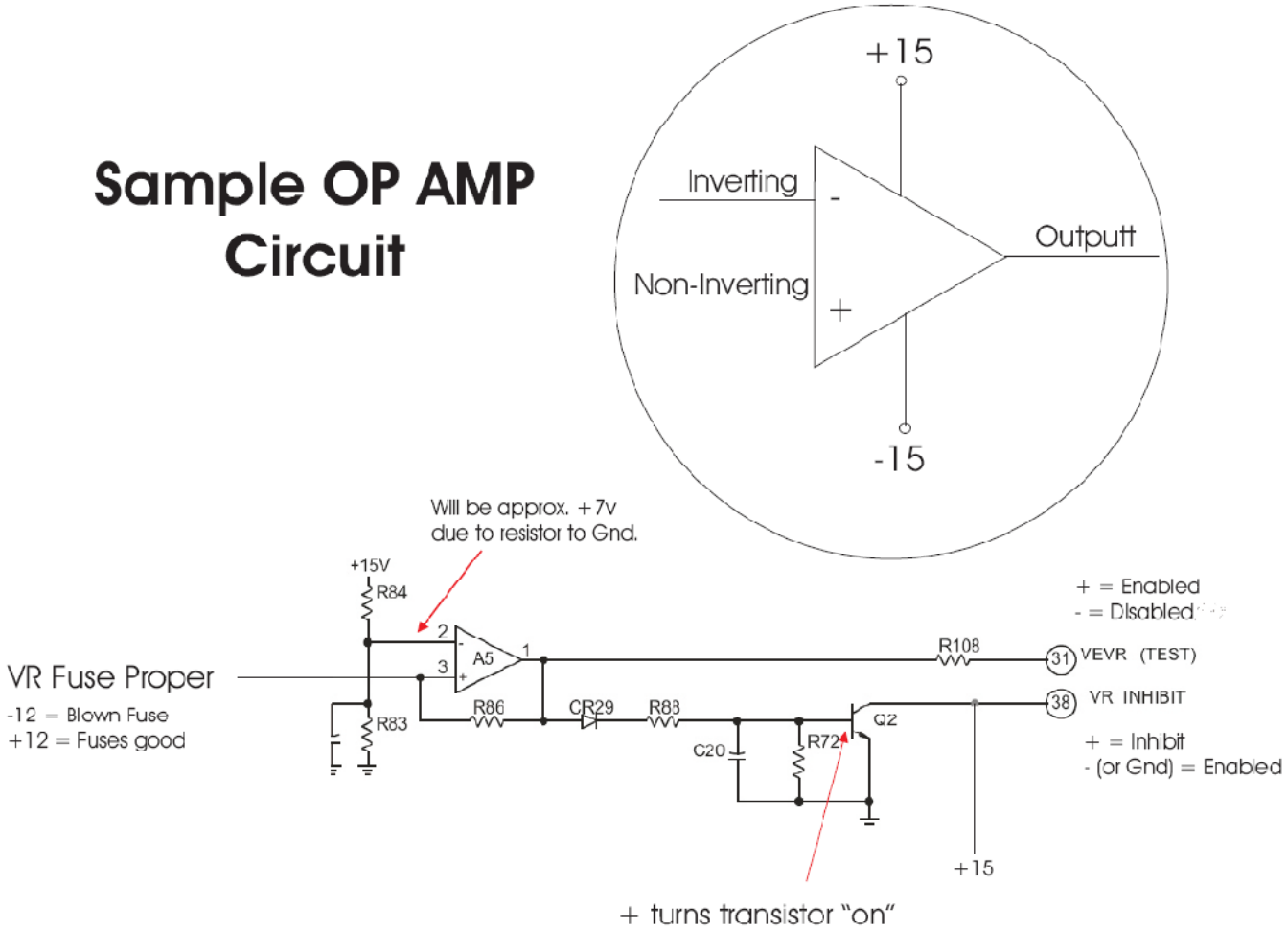
LeTourneau Technologies, Inc.



Component Descriptions

LeTourneau Technologies, Inc.

Sample OP AMP Circuit

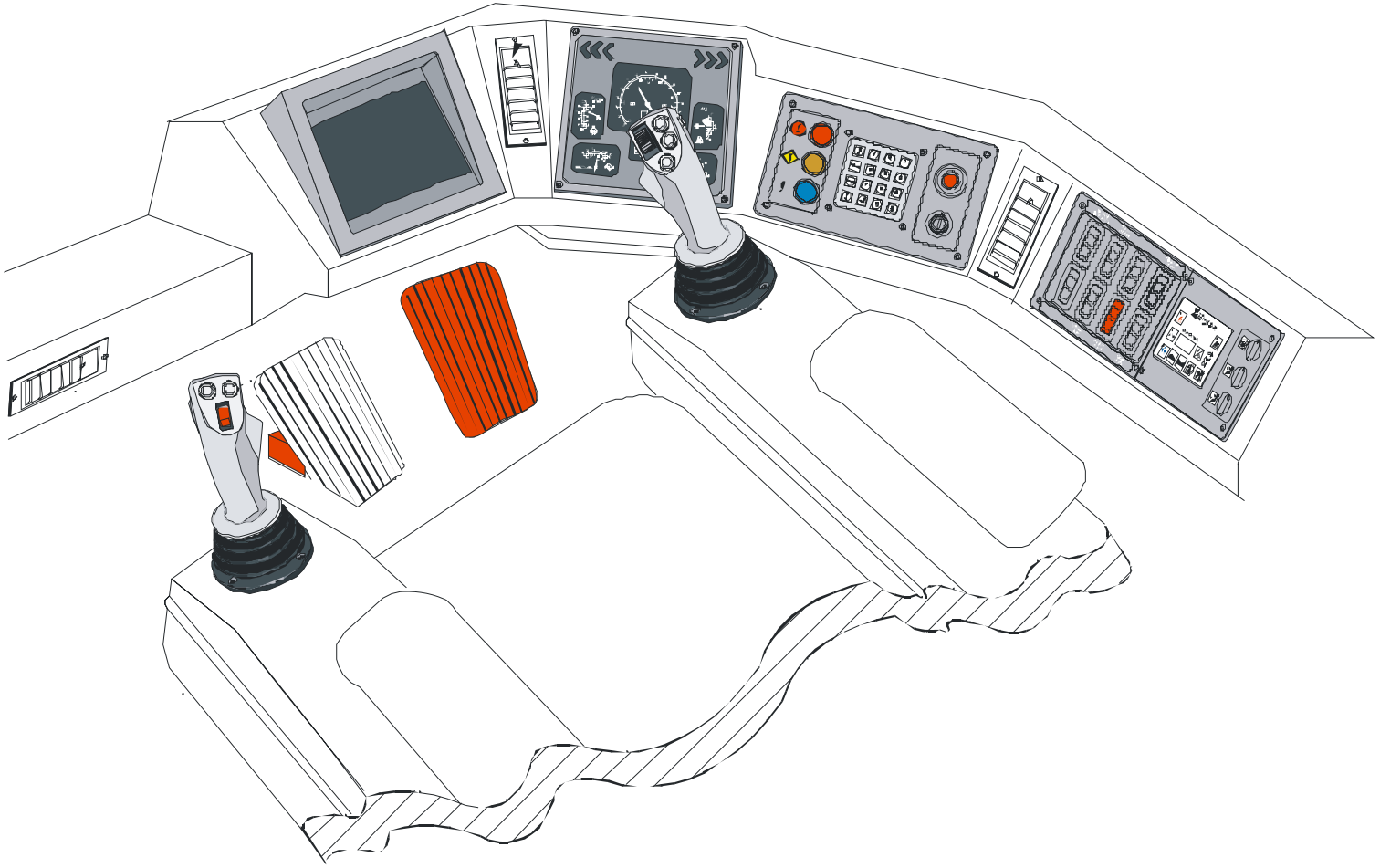


CONTROLLER [CARD OPERATION]

REMOTE CAB TESTER

Component Descriptions

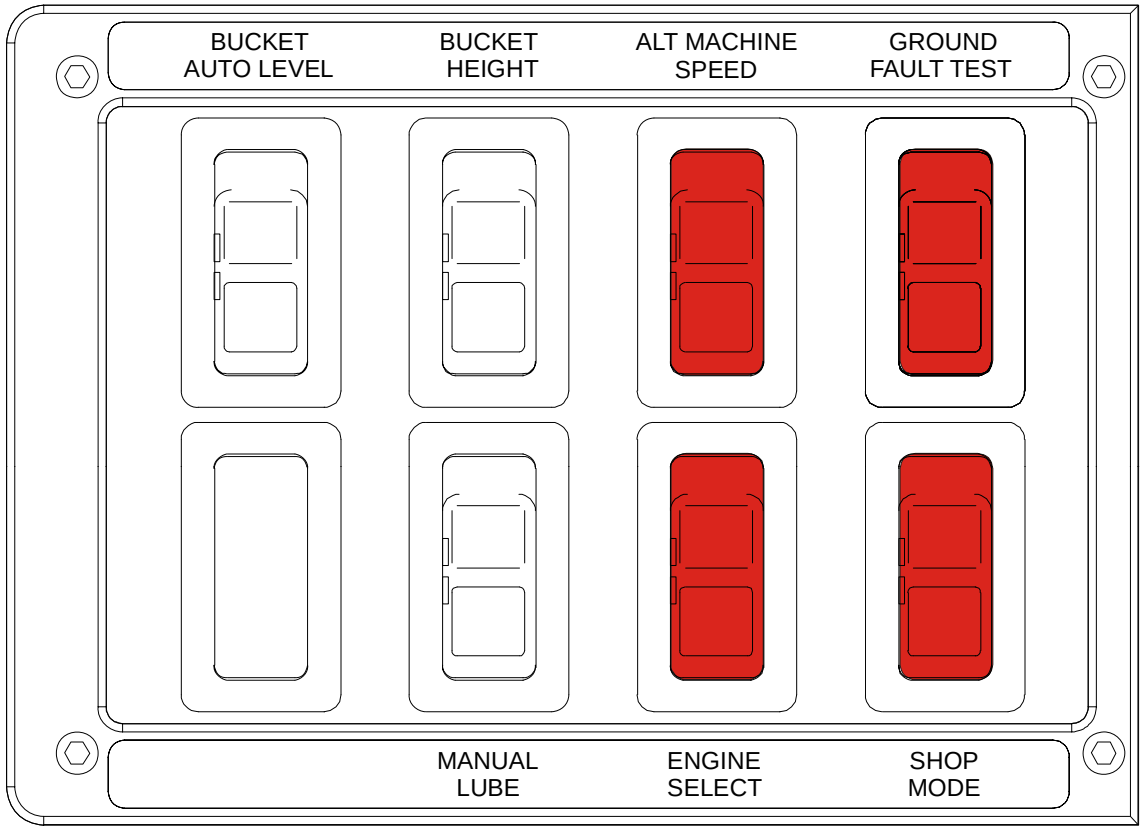
LeTourneau Technologies, Inc.



INPUT DEVICES

Component Descriptions

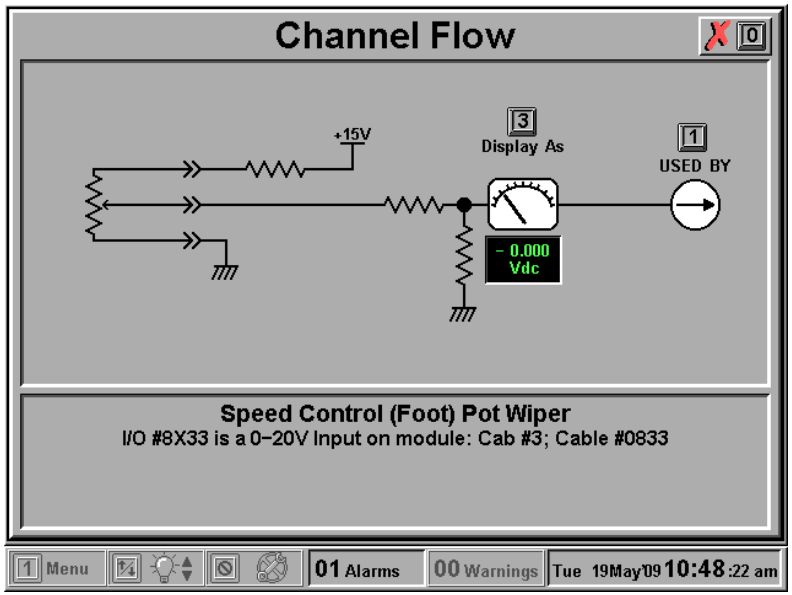
LeTourneau Technologies, Inc.



ROCKER SWITCHES

Component Descriptions

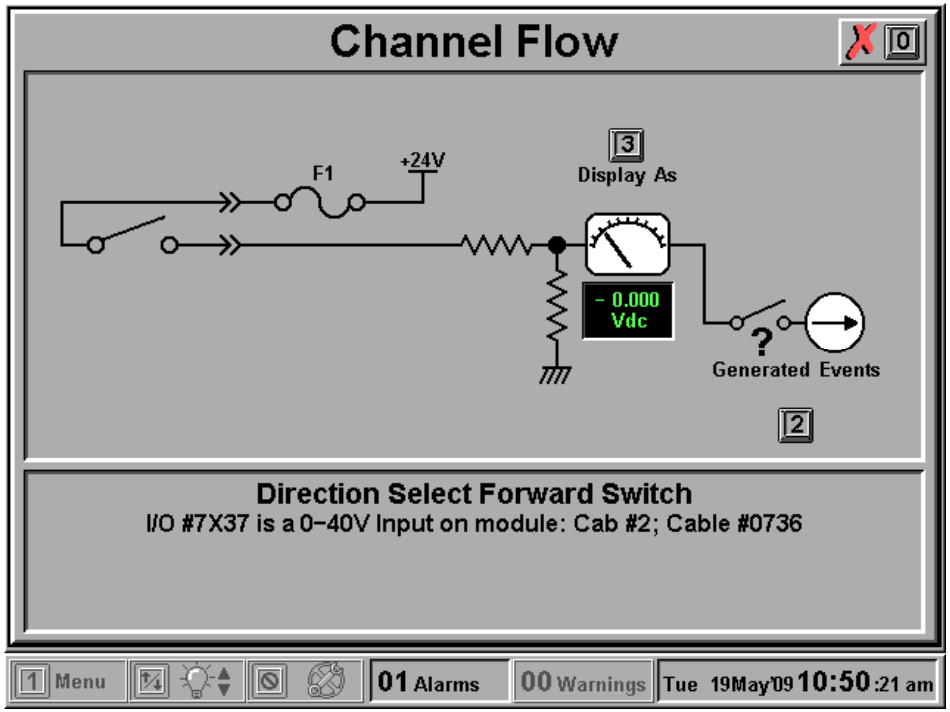
LeTourneau Technologies, Inc.



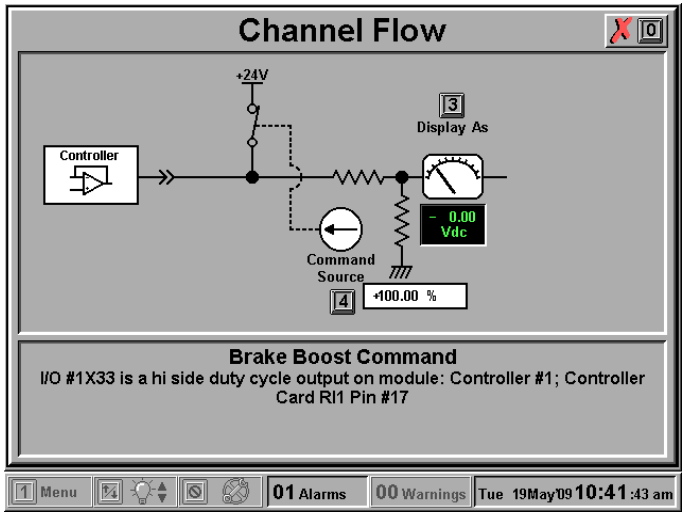
FOOT POT

Component Descriptions

LeTourneau Technologies, Inc.



DIRECTION SELECT SWITCH



BRAKE BOOST

Component Descriptions

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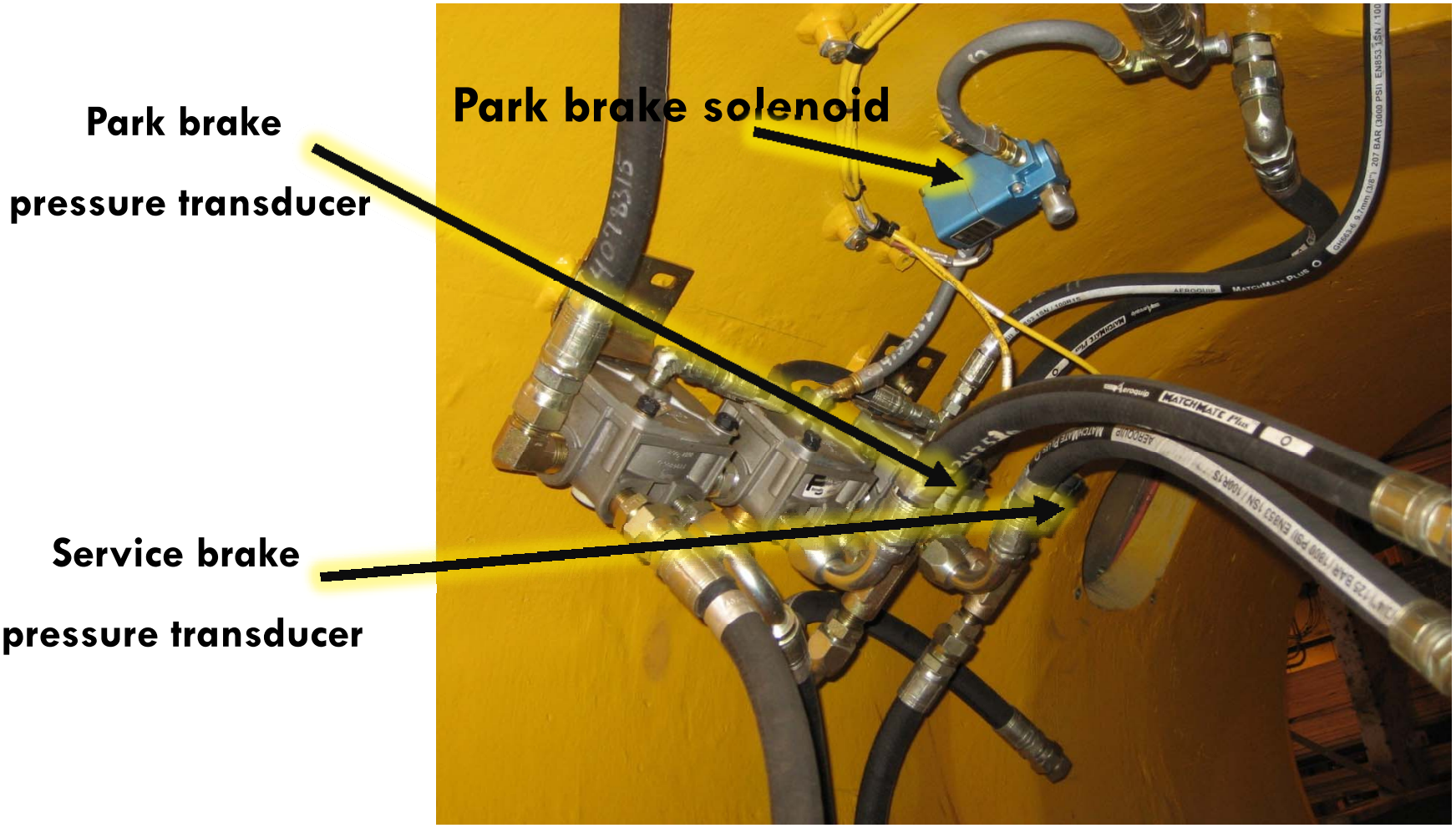


PARK AND SERVICE BRAKES

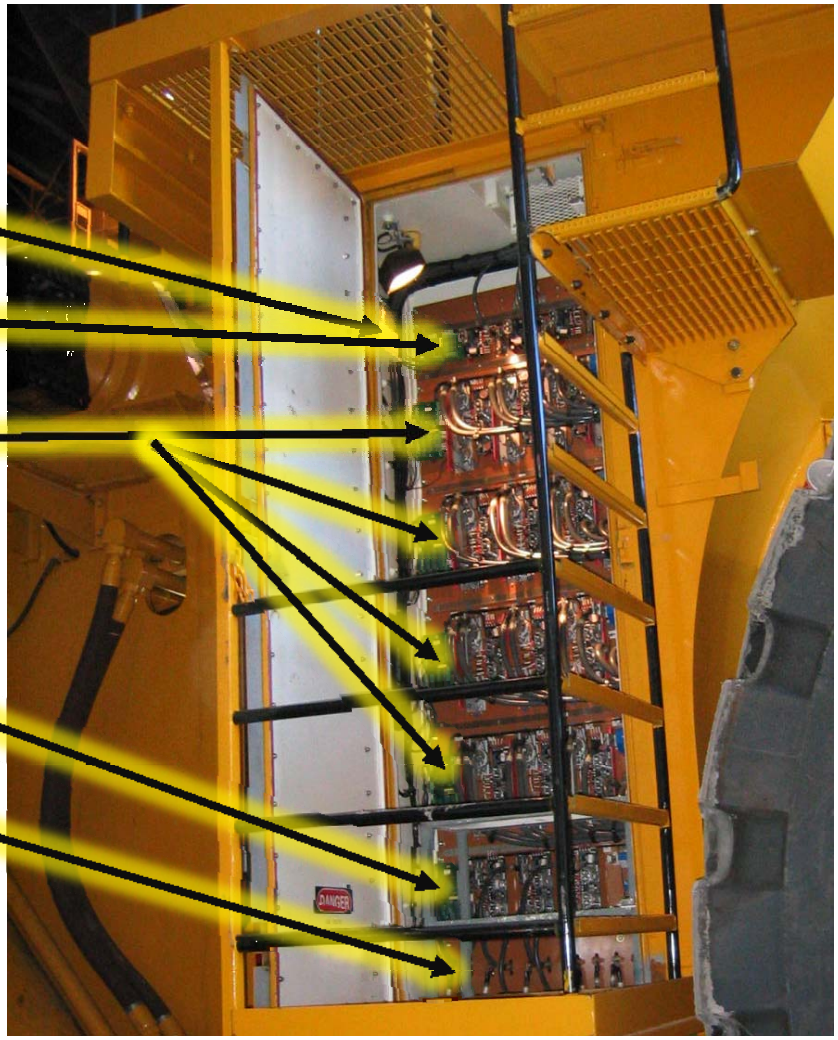
Generator Suppression

Voltage Regulator

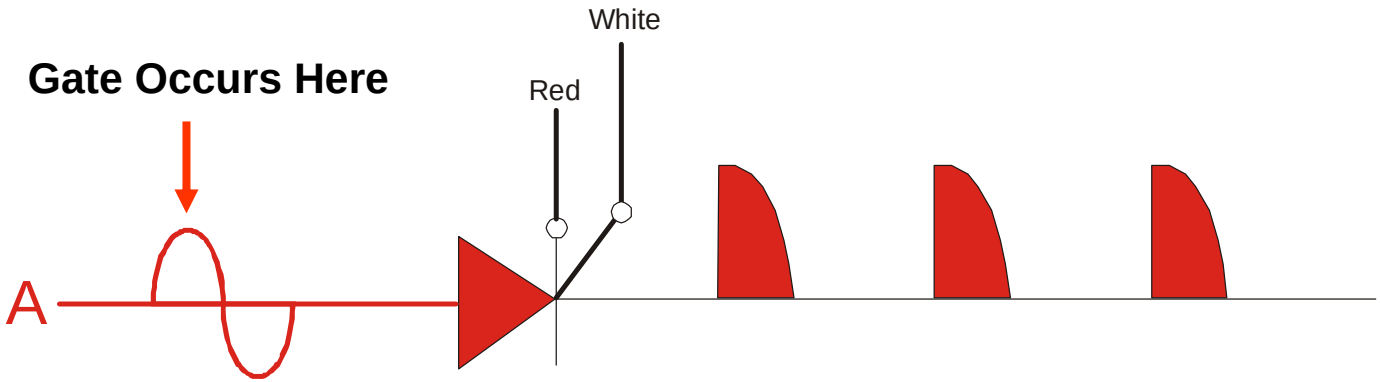
Armature 1 - 4

Field Converter

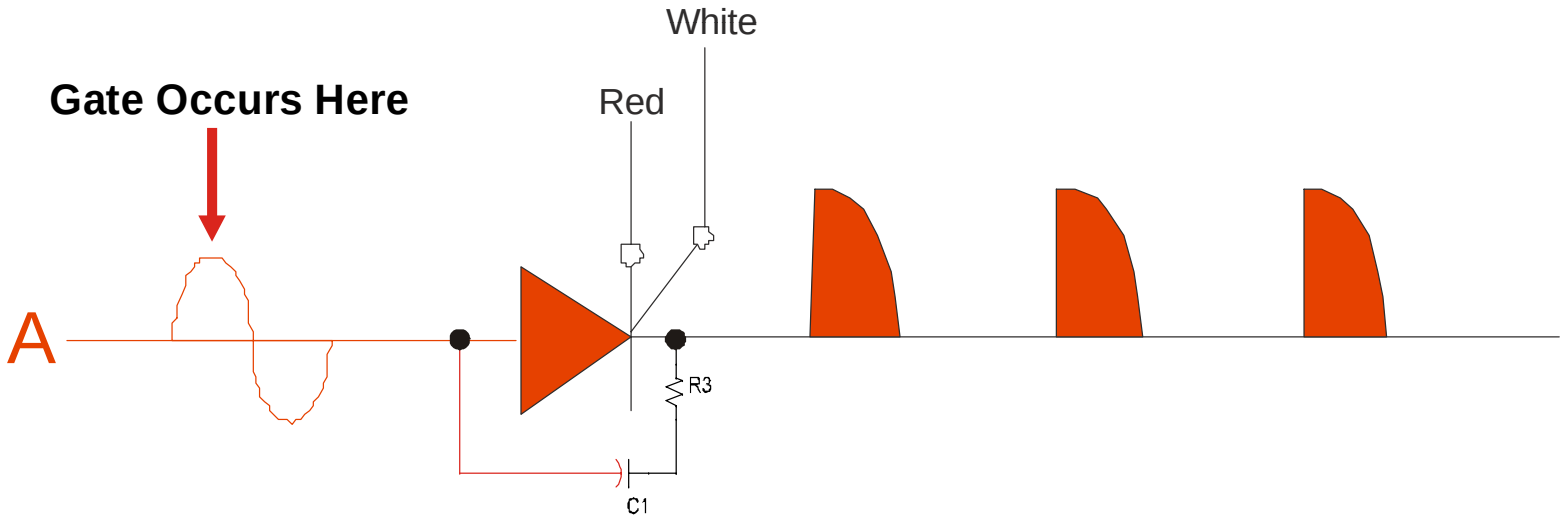
Inductor Coils



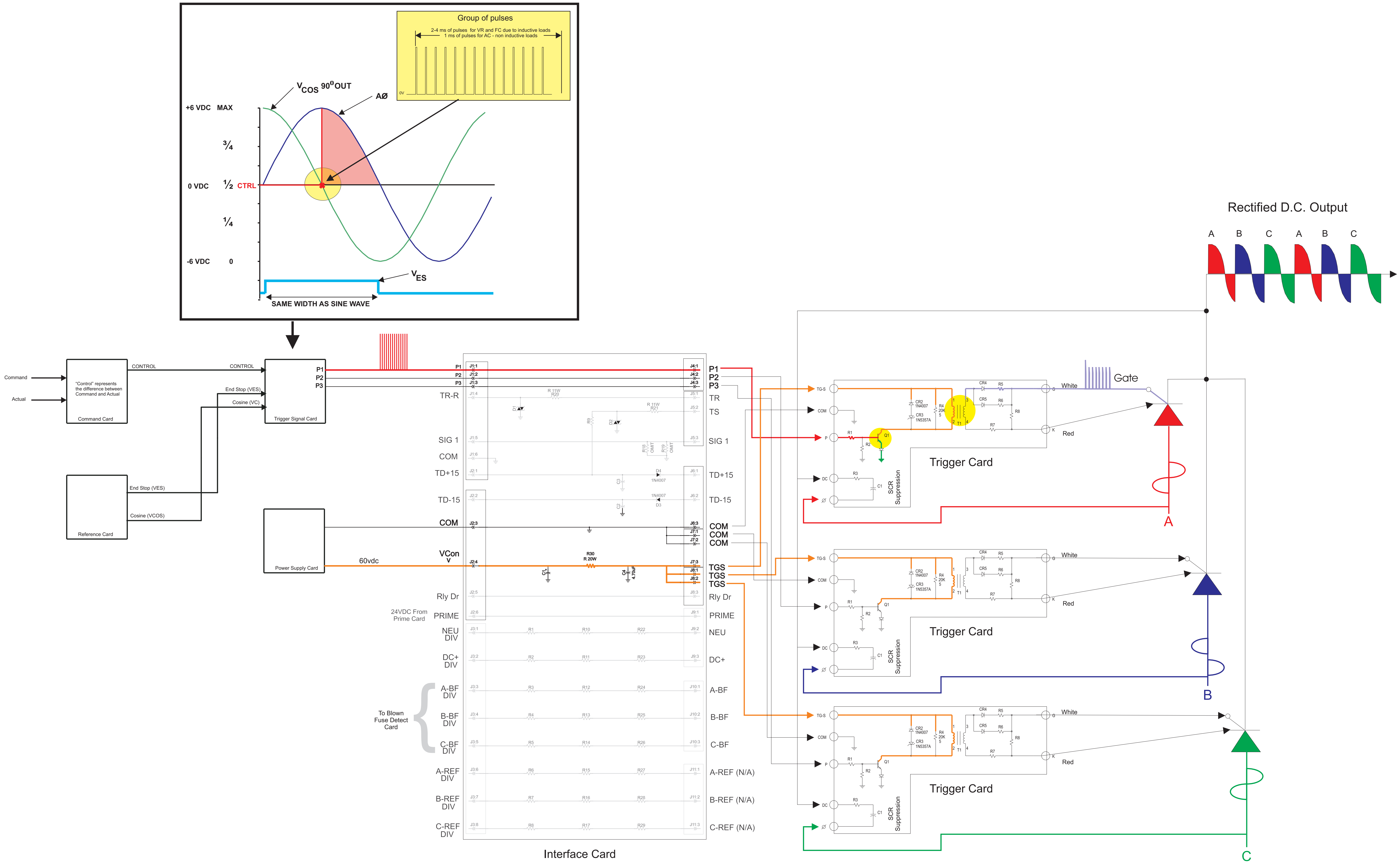
CONVERTER PANELS

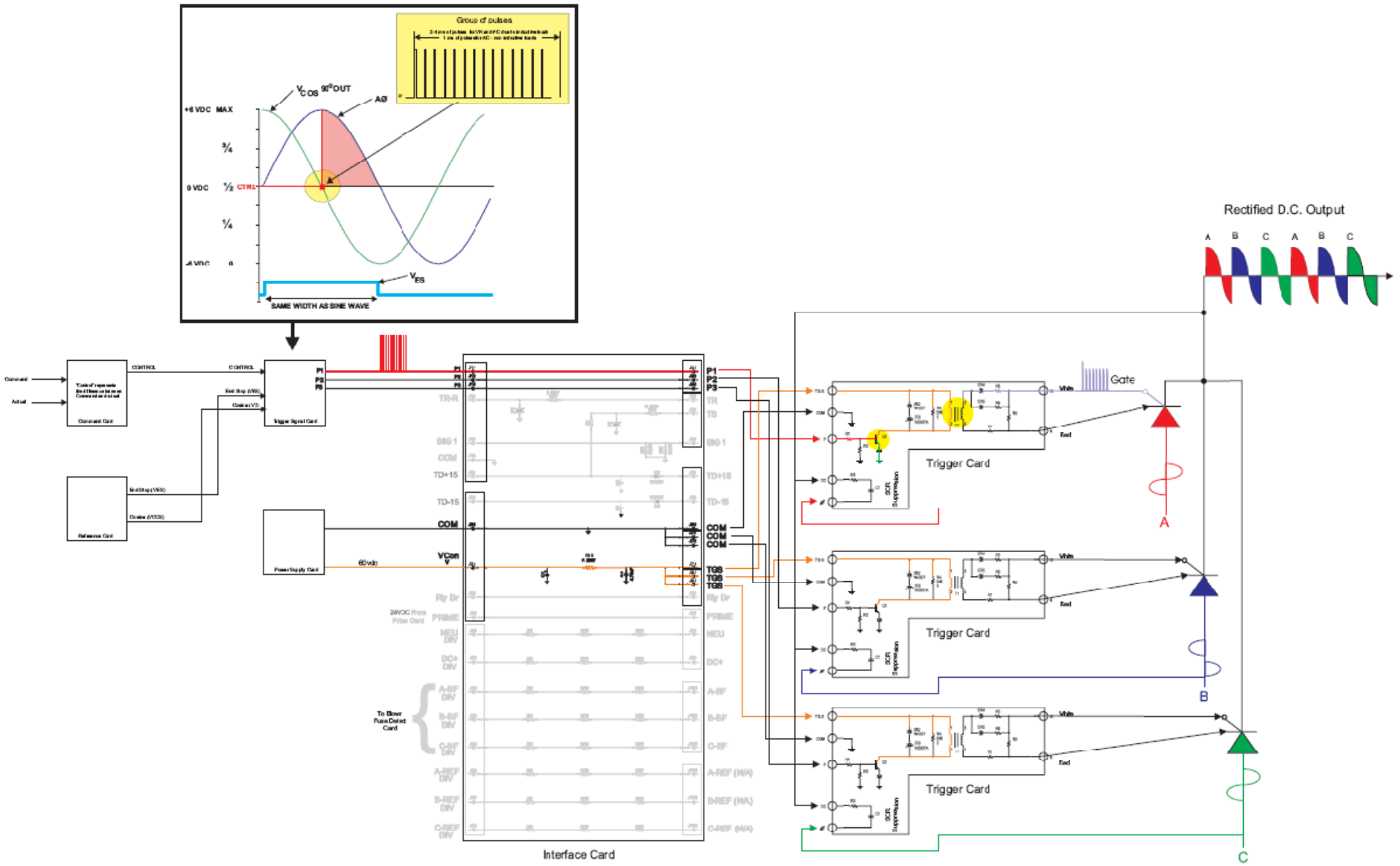


SCR



SCR


Group of pulses
2-4 ms of pulses for VR and FC due to inductive loads
1 ms of pulses for AC - non inductive loads
VCOS 90°OUT
AØ
+6 VDC MAX
¾
0 VDC ½ CTRL
¼
-6 VDC 0
VES
SAME WIDTH AS SINE WAVE
Rectified D.C. Output
A B C A B C
Command
Actual
"Control" represents the difference between Command and Actual
Command Card
CONTROL
End Stop (VES)
Cosine (VC)
Trigger Signal Card
Reference Card
Cosine (VCOS)
Power Supply Card
60vdc
24VDC From Prime Card
To Blown Fuse Detect Card
Interface Card
P1
P2
P3
TR-R
SIG 1
COM
TD+15
TD-15
VCon V
Rly Dr
PRIME
NEU DIV
DC+ DIV
A-BF DIV
B-BF DIV
C-BF DIV
A-REF DIV
B-REF DIV
C-REF DIV
TR
TS
TGS
NEU
DC+
A-BF
B-BF
C-BF
A-REF (N/A)
B-REF (N/A)
C-REF (N/A)
Trigger Card
SCR Suppression
Gate
White
Red
A
B
C

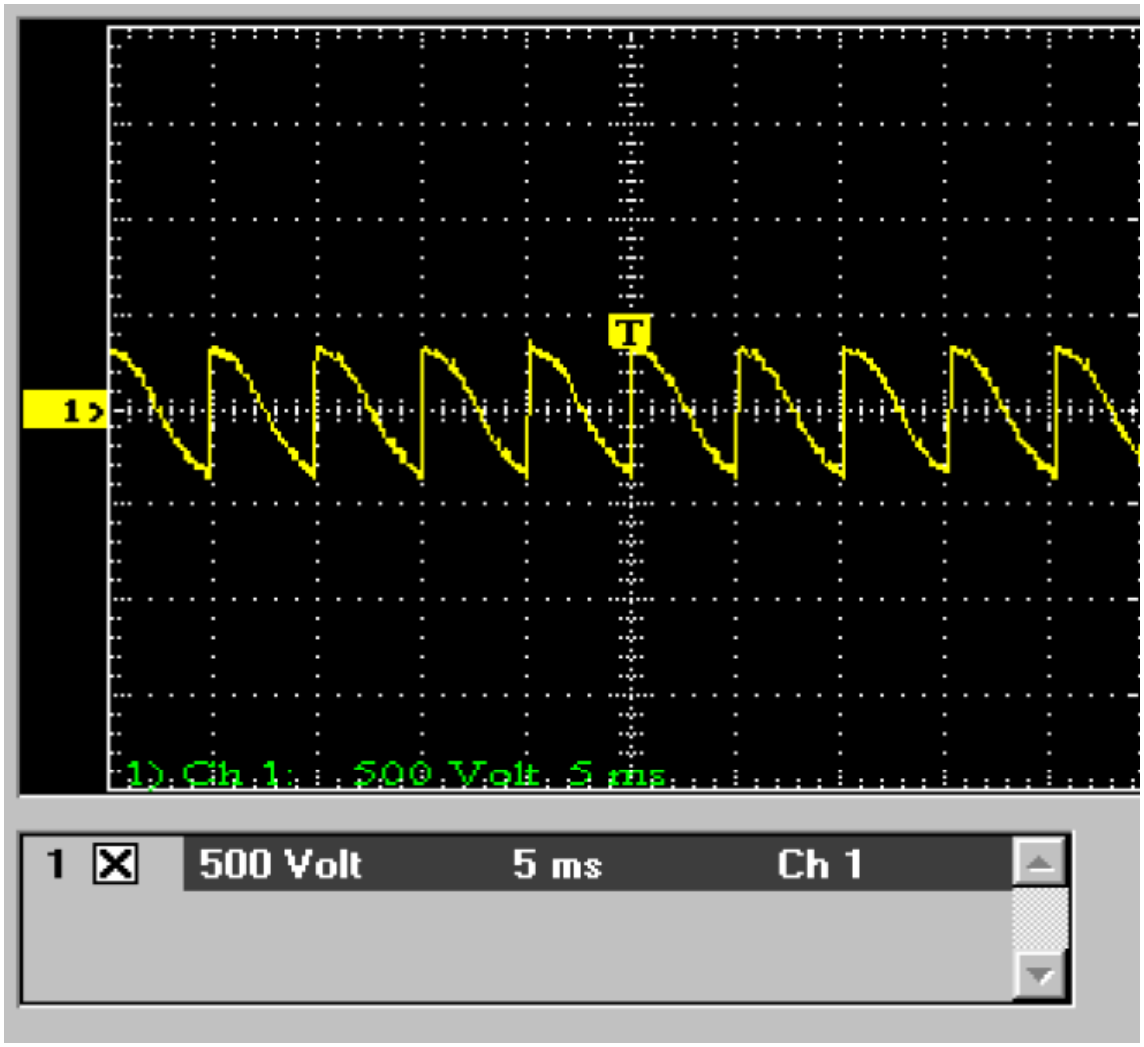


Component Descriptions

LeTourneau Technologies, Inc.

SCR firing.

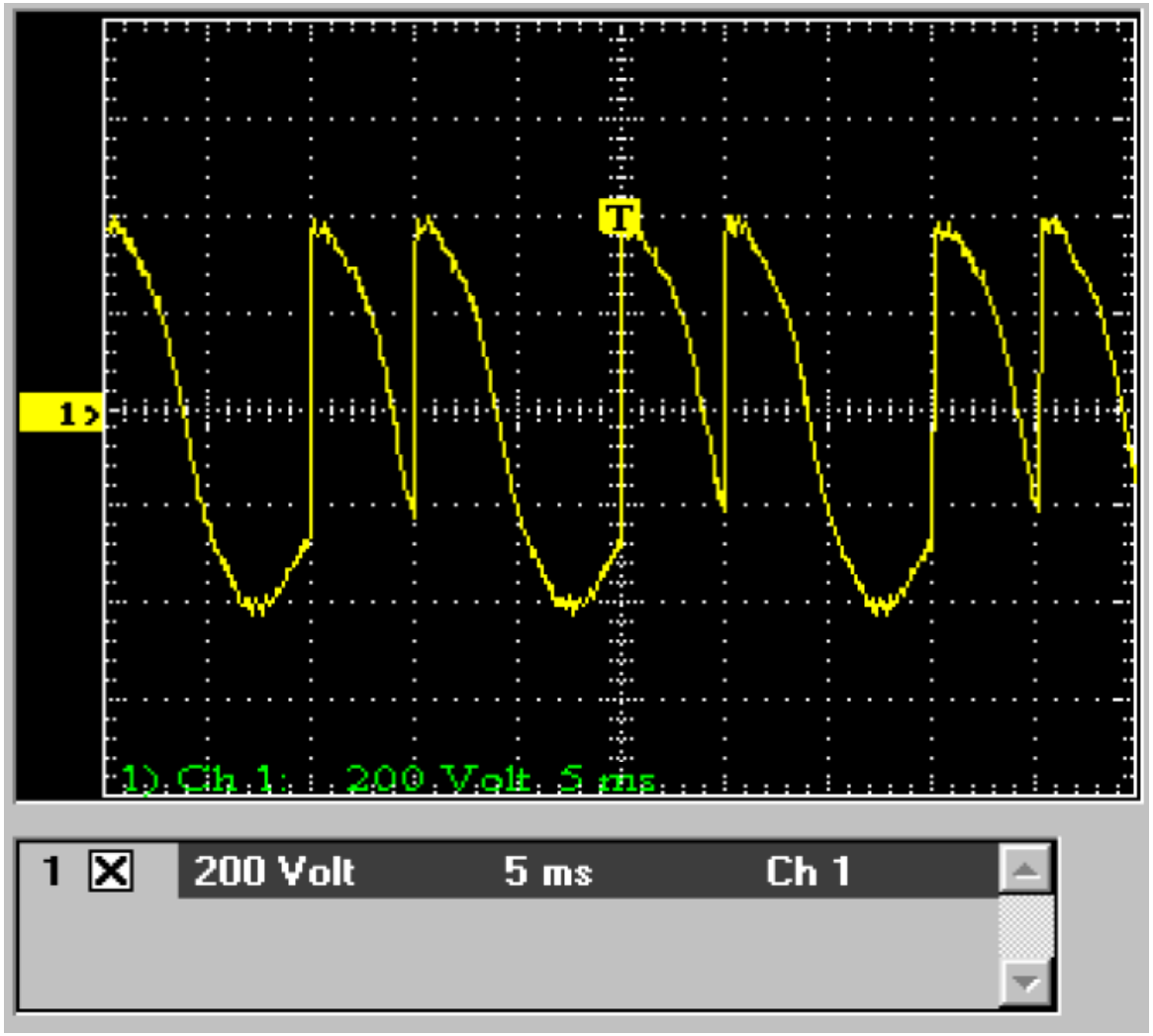
#7 to N



VOLTAGE REGULATOR

SCR firing.

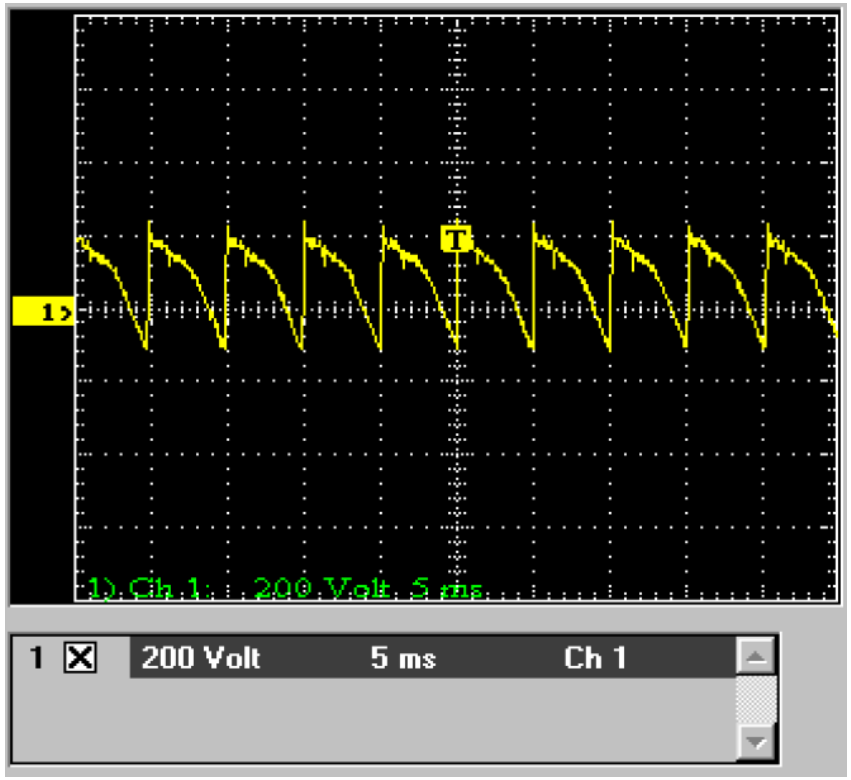
#7 to N



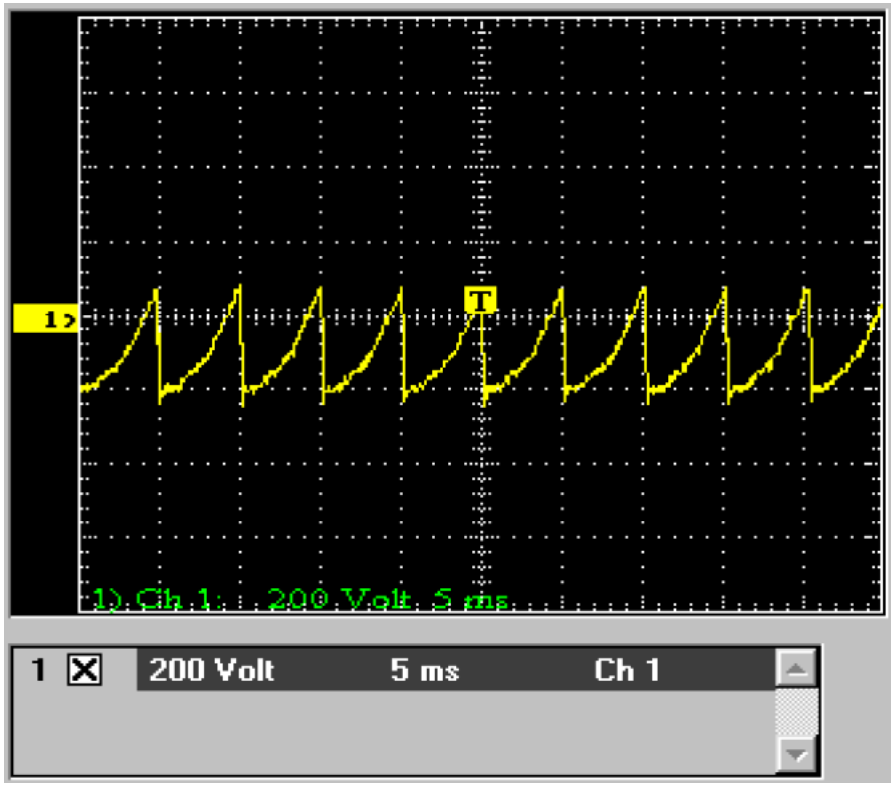
VOLTAGE REGULATOR

SCR Firing - #44 to N

FWD TQ



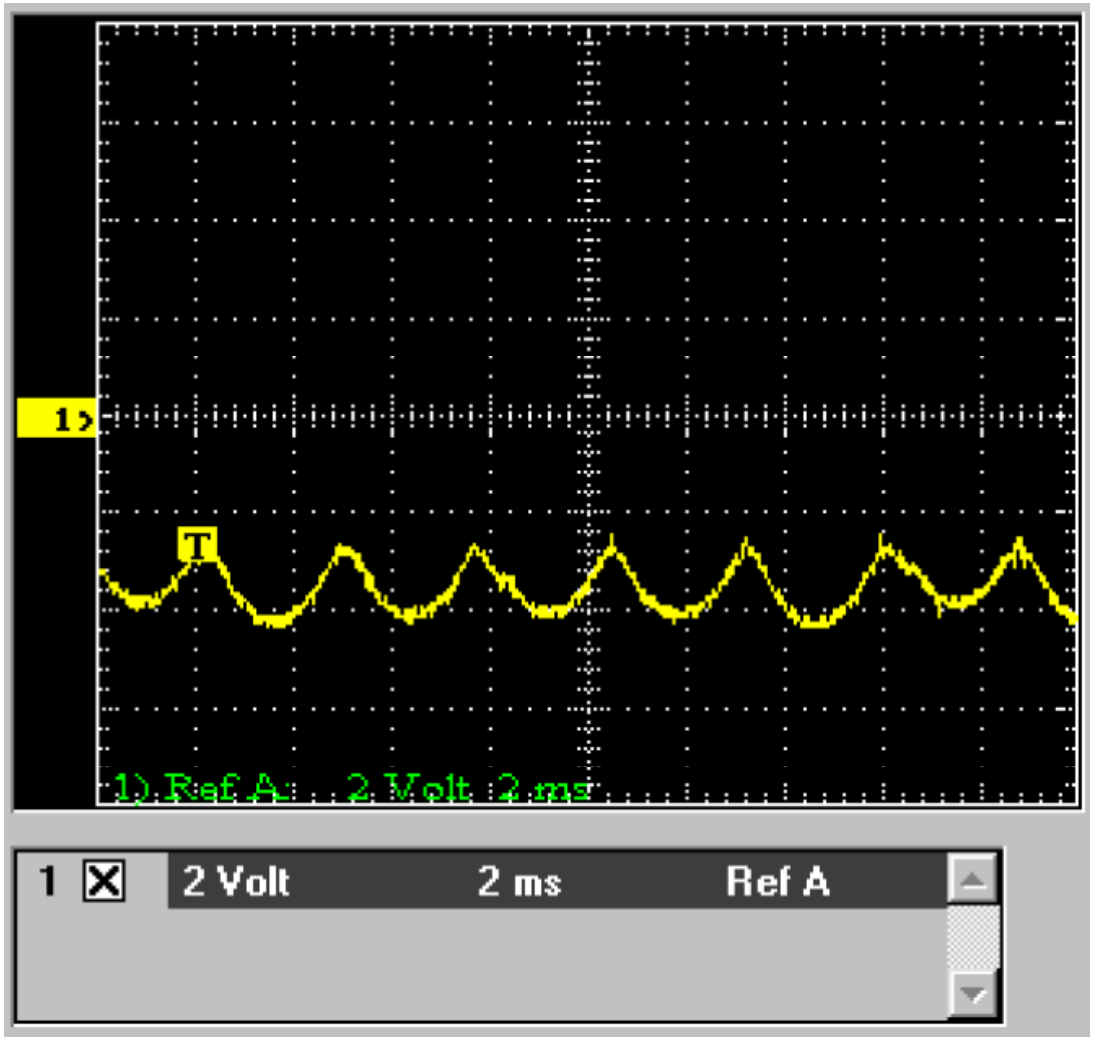
REV TQ



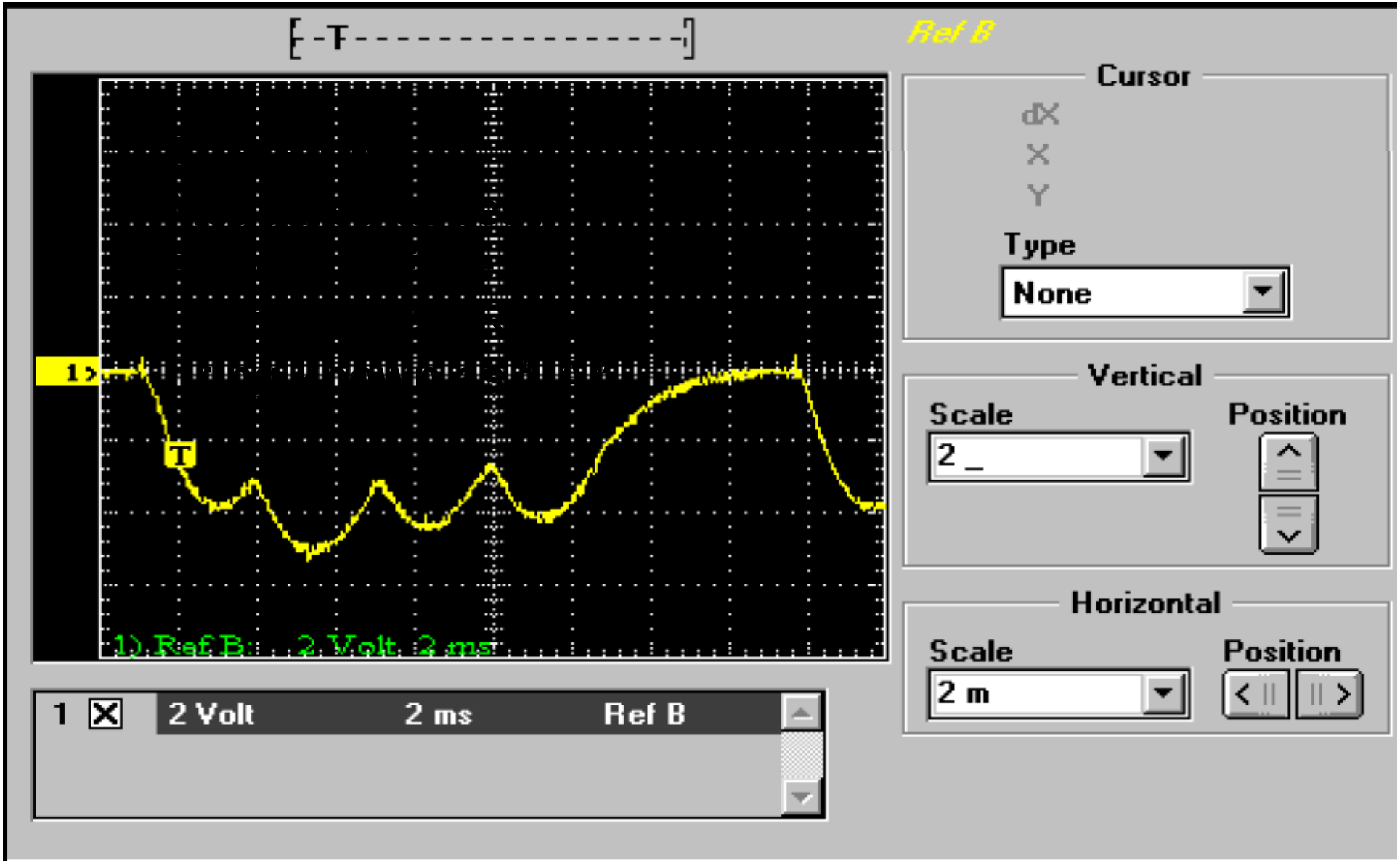
FIELD CONVERTER

SCR Firing - Measured at Test Points on Face of Controller.

Known as "IA"



ARMATURE CONVERTER

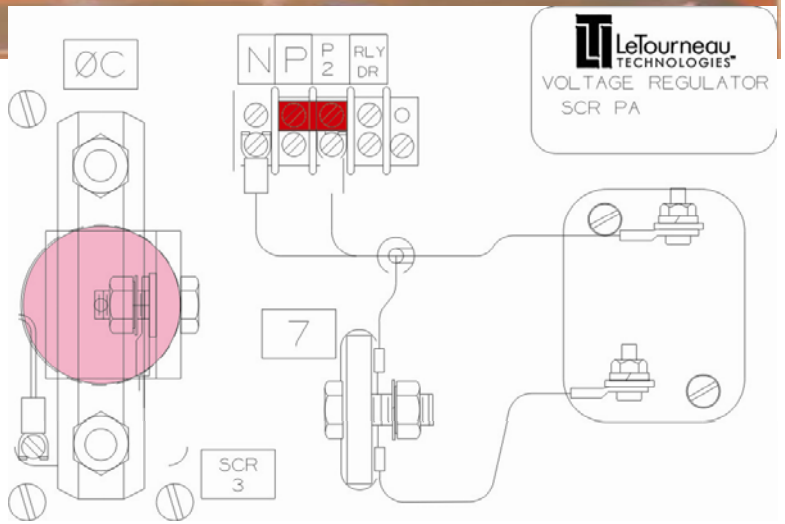


ARMATURE CONVERTER

Component Descriptions

LeTourneau Technologies, Inc.

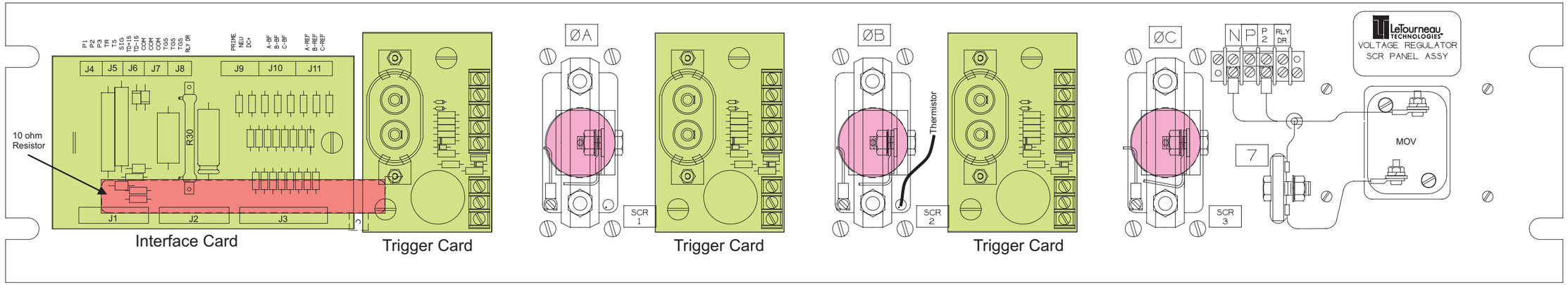
NOTES:

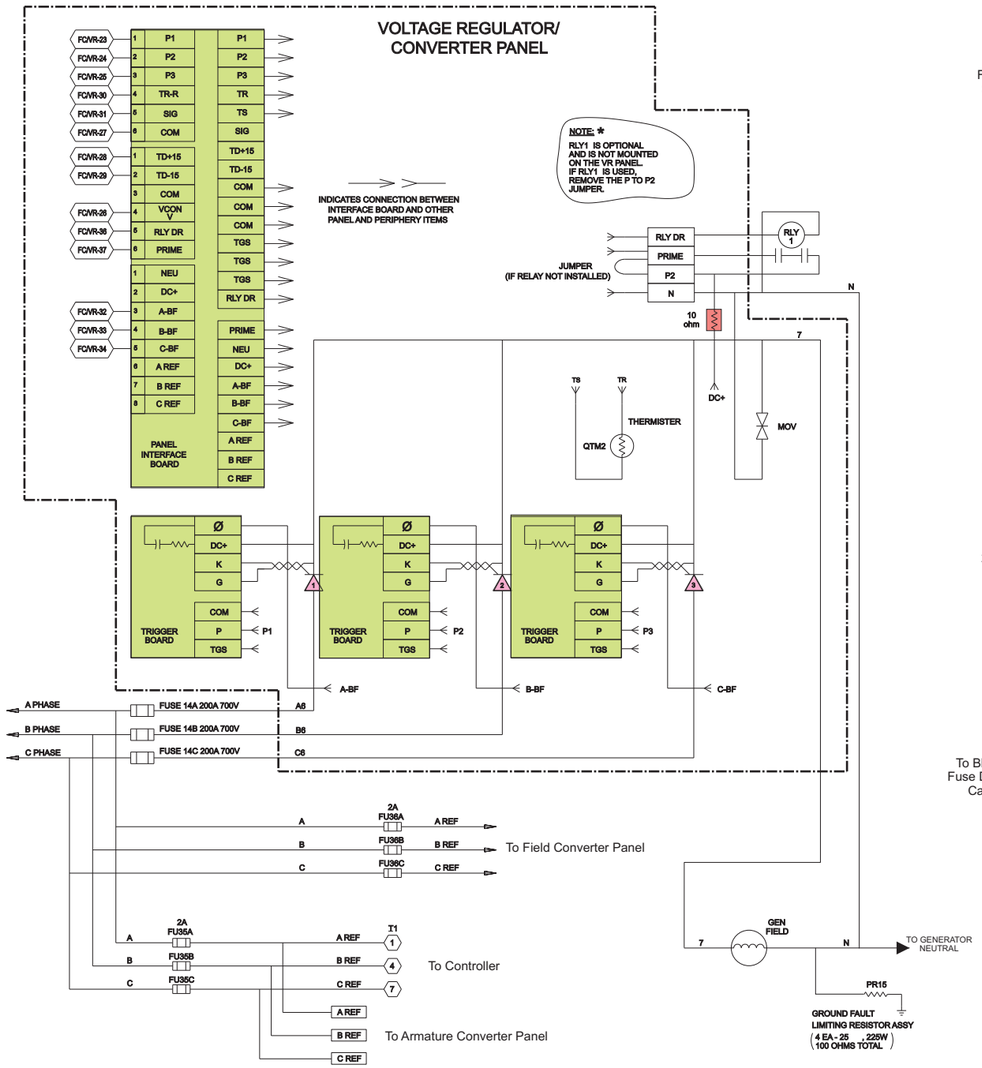


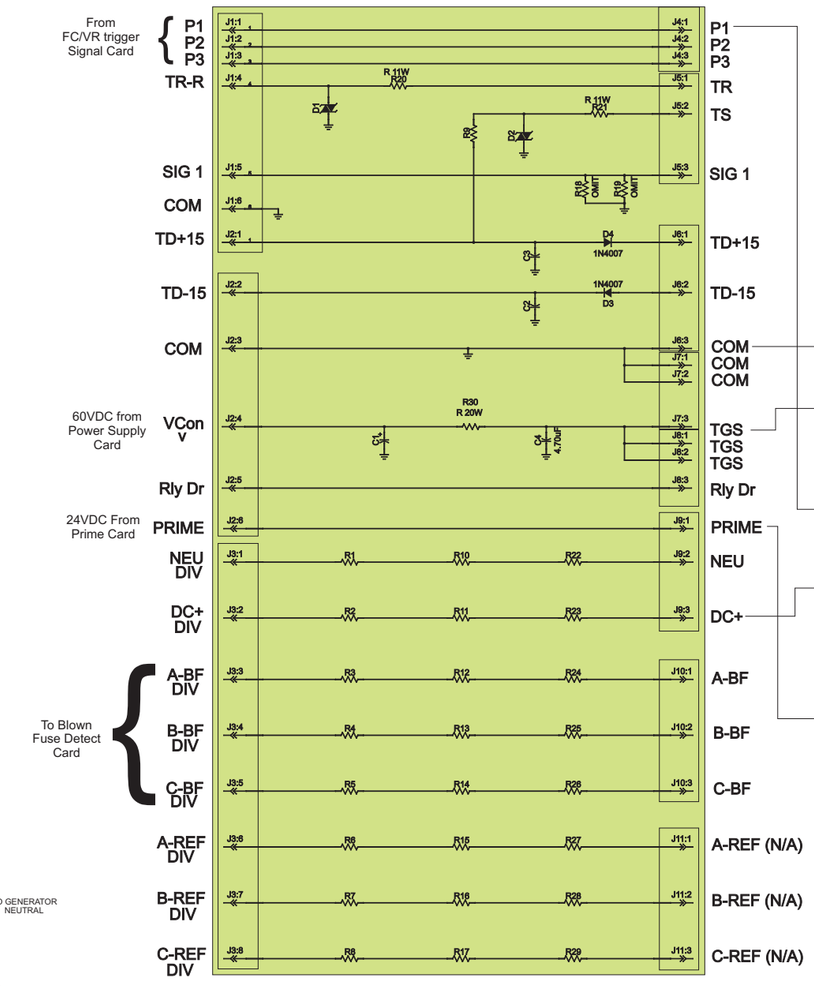
VOLTAGE REGULATOR

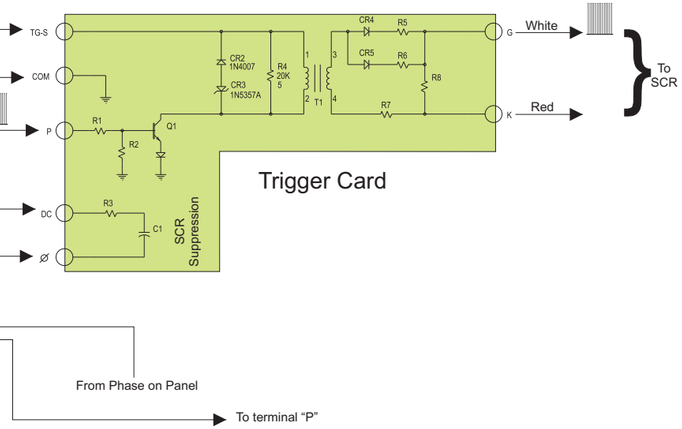
Component Descriptions

LeTourneau Technologies, Inc.



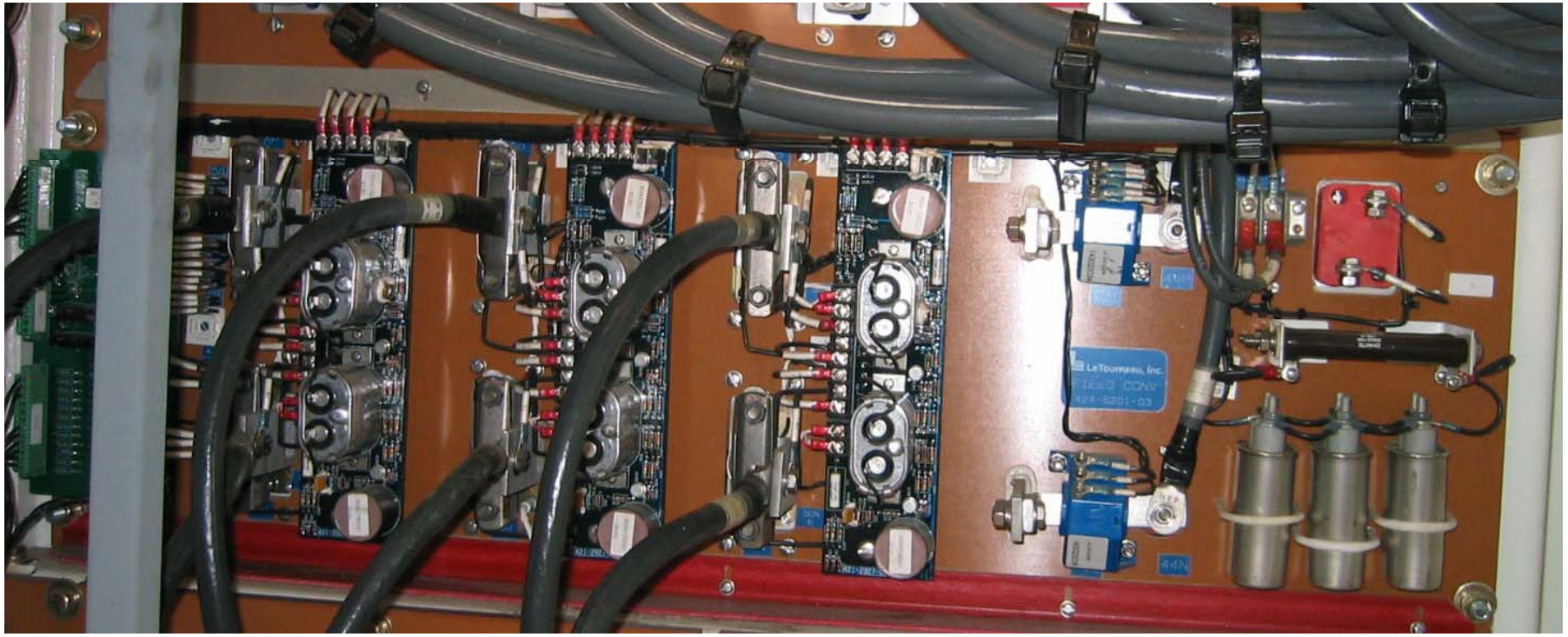






VOLTAGE REGULATOR PANEL

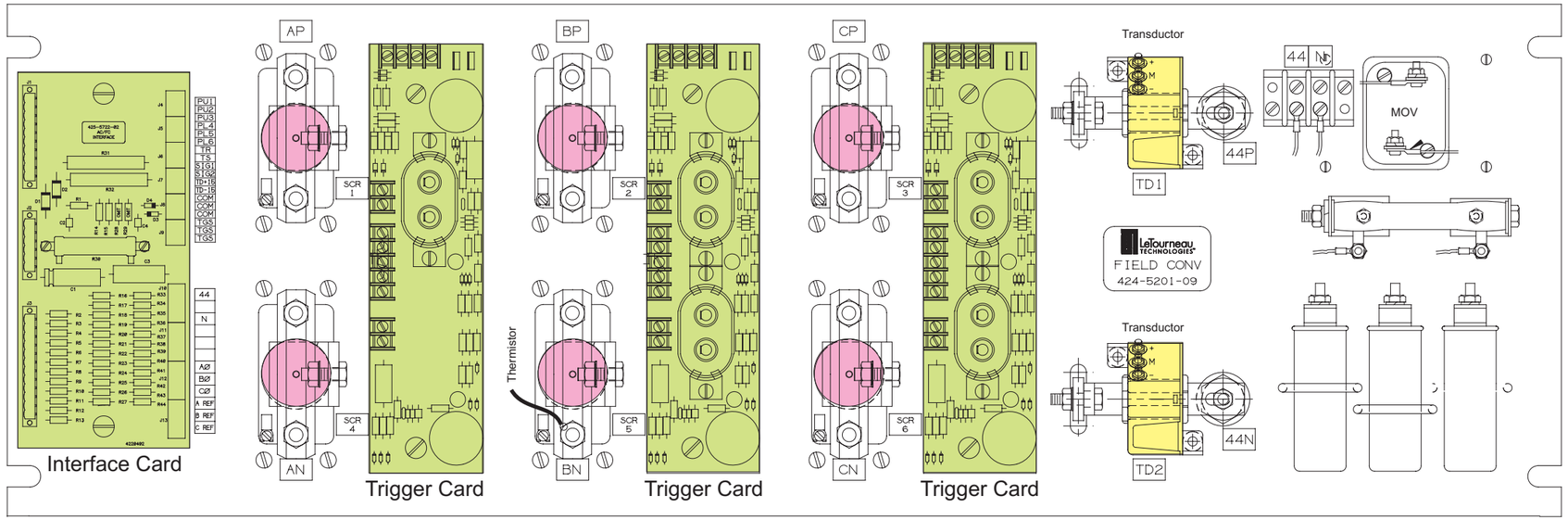
NOTES:

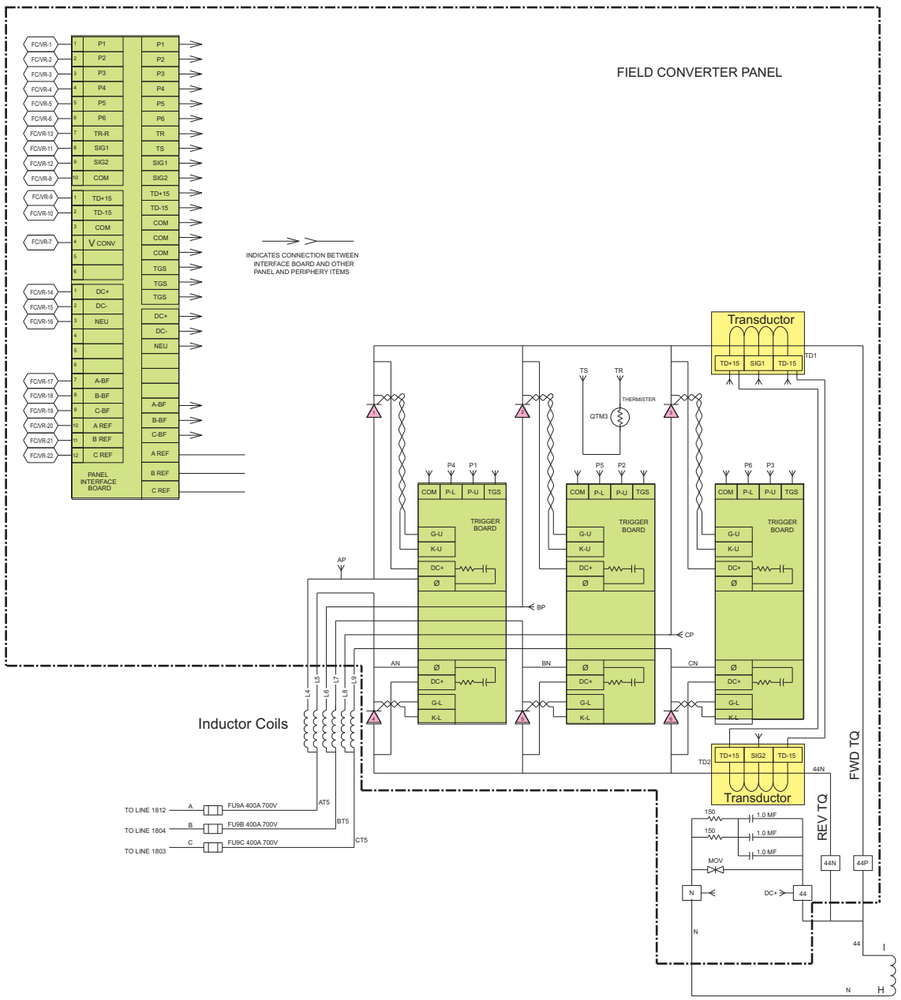


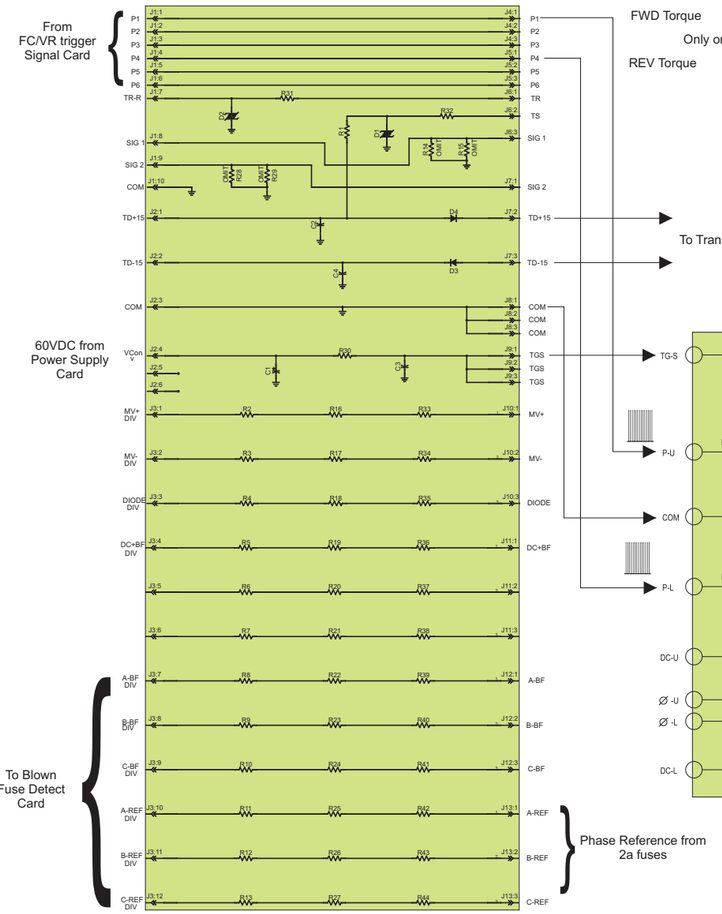
FIELD CONVERTER

Component Descriptions

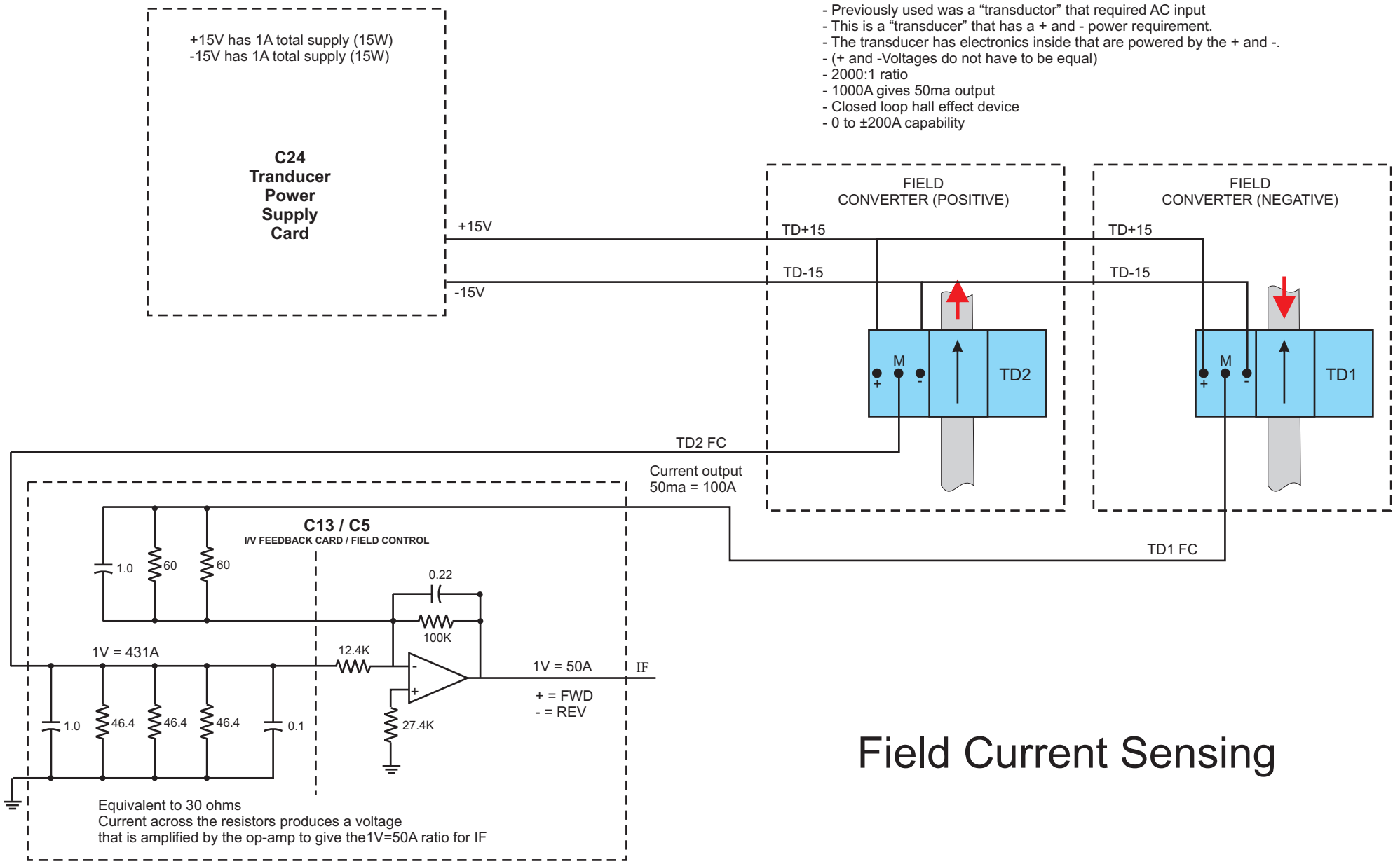
LeTourneau Technologies, Inc.







FIELD CONVERTER PANEL



Field Current Sensing

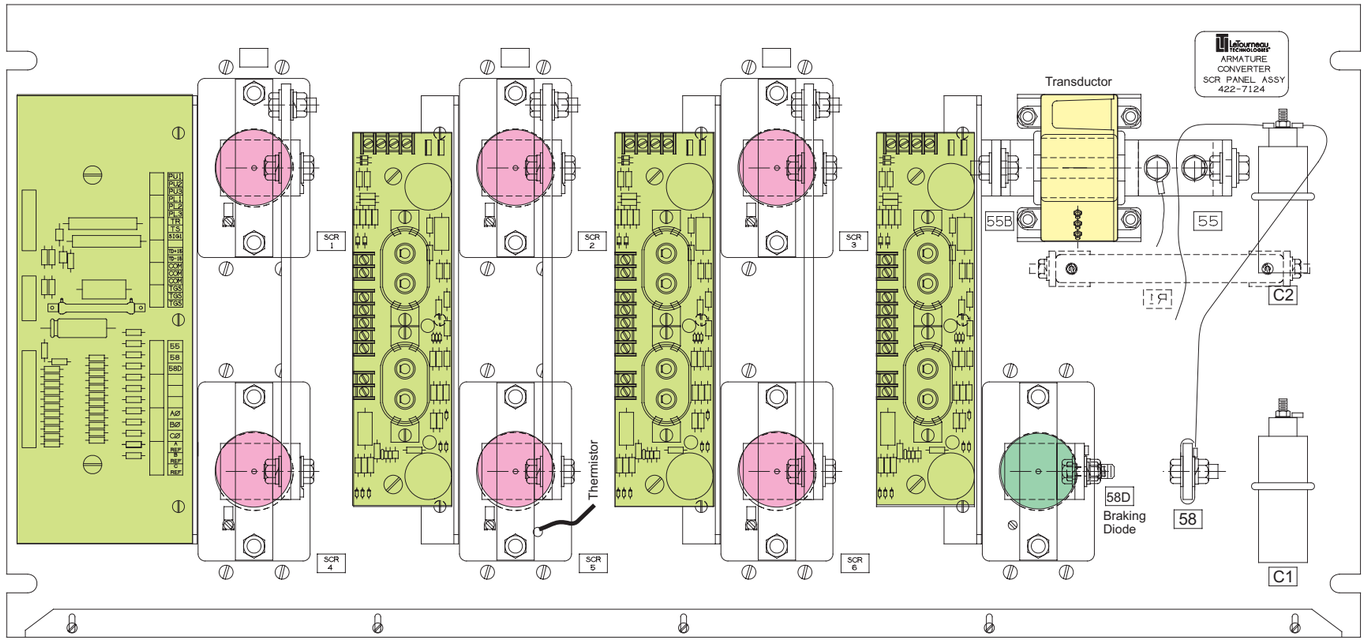
INDUCTOR COILS

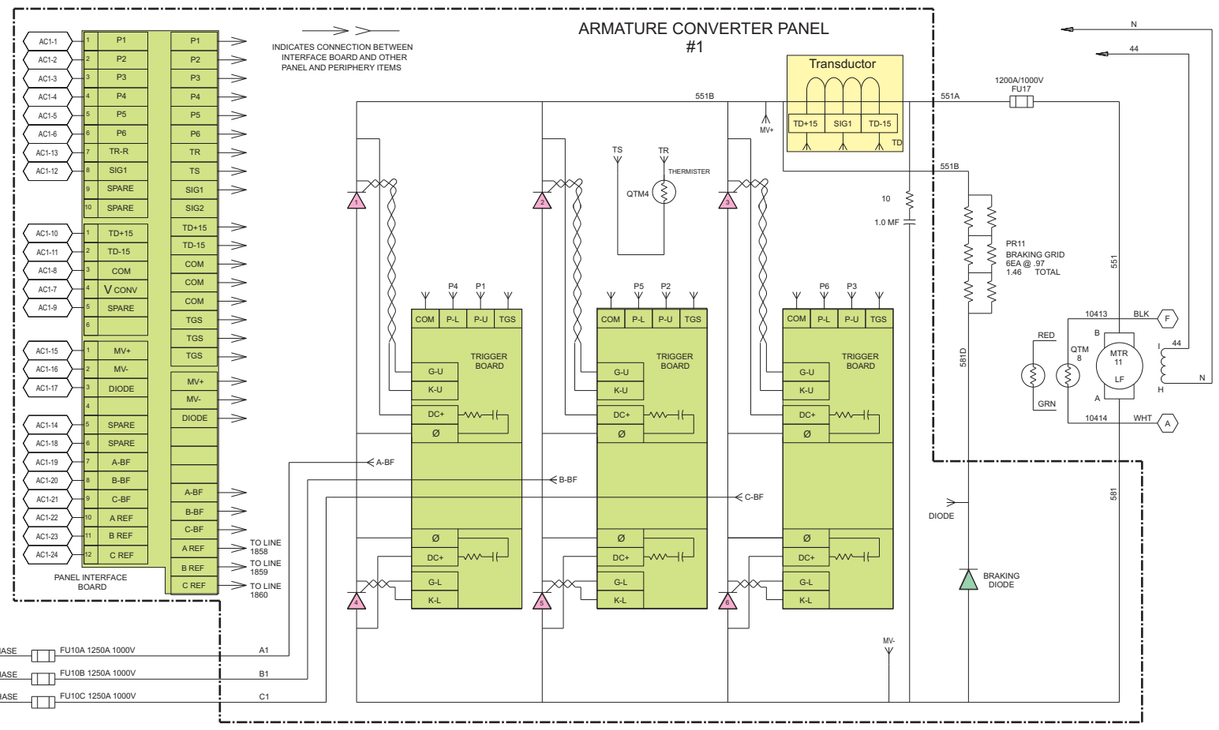
ARMATURE CONVERTER

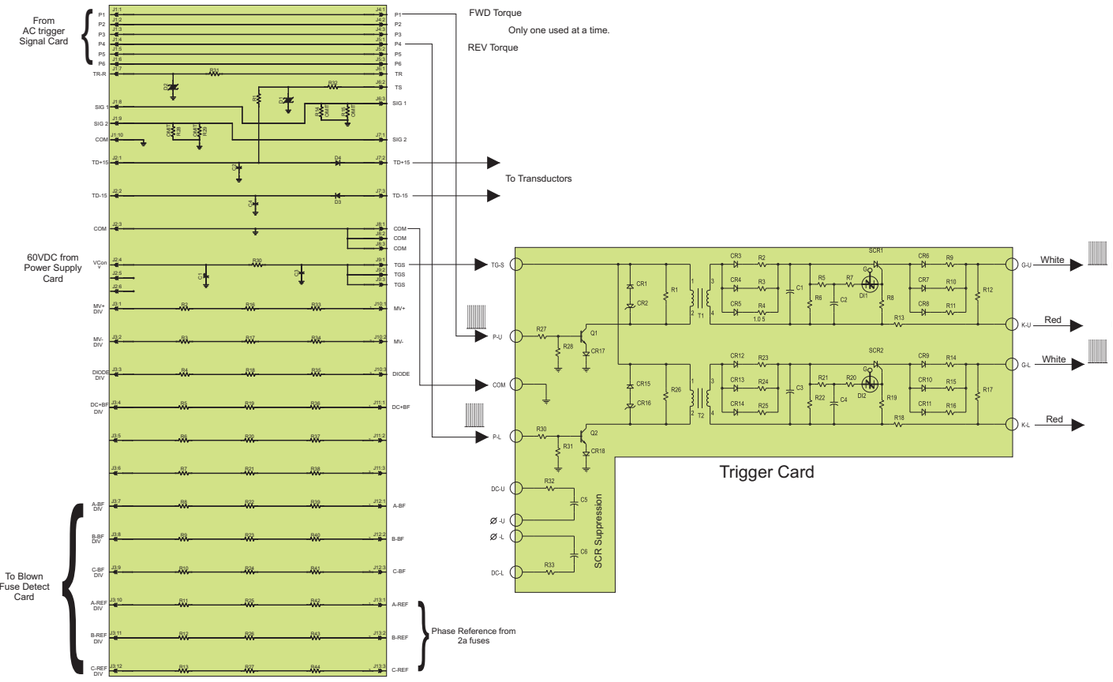
Component Descriptions

LeTourneau Technologies, Inc.

NOTES:







ARMATURE CONVERTER PANEL

- Previously used was a “transductor” that required AC input
- This is a “transducer” that has a + and - power requirement.
- The transducer has electronics inside that are powered by the + and -.
- (+ and -Voltages do not have to be equal)
- 4000:1 ratio
- 1000A gives 250ma output
- Closed loop hall effect device
- 0 to ±2000A capability

+15V has 3A total supply (45W)
-15V has 1A total supply (15W)
(Armature current is only one direction - so most of load is on +15V circuits)

C24 Tranducer Power Supply Card

+15V AC1

AC1 -15V

ARMATURE CONVERTER

TD+15

TD-15

M

+

-

TD AC1

SIG1

Current output
250ma = 1000A

C13 I/V FEEDBACK CARD

-15V

To HP circuit

4.7M

.01

21.5K

1V = 431A

12.4K

1V = 250A

IA1

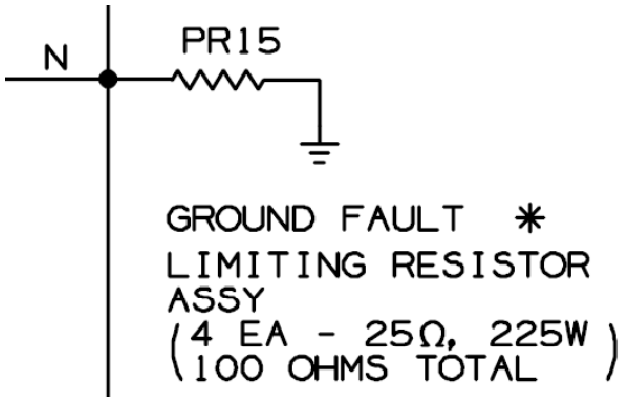
46.4 46.4 46.4 46.4 46.4

4.32K

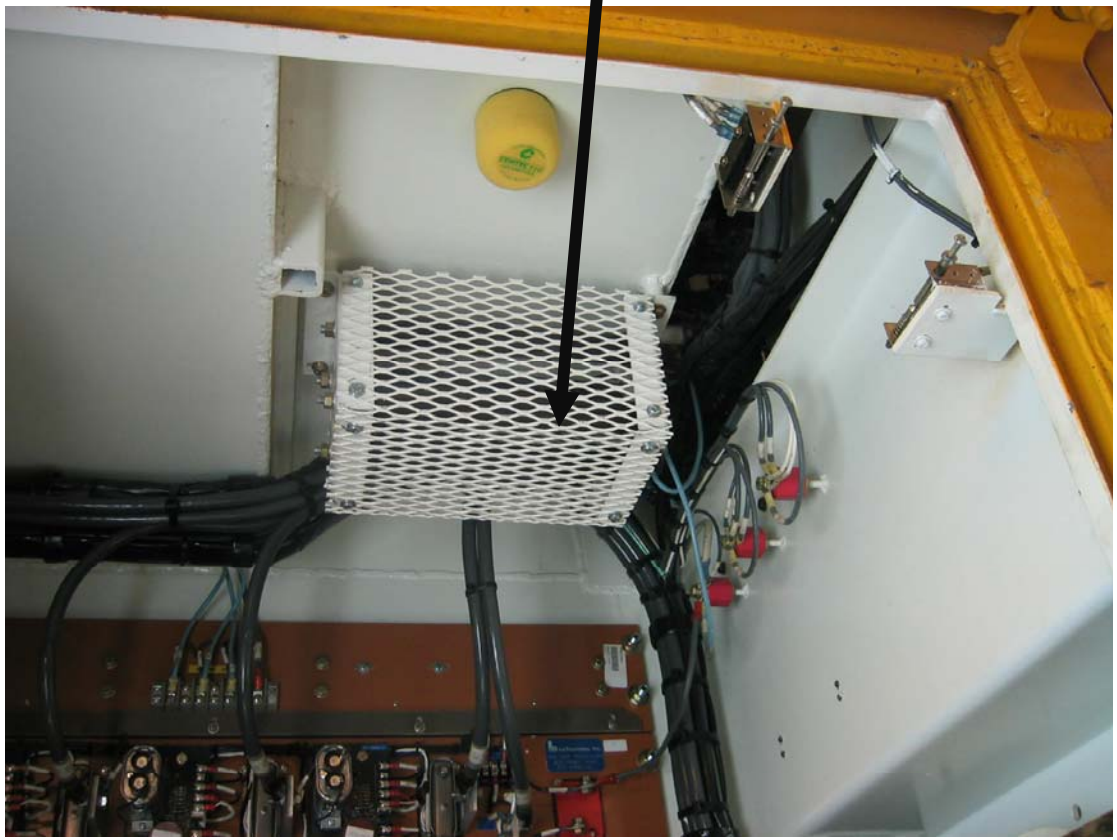
Equivalent to 9.28 ohms
Current across the resistors produces a voltage
that is amplified by the op-amp to give the1V=250A ratio for IA

Armature Current Sensing

BRAKING GRID



Current Limiting Resistors



GROUND FAULT RESISTORS

NOTES:

NOTES:

NOTES:

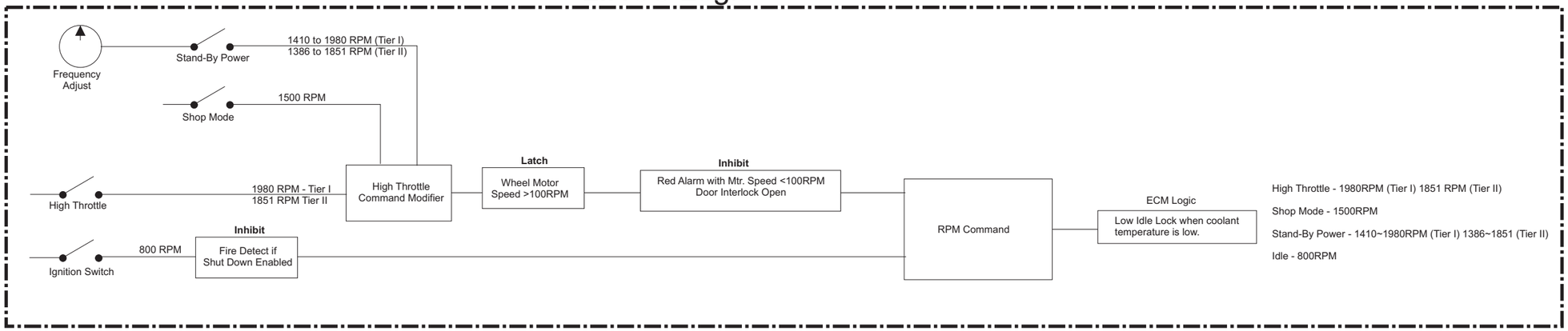
CIRCUIT DESCRIPTIONS

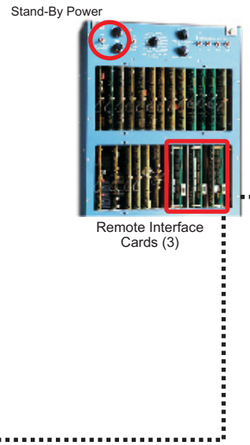
CIRCUIT DESCRIPTIONS

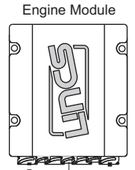
- Engine
- Prime
- Voltage Regulator
- Field Converter
- Armature Converter
- Dynamic Brake Fail
- Ground Fault Detection
- Load Bank Mode
- Stand-By Power

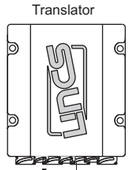
Engine RPM Command - Cummins

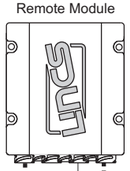
LINCS Logic

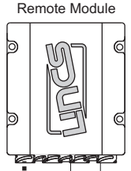


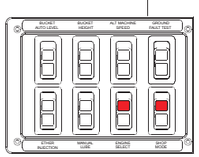


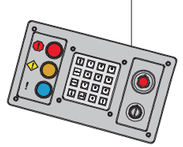


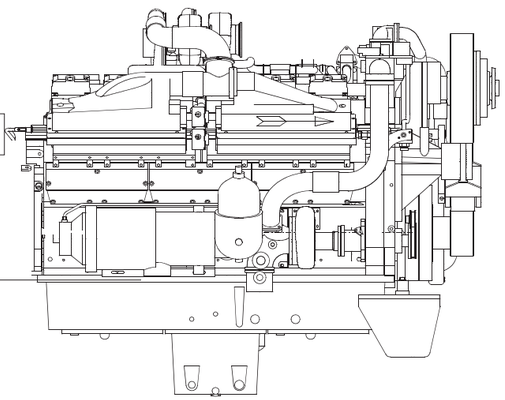








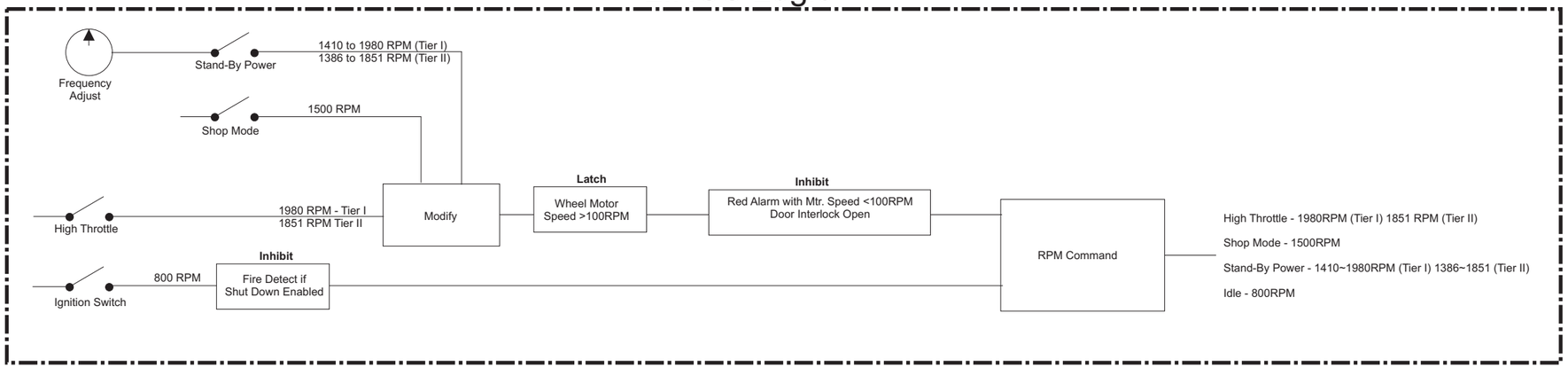




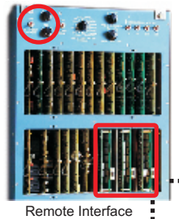
Cummins Engine

Engine RPM Command - Detroit

LINCS Logic

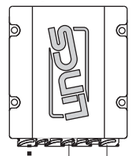


Stand-By Power



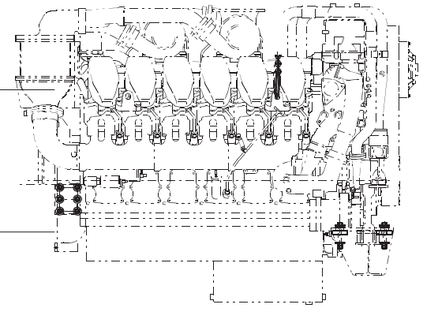
Remote Interface Cards (3)

Engine Module



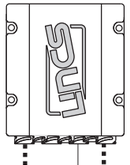
Speed Command - 1hz = 5RPM

Ignition Signal

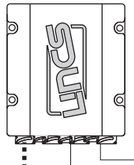


Detroit Engine

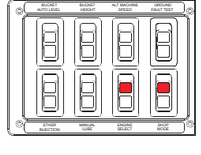
Remote Module

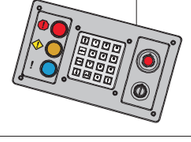


Remote Module



ELECTRICAL CABINET DOOR INTERLOCK SWITCHES





PRIME / VOLTAGE REGULATOR SIGNAL FLOW

Remote Interface Cards (3)

REMOTE INTERFACE CARD RI3-37

REMOTE INTERFACE CARD RI1-1

VCONV6 (60VDC)

24VCD VOLTAGE STABALIZER

C241P

CONTACTS CLOSED WITH LINCS BOOTED

CR 9

3B1

33

36,37 39,40 COM 46 **PS**

24VDC

35,36 2 GROUND FAULT

33 RLY DRIVE

47 VOLTAGE ENABLE

HIGH THROTTLE 16

43,44,45 PRIME OUT

22 VGEN >200 2 **C4**

PRIME INHIBIT 12

NEUTRAL 40 **C20**

RLY 1 — N

RLY 1 P1 P2

J1

J1 INSTALLED IF RLY 1 IS NOT USED

10 OHM CURRENT LIMITING RESISTOR

VCONV 300 OHM 3 - TGS

VOLTAGE REGULATOR PANEL INTERFACE CARD

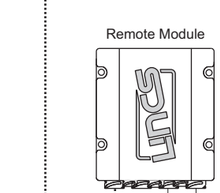
P1 P2 P3

A B C

TRIGGER CARD G K

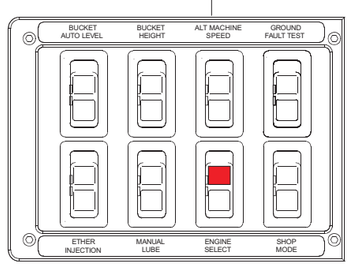
TRIGGER CARD G K

TRIGGER CARD G K



Remote Module

ELECTRICAL CABINET DOOR INTERLOCK SWITCHES



309V

A B C

3Ø AC REFERENCE 37-43 4 28 2 **T1/C8**

VES1-6(2)

VES1-6(2)

VCA

VBC

VAB

4 5 6 VOLTAGE 2 **C4**

9,10,11,15,16,17 FREQUENCY 4 **C1**

VH — RI 2 - 11

VGEN RI 1 -6

ENGINE RPM CMD 29 27 40 **C1**

VHC — RI 2 -6 C4-17

FREQ ADJ

STANDBY SW

STANDBY POWER MODE 43 40 **C1**

Shop Mode 350 VAC Constant

VOLT ADJ

-|VN| 350 to 600VAC

LOAD BANK MODE 700 VAC Constant

45 20 43 8 19 33 GEN VOLT CMD **C4**

VR CMD

VR CONTROL 21 47 2 **C4**

CONTROL

17 11,12,13 14,15,16 **C10** 29 41 40 39 TRIGGER

INHIBIT 38

ENABLE INHIBIT 31 **C4**

REFERENCE

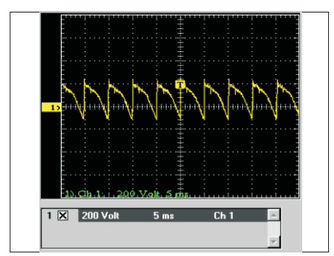
SEE VR STATUS PAGE FOR ALL

VEVR

7 N

GENERATOR SLIP RINGS

GROUND FAULT LIMITING RESISTOR 100 OHM

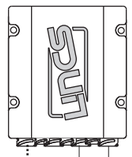


VOLTAGE REGULATOR STATUS

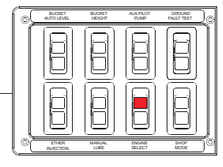
Remote Interface Cards (3)

REMOTE INTERFACE CARD
RI 1
1
HI IDLE

ELECTRICAL CABINET DOOR INTERLOCK SWITCHES



Remote Module



VR THERM
GEN THERM
26
28
C23
40
38
VR THERM
GEN THERM

AØ REF
BØ REF
CØ REF
34
39
44
28
AØ VR
BØ VR
CØ VR
37
42
47
C22
RI 2 - 16
(VR FUSE STATUS)
VR FUSE PROPER

29
28
35
6
5
4
37
20
17
19
C4
VAB
VBC
VCA
31
38
42
27
VEVR
VR INHIBIT
RI 2 - 37
(VR OP ALM)
VGEN > 3.0v

VR/PRIME ENABLE
NEUTRAL
COMMON
16
40
30
8
2
C20
47
6
VOLT ENABLE
|VN| (<1MPH)
RI 3 - 37
(GROUND FAULT)

+15V
PS
7
S6
STD BY SWITCH
43
31
27
3
C1
26
40
29
COM
FREQ ADJ
FREQ ADJ SUP
NOT STANDBY
VHC

#134S ENG SPD
T1 REF
2-4
27-29
C8
38-40
41-43
VES 1-6
2
9-11
15-17
4
C1
VH

VOLTAGE REGULATOR

JUST INHIBIT	INHIBIT and ALM	JUST ALM
LOW THROTTLE	*GROUND FAULT (<1MPH)	VGEN < 3.0
	VH NOT PROPER STBY MODE ONLY	VR PANEL TEMP HIGH
		GENERATOR TEMP HIGH
		BLOWN VR FUSE

CARD	COMMON
POWER SUPPLY	PIN # 47
C1	PIN # 30
C4	PIN # 30
C8	PIN # 30
C20	PIN # 30
C22	PIN # 30
C23	PIN # 45

LINCS

Accelerator Pedal

Direction Select

Brake Boost

LF Speed Sensor

RF Speed Sensor

Inhibit

Red Warning Active
Park Brake Set - unless Load Bank
Fire Detected
Ladder Down

Limit

Service Brakes Applied
10psi to 50psi. >50psi full limit

VAW

FWD

REV

Operators Commanded Speed and Direction

Inhibit

Speed Sensor Failure (>4mph)
No Direction Selected
Ground Fault Active

{ + = FWD
- = REV } VA

{ - = FWD
+ = REV } -VN

Actual Speed
Multiply by 4

Difference between Commanded and Actual (ERROR)

{ - = FWD TQ
+ = REV TQ } VE POL

{AMOUNT} -|VE|

Field

Inhibit

Load Bank Mode
Low VGEN (120VAC)
Blown FC Fuse

Limit

Motor Voltage
Motor Speed (Field Shaping)
Field Conv Temp
Operating Wheel Motor Switches

Boost

Brake Boost Switch

VIF

Armature

All Four Armatures

Inhibit

Power Supply Not Proper
Park Brake Set unless Load Bank
Open Card Interlock
Low VGEN (120vac)

Limit

Gen/VR Temp
Low VGEN (300)
VHL
HP Limit
IF Proper (yes or no)

Front or Rear Armatures

Front Motor Limits

Front Torque Adjust Pot

VIAF

Rear Motor Limits

Rear Torque Adjust Pot

VIAR

Individual Armatures

AC 1 Inhibit

Blown AC/DC Fuse

AC 1 Limit

Motor / AC Conv Temp
Slip Limit

VIA 1

AC 2 Inhibit

Blown AC/DC Fuse

AC 2 Limit

Motor / AC Conv Temp
Slip Limit

VIA 2

AC 3 Inhibit

Blown AC/DC Fuse

AC 3 Limit

Motor / AC Conv Temp
Slip Limit

VIA 3

AC 4 Inhibit

Blown AC/DC Fuse

AC 4 Limit

Motor / AC Conv Temp
Slip Limit

VIA 4

Controller Signals

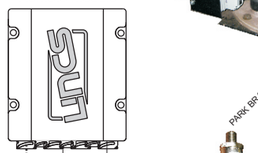
VAW	0 to 10v
FWD	0 to 24v
REV	0 to 24v
VA	0 to 12v (+ = FWD) (- = REV)
-VN	0 TO 4.6V (+ = REV) (- =FWD)
VE POL	(- =FWD TQ) (+ = REV TQ)
-|VE|	0 TO 6.9V
VIF	0 TO 5V (1V = 50 AMPS)
VIAF	0 TO 4.2V / 5V (1V = 250AMPS)
VIAR	0 TO 4.2V / 5V (1V = 250AMPS)
VIA1	0 TO 4.2V / 5V (1V = 250AMPS)
VIA2	0 TO 4.2V / 5V (1V = 250AMPS)
VIA3	0 TO 4.2V / 5V (1V = 250AMPS)
VIA4	0 TO 4.2V / 5V (1V = 250AMPS)

FIELD CONVERTER SIGNAL FLOW

Remote Interface Cards (3)

Remote Module

Remote Module



PARK BRAKE PSI FRONT
SERVICE BRAKE PSI REAR
PARK BRAKE PSI FRONT
SERVICE BRAKE PSI REAR

REMOTE INTERFACE CARD RI 2 (32, 1, 2)
REMOTE INTERFACE CARD RI 1 (17)

VAW
FWD
REV
SPEED SENSE 1
SPEED SENSE 2
DYN BRK BOOST

1. GROUND FAULT
2. FWD/REV NOT SELECTED
3. SPEED SENSOR FAILURE (>4MPH)

DIRECTION & SPEED COMMAN C2
CLAMP VA
VA
SPEE SIGNAL C9
-VN
ERROR C2
VE POS(POLARITY)
|-VE|
VN MULTIPLY C2

Vm1
Vm2
Vm3
Vm4
VM C3/C5
POWER MODE
FIELD RAMP C7
|VN|
FC TEMP
MTR VOLT LIM 550V 520/420V BRAKING C5
SET MOTOR VOLTAGE C5
FIELD SHAPING C5
OVER TEMPERATURE C23
FL
FIELD CURRENT LIMIT C5
VLFC
CMD MOTOR VOLTAGE C5
OPERATING MOTORS SWITCHES
DYN BRK BOOST
FIELD CURRENT CMD C5
VIF
FIELD COMMAND (SELECT SMALLER) C5
FIELD CONTROL C5
VE POS
IF
INHIBIT CMD C5
FIELD CURREN C13/C5
FIELD CURRENT 1
FIELD CURRENT 2
FIELD PROPER C5
IF PROPER
USED IN ARMATURE COMMAND LOGIC

309V A B C
3Ø AC REFERENCE T1/C8

SEE FC STATUS PAGE FOR INHIBIT LOGIC
VEFC
ENABLE INHIBIT C5
INHIBIT 1
INHIBIT 2
TRIGGER C10
PA 1
PA 2
PA 3
PB 4
PB 5
PB 6

FIELD CONVERTER PANEL INTERFACE CARD
P1
P2
P3
P4
P5
P6
TGS
300 OHM

24VCD
VOLTAGE STABALIZER
C241P
CONTACTS CLOSED WITH LINCS BOOTED
CR 9
3B1
36,37
32
COM 46
PS
VCONV5 (60VDC)

TGS
P1 PU TRIG CARD#1
P2 PU TRIG CARD#2
P3 PU TRIG CARD#3
P4 PL TRIG CARD#1
P5 PL TRIG CARD#2
P6 PL TRIG CARD#3

A
B
C
44P
44N
44

FWD TQ
REV TQ
N

LF MOTOR #1
RF MOTOR #2
LR MOTOR #3
RR MOTOR #4

FIELD CONVERTER STATUS

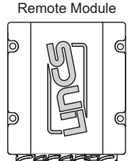
FIELD CONVERTER

JUST INHIBIT	INHIBIT and ALM	JUST ALM
LOAD BANK MODE	BLOWN FC FUSE	FC PANEL TEMP HIGH
	VGEN < 3.0	

Remote Interface Cards (3)

REMOTE INTERFACE CARD
RI 3

Remote Module



PARK BRAKE PSI FRONT

PARK BRAKE PSI REAR

FC THERM → 30 C23 39 → FC TEMP

AØ REF → 34
AØ FC1 → 35
BØ REF → 39
BØ FC1 → 40
CØ REF → 44
CØ FC1 → 45
C22
26 → RI 2 - 15 (FC FUSE STATUS)
FC FUSE PROPER → 9

+15V → 7 PS → S7 → LOAD BANK SWITCH → 7

24
37 → VEFC
47 → RI 1 - 37 (FC OP ALM)
8 → LOAD BANK MODE RI 3 - 35 (LOAD BNK MODE)
3 10 C5

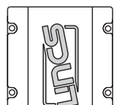
PARK BRAKE REL → 10

VCA → 4
VBC → 5
VAB → 6
C4
27 → VGEN >3.0 → 3

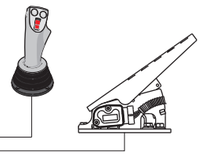
CARD	COMMON
POWER SUPPLY	PIN # 47
C4	PIN # 30
C5	PIN # 30
C22	PIN # 30
C23	PIN # 45

ARMATURE CONVERTER SIGNAL FLOW

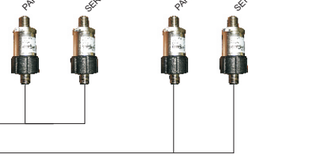
Remote Interface Cards (3)



Remote Module



Remote Module



Steering Position Sensor

1. GROUND FAULT
2. FWD/REV NOT SELECTED
3. SPEED SENSOR FAILURE (>4MPH)

DIRECTION & SPEED COMMAND C2
CLAMP VA
VA
ERROR C2
VE POS(POLARITY)
|-VE|
SIGNA C9
-VN
VN MULTIPLY C2
SLIP BIAS C3
OPERATING MOTORS SWITCHES
+6 C2

REMOTE INTERFACE CARD RI 2 (32, 1, 2)
REMOTE INTERFACE CARD RI 1 (17, 33)
VAW
FWD
REV
SPEED SENSE 1
SPEED SENSE 2
DYN BRK BOOST
STEER POT POS

VM C3/C5
POWER MODE
FIELD RAMP C7
309V A B C
3Ø AC REFERENCE T1/C8

VR TEMP
GEN TEMP
OVER TEMPERATURE C23/C4
HP LIMIT C13
VGEN
VGEN LIMIT C6
VH
< 63.0 or >68.0 (Tier I)
< 59.7 or >62.5 (Tier II)
VHL C1
FRONT REDUCTION
FRONT TORQUE ADJUST
|VN|
MOTOR SHAPE C2
POWER MODE
BRAKE MODE
ACCELERATION LIMIT C2
AVERAGE CEMF C3
SLIP LIMIT C3
OVER TEMPERATURE C23
AC1
M1
V_{M1}
$-I_{A1}$
CEMF C3
V_{M2}
$-I_{A2}$
AC2
M2
REAR REDUCTION
REAR TORQUE ADJUST
V_{M3}
$-I_{A3}$
AC3
M3 TEMP
V_{M4}
$-I_{A4}$
AC4
M4 TEMP
CEMF 3 C3

VE POS
IF
FIELD CURRENT C13/C5
FLD CURRENT 1
FLD CURRENT 2
IF PROPER
FIELD PROPER C5
IF

FRONT ARMATURE COMMAND (SELECT SMALLEST) C6
IF PROPER
6 - VCLF
6 - |VE|
HP LMT

REAR ARMATURE COMMAND (SELECT SMALLEST) C6
IF PROPER
6 - VCLR
6 - [VE]
HP LMT

OVERALL ARM CONV 1 COMMAND C6
OVERALL ARM CONV 2 COMMAND C6
OVERALL ARM CONV 3 COMMAND C6
OVERALL ARM CONV 4 COMMAND C6
GEN & VR TEMP
LOW VGEN
V_{HL}
-VIAF
SLIP LIMIT
TEMP

VIA1
VIA2
VIA3
VIA4
RAMP VIA1 C7
RAMP VIA2 C7
RAMP VIA3 C7
RAMP VIA4 C7

SEE AC STATUS PAGE FOR INHIBITS

ARM 1 VOLTAGE C13
ARM 2 VOLTAGE C13
ARM 3 VOLTAGE C13
ARM 4 VOLTAGE C13
Vm1
Vm2
Vm3
Vm4

VEAC1
VEAC2
VEAC3
VEAC4
ENABLE INHIBIT C7
INHIBIT
REFERENCE
CONTROL
CONTROL C7
TRIGGER C11(A)
TRIGGER C11(B)
TRIGGER
ARM 1 CURRENT C13
ARM 2 CURRENT C13
ARM 3 CURRENT C13
ARM 4 CURRENT C13
$-I_{A1}$
$-I_{A2}$
$-I_{A3}$
$-I_{A4}$
MOTOR 1 ARMATURE
MOTOR 2 ARMATURE
MOTOR 3 ARMATURE
MOTOR 4 ARMATURE

ARMATURE 3Ø REFERENCE C8

TRIGGER CARDS
TGS
P1 PU PL SCR #1
P4 PU PL SCR #4
P2 PU PL SCR #2
P5 PU PL SCR #5
P3 PU PL SCR #3
P6 PU PL SCR #6

ARM 1 CONVERTER PANEL INTERFACE CARD
VCONV 1
P1A
P4B
P2A
P5B
P3A
P6B

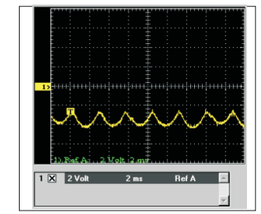
ARM 2 CONVERTER PANEL INTERFACE CARD
VCONV 2
P1C
P4D
P2C
P5D
P3C
P6D

ARM 3 CONVERTER PANEL INTERFACE CARD
VCONV 3

ARM 4 CONVERTER PANEL INTERFACE CARD
VCONV 4

ARMATURE CONVERTER PANEL
TO M1
TO M2
TO M3
TO M4

CONTACTS CLOSED WITH LINCS BOOTED
24VCD
VOLTAGE STABALIZER
C241P
CR 9
3B1
36,37
COM
46
PS
28
29
30
31
VCONV1 (60VDC)
VCONV2 (60VDC)
VCONV3 (60VDC)
VCONV4 (60VDC)



ARMATURE CONVERTER STATUS

M1 THERM — 5
AC1 THERM — 2
M2 THERM — 11
AC2 THERM — 8
M3 THERM — 17
AC3 THERM — 14
M4 THERM — 23
AC4 THERM — 20
C23

33 — M1 TEMP
44 — AC1 TEMP
34 — M2 TEMP
43 — AC2 TEMP
35 — M3 TEMP
42 — AC3 TEMP
36 — M4 TEMP
41 — AC4 TEMP

29 — M1 TEMP
30 — AC1 TEMP
31 — M2 TEMP
32 — AC2 TEMP
33 — M3 TEMP
34 — AC3 TEMP
35 — M4 TEMP
36 — AC4 TEMP
C21

37 — AC1/M1 TEMP
38 — AC2/M2 TEMP
39 — AC3/M3 TEMP
40 — AC4/M4 TEMP

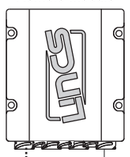
ARMATURE CONVERTER

JUST INHIBIT	INHIBIT and ALM	JUST ALM
	BLOWN AC/DC FUSE	AC TEMP HIGH
	P.S. NOT PROPER	MOTOR TEMP HIGH
	PARK BRK. SET UNLESS L.B. MODE	
	OPEN INTERLOCK	
	VGEN < 3.0	

Remote Interface Cards (3)

REMOTE INTERFACE CARD 1 — RI 3

Remote Module



INTERLOCK 22 C13
VGEN >3.0V 27 C4 2 — VGEN (RI 1 - 6)
POWER SUPP PROPER 1 PS
PARK BRAKE REL
+15V PS 7 — S7 — LOAD BANK SWITCH — 7 3 C5 8 — LOAD BANK MODE — RI 3 - 35

46
43
47
45
24 C6
COMMON ENABLE

AC1 2 / 42 / 29 / 44 — ARM 1 — RI 1 - 34 (AC 1 OP ALM)
AC2 1 / 41 / 28 / 40 — ARM 2 — RI 1 - 36 (AC 2 OP ALM)
AC3 33 / 38 / 27 / 39 — ARM 3 — RI 3 - 34 (AC 3 OP ALM)
AC4 34 / 37 / 26 / 36 — ARM 4 — RI 3 - 36 (AC 4 OP ALM)
C6

A REF 13
AF1 9
AF2 10
AF3 11
AF4 12
B REF 15
BF1 16
BF2 17
BF3 18
BF4 19
C REF 25
CF1 21
CF2 22
CF3 23
CF4 24
VM1 42
VM2 41
VM3 45
VM4 43
C21

5 — RI 1 - 15 (AC 1 FU PROP) — AC1 FUSE PROPER
4 — RI 1 - 16 (AC 2 FU PROP) — AC2 FUSE PROPER
3 — RI 3 - 15 (AC 3 FU PROP) — AC3 FUSE PROPER
2 — RI 3 - 16 (AC 4 FU PROP) — AC4 FUSE PROPER

>700VDC = BLOWN DC FUSE

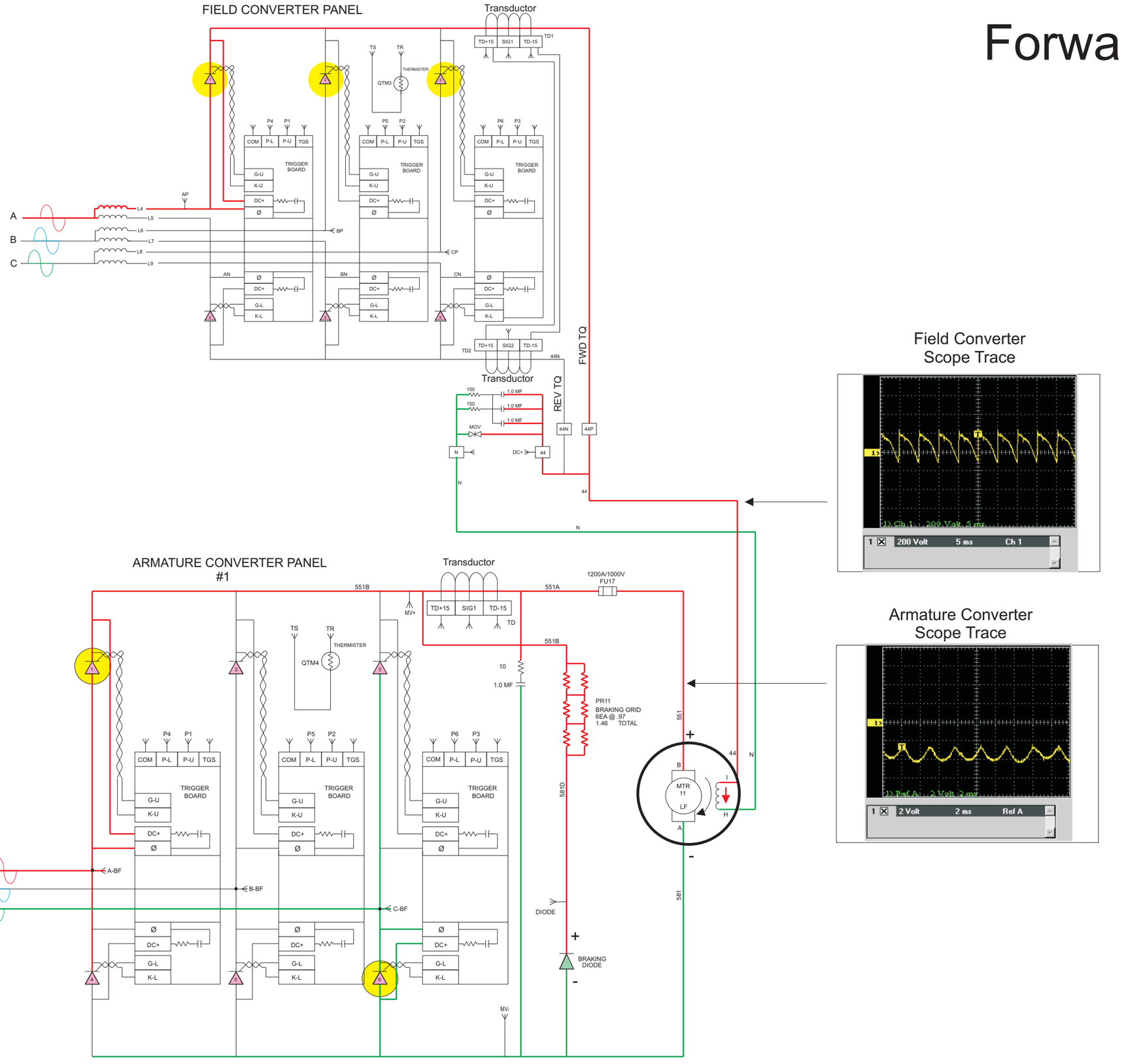
Vm1 (RI 2 -3)
Vm2 (RI 2 -4)
Vm3 (RI 3 -3)
Vm4 (RI 3 -4)

VEAC1 — 5
VEAC2 — 10
VEAC3 — 32
VEAC4 — 44

C7 AC Control
7 — AC1 INHIBIT
17 — AC2 INHIBIT
29 — AC3 INHIBIT
45 — AC4 INHIBIT

CARD	COMMON
POWER SUPPLY	PIN # 47
C4	PIN # 30
C5	PIN # 30
C6	PIN # 30
C13	PIN # 30
C21	PIN # 7
C23	PIN # 45
C24	PIN # 30

Forward Propel



Field Converter
Scope Trace

Armature Converter
Scope Trace

Forward Braking

FIELD CONVERTER PANEL

Transductor

TD1 TD+15 SIG1 TD-15

TS TR THERMISTER QTM3

P4 P1 P5 P2 P6 P3

COM P-L P-U TGS

TRIGGER BOARD

G-U K-U DC+ Ø G-L K-L

AP BP CP AN BN CN

A B C

L4 L5 L6 L7 L8 L9

TD2 TD+15 SIG2 TD-15

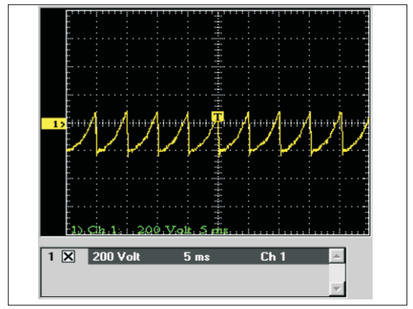
Transductor

150 1.0 MF MOV

N DC+ 44 44N 44P

FWD TQ REV TQ

Field Converter
Scope Trace



ARMATURE CONVERTER PANEL
#1

Transductor

TD+15 SIG1 TD-15 TD

MV+ MV-

551B 551A 1200A/1000V FU17

TS TR THERMISTER QTM4

10 1.0 MF

PR11
BRAKING GRID
6EA @ .97
1.46 TOTAL

551 581 581D

MTR 11 LF

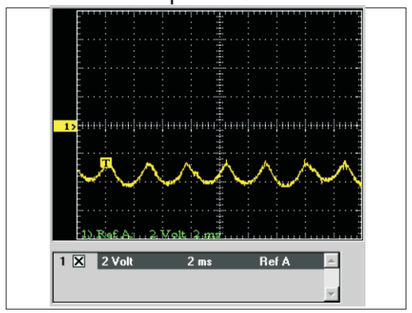
B I H A

44 N

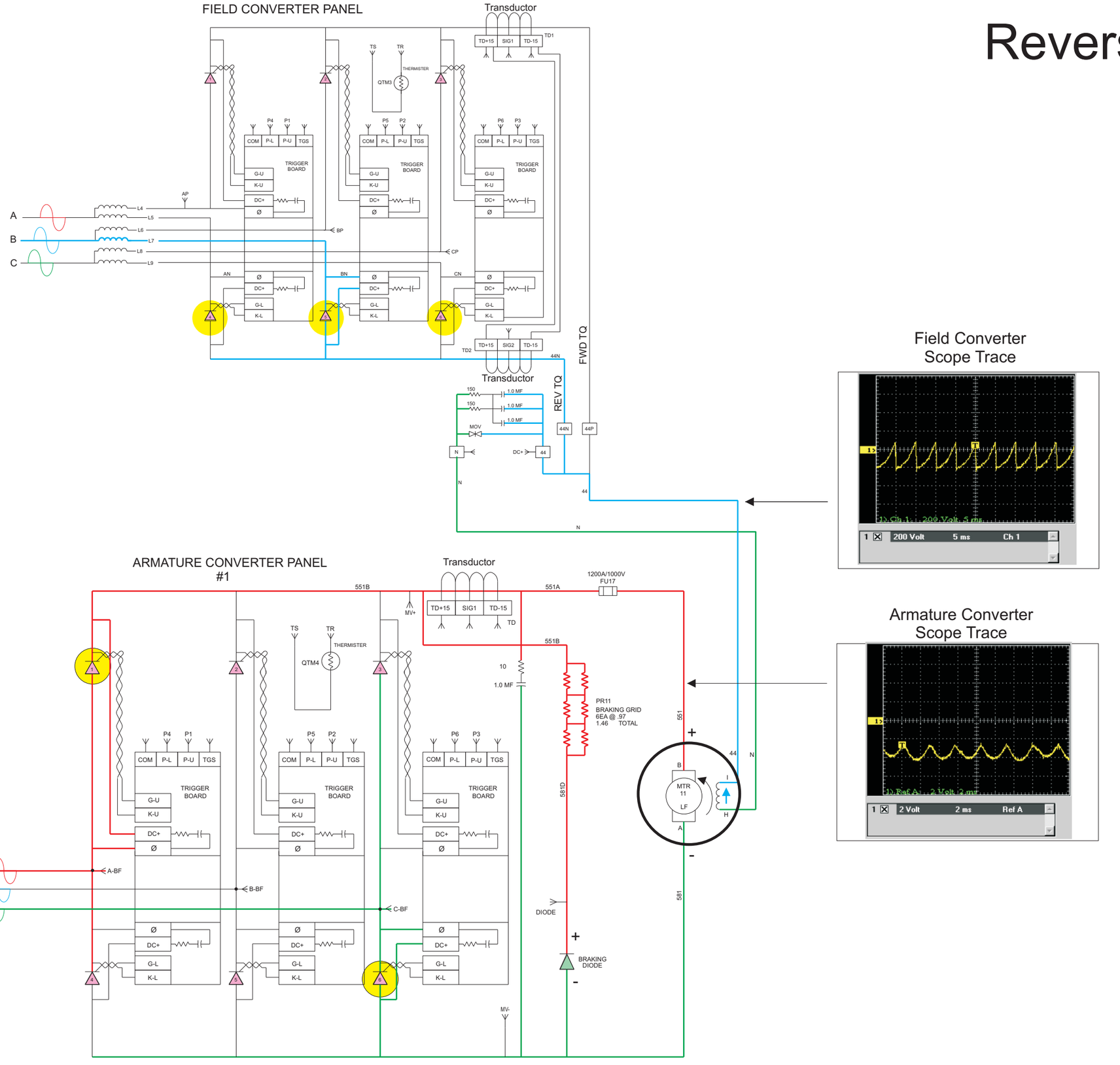
DIODE BRAKING DIODE

A B C A-BF B-BF C-BF

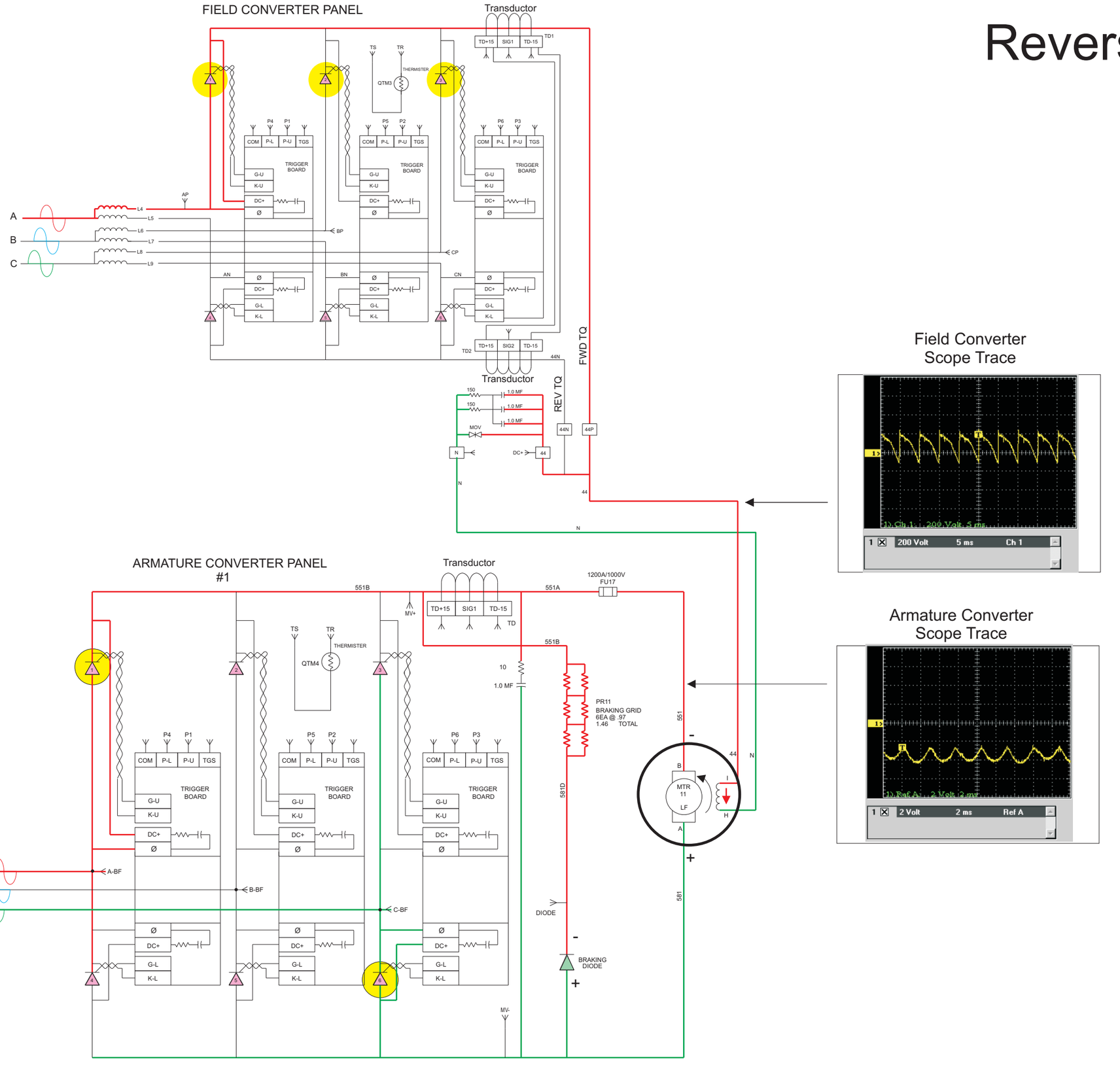
Armature Converter
Scope Trace



Reverse Propel

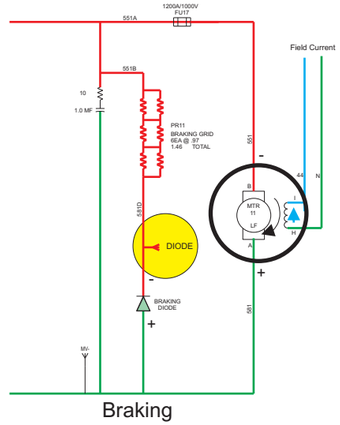


Reverse Braking

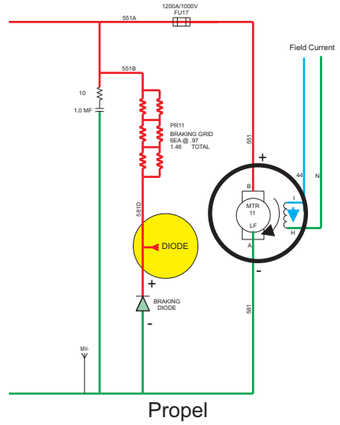


DYNAMIC BRAKE FAIL

DIODE wire must be positive to be good.



Braking



Propel

AC1 PANEL DIVIDER CARD 4 MV1+
AC1 PANEL DIVIDER CARD 5 MV1-
AC2 PANEL DIVIDER CARD 4 MV2+
AC2 PANEL DIVIDER CARD 5 MV2-
AC3 PANEL DIVIDER CARD 4 MV3+
AC3 PANEL DIVIDER CARD 5 MV3-
AC4 PANEL DIVIDER CARD 4 MV4+
AC4 PANEL DIVIDER CARD 5 MV4-

MV1+ → 16
MV1- → 18
MV2+ → 24
MV2- → 26
MV3+ → 20
MV3- → 21
MV4+ → 35
MV4- → 29

C13: 19 → VM1, 27 → VM2, 28 → VM3, 14 → VM4

VM1 → C3 6
VM2 → C3 7
VM3 → C3 10
VM4 → C3 11

C3 13 → BRK MODE → C22 18

AC1 PANEL DIVIDER CARD 6 → V581D → C22 2
AC2 PANEL DIVIDER CARD 6 → V582D → C22 4
AC3 PANEL DIVIDER CARD 6 → V583D → C22 6
AC4 PANEL DIVIDER CARD 6 → V584D → C22 8

C3 13 → |VM| GREAT → C22 18

C22 29 → RI 2 - 35 (RTD FAIL)

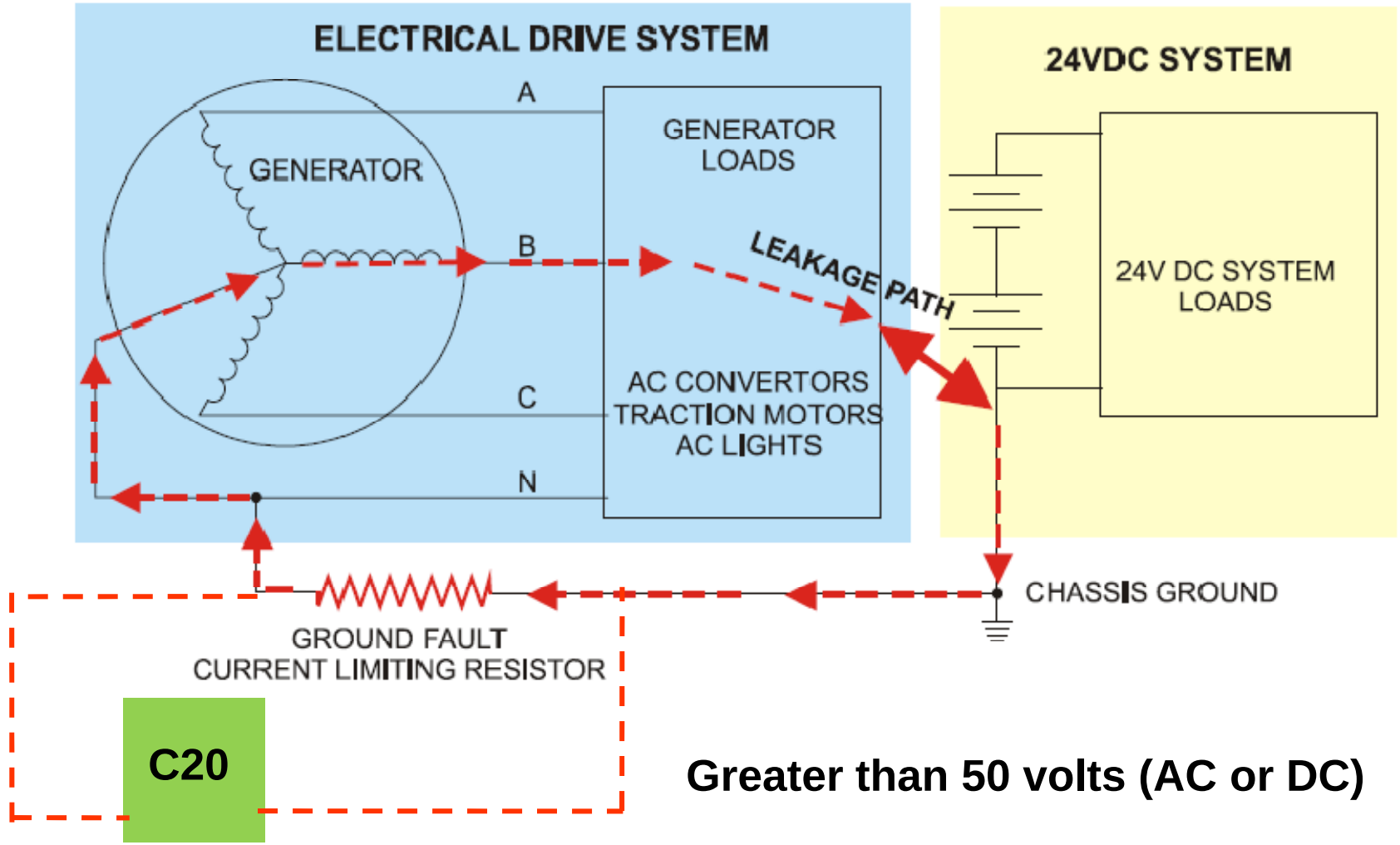
C22 11 12 13 14 ← BIAS 1, BIAS 2, BIAS 3, BIAS 4

C3 16 → SW SUPPLY → OPER. MOTOR SWITCHES S1, S2, S3, S4

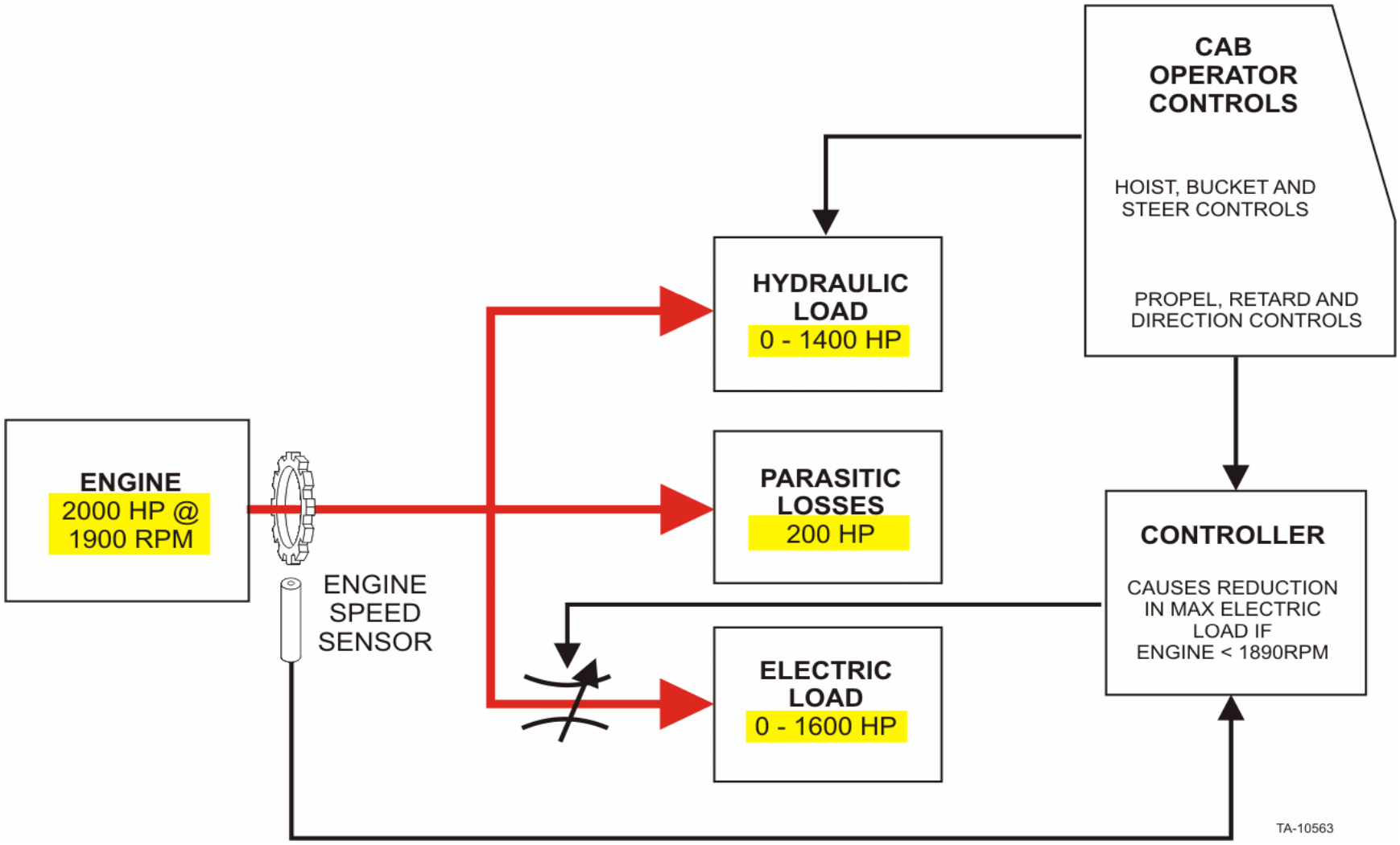
PROPULSION = OPEN GRID OR SHORTED BRAKING DIODE

BRAKING = OPEN BRAKING DIODE

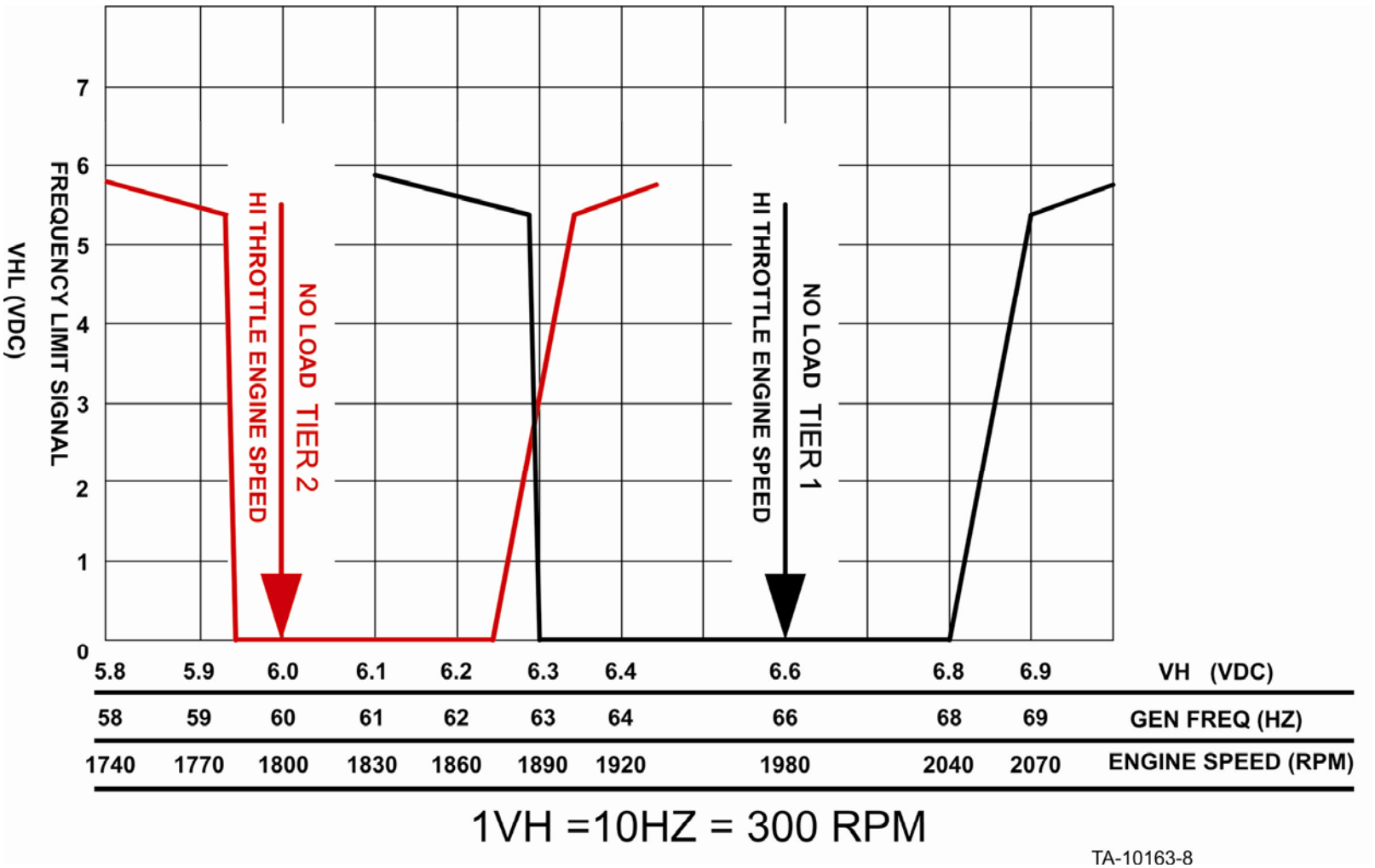
Ground Fault Detection



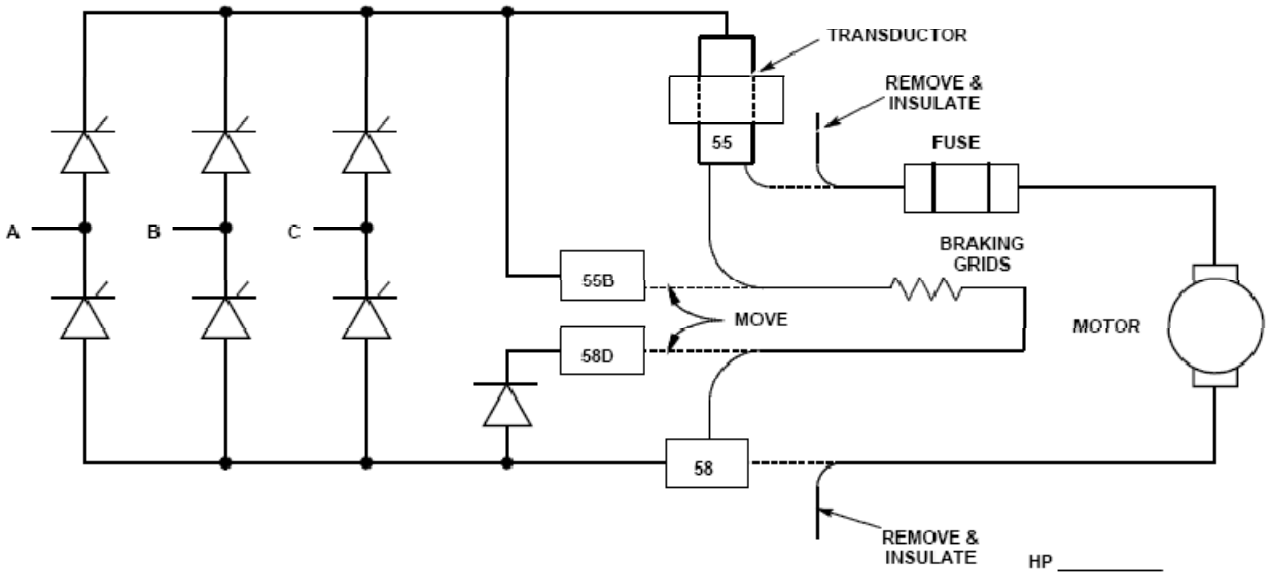
Greater than 50 volts (AC or DC)



POWER SHARING


VHL (VDC)
FREQUENCY LIMIT SIGNAL
0
1
2
3
4
5
6
7
HI THROTTLE ENGINE SPEED
NO LOAD TIER 2
HI THROTTLE ENGINE SPEED
NO LOAD TIER 1
5.8 5.9 6.0 6.1 6.2 6.3 6.4 6.6 6.8 6.9 VH (VDC)
58 59 60 61 62 63 64 66 68 69 GEN FREQ (HZ)
1740 1770 1800 1830 1860 1890 1920 1980 2040 2070 ENGINE SPEED (RPM)
1VH =10HZ = 300 RPM
TA-10163-8

VHL CURVE



TESTER READINGS

HP _____

VH _____ (6.3 – 63 Hz Approx.)

VHL _____ (must be greater than zero)

VGEN _____(L-1350 - ~550-VAC) (L-1850/L-2350 - ~700-VAC)

Grid HP = _____

Calculation of HP using IA and VM:

IA1 _____ X VM1 _____ = _____Watts

IA2 _____ X VM2 _____ = _____Watts

IA3 _____ X VM3 _____ = _____Watts

IA4 _____ X VM4 _____ = _____Watts

_____Watts Total

Grid HP = (_____Watts) X (1.06 Form Factor) / 746 = _____Estimated (Grid) HP

L-1350/L-2350 Engine HP = (_____Grid HP) X (1.05 efficiency) + (parasitics) = _____

Estimated parasitics: _____

HI Fan Speed (L-1350 -360 HP) (L-1850/L-2350-380 HP)

LOAD BANK MODE

Voltage Adjustment - 300 to 500vac (L-1350)

300 to 600vac (L-1850/2350)

Frequency Adjustment - 47hz to 66hz Tier I

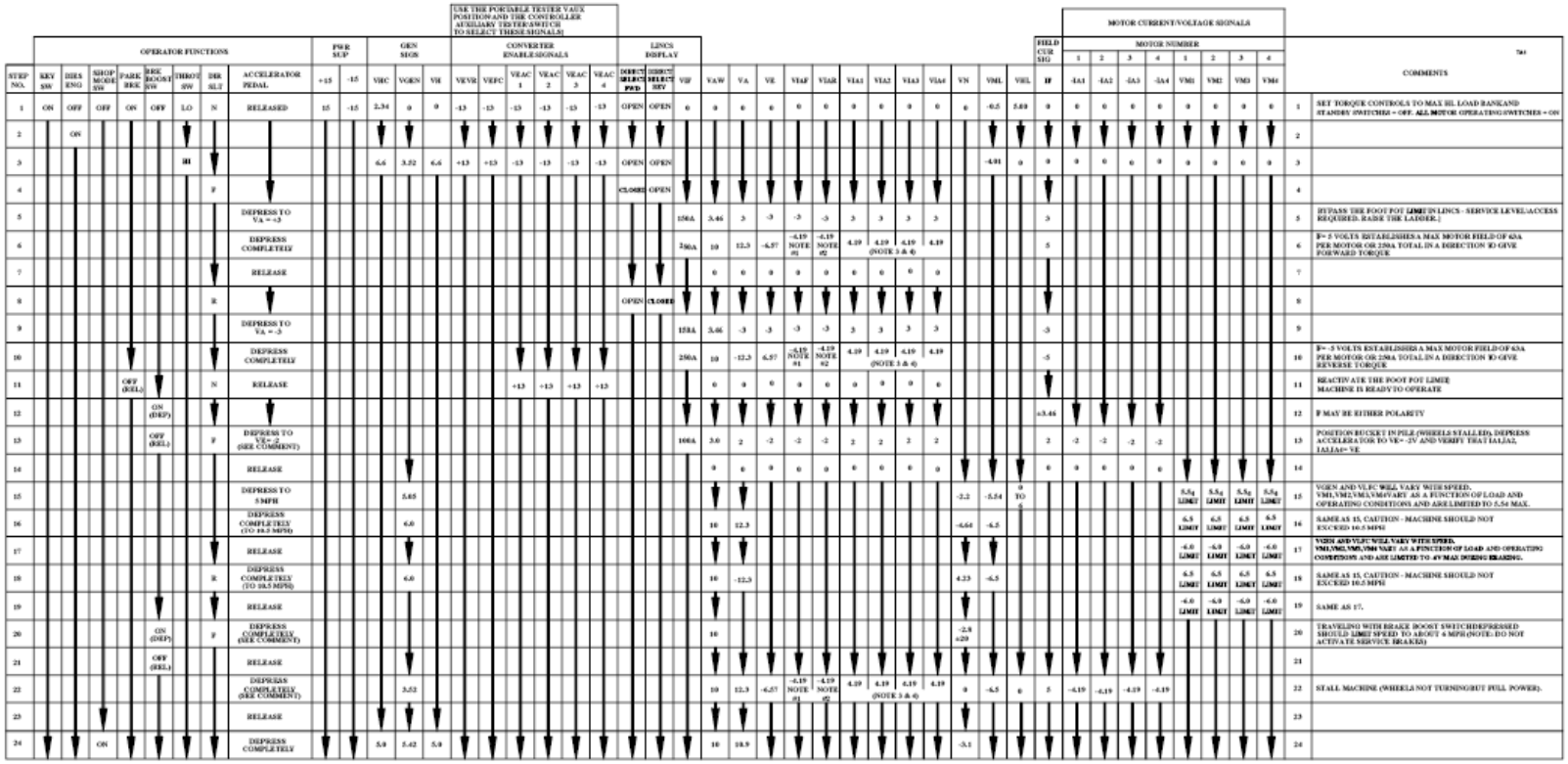
46.2hz to 61.6hz Tier II

STAND-BY POWER

TROUBLESHOOTING

SUPPORT SOFTWARE AND TOOLS

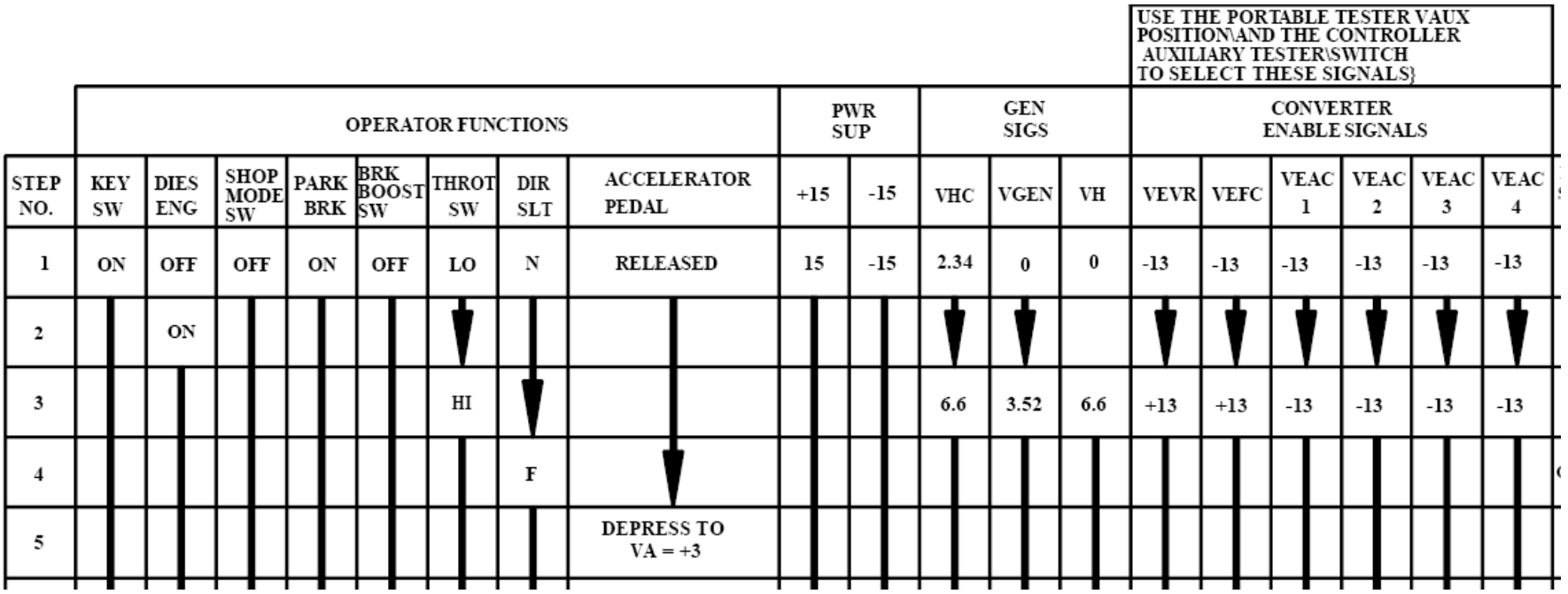
50 Series Diagnostic Tool



CHECKOUT PROCEDURE FOR USE WITH 4255812 REMOTE INTERFACE CARD

L1850 ONLY

23 STEP CHART



	OPERATOR FUNCTIONS								PWR SUP		GEN SIGS			USE THE PORTABLE TESTER VAUX POSITION\AND THE CONTROLLER AUXILIARY TESTER\SWITCH TO SELECT THESE SIGNALS} CONVERTER ENABLE SIGNALS					
STEP NO.	KEY SW	DIES ENG	SHOP MODE SW	PARK BRK	BRK BOOST SW	THROT SW	DIR SLT	ACCELERATOR PEDAL	+15	-15	VHC	VGEN	VH	VEVR	VEFC	VEAC 1	VEAC 2	VEAC 3	VEAC 4
1	ON	OFF	OFF	ON	OFF	LO	N	RELEASED	15	-15	2.34	0	0	-13	-13	-13	-13	-13	-13
2		ON																	
3						HI					6.6	3.52	6.6	+13	+13	-13	-13	-13	-13
4							F												
5								DEPRESS TO VA = +3											

23 STEP CHART

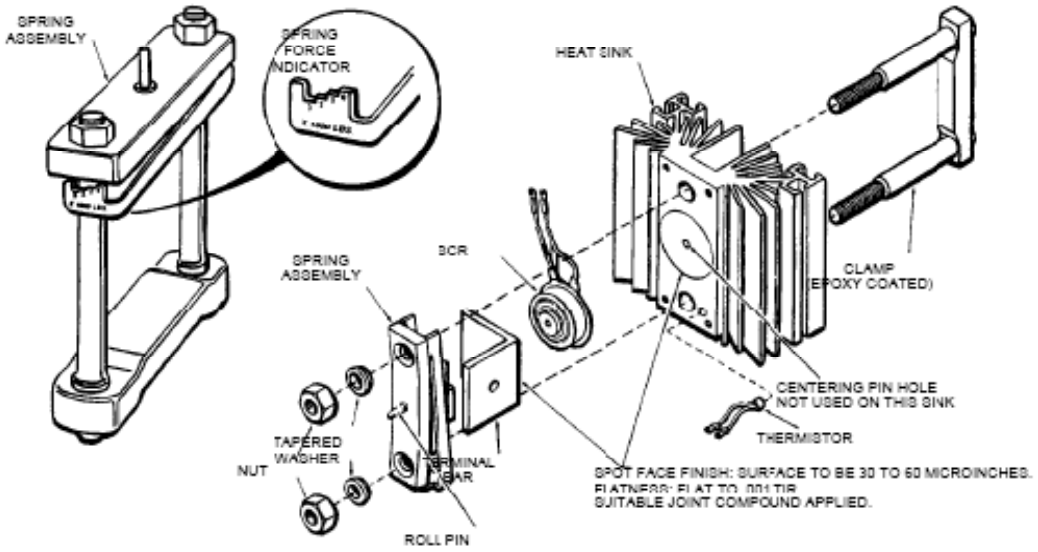
NOTES:

NOTES:

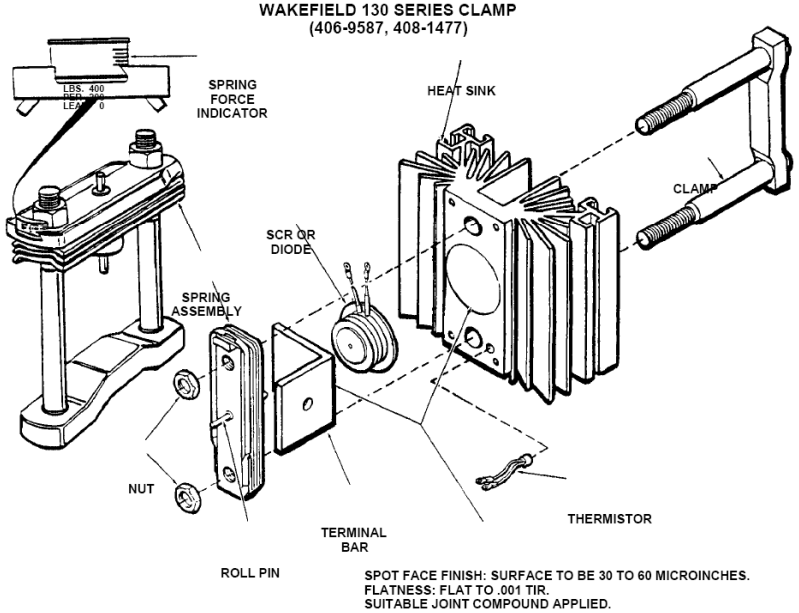
NOTES:

INSTALLATION/REMOVAL

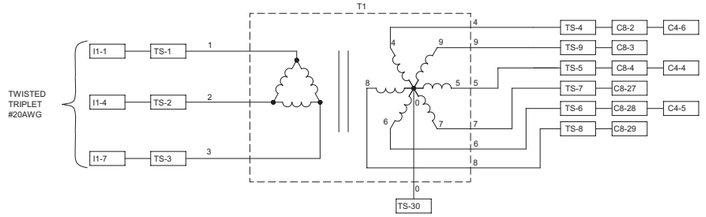
WAKEFIELD 139 SERIES CLAMP
(415-7686)

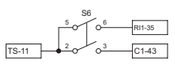


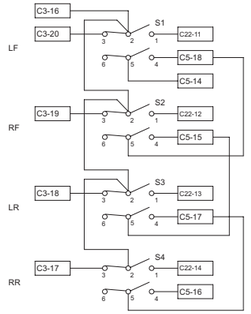
WAKEFIELD 130 SERIES CLAMP
(406-9587, 408-1477)

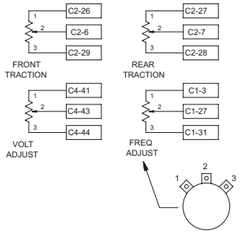


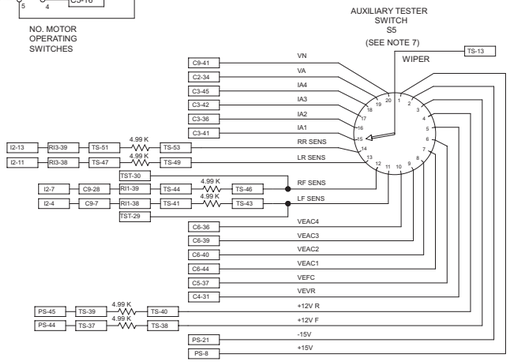
REVISIONS							
ZONE	REV	DESCRIPTION	ECN	DATE	CHG	CHK	APP
	00	RELEASE	NL05-0099	5-5-99	JFM	BS	BS

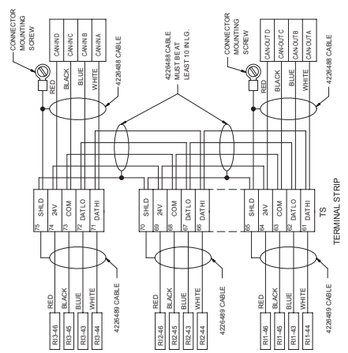


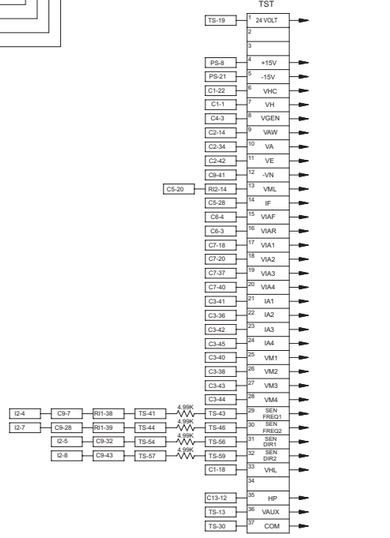


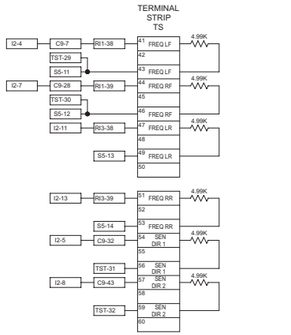


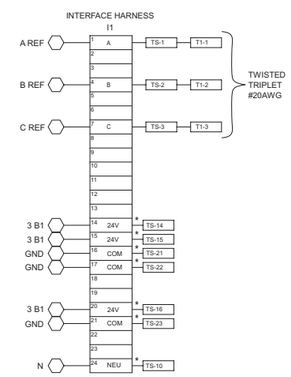


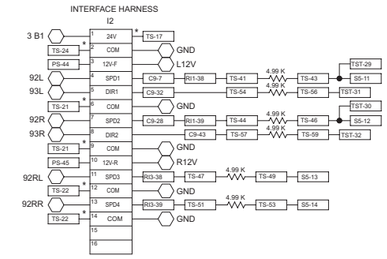


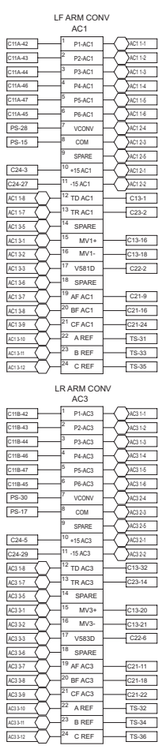


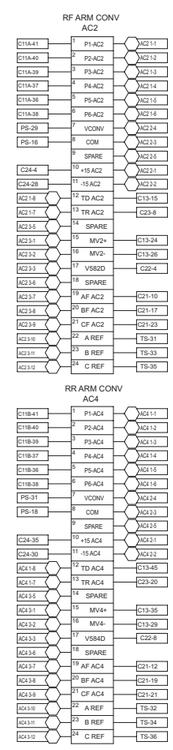












NOTES:

1) THE DIAGRAM IS LAID OUT WITH ELEMENTS THAT REPRESENT THE CONNECTORS AND ALL OTHER PERMANENTLY MOUNTED COMPONENTS IN THE CONTROLLER ASSEMBLY. INDIVIDUAL CARD SCHEMATICS SHOW THE CONTROL CIRCUITRY, WHILE THIS DIAGRAM SHOWS THE INTERCONNECTION BETWEEN THE CARDS, CONNECTORS AND THE OTHER COMPONENTS. THE ELEMENTS WITH A-D,16,24 & 37 DESIGNATIONS ARE CIRCULAR CONNECTORS THAT INTERFACE TO OUTSIDE THE CONTROLLER. THE ELEMENTS WITH 47 DESIGNATIONS ARE THE CARD CONNECTORS. THE NUMBERS REPRESENT THE PIN NUMBER OF THE CONNECTOR. THE SIGNALS ARE NAMED AFTER THE PIN NUMBER. THE BLOCKS GOING FROM AND COMING TO THE CONNECTORS AND COMPONENTS INDICATE WHERE THE CONNECTIONS ARE GOING TO AND COMING FROM.
2) ON A SERIES STRING OF CONNECTING POINTS, THE TOTAL STRING IS SHOWN AT EACH ELEMENT. THE EXCEPTION TO THIS IS THE INTERLOCK STRING WHICH IS SHOWN ON PAGE 3.
3) THE HEX (⬡) DESIGNATION INDICATES A CONNECTION TO THE MACHINE ELECTRICS WHICH REQUIRES A MACHINE SCHEMATIC TO FURTHER TRACE THE CONNECTION.
4) AN ARROW (⟶) DESIGNATES A CONNECTION THAT IS AVAILABLE BUT NOT NORMALLY CONNECTED.
5) THE ASTERISK (*) INDICATES A #18AWG BLACK WIRE.
6) ALL OTHER WIRE IS #20 AWG BLACK UNLESS OTHERWISE NOTED.
7) 4.99 K RESISTOR (QTY 6) TO BE SPLICED IN LINE, COVERED WITH HEAT SHRINK TUBING, AND PLACED IN BUNDLE NEAR S5.

UNLESS OTHERWISE SPECIFIED:
- DIMENSIONS ARE IN INCHES & APPLY BEFORE PLATING OR FINISH COATINGS.
- TOLERANCES ON: ANGLES ±1°; FRACTIONS ±1/16; XX DECIMAL ±.03; XXX DECIMAL ±.015
- MACHINED CORNERS 1/64 X 45°
- WELD PROPERTIES SHALL MEET THE MINIMUM REQUIREMENTS OF THE BASE MATERIAL.

THIRD ANGLE PROJECTION

FIRST USED ON/CONTRACT NO	425-5742	
DWN	J.MARTIN	5-5-05
CHK	B.SHAFER	5-5-05
ENGR	B.SHAFER	5-5-05
PROD ENGR	B.SHAFER	5-5-05
PROJ APPROVAL		
MATL	-	

LeTourneau Technologies™

INTERCONNECTION DIAGRAM L1850/L2350

SIZE	DWG NO	REV
E	4255743	00

DO NOT SCALE

SCALE 1/1 | WT - | SHEET 1 OF 3

REVISIONS							
ZONE	REV	DESCRIPTION	ECN	DATE	CHK	CHK	APP
	00	RELEASE	NL05-0099	5-5-05	JFM	BS	BS

THROTTLE LOGIC
C1
NOTCH 25,33,41

SPEED ERROR
C2
NOTCH 1,17,33

SLIP LIM/BRK MODE
C3
NOTCH 9,17,33

VR CONTROL
C4
NOTCH 9,17,25

FC CONTROL
C5
NOTCH 9,33,41

AC CMD LIMIT
C6
NOTCH 1,25,33

AC CONTROL
C7
NOTCH 1,9,17

SIGNAL REFERENCE
C8
NOTCH 17,25,33

SPEED
C9
NOTCH 17,33,41

SCR TRIGGER-VR/FC
C10
NOTCH 1,9,25

SCR TRIGGER-AC1/AC2
C11(A)
NOTCH 1,17,25

SCR TRIGGER-AC3/AC4
C11(B)
NOTCH 1,17,25

CURRENT FEEDBACK
C13
NOTCH 17,25,41

INTERCONNECTION DIA. L1650/2350		SIZE E	DO NOT SCALE	DWG NO 4255743	REV 00
DRAWN J.MARTIN	DATE 5-5-05	SCALE 1/1	SHT WT -	SHEET 2 OF 3	

REVISIONS						
ZONE	REV	DESCRIPTION	ECN	DATE	CHK	CHK	APP
	00	RELEASE	NL05-0099	5-5-05	JFM	BS	BS

POWER SUPPLY
PS

PRIME/GROUND FAULT DET
C20

AC BLOWN FUSE DETECTOR
C21

VR/FC FUSE/BRAKING DETECTOR
C22

THERMISTER/TEMPERATURE
C23

TRANSDUCER PWR SUPPLY
C24

RIBBON CABLES

REMOTE 1 INTERFACE RI1

RIBBON CABLES

REMOTE 2 INTERFACE RI2

RIBBON CABLES

REMOTE 3 INTERFACE RI3

INTERLOCK SEQUENCE

SHIELD

REMOTE MODULE 1

SHIELD

REMOTE MODULE 2

SHIELD

REMOTE MODULE 3

NOTCH 1,25,41

NOTCH 1,33,41

NOTCH 1,9,33

NOTCH 9,25,33

NOTCH 9,25,41

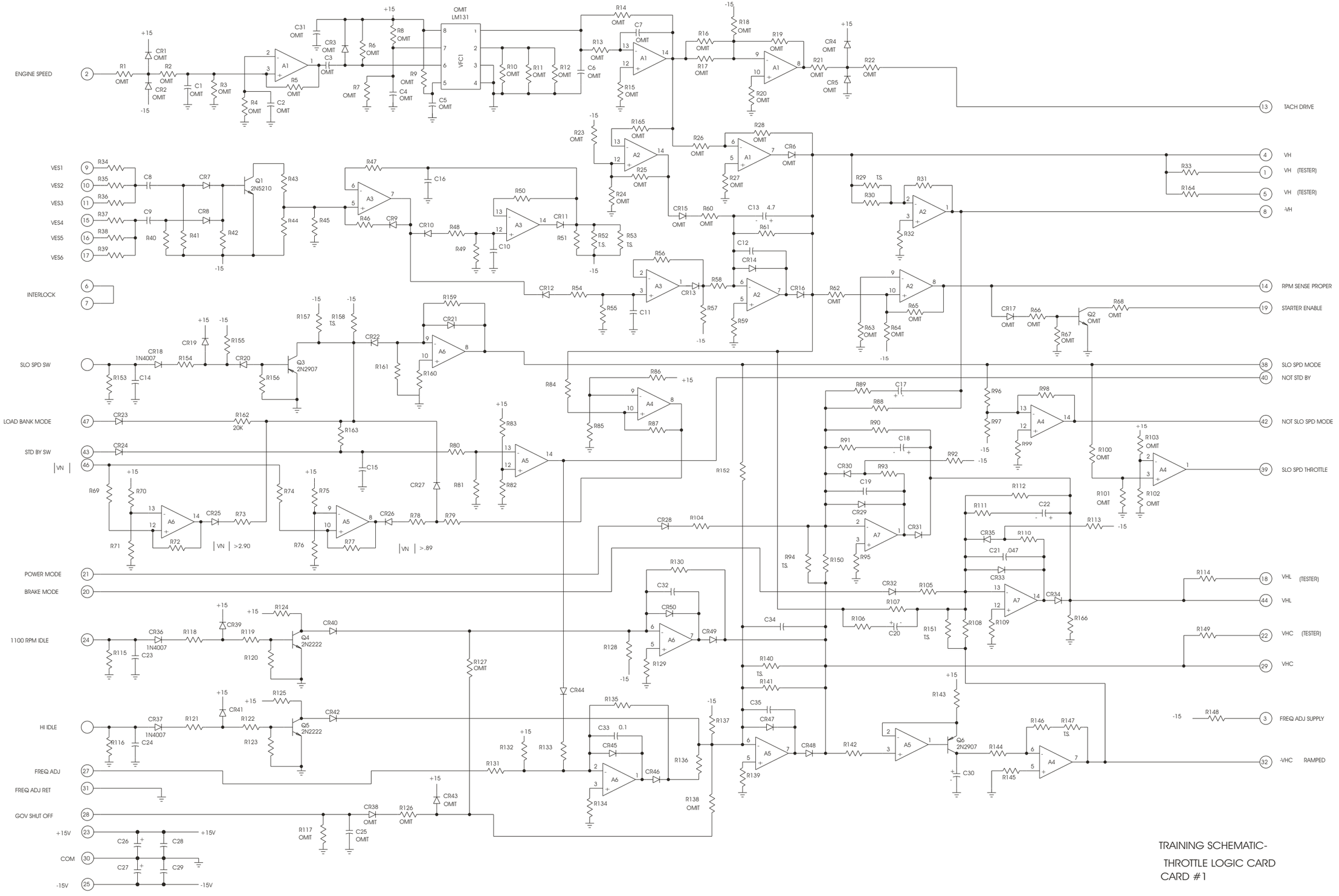
NOTCH 17,23,33

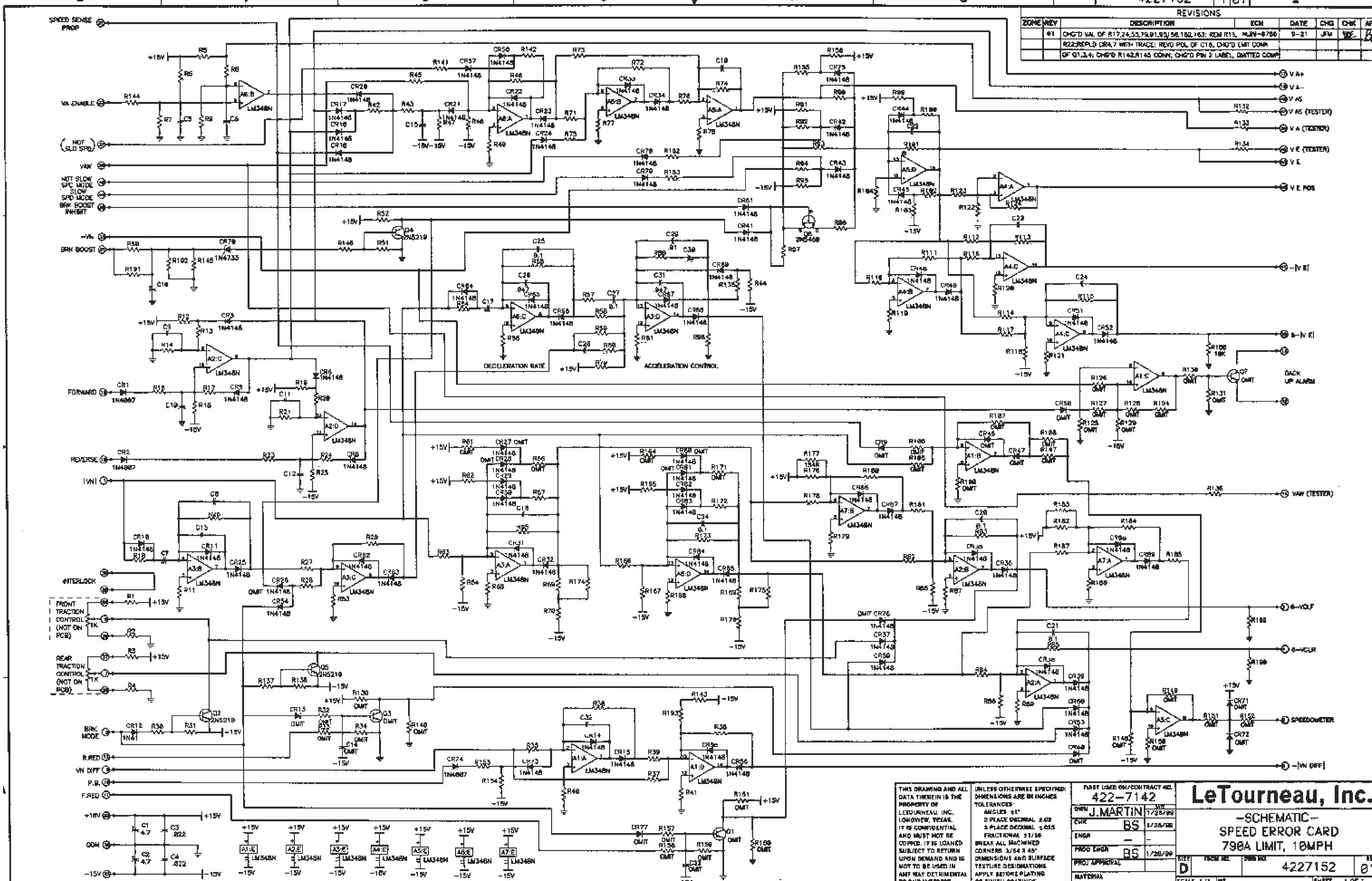
NOTCH 9,17,41

NOTCH 9,17,41

NOTCH 9,17,41

INTERCONNECTION DIA. L1850/2350		E	DO NOT SCALE	DWG NO 4255743	REV 00
DRAWN J.MARTIN 5-5-05					
ISSUED		SCALE 1/1	SHEET 3 OF 3		


ENGINE SPEED
VES1
VES2
VES3
VES4
VES5
VES6
INTERLOCK
SLO SPD SW
LOAD BANK MODE
STD BY SW
VN
POWER MODE
BRAKE MODE
1100 RPM IDLE
HI IDLE
FREQ ADJ
FREQ ADJ RET
GOV SHUT OFF
+15V
COM
-15V
TACH DRIVE
VH
VH (TESTER)
VH (TESTER)
-VH
RPM SENSE PROPER
STARTER ENABLE
SLO SPD MODE
NOT STD BY
NOT SLO SPD MODE
SLO SPD THROTTLE
VHL (TESTER)
VHL
VHC (TESTER)
VHC
FREQ ADJ SUPPLY
-VHC RAMPED
VN >2.90
VN >.89
LM131
TRAINING SCHEMATIC-
THROTTLE LOGIC CARD
CARD #1



REVISIONS							
ZONE	REV	DESCRIPTION	ECN	DATE	CHG	CHK	APR
	01	CHG'D VAL OF R17,24,53,79,91,95,156,162,163; REM R15,	[illegible]	9-21	JFM	[illegible]	[illegible]
		R22;REPL'D CR4,7 WITH TRACE; REV'D POL OF C16, CHG'D EMIT CONN					
		OF Q1,3,4; CHG'D R142,R145 CONN; CHG'D PIN 2 LABEL, OMITTED COMP					

4227152 | 1 | 01

THIS DRAWING AND ALL DATA THEREIN IS THE PROPERTY OF LETOURNEAU, INC. LONGVIEW, TEXAS. IT IS CONFIDENTIAL AND MUST NOT BE COPIED. IT IS LOANED SUBJECT TO RETURN UPON DEMAND AND IS NOT TO BE USED IN ANY WAY DETRIMENTAL TO OUR INTEREST.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
TOLERANCES:
ANGLES ±1°
2 PLACE DECIMAL ±.03
3 PLACE DECIMAL ±.015
FRACTIONAL ±1/16
BREAK ALL MACHINED CORNERS 1/64 X 45°
DIMENSIONS AND SURFACE TEXTURE DESIGNATIONS APPLY BEFORE PLATING OR FINISH COATINGS.

FIRST USED ON/CONTRACT NO. 422-7142

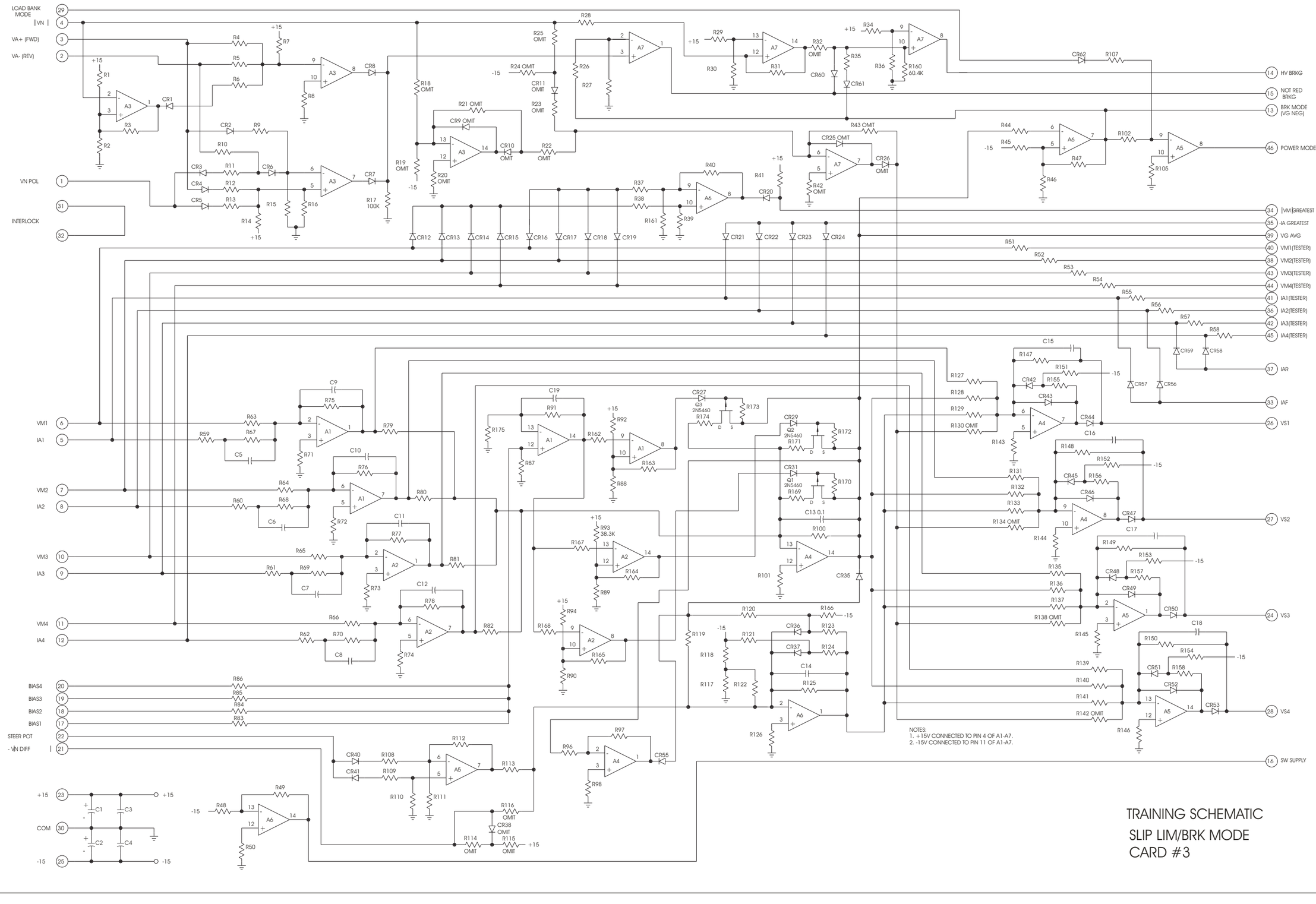
		DATE
DWN	J.MARTIN	1/26/99
CHK	BS	1/26/99
ENGR	—	—
PROD ENGR	BS	1/26/99
PROJ APPROVAL		
MATERIAL		

LeTourneau, Inc.

-SCHEMATIC-
SPEED ERROR CARD
790A LIMIT, 10MPH

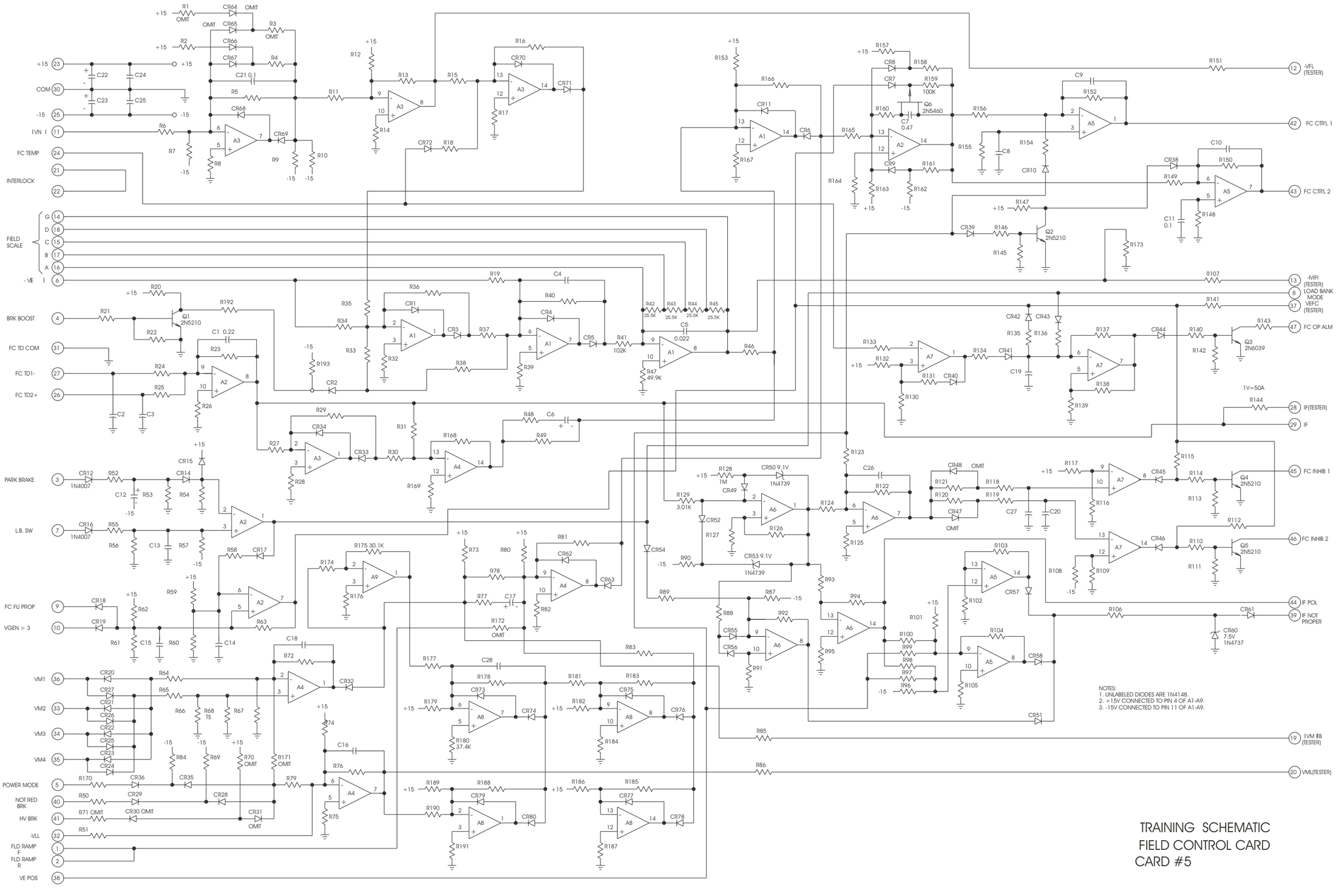
SIZE D | DWG NO. 4227152 | REV 01

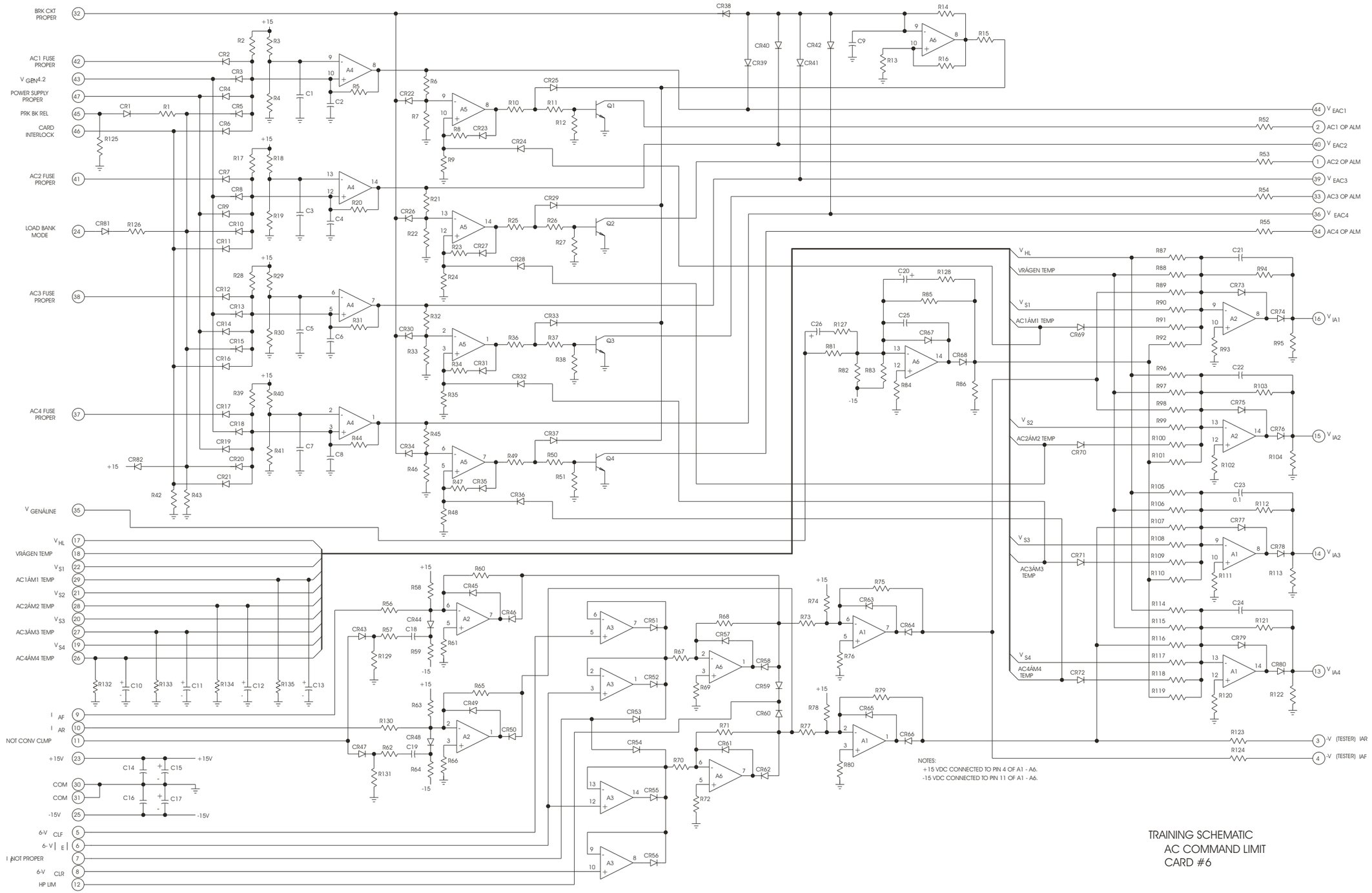
SCALE 1/1 | WT — | SHEET 1 OF 1

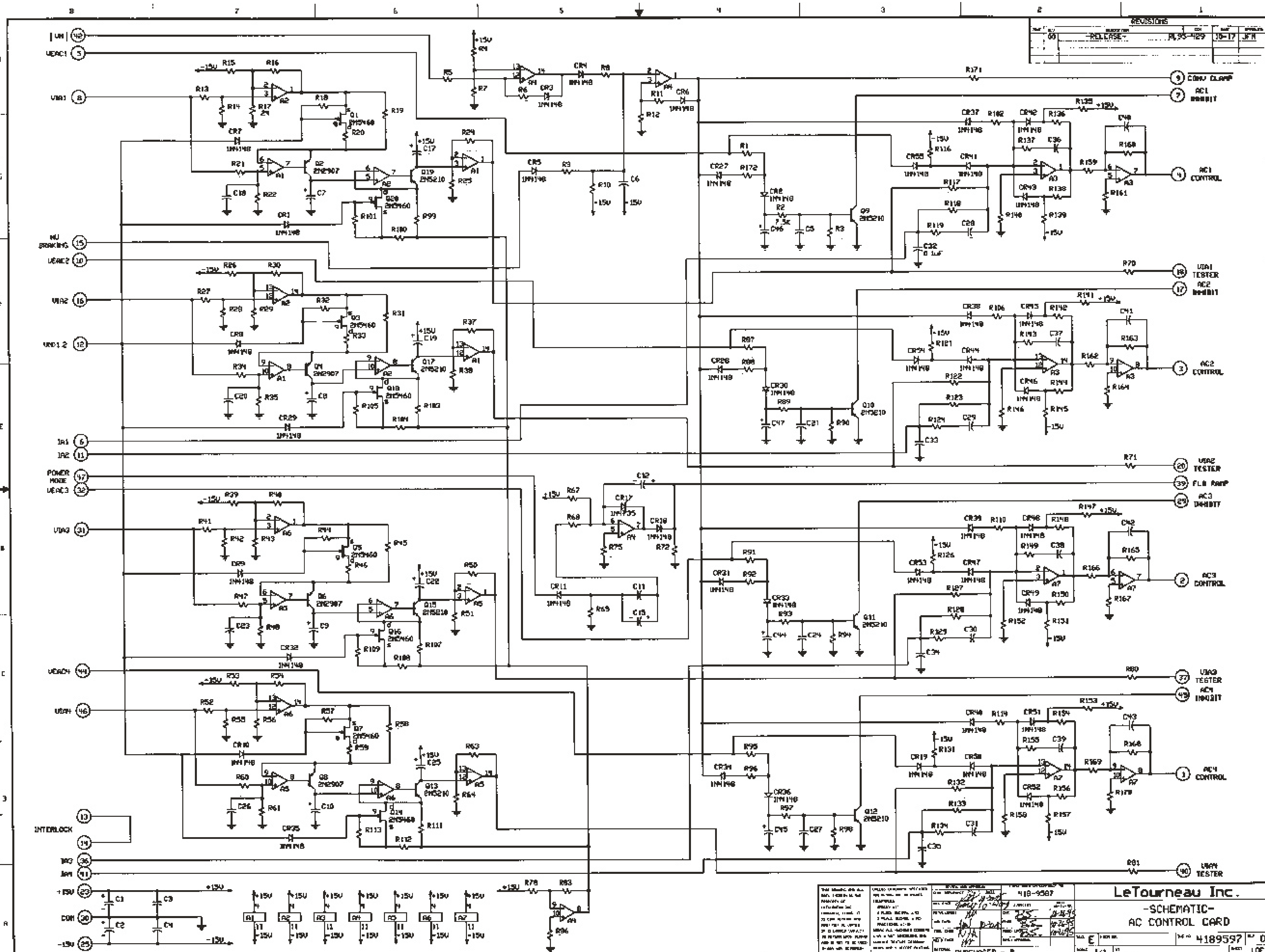

LOAD BANK MODE
VN
VA+ (FWD)
VA- (REV)
VN POL
INTERLOCK
HV BRKG
NOT RED BRKG
BRK MODE (VG NEG)
POWER MODE
VM GREATEST
IA GREATEST
VG AVG
VM1(TESTER)
VM2(TESTER)
VM3(TESTER)
VM4(TESTER)
IA1(TESTER)
IA2(TESTER)
IA3(TESTER)
IA4(TESTER)
IAR
IAF
VS1
VS2
VS3
VS4
SW SUPPLY
VM1
IA1
VM2
IA2
VM3
IA3
VM4
IA4
BIAS4
BIAS3
BIAS2
BIAS1
STEER POT
- VN DIFF
COM
NOTES:
1. +15V CONNECTED TO PIN 4 OF A1-A7.
2. -15V CONNECTED TO PIN 11 OF A1-A7.
TRAINING SCHEMATIC
SLIP LIM/BRK MODE
CARD #3

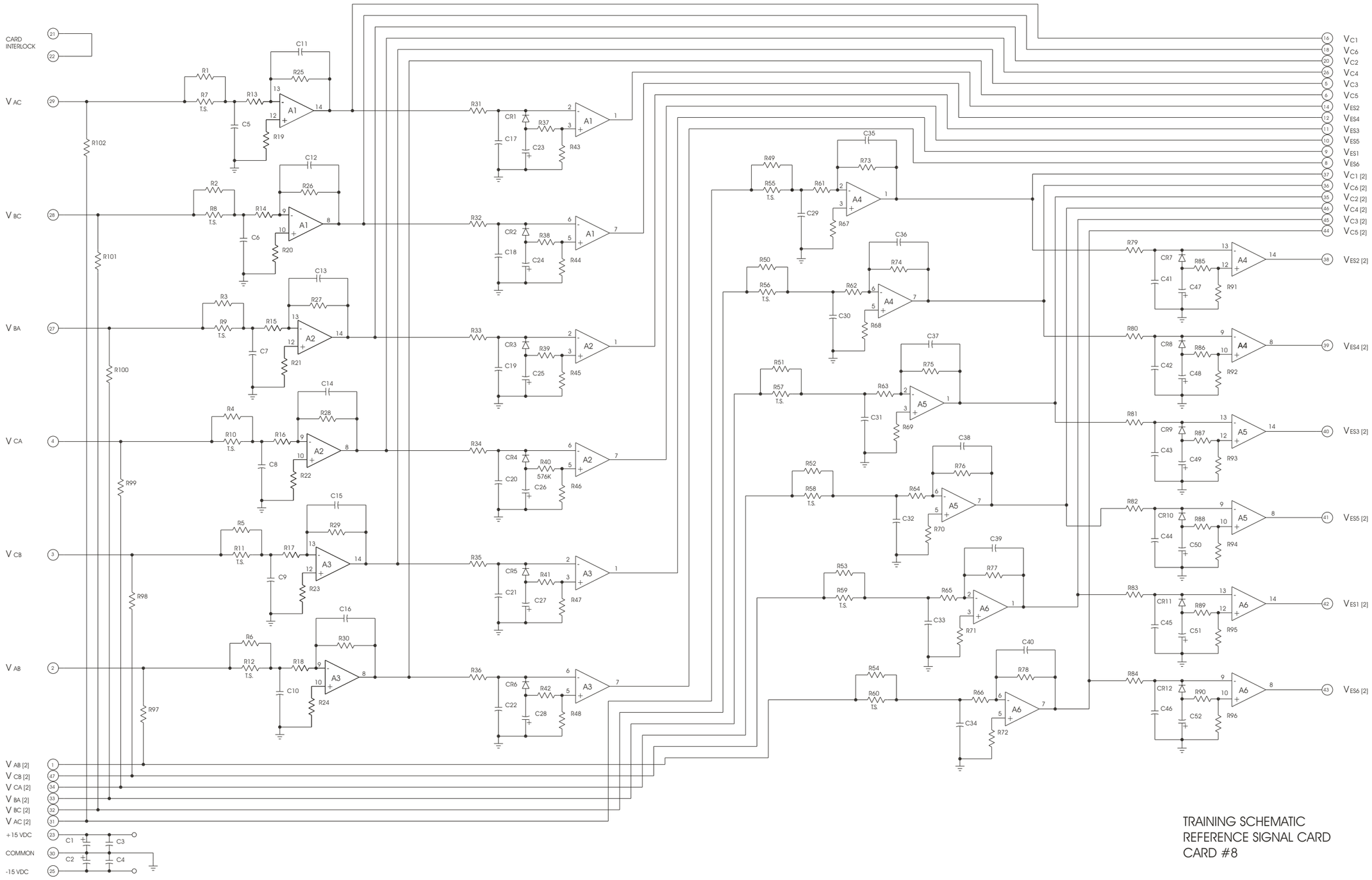
TRAINING SCHEMATIC
VR CONTROL CARD #4

NOTE:
1. +15V CONNECTED TO PIN 4 OF A1-A6
2. -15V CONNECTED TO PIN 11 OF A1-A6
3. UNLABELED DIODES ARE 1N4148

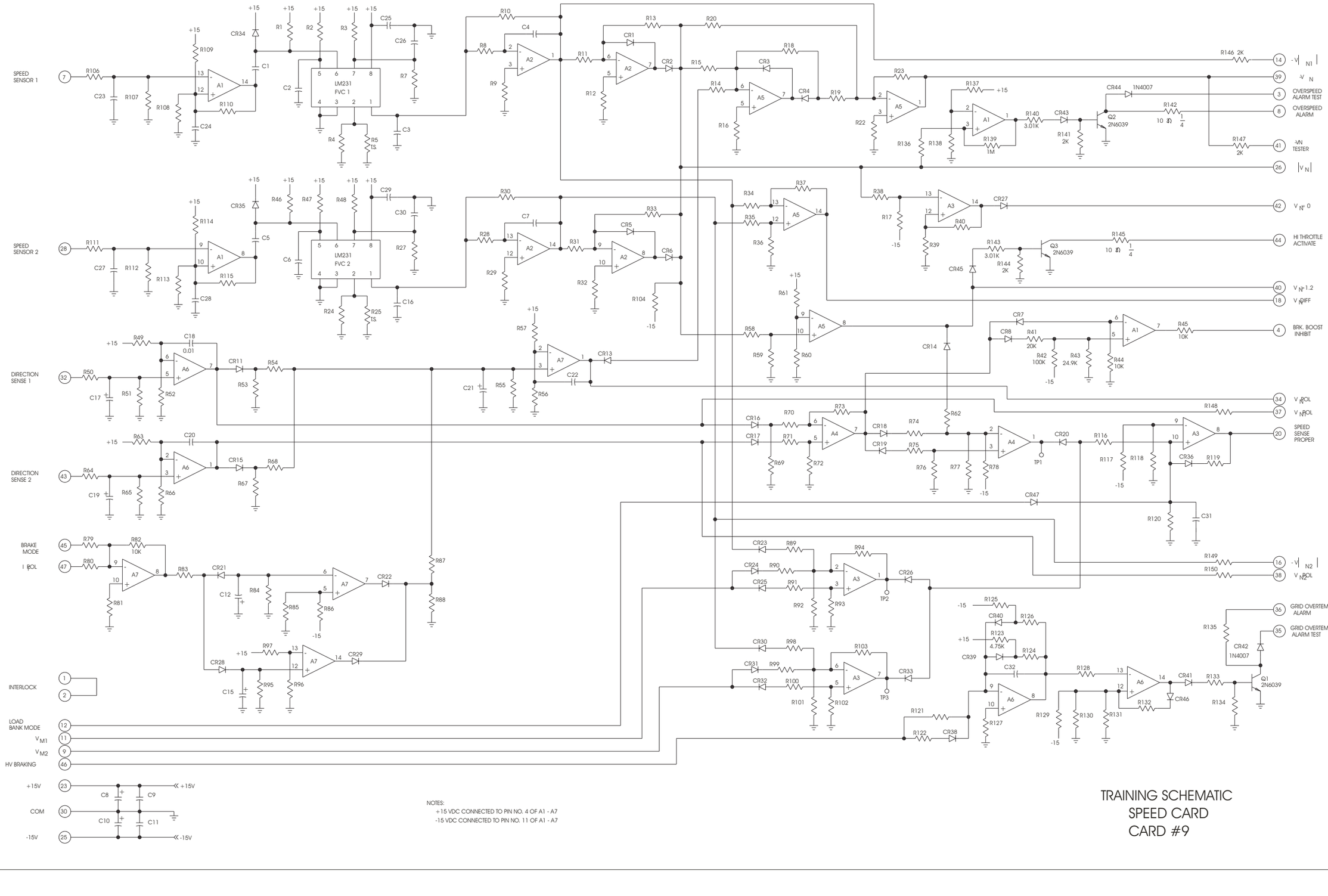

FC TEMP
INTERLOCK
FIELD SCALE
- VE
BRK BOOST
FC TD COM
FC TD1-
FC TD2+
PARK BRAKE
L.B. SW
FC FU PROP
VGEN > 3
VM1
VM2
VM3
VM4
POWER MODE
NOT RED BRK
HV BRK
-VLL
FLD RAMP F
FLD RAMP R
VE POS
-VFL (TESTER)
FC CTRL 1
FC CTRL 2
-VIFI (TESTER)
LOAD BANK MODE
VEFC (TESTER)
FC OP ALM
1V=50A
IF(TESTER)
IF
FC INHIB 1
FC INHIB 2
IF POL
IF NOT PROPER
IVM #8 (TESTER)
VML(TESTER)
NOTES:
1. UNLABELED DIODES ARE 1N4148.
2. +15V CONNECTED TO PIN 4 OF A1-A9.
3. -15V CONNECTED TO PIN 11 OF A1-A9.
TRAINING SCHEMATIC
FIELD CONTROL CARD
CARD #5

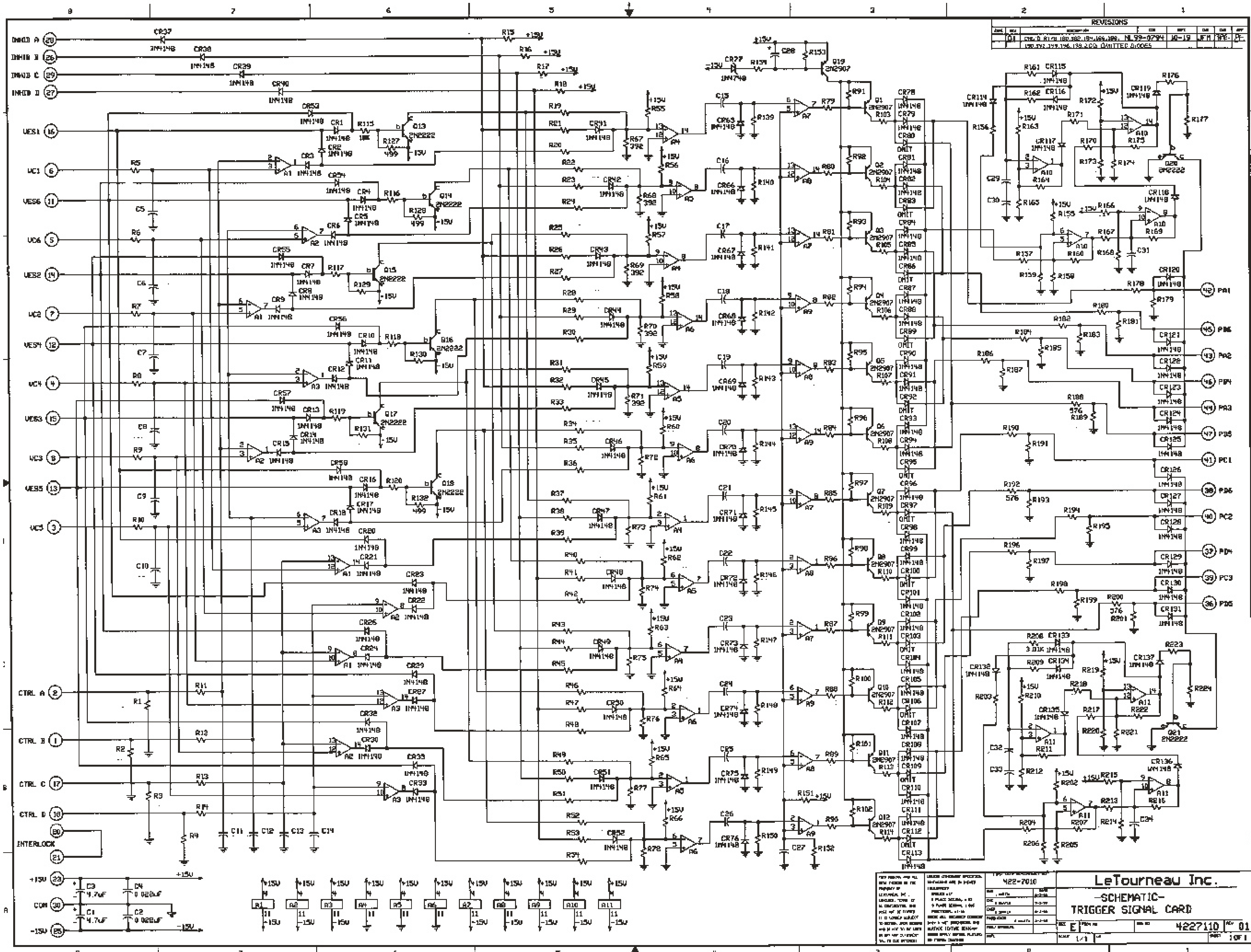

BRK CKT PROPER
AC1 FUSE PROPER
V GEN4.2
POWER SUPPLY PROPER
PRK BK REL
CARD INTERLOCK
AC2 FUSE PROPER
LOAD BANK MODE
AC3 FUSE PROPER
AC4 FUSE PROPER
V GENÁLINE
V HL
VRÁGEN TEMP
V S1
AC1ÁM1 TEMP
V S2
AC2ÁM2 TEMP
V S3
AC3ÁM3 TEMP
V S4
AC4ÁM4 TEMP
I AF
I AR
NOT CONV CLMP
+15V
COM
COM
-15V
6-V CLF
6-V E
I NOT PROPER
6-V CLR
HP LIM
V EAC1
AC1 OP ALM
V EAC2
AC2 OP ALM
V EAC3
AC3 OP ALM
V EAC4
AC4 OP ALM
V IA1
V IA2
V IA3
V IA4
-V (TESTER) IAR
-V (TESTER) IAF
NOTES:
+15 VDC CONNECTED TO PIN 4 OF A1 - A6.
-15 VDC CONNECTED TO PIN 11 OF A1 - A6.
TRAINING SCHEMATIC
AC COMMAND LIMIT
CARD #6

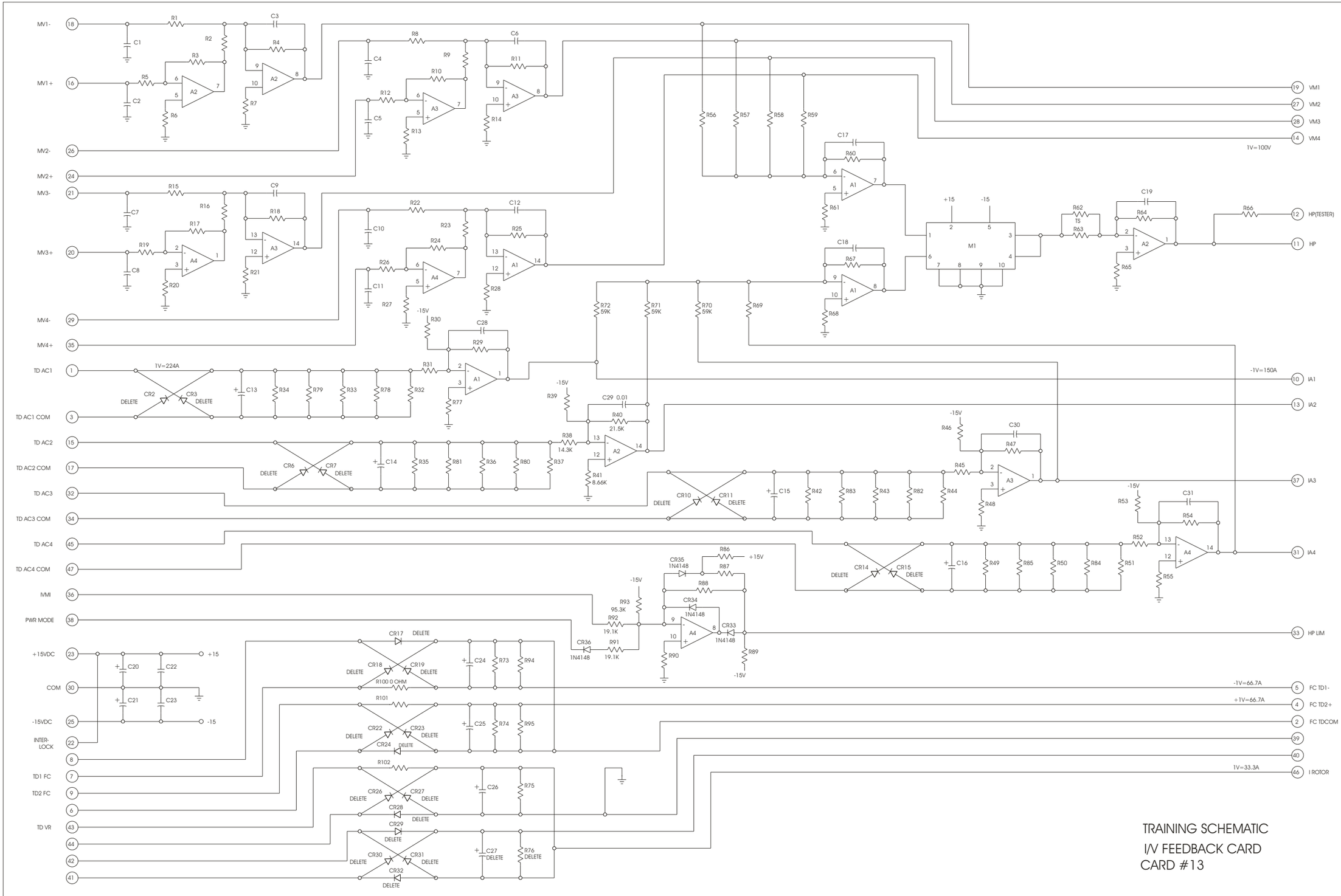

REVISIONS
RELEASE
CONV CLAMP
AC1 INHIBIT
AC1 CONTROL
VIA1 TESTER
AC2 INHIBIT
AC2 CONTROL
VIA2 TESTER
FLR RAMP
AC3 INHIBIT
AC3 CONTROL
VIA3 TESTER
AC4 INHIBIT
AC4 CONTROL
VIA4 TESTER
VEAC1
VIA1
NU BRAKING
VEAC2
VIA2
POWER MODE
VEAC3
VIA3
VEAC4
VIA4
INTERLOCK
COM
LeTourneau Inc.
-SCHEMATIC-
AC CONTROL CARD
4189597
PURCHASED - B

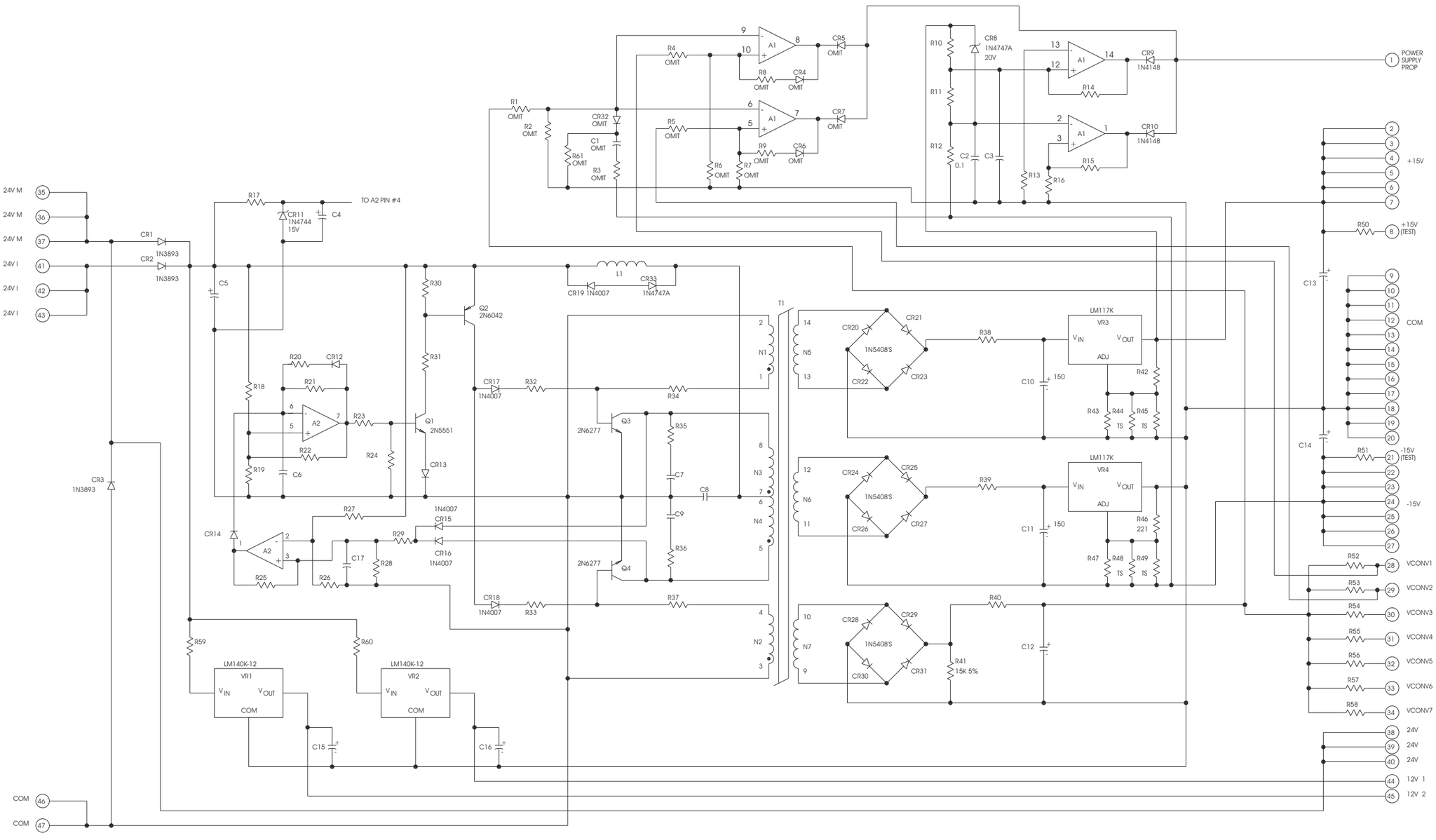


TRAINING SCHEMATIC
REFERENCE SIGNAL CARD
CARD #8


SPEED SENSOR 1
SPEED SENSOR 2
DIRECTION SENSE 1
DIRECTION SENSE 2
BRAKE MODE
I POL
INTERLOCK
LOAD BANK MODE
VM1
VM2
HV BRAKING
+15V
COM
-15V
LM231 FVC 1
LM231 FVC 2
-V N1
-V N
OVERSPEED ALARM TEST
OVERSPEED ALARM
-VN TESTER
VN
VN 0
HI THROTTLE ACTIVATE
VN 1.2
VN DIFF
BRK. BOOST INHIBIT
VN POL
VN POL
SPEED SENSE PROPER
-V N2
VN POL
GRID OVERTEMP ALARM
GRID OVERTEMP ALARM TEST
TP1
TP2
TP3
Q1 2N6039
Q2 2N6039
Q3 2N6039
1N4007
NOTES:
+15 VDC CONNECTED TO PIN NO. 4 OF A1 - A7
-15 VDC CONNECTED TO PIN NO. 11 OF A1 - A7
TRAINING SCHEMATIC
SPEED CARD
CARD #9


REVISIONS
01 CHG'D R179,180,182,184,186,188, NL99-0794 10-19
190,192,194,196,198,200 OMITTED DIODES
INHIB A
INHIB B
INHIB C
INHIB D
VES1
VC1
VES6
VC6
VES2
VC2
VES4
VC4
VES3
VC3
VES5
VC5
CTRL A
CTRL B
CTRL C
CTRL D
INTERLOCK
+15V
COM
-15V
PA1
PB6
PA2
PB4
PA3
PB5
PC1
PB6
PC2
PD4
PC3
PD5
422-7010
LeTourneau Inc.
-SCHEMATIC-
TRIGGER SIGNAL CARD
E
4227110
01
1/1
1 OF 1


MV1-
MV1+
MV2-
MV2+
MV3-
MV3+
MV4-
MV4+
TD AC1
TD AC1 COM
TD AC2
TD AC2 COM
TD AC3
TD AC3 COM
TD AC4
TD AC4 COM
IVMI
PWR MODE
+15VDC
COM
-15VDC
INTER-LOCK
TD1 FC
TD2 FC
TD VR
VM1
VM2
VM3
VM4
1V=100V
HP(TESTER)
HP
-1V=150A
IA1
IA2
IA3
IA4
HP LIM
-1V=66.7A
FC TD1-
+1V=66.7A
FC TD2+
FC TDCOM
1V=33.3A
I ROTOR
1V=224A
DELETE
R100 0 OHM
M1
+15
-15
-15V
TRAINING SCHEMATIC
I/V FEEDBACK CARD
CARD #13



TRAINING SCHEMATIC-
POWER SUPPLY CARD

PRIME INHIBIT 12

24 VDC CONTROL VOLTAGE 35 36 37

CR1 S2120

C1

VR/PRIME ENABLE 16

CR2 R1 R2 R3 R70 CR3 1N4742 CR4 C6 R4 R5 LM348 A1 R7

+15V R6 R8 R9 A1 R10

CR16 R11 R12 -15V R13

R67 R14 R15 Q1 2N6045 Q2 2N5884

R17 R18 R19 -15V R20 A1

CR5 R16

R21 R22 R23 A1

+15V R24 R25 R26 Q3 2N5210

+15V R27 R28 C7 Q4 2N6027 A G K

+15V R30 R29 R31 R66

R68 C16

T1

Q5 2N5886 Q6 2N5886 R33 R32 C8

CR6 S2120 CR7 S2120 CR8 NO44RH15 C9 CR17 1N4007

47 VOLTAGE ENABLE

43 44 45 PRIME OUTPUT

33 RLY DRIVE

T2 R69 Q9 2N6045

CR15 1N4007 R71 2.2 OHM,5% C17 R61

VN 6

+15V R51 R52 CR10 R47 R49 R50 A3 LM324 R53

+15V R54 A3 R62 R63 R56 R58

Q8 2N6039 CR14 R64 8 RELAY

NEUTRAL 39 40 41 R34 R35 1.5 C10 C11 1.5 C12 1.5 R38 R39 1.5

+15V R36 +15V R37 R40 R41 A2 LM324 R42 R43

+15V R45 R44 C13 A2 CR9 R46 C14 R48

A3 R55 R57 C15 R59 R60 Q7 2N6039 CR11 CR12 CR13 4 VA SHUTDOWN

R65 2 GROUND FAULT LIGHT

+15VDC 23 14 28 +15VDC

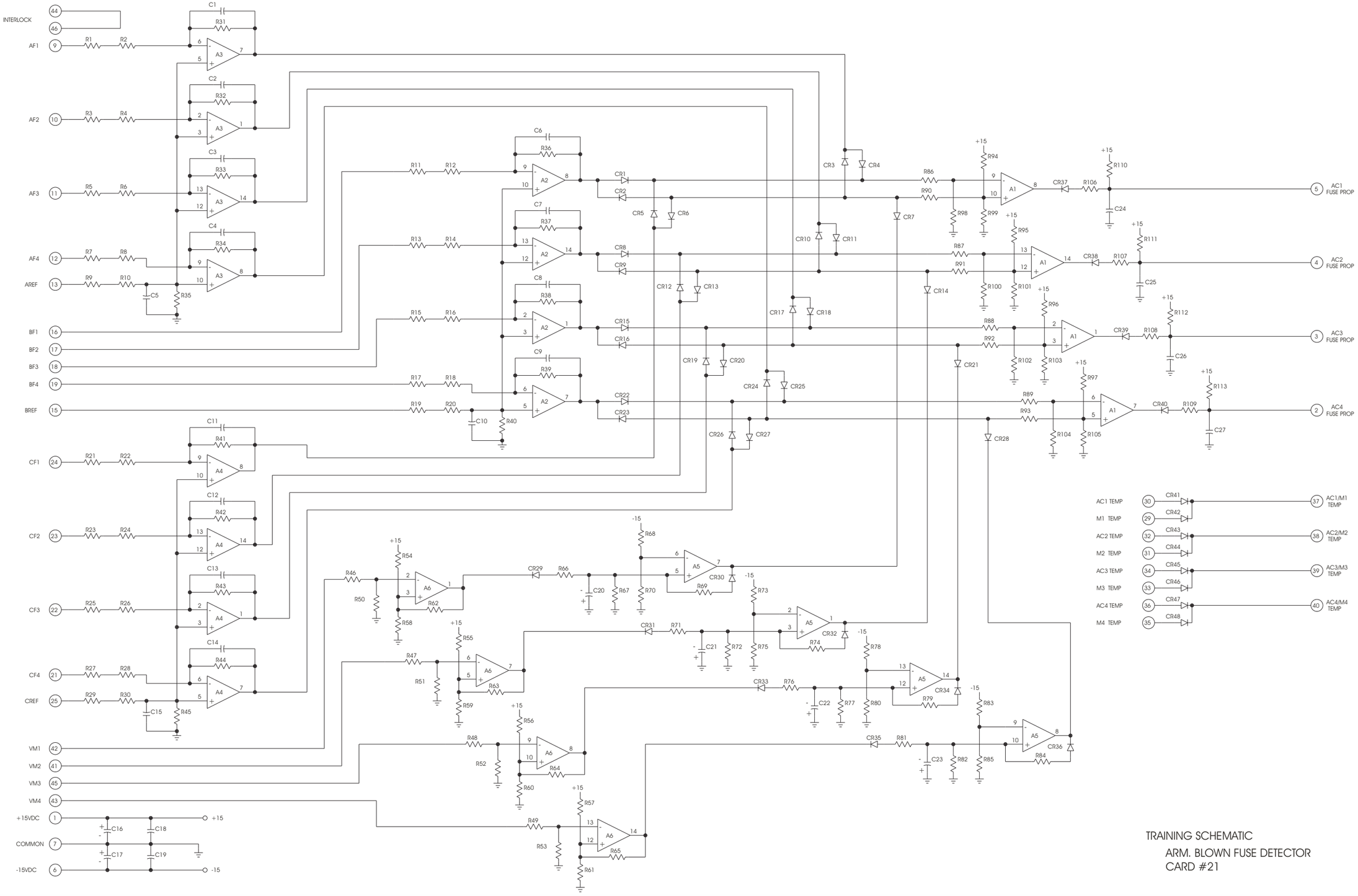
C4 C5

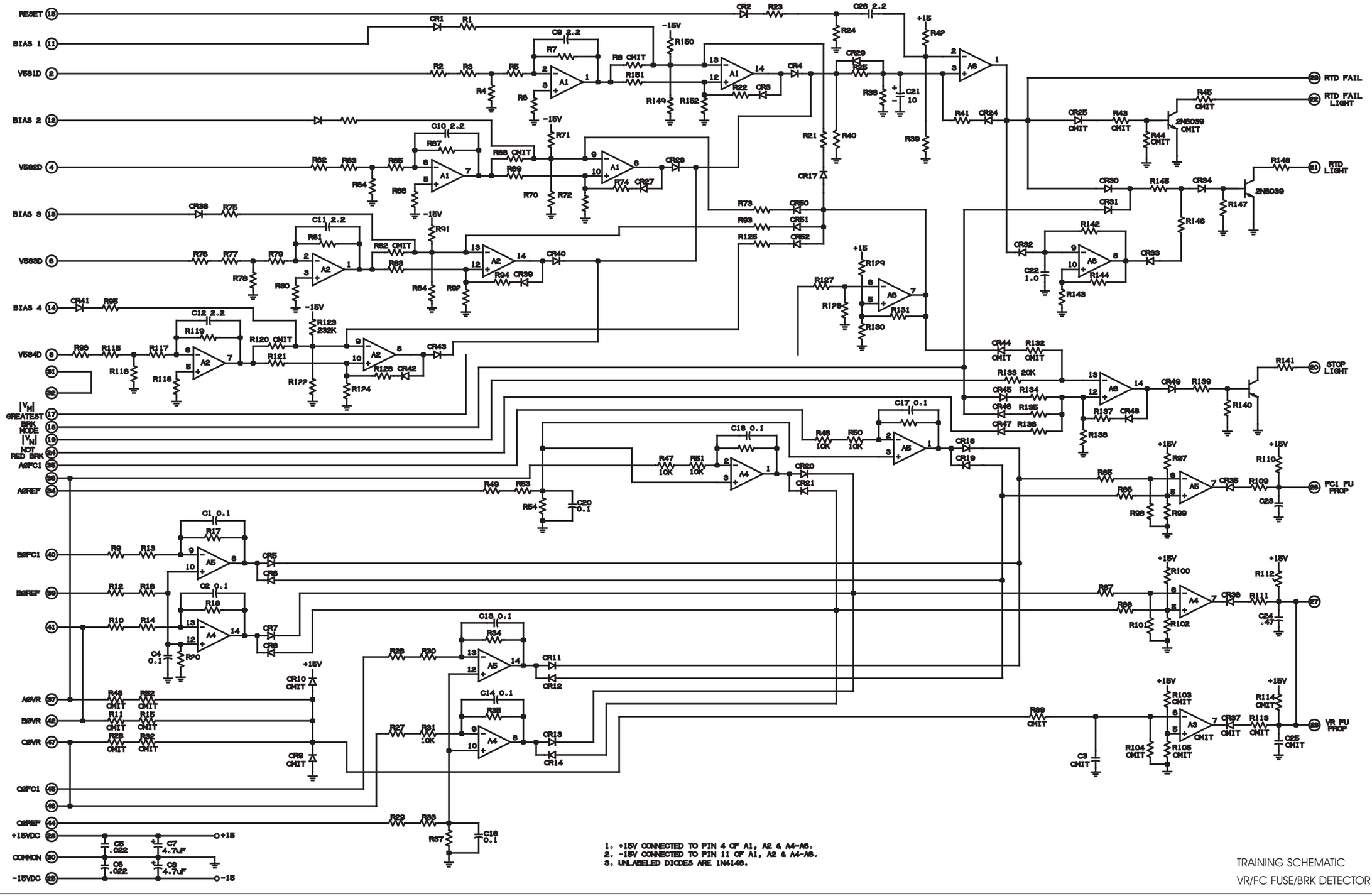
COMMON 29 30

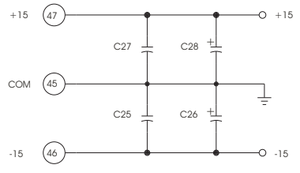
C2 C3

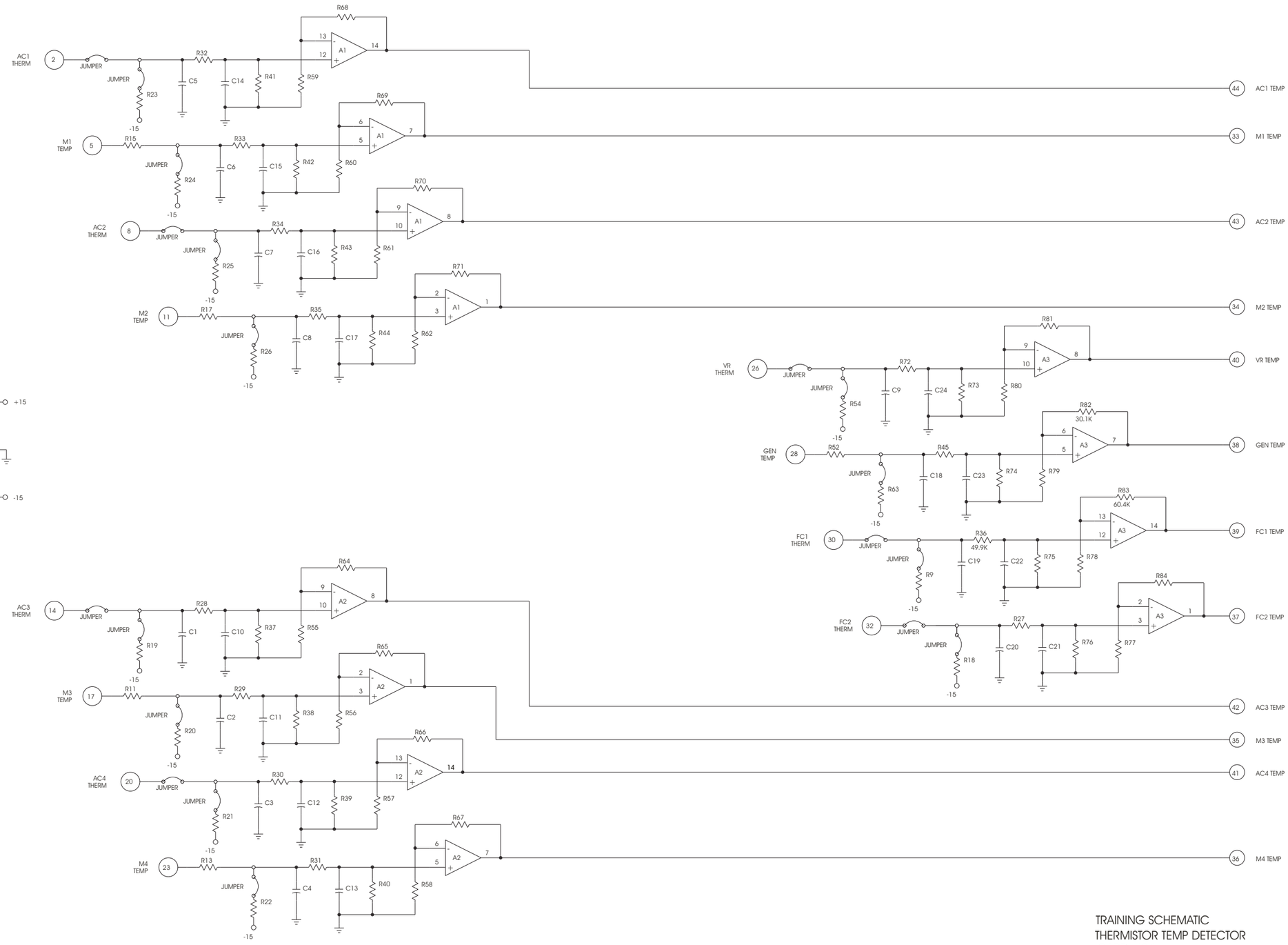
-15VDC 25 -15VDC

TRAINING SCHEMATIC
PRIME/GRD FAULT DETECT
CARD #20


INTERLOCK
AF1
AF2
AF3
AF4
AREF
BF1
BF2
BF3
BF4
BREF
CF1
CF2
CF3
CF4
CREF
VM1
VM2
VM3
VM4
+15VDC
COMMON
-15VDC
AC1 FUSE PROP
AC2 FUSE PROP
AC3 FUSE PROP
AC4 FUSE PROP
AC1 TEMP
M1 TEMP
AC2 TEMP
M2 TEMP
AC3 TEMP
M3 TEMP
AC4 TEMP
M4 TEMP
AC1/M1 TEMP
AC2/M2 TEMP
AC3/M3 TEMP
AC4/M4 TEMP
TRAINING SCHEMATIC
ARM. BLOWN FUSE DETECTOR
CARD #21


RESET 15
BIAS 1 11
V581D 2
BIAS 2 12
V582D 4
BIAS 3 13
V583D 6
BIAS 4 14
V584D 8
21
22
|VM| GREATEST 17
BRK MODE 18
|VL| 19
NOT RED BRK 24
A2FC1 35
36
A2REF 34
B2FC1 40
39
B2REF 38
41
A2VR 37
B2VR 42
C2VR 47
C2FC1 45
46
C2REF 44
+15VDC 29
COMMON 30
-15VDC 25
+15
-15
1. +15V CONNECTED TO PIN 4 OF A1, A2 & A4-A6.
2. -15V CONNECTED TO PIN 11 OF A1, A2 & A4-A6.
3. UNLABELED DIODES ARE 1N4148.
29 RTD FAIL
32 RTD FAIL LIGHT
21 RTD LIGHT
20 STOP LIGHT
28 FC1 FU PROP
27
26 VR FU PROP
TRAINING SCHEMATIC
VR/FC FUSE/BRK DETECTOR





TRAINING SCHEMATIC
THERMISTOR TEMP DETECTOR
CARD #24

TRAINING SCHEMATIC

REMOTE INTERFACE CARD - ANALOG

NOTE: THRU ARE P1-1 THRU P10-5 SOLDER CONNECTION POINTS ON SURFCE OF THE CARD THAT WILL INTERFACE TO THE REMOTE MODULE CARD

NOTE: C-1 THRU C-47 IS THE CARD EDGE CONNECTOR.

COMMON P2-7 P2-6 P2-5 P2-4 P2-3 P2-2 P2-1

I/O P1-6 P1-5 P1-4 P1-3 P1-2 P1-1

I/O P3-6 P3-5 P3-4 P3-3 P3-2 P3-1

ADDRESS P4-7 P4-6 P4-5 P4-4 P4-3 P4-2 P4-1

I/O P5-7 P5-6 P5-5 P5-4 P5-3 P5-2 P5-1

COMMON P6-7 P6-6 P6-5 P6-4 P6-3

24V P6-2 P6-1

I/O P7-7 P7-6 P7-5 P7-4 P7-3 P7-2 P7-1

RS232 9 PIN D-SUB CONNECTOR D-7 D-2 D-3 D-5 NC P9-5 P9-4 P9-3 P9-2 P9-1

INTERLOCK C-26 C-27

CAN DAT LO P10-5
CAN DAT HI P10-4
CAN COM P10-3
CAN 24V P10-2
CAN SHLD P10-1

C-1 DIR HI/LO SW
C-2 DIR HI/LO SW
C-3 BI POL BUF
C-4 BI POL BUF
C-5 NEG BUF
C-6 POS BUF
C-7 POS BUF/BIAS
C-8 POS BUF/BIAS
C-11 POS BUF
C-12 POS BUF
C-13 BI POL BUF
C-14 NEG BUF
C-15 HI/LO DET
C-16 HI/LO DET
C-17 DIR HI/LO SW
C-19 ADDRESS
C-18 ADDRESS
C-20 24V IN
C-21 24V IN
C-32 PWM DET OUT
C-33 PWM DET OUT
C-34 LITE DET
C-35 HI/LO DET
C-36 LITE DET
C-37 LITE DET
C-38 POS BUF FREQ
C-39 POS BUF FREQ
C-40 PWM DET OUT
C-43 CAN DAT LO
C-44 CAN DAT HI
C-45 CAN COM
C-46 CAN 24V
C-47 CAN SHLD

C-23 +15V
C-29 COM
C-30 COM
C-25 -15V

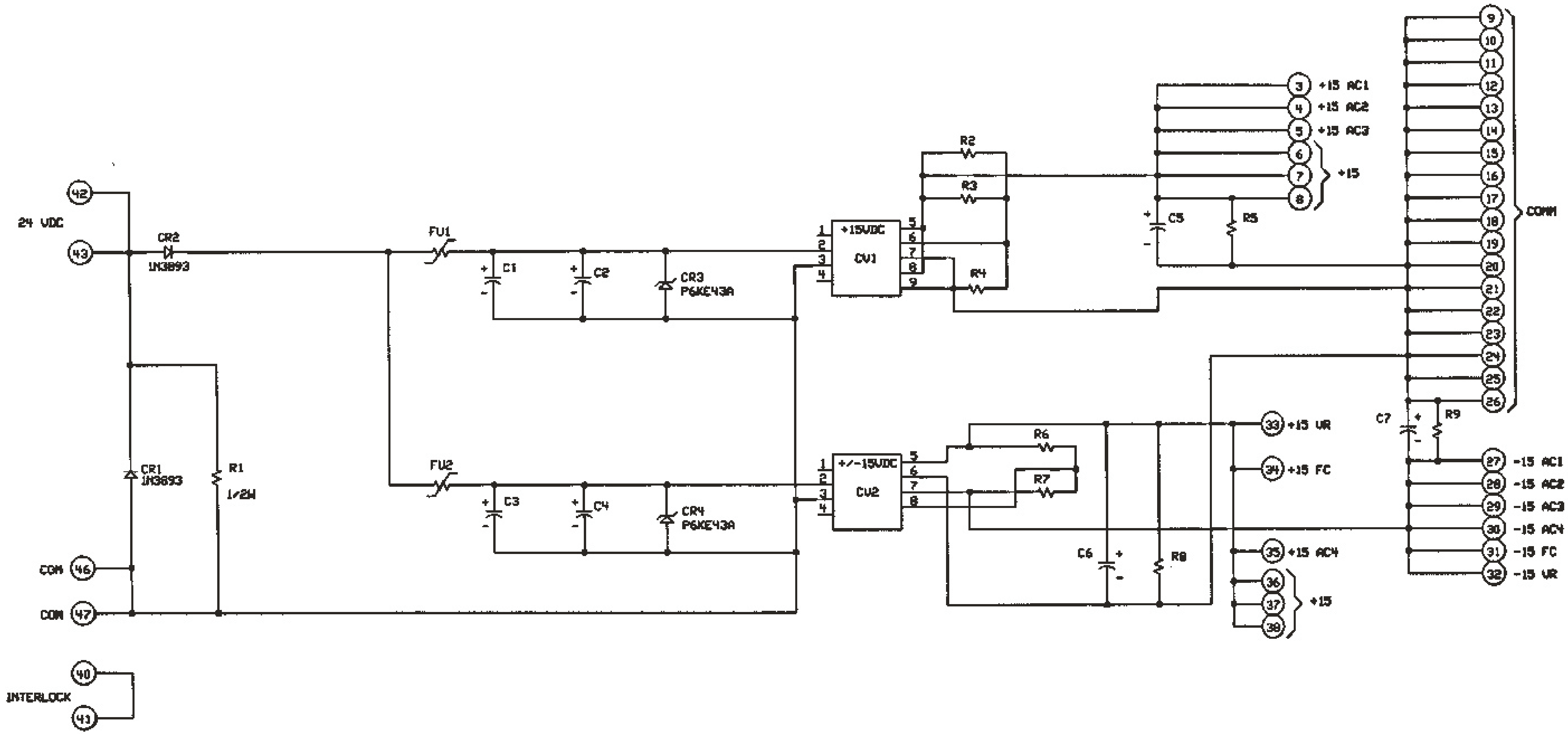
R1 20K, R2 +15V, R3, R4, R5, A1, CR16 1N4148
R6 20K, R7 +15V, R8, R9, R10, A1, CR17 1N4148
R11, R12, R13, R14, A2, CR18 1N4148
R15, R16, R17, A2, CR19 1N4148
R18, R19 +15V, R20, R21 66.5K -15V, R22, R23, R24, A3, CR20 1N4148
R25 37.4K, R26 TS, R27, R28 66.5K -15V, R29, R30, R116, A3, CR21 1N4148
R31, R32, R33, R34, A1, CR22 1N4148
R35, R36, R37, R38, A1, CR23 1N4148
R39, R40 -15V, R41, R42, R43, R44 TS, R45, A2, CR24 1N4148
R46, R47, R48, A2, CR25 1N4148
R49, R50 +15V
R51 +15V, CR1 1N4148, R52, R53, Q1 2N2222, R54 +10V, R55, R56, R57, C11, A6, R58, R59, C10, R60, A6
R61 +15V, CR2 1N4148, R117, R62, Q2 2N2222, R63 +10V, R64, C9 0.1uF, R65, R66, A5, R67, R68 +15V, C8, R69, R70, A5
R71, R72, CR4 1N4148, CR5 1N4148 -15V, R74 140K, R73 10K, CR26 1N4148, A3, R75 10K, R76 1 M, CR6 1N4148 +15V, CR7 1N4148 -15V, R78 +15V, R77 10K, CR27 1N4148, A3
R79 200K, R80 10K, CR8 1N4148 +15V, CR9 1N4148 -15V, R81 +15V, R82, A4, CR28 1N4148
R93, R94, CR14 1N4148 +15V, CR15 1N4148 -15V, R91 +15V, R92, A4, CR31 1N4148
R90, R89 +15V, CR12 1N4148, CR13 1N4148 -15V, R87 +15V, R88, A4, CR30 1N4148
R85, R86, CR10 1N4148 +15V, CR11 1N4148 -15V, R83 +15V, R84, A4, CR29 1N4148
R95, R96, A5, CR32 1N4148, R97, R98, R99 29.4K, R100, A5, CR33 1N4148, R101, R102, R120, R121, R103, C7 0.1uF, R104, A6, R105, R106, C6 0.1uF, R107, A6, R108, R109 +10V, Q3 2N2222, R110, R111, CR3 1N4148, R112 +15V
C1, C2, C3, C4, C5, R113 1S, R114, R115, VR1, +10V

A1 A2 A3 A4 A5 A6 +15V 4 11 -15V

4212948 | 1/1 | 01

REVISIONS

ZONE	REV	DESCRIPTION	ECN	DATE	DWN	CHK	APP
	01	ADDED +15V DC/DC CONVERTER AND CIRCUITRY. -REDRAWN-	NL99-1904	11-1	JFM		



421-2949

LeTourneau Inc.

-SCHEMATIC-
POWER SUPPLY CARD

SIZE	DWG NO	REV
D	4212948	01

SCALE 2/1 — SHEET 1 OF 1