Field Regulator

Instruction Manual
FR1000-000
FR3500-000

CAROTRON

Driven by Excellence

D.C. DRIVES, A.C. INVERTERS,
SOLID STATE STARTERS, SYSTEM INTERFACE
CIRCUITS AND ENGINEERED SYSTEMS

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1 General Description

The Carotron FR1000-000 and FR3500-000 are designed to provide current regulation for DC motor or generator field windings rated from 0.1A-10A and 10A to 35A, respectively. These units are easily set up as constant horsepower "crossover" controls to give a motor extended speed operation. Also, they can be set up as alternative field current supplies in single or multiple motor applications.

These units will operate from a single-phase 50/60 Hz line between 230 and 460VAC, ±10%, with no line voltage programming required. They have intuitive set-up with three basic adjustments: MIN CURRENT, MAX CURRENT and CROSSOVER set point. A built-in field current ammeter with 0.1-ampere resolution further simplifies set-up.

The units also have a field economy feature. When the motor is stopped (after a 3 minute delay), the regulator will reduce the field current output to prevent excessive heating in the motor.

A built-in independent DC tachometer scaling circuit is included. When the unit is used in a constant horsepower application (with CAROTRON drives from the CHOICE® or ELITE® series), the extended speed tachometer voltage can be easily scaled to interface with the standard 7V/1000 RPM tachometer input range. This alleviates the need to calculate resistor values to be added for scaling the tachometer input for models that do not have an adjustable tachometer input range.

Current control resolution is optimized with a programming jumper. The FR1000 has selections for 2, 4, 6, 8, & 10A. The FR3500 has selections for 15, 20, 25, 30 & 35A. There's no need to calculate the number of turns of wire to thread through a current sensor.

Fuses are provided for protection of the components in both the low voltage power supply and high current section.

2 Specifications

2.1 Electrical

A.C. Input (single phase)

- 230 VAC ± 10%, 50/60 Hz ± 2 Hz
- 460 VAC ± 10%, 50/60 Hz ± 2 Hz

Maximum DC Field Output

230VAC Input

- FR1000: 200 VDC, 10 Amps
- FR3500: 200 VDC, 35 Amps

460VAC Input

- FR1000: 400 VDC, 10 Amps
- FR3500: 400 VDC, 35 Amps

Field Current Trim

- 6 to 1 Range

Current Regulation

- ± 0.5% of set current

Operating Temperature Range

- 0-55º C

Adjustments

- P1 Tach Gain
- P2 Tach Offset
- P3 Min Field Current
- P4 Max Field Current
- P5 Crossover Set Point

Armature Input (Constant HP/Crossover Mode)

- 0 to ±240 VDC
- 0 to ±500 VDC

Maximum Tachometer Input

- ±250 VDC

2.2 Physical

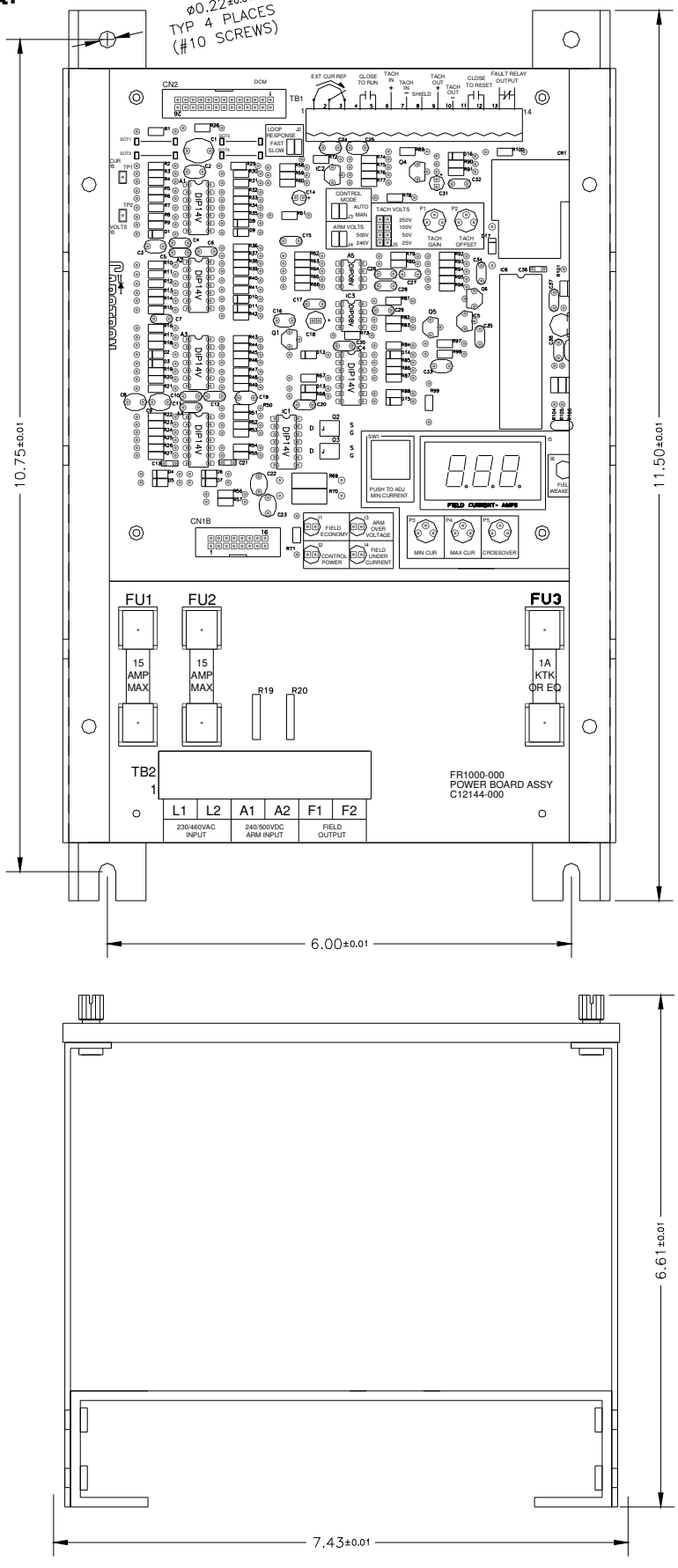
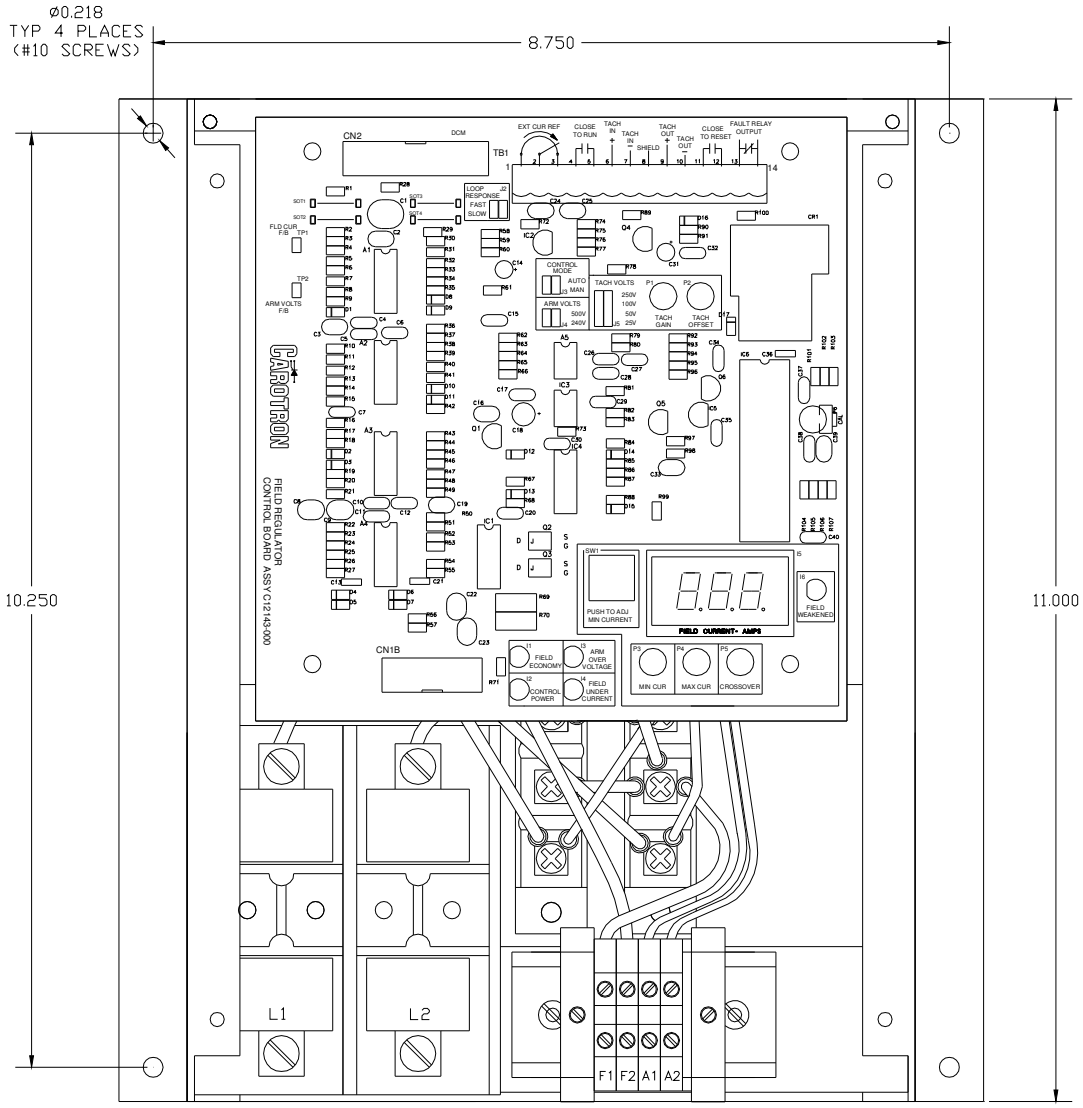


Figure 1: FR1000-000 Dimensions



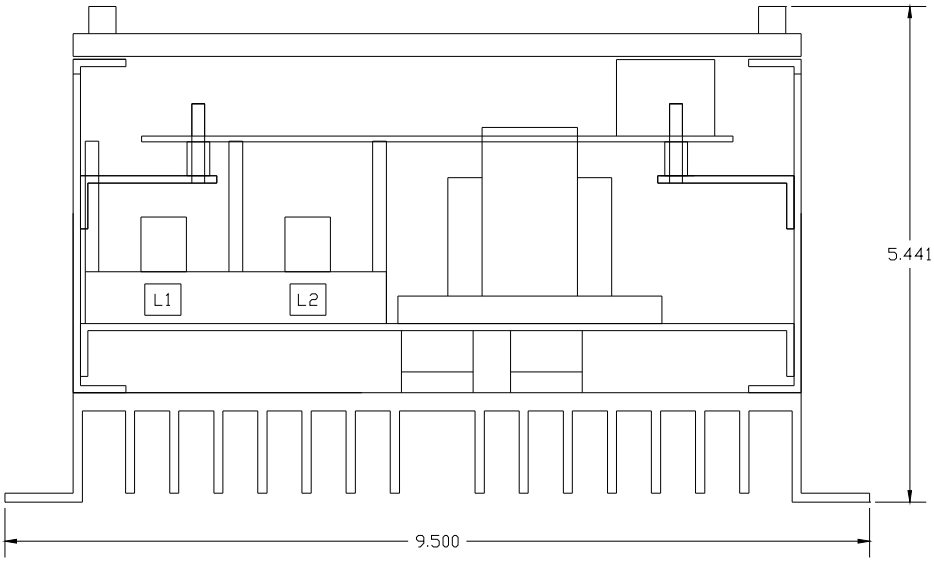


Figure 1: FR3500-000 Dimensions

3 Installation

3.1 Wiring Guidelines

To prevent electrical interference and to minimize start-up problems, adhere to the following guidelines:

The unit should be installed in accordance with the National Electric Code and any applicable local or state codes.

Use fully insulated and shielded cable for all signal wiring. The shield should be connected to circuit common at one end only. The other end of the shield should be clipped and insulated to prevent the possibility of accidental grounding.

Signal level wiring such as listed above should be routed separately from high level power wiring (such as the A.C. line, motor, operator control, and relay control wiring). When these two types of wire must cross, they should cross at right angles to each other.

Any relay, contactor, starter, solenoid or other electro-mechanical device located in close proximity to or on the same line supply as the unit should have a transient suppression device such as an MOV or R-C snubber connected in parallel with its coil. The suppressor should have short leads and be connected as close to the coil as possible.

3.2 Signal Connections

TB1 Terminals 1-3
Connections for an external potentiometer for field current control when in the manual mode. Note that a potentiometer connected with the clockwise terminal at TB1-3 will increase field current as the potentiometer setting is increased. When this potentiometer is used to control motor speed, it may be advantageous to swap the connections on TB1 terminals 1 & 3. Then, clockwise rotation of the potentiometer will cause a decrease in motor field which in turn will cause an increase in motor speed.

TB1 Terminals 4-5
RUN terminal. A contact closure signals the regulator to turn off field economy and return the output to full field. When this contact opens, the regulator will enter the field economy mode after approximately 3 minutes.

TB1 Terminals 6-8
DC tachometer from motor. Only used in Constant HP/Crossover mode. Terminal 8 is for incoming tachometer shield.

TB1 Terminals 9-10
Scaled tachometer output voltage to be used by the armature control/drive. Only used in Constant HP/Crossover mode.

TB1 Terminals 11-12
Fault reset. Momentary close a contact across these terminals to reset the fault

output.

TB1 Terminals 13-14
Fault contact. This is a contact that is closed during normal operation. The contact opens during a fault condition.

CN1
This connector is for the use of the DCM100-000 (Drive Circuit Monitor). This is an optional digital meter that can be used on many Carotron products for monitoring and troubleshooting.

3.3 Power Connections

L1-L2
The 230/460VAC power connects here. Typically, this power is any 2 lines of the 3 lines used to power the armature control/drive.

TB2 Terminals 1-2
The field output. These terminals connect to the motor field. F1 is positive and F2 is negative.

TB2 Terminals 3-4
Input terminals for the motor armature. These terminals are only used in the Constant HP/Crossover mode. If an Armature contactor is used, these terminals must be connected to the motor side of the contactor.

4 Programming & Adjustments

4.1 Programming Jumpers

JUMPER J1: Field Current (power board)
The unit has 5 ranges of current. The jumper should be set to the field current level required by the motor nameplate. The FR1000 has selections for 2, 4, 6, 8, & 10A. The FR3500 has selections for 15, 20, 25, 30, & 35A.

JUMPER J2: Loop Response (control board)
This setting is a function of the motor size. Smaller motors have less inductance and may need the FAST setting. Large motors may need the SLOW setting. The SOT terminals on the control board are provided for use in special applications.

JUMPER J3: Control Mode (control board)
The AUTO setting should be selected when operating in the Constant HP/Crossover mode. Otherwise, the manual (MAN) selection should be used.

JUMPER J4: Arm Volts (control board)
This setting is only applicable in the Constant HP/Crossover mode of operation. Set according to the motor's armature voltage rating.

JUMPER J5: Tach Volts (control board)
This setting is only applicable in the Constant HP/Crossover mode of operation. Set this according to the maximum DC tachometer voltage expressed as follows:

$$MaxVoltage = MaxMotorRPM \times \frac{TachVoltageRating}{1000}$$

For example, if the maximum motor speed is 2300RPM and the tachometer is rated for 50V (@1.000 RPM), the maximum tachometer voltage would be 2300*50/1000=115V.

4.2 Adjustment Potentiometers

P1: TACH GAIN
This setting is only applicable in the Constant HP/Crossover mode of operation. This adjustment sets the scaling of the tachometer output relative to the voltage from the motor tachometer.

P2: TACH OFFSET
This setting is only applicable in the Constant HP/Crossover mode of operation. This adjustment sets the tachometer output to zero with no voltage from the motor tachometer.

P3: MIN CUR
This adjustment sets the lowest level of field current (minimum current) when in the crossover mode or when the TB1 potentiometer is at full CCW in the manual mode. This level is also used when the unit enters field economy.

P4: MAX CUR
This adjustment sets the highest level of field current (maximum current) when in the crossover mode or when the TB1 potentiometer is at full CW in the manual mode.

P5: CROSSOVER
This setting is only applicable in the Constant HP/Crossover mode of operation. This sets the armature voltage level at which the field current begins to reduce (begins field weakening).

P6: FIELD CURRENT METER CALIBRATE
Factory set – do not adjust.

4.3 DCM Checkpoints/Testpoints

The reference point for test point measurements can be circuit common at TB1-1,7,8 or 10.

TP1:	Field current; 10V=100% (100% is the J1 selected value)
TP2:	Armature voltage (7.7V=motor base voltage)
DCM A:	+12VDC±5%
DCM B:	+5VDC±5%
DCM C:	+15VDC±5%
DCM D:	-15VDC±5%
DCM E:	Field current (scaled IFB, 2.37V=100%)
DCM F:	Armature over voltage fault status (high=fault)
DCM G:	+20VDC±7%
DCM I:	Scaled tachometer output (7V/1000RPM)
DCM J:	Field current (10V = 100%)
DCM K:	Field undercurrent fault status (high=fault)
DCM L:	Scaled tachometer input
DCM M:	Current reference (10V=Max current, 0v=Min current)
DCM N:	Scaled armature volts (7.7V=100% armature volts)
DCM O:	Field economy status (low=in field economy)
DCM P:	Crossover set point
DCM R:	-20VDC±7%
DCM S:	Regulation trigger voltage (regulation loop error): sums with the phase reference saw tooth voltage to create the trigger pulses
DCM T:	Field weakening voltage (>10V = Max field, <0V = Min field)

5 Adjustment Procedure

5.1 Modes of Operation

The Field Regulator Unit has three programmable modes of operation. Two of the modes use field current reduction to increase motor speed, which also results in reduced output torque from the motor. Each of the modes is described in greater detail below.

FIXED SUPPLY

In this mode, the field regulator provides a fixed field current output while the motor is running.

VARIABLE SUPPLY

In this mode, the extended motor speed is utilized by weakening the motor field. This can be accomplished with a manual potentiometer or with a dancer potentiometer.

CONSTANT HORSEPOWER/CROSSOVER SUPPLY

This mode allows extended speed operation of the motor (with constant horsepower above base speed). In this mode, the regulator monitors the motor armature voltage and sets the motor field current appropriately. The tachometer feedback is required to keep motor speed linear with respect to the speed reference.

5.2 FIXED SUPPLY QUICK START

1. Refer to Figure 3 on Page 23.
2. Make preparations to measure the armature voltage with a DC voltmeter.
3. Have a tachometer ready to measure the motor shaft or machine speed.
4. Pre-set pots and jumpers as follows:
    a. J1, CURRENT RANGE, (on Power Board) position near base (max) field current
    b. J3, CONTROL MODE, jumper to MAN position
    c. P3, MIN FIELD CURRENT, fully CCW (counter clock-wise)
    d. P4, MAX FIELD CURRENT, fully CCW
    e. Connect a wire jumper across TB1 terminals 2 to 3.
    f. Temporarily connect a wire jumper across TB1 terminals 4 & 5 to defeat the field economy feature.
    g. Other potentiometers and jumpers not critical for initial startup
5. Place the armature control/drive in “Armature Feedback” mode.
6. Power up the Field Regulator. Do not run the drive/armature supply!
7. Press and hold SW1, MIN FIELD SET, and adjust P3 to approximately 50% of desired field current. Release SW1. Adjust P4 to obtain the desired maximum field current. Typically, this is the maximum rated motor field current (on motor nameplate).
8. Power down the regulator, remove temporary jumper on TB1 terminals 4 & 5, and connect a run contact to these terminals. This enables the field economy feature.
9. Re-apply power, start the drive, and adjust for maximum rated armature voltage. Measure motor speed. If required, the field current can be reduced

to increase speed, but this will result in decreased motor torque. If a reduction in motor speed is required, use the drive's max speed adjustments.

10. Stop the drive and place in Tachometer Feedback mode if necessary. Re-check maximum speed and adjust with the armature voltage as required.

5.3 VARIABLE SUPPLY QUICK START

1. Refer to Figure 4 on Page 23.
2. Make preparations to measure the armature voltage with a DC voltmeter.
3. Have a tachometer ready to measure the motor shaft or machine speed.
4. Connect a potentiometer (2k minimum), on TB1 terminals 1-3. This is the field control potentiometer.
5. Pre-set pots and jumpers as follows:
    a. J1, CURRENT RANGE, (on Power Board) position near base (max) field current
    b. J3, CONTROL MODE, jumper to MAN position
    c. P3, MIN FIELD CURRENT, fully CCW (counter clock-wise)
    d. P4, MAX FIELD CURRENT, fully CCW
    e. Adjust the external field control potentiometer fully CW to demand maximum field current.
    f. Temporarily connect a wire jumper across TB1 terminals 4 & 5 to defeat the field economy feature.
    g. Other potentiometers and jumpers not critical for initial startup
6. Place the armature control/drive in “Armature Feedback” mode.
7. Power up the Field Regulator and adjust P4 to base (max) field current (on motor nameplate). Reset any regulator faults, if present.
8. Start the armature control/drive, and adjust to maximum rated armature voltage. This should produce base speed on the motor.
9. While monitoring motor speed, SLOWLY decrease the external field control potentiometer until rated extended speed (or desired maximum speed) is reached. Note this field current level.
10. Stop the armature control/drive. Set P4 fully CCW. Press and hold SW1 MIN FIELD SET button. Adjust P3 to the current for extended speed (step 9). Release the button. Set P4 until base (max) field current is obtained.
11. Power down the regulator, remove temporary jumper on TB1 terminals 4 & 5, and connect a run contact to these terminals. This enables the field economy feature.
12. Turn on the motor and confirm the range of the TB1 pot to cover the speed range of base speed to max speed.

5.4 CONSTANT HP/CROSSOVER QUICK START

NOTE: The armature control/drive must have a 7V/1000RPM tachometer input setting or it must be able to directly scale the extended speed tachometer voltage. An encoder may also be used if the drive can directly scale the extended speed level. Steps below marked with an * may be skipped if the tachometer or encoder will be scaled directly by the drive.

1. Refer to Figure 5 on Page 23.
2. Make preparations to measure the armature voltage with a DC voltmeter.
3. Have a tachometer ready to measure the motor shaft or machine speed.
4. Pre-set pots and jumpers as follows:
    a. J1, CURRENT RANGE, (Power Board) near base (max) field

current.
   b. J2, LOOP RESPONSE, to the fast position.
   c. J3, CONTROL MODE, jumper on the Control Board to MAN position.
   d. J4, ARM VOLTS, to correct voltage position.
   e. *J5, TACH VOLTS, to tachometer voltage at full speed
   f. Connect a wire jumper across TB1 terminals 2 to 3.
   g. *P1, TACH GAIN, fully CCW (counter clock-wise)
   h. P3, MIN FIELD CURRENT, fully CCW
   i. P4, MAX FIELD CURRENT, fully CCW
   j. P5, CROSSOVER, fully CW.
   k. Temporarily connect a wire jumper across TB1 terminals 4 & 5 to defeat the field economy feature.
   l. Other pots and jumpers not critical for the initial startup.
5. On the armature control/drive:
   a. Place in “Armature Feedback” mode
   b. TACH VOLTS jumper to 7V/1000RPM on the armature control
   c. Temporarily adjust ACCEL and DECEL times of armature control to at least 15 to 20 seconds.
6. Power up the field regulator. Do not run the armature control/drive.
7. Adjust P4, MAX FIELD CURRENT, to get the base field current (from the nameplate). Raise P3, MIN FIELD CURRENT, slightly if desired current cannot be obtained by adjusting P4.
8. *Adjust the P2, TACH OFFSET, so there is 0.0 volts on the TACH OUT terminals (TB1-9 &10)
9. Start the armature control/drive, and adjust to motor maximum rated armature voltage. This should produce motor base speed. Check the motor speed with a tachometer.
10. Reduce the field current with P4 (MAX FIELD CURRENT) to achieve the desired extended speed. The field current now flowing is the <u>weakened field</u> current. Note this current level.
11. If the tachometer is being re-scaled by the regulator, measure across TB1 terminals 9 & 10, and adjust P1, TACH GAIN, to get 12.25VDC. If the tachometer or encoder is being rescaled directly by the drive, measure the feedback level and scale appropriately in the drive.
12. Stop the armature control/drive. Set P4 fully CCW. Press and hold SW1 MIN FIELD SET button. Adjust P3, MIN FIELD CURRENT, to the weakened field current (step 10). Release the button, and set P4, MAX FIELD CURRENT, to the base field current level (same as step 7).
13. Re-start the armature supply and slowly increase the speed reference to make the armature voltage equal to about 92% of the rated armature voltage.
14. Decrease the P5 ,CROSSOVER SET POINT, to the level where the I6, FIELD WEAKENED, LED just turns on. Stop at that point. Stop the armature control/drive and remove all power.
15. Select Tach Feedback (or Encoder if applicable) on the armature control. On the field regulator, place jumper J3 in the AUTO position.

NOTE: Closely monitor the motor speed during the next step. If the speed is unstable, go to step 17 to adjust out this instability.

16. Re-apply power and start the armature control/drive with the speed reference at zero. Slowly raise the speed and monitor the field current and armature voltage. When the armature voltage reaches the crossover level (92%), the field current will begin to decrease. As the speed reference is increased to maximum, the field current will decrease to the minimum level. With tachometer (or encoder) feedback, the speed will be proportional to the speed reference. Adjust the max speed pot on the armature control to get the speed range desired. Do not exceed the nameplate armature voltage. If the operation is stable, set-up is complete.
17. With the speed reference fixed at an unstable point, try to adjust the velocity and current tuning adjustments on the armature control/drive. If this is not successful, stop the motor, remove AC power from the Field Regulator, and move the J2 jumper to the “SLOW” position. Restart the motor, and if necessary, retry the armature velocity and current tuning adjustments. When the speed is steady, go back to step 16.

6 Special Circuit Functions

6.1 Fault Conditions

The regulator has two fault modes, ARMATURE OVER VOLTAGE and FIELD UNDER CURRENT. The ARMATURE OVER VOLTAGE fault will latch if the actual armature voltage exceeds 125% of the level selected by J4. The FIELD UNDER CURRENT fault will latch if the actual field current falls below 25% of the actual setpoint. Each fault has an LED Indicator. Either fault will cause the fault relay contact on TB1 terminals 13 and 14 to open. Momentarily closing a contact across TB1 terminals 11 and 12 will reset the fault.

6.2 Analog Outputs

The regulator provides analog output signals for field current (TP1) and armature voltage (TP2). These signals are measured with respect to circuit common at TB1 terminals 1, 7, 8 or 10. The signals are accessed as test point connections (0.110" x 0.020") quick connects. TP1, IFB Meter, outputs 10 VDC at 100% of the current range programmed by J1 on the Power Board. TP2, Scaled Armature Volts, outputs 7.7 VDC at 100% of the voltage range programmed by J4 on the Control Board.

7 Spare Parts

7.1 Circuit Board Assemblies

Control Board
All Models C12143-000

Power Board
Model FR1000-000 ..... C12144
Model FR3500-000 ..... C12251

7.2 Power Components

Model FR1000-000
Dual diode, 31 ampere, 1400 V PMD1028-00
Dual SCR, 25 ampere, 1400 V PMD1017-00

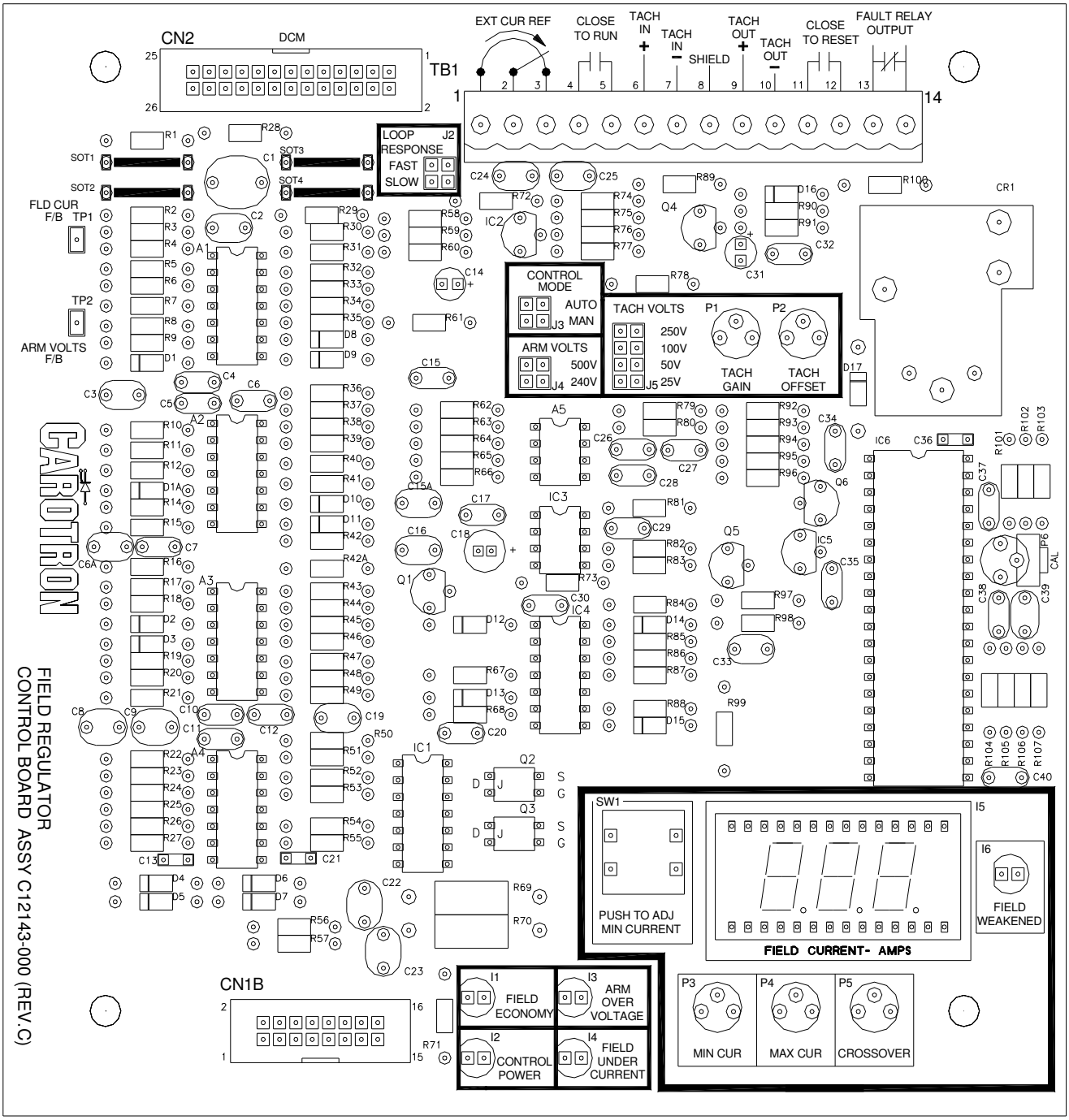
Model FR3500-000
Dual diode, 61 ampere, 1400 V PMD1028-01
Dual SCR, 56 ampere, 1400 V PMD1026-00

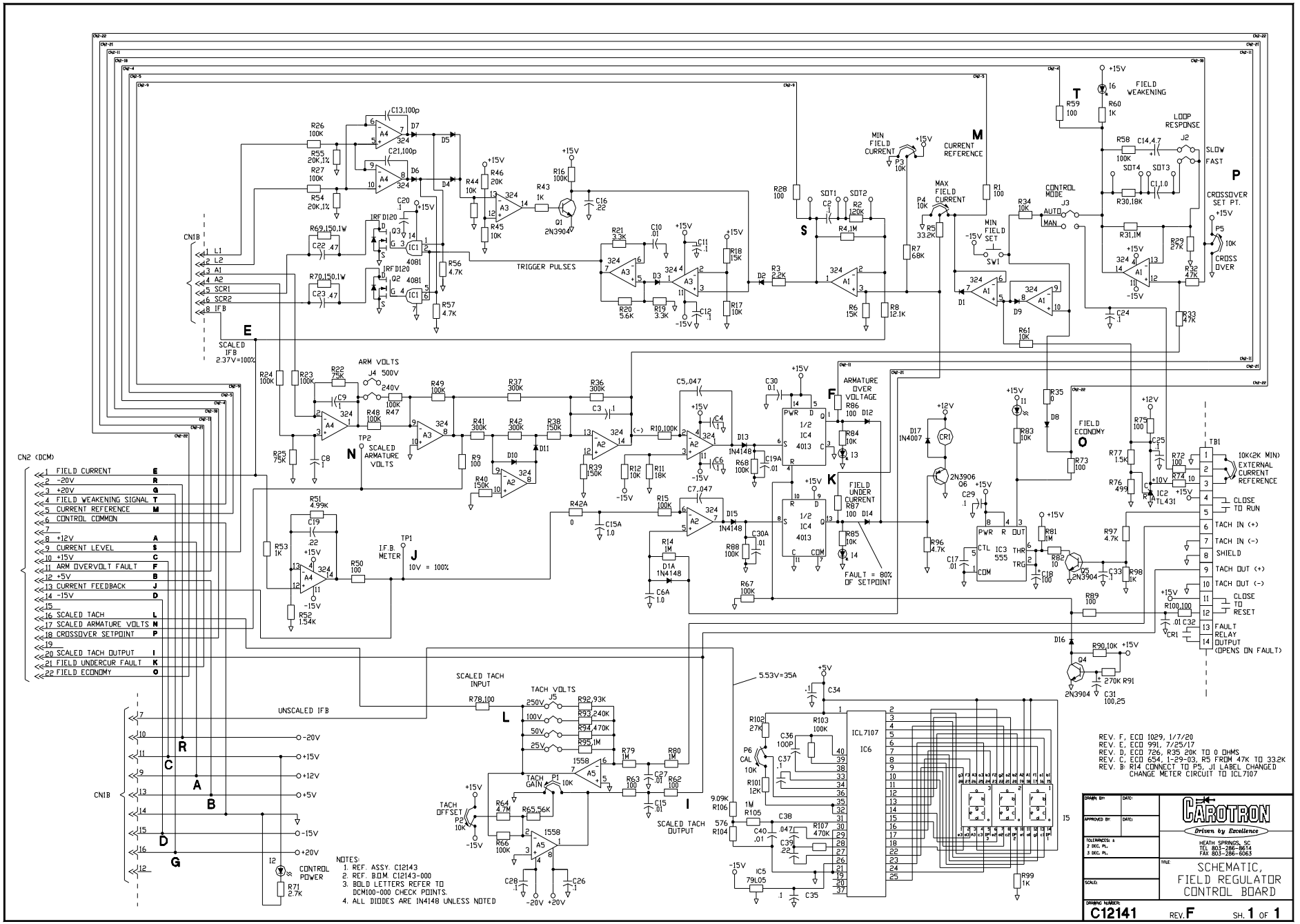
7.3 Fuses

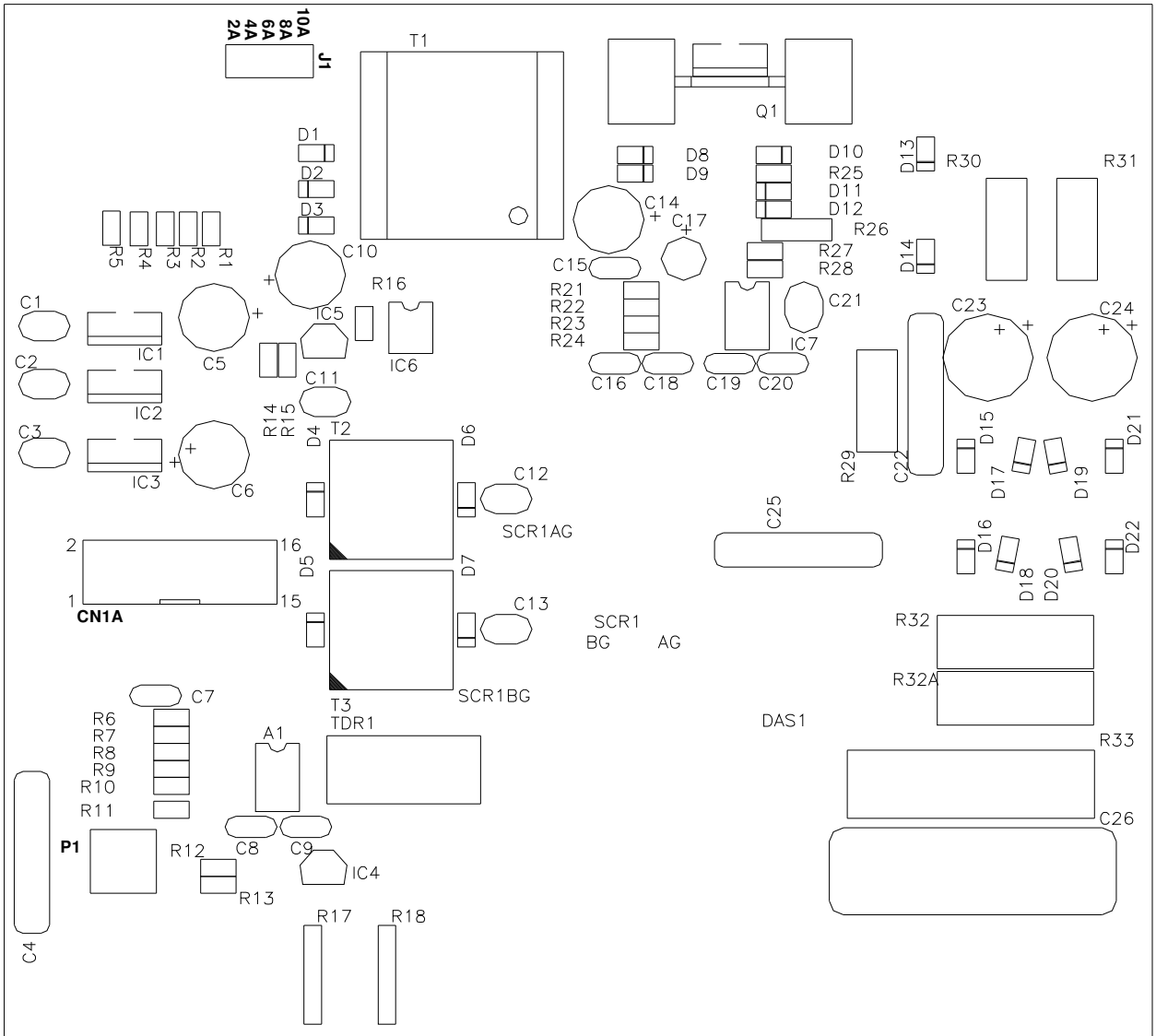
Model FR1000-000
FU1 & FU2: 15A, 600V, Buss KTK FUS1004-00
FU3: 1A, 600V, Littelfuse KTK FUS1004-01

Model FR3500-000
Main: 40A, 600V, Littelfuse type JLS40 ..... FUS1015-00
FU1: 1A, 600V, Buss FNQ-R FUS1007-00

8 Prints


CN2
DCM
TB1
EXT CUR REF
CLOSE TO RUN
TACH IN +
TACH IN −
SHIELD
TACH OUT +
TACH OUT −
CLOSE TO RESET
FAULT RELAY OUTPUT
LOOP RESPONSE
J2
FAST
SLOW
FLD CUR F/B
TP1
TP2
ARM VOLTS F/B
CONTROL MODE
AUTO
MAN
J3
ARM VOLTS
500V
240V
J4
TACH VOLTS
250V
100V
50V
25V
J5
P1
P2
TACH GAIN
TACH OFFSET
CR1
GARROTTRON
FIELD REGULATOR
CONTROL BOARD ASSY C12143-000 (REV.C)
CN1B
SW1
PUSH TO ADJ MIN CURRENT
FIELD CURRENT- AMPS
FIELD WEAKENED
I1
FIELD ECONOMY
I2
CONTROL POWER
I3
ARM OVER VOLTAGE
I4
FIELD UNDER CURRENT
P3
P4
P5
MIN CUR
MAX CUR
CROSSOVER


CN2 (DCM)
1 FIELD CURRENT E
2 -20V R
3 +20V Q
4 FIELD WEAKENING SIGNAL T
5 CURRENT REFERENCE M
6 CONTROL COMMON
7
8 +12V A
9 CURRENT LEVEL S
10 +15V C
11 ARM OVERVOLT FAULT F
12 +5V B
13 CURRENT FEEDBACK J
14 -15V D
15
16 SCALED TACH L
17 SCALED ARMATURE VOLTS N
18 CROSSOVER SETPOINT P
19
20 SCALED TACH OUTPUT I
21 FIELD UNDERCUR FAULT K
22 FIELD ECONOMY O
CN1B
L1
L2
A1
A2
SCR1
SCR2
IFB
SCALED IFB 2.37V=100%
TRIGGER PULSES
MIN FIELD CURRENT
MAX FIELD CURRENT
CURRENT REFERENCE
MIN FIELD SET
CONTROL MODE
AUTO
MAN
FIELD WEAKENING
LOOP RESPONSE
SLOW
FAST
CROSSOVER SET PT.
CROSS OVER
ARM VOLTS
SCALED ARMATURE VOLTS
ARMATURE OVER VOLTAGE
FIELD UNDER CURRENT
FAULT = 80% OF SETPOINT
FIELD ECONOMY
10K(2K MIN) EXTERNAL CURRENT REFERENCE
CLOSE TO RUN
TACH IN (+)
TACH IN (-)
SHIELD
TACH OUT (+)
TACH OUT (-)
CLOSE TO RESET
FAULT RELAY OUTPUT (OPENS ON FAULT)
I.F.B. METER
10V = 100%
UNSCALED IFB
SCALED TACH INPUT
TACH VOLTS
250V
100V
50V
25V
TACH GAIN
TACH OFFSET
SCALED TACH OUTPUT
5.53V=35A
ICL7107
IC6
CONTROL POWER
-20V
+15V
+12V
+5V
-15V
+20V
NOTES:
1. REF. ASSY. C12143
2. REF. BOM C12143-000
3. BOLD LETTERS REFER TO DCM100-000 CHECK POINTS.
4. ALL DIODES ARE IN4148 UNLESS NOTED
REV. F, ECO 1029, 1/7/20
REV. E, ECO 991, 7/25/17
REV. D, ECO 726, R35 20K TO 0 OHMS
REV. C, ECO 654, 1-29-03, R5 FROM 47K TO 33.2K
REV. B: R14 CONNECT TO P5, J1 LABEL CHANGED
CHANGE METER CIRCUIT TO ICL7107
DRAWN BY:
DATE:
APPROVED BY:
DATE:
TOLERANCES: ± 2 DEC. PL. 3 DEC. PL.
SCALE:
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
TITLE:
SCHEMATIC, FIELD REGULATOR CONTROL BOARD
DRAWING NUMBER:
C12141
REV. F
SH. 1 OF 1



FU1

15 AMP MAX

FU2

15 AMP MAX

R19

R20

FU3

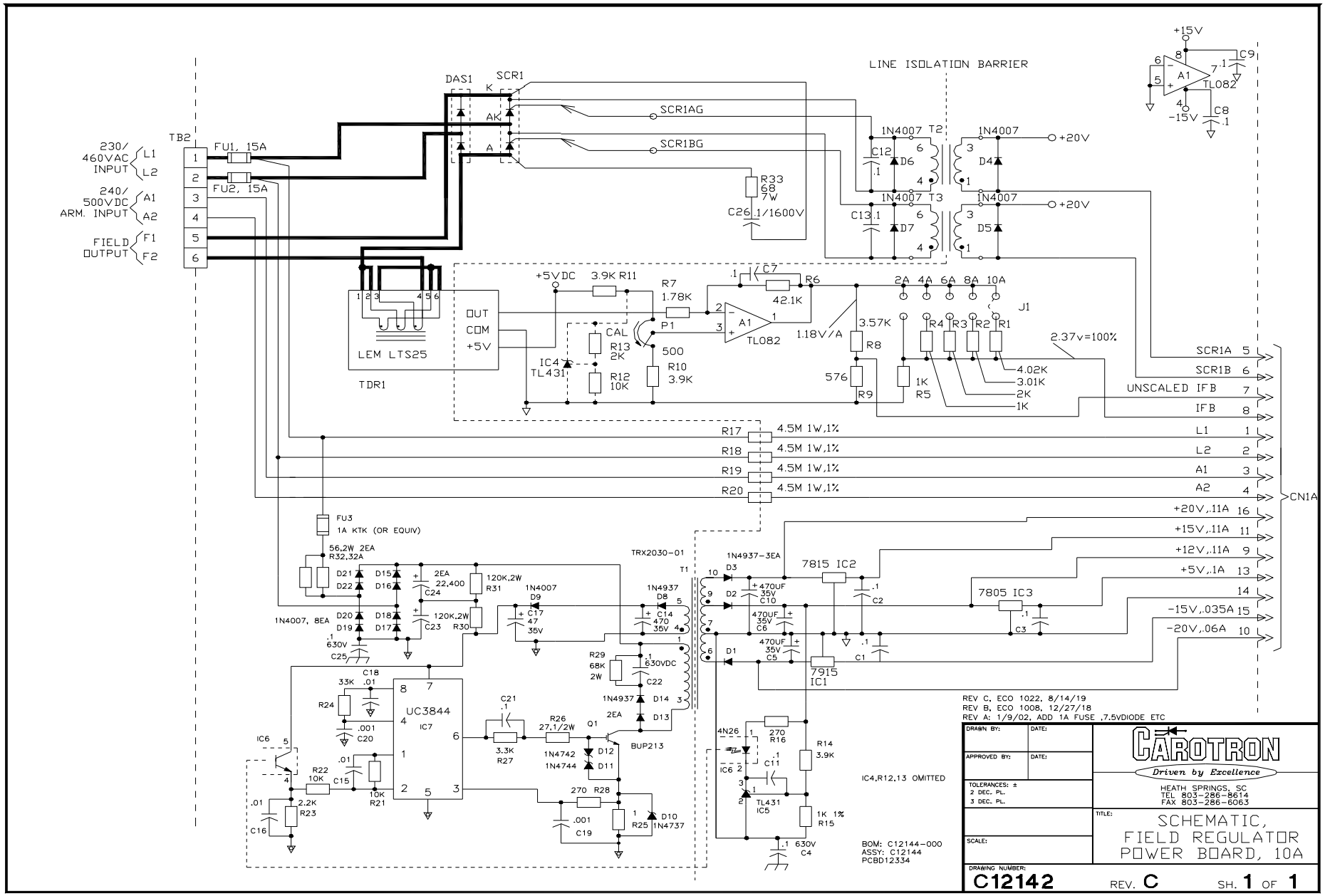
1A KTK OR EQ

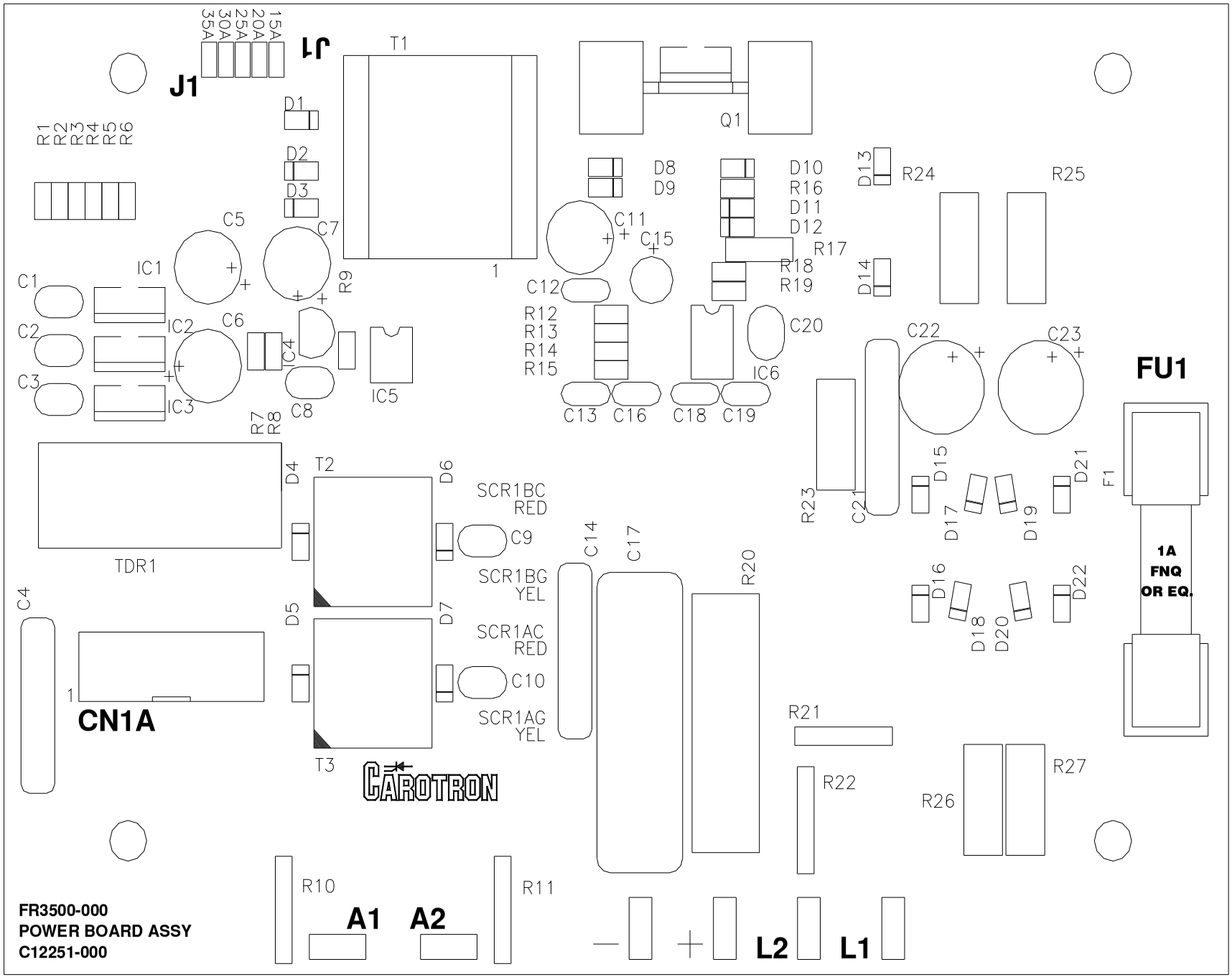
TB2

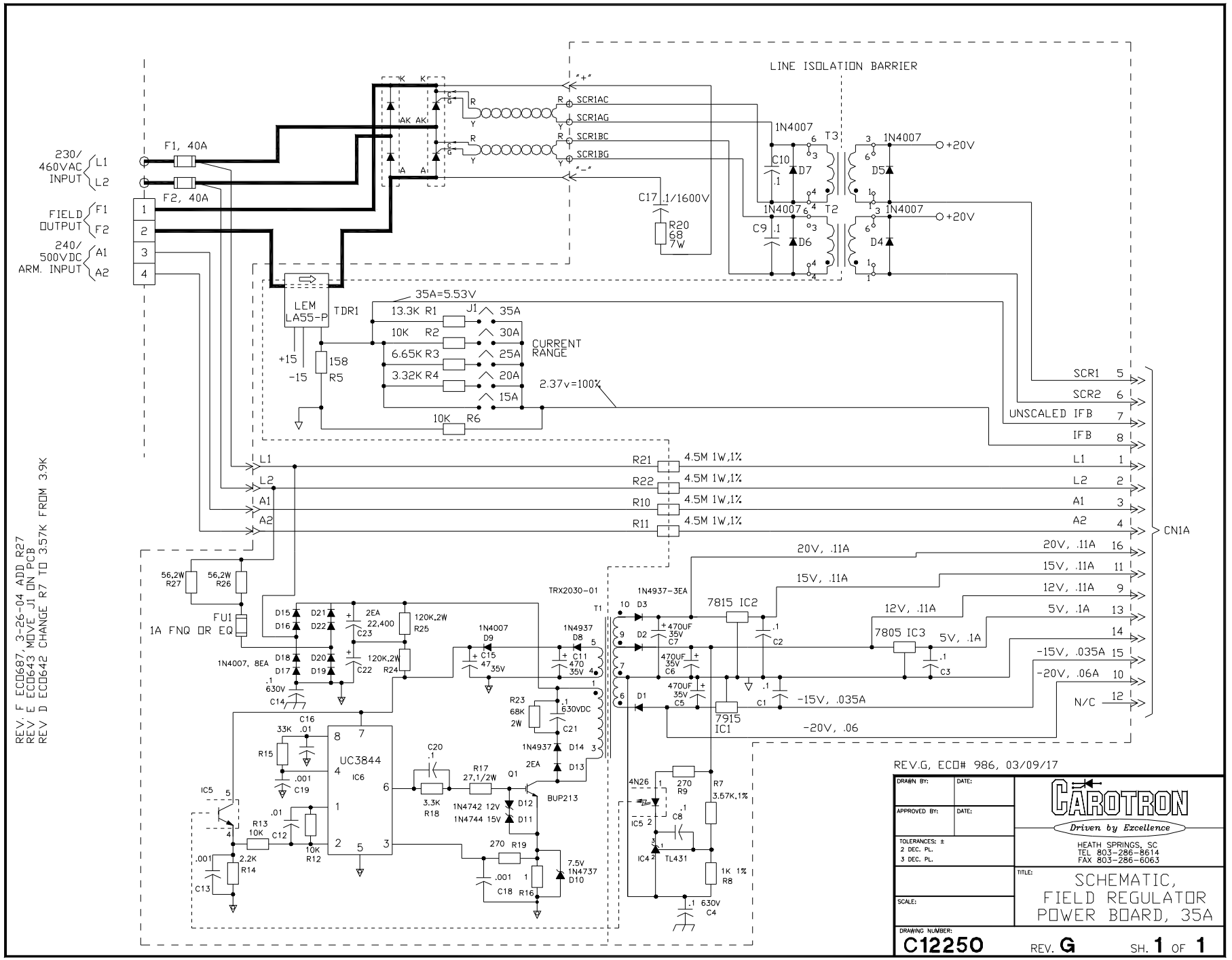
1

L1	L2	A1	A2	F1	F2
230/460VAC INPUT		240/500VDC ARM INPUT		FIELD OUTPUT	

FR1000-000
POWER BOARD ASSY
C12144-000


LINE ISOLATION BARRIER
TB2
230/ 460VAC INPUT
240/ 500VDC ARM. INPUT
FIELD OUTPUT
FU1, 15A
FU2, 15A
DAS1
SCR1
SCR1AG
SCR1BG
R33 68 7W
C26 .1/1600V
1N4007 T2
1N4007 T3
C12 .1
C13 .1
D6
D7
D4
D5
+20V
+15V
-15V
A1 TL082
C9 .1
C8 .1
LEM LTS25
TDR1
OUT
COM
+5V
+5VDC
3.9K R11
R7 1.78K
C7 .1
R6 42.1K
2A 4A 6A 8A 10A
J1
CAL
R13 2K
P1 500
R10 3.9K
IC4 TL431
R12 10K
1.18V/A
3.57K
R8
576
R9
1K
R5
R4
R3
R2
R1
4.02K
3.01K
2K
1K
2.37v=100%
SCR1A 5
SCR1B 6
UNSCALED IFB 7
IFB 8
L1 1
L2 2
A1 3
A2 4
CN1A
R17 4.5M 1W,1%
R18 4.5M 1W,1%
R19 4.5M 1W,1%
R20 4.5M 1W,1%
FU3
1A KTK (OR EQUIV)
56,2W 2EA
R32,32A
1N4007, 8EA
D21
D22
D15
D16
D20
D19
D18
D17
2EA
22,400
C24
C23
120K,2W
R31
R30
1N4007
D9
C17 47 35V
.1 630V
C25
TRX2030-01
T1
1N4937
D8
C14 470 35V
1N4937-3EA
D3
D2
D1
470UF 35V C10
470UF 35V C6
470UF 35V C5
7815 IC2
7805 IC3
7915 IC1
C2
C3
C1
+20V,.11A 16
+15V,.11A 11
+12V,.11A 9
+5V,.1A 13
14
-15V,.035A 15
-20V,.06A 10
R29 68K 2W
.1 630VDC
C22
1N4937
D14
D13
2EA
C18
33K .01
R24
.001
C20
UC3844
IC7
C21 .1
3.3K R27
R26 27,1/2W
Q1
BUP213
1N4742
1N4744
D12
D11
270 R28
.001
C19
R25
D10 1N4737
IC6
R22 10K
C15 .01
10K R21
.01
2.2K R23
C16
4N26
270 R16
C11 .1
R14 3.9K
IC6
IC5 TL431
1K 1% R15
.1 630V C4
IC4,R12,13 OMITTED
BOM: C12144-000
ASSY: C12144
PCBD12334
REV C, ECO 1022, 8/14/19
REV B, ECO 1008, 12/27/18
REV A: 1/9/02, ADD 1A FUSE ,7.5VDIODE ETC
DRAWN BY:
DATE:
APPROVED BY:
DATE:
TOLERANCES: ±
2 DEC. PL.
3 DEC. PL.
SCALE:
DRAWING NUMBER:
C12142
REV. C
SH. 1 OF 1
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
TITLE:
SCHEMATIC,
FIELD REGULATOR
POWER BOARD, 10A


15A
20A
25A
30A
35A
J1
J1
T1
Q1
D1
D2
D3
R1
R2
R3
R4
R5
R6
C5
C7
IC1
C1
C2
C3
IC2
IC3
C6
C4
C8
R9
R7
R8
IC5
D8
D9
C11
C15
C12
D10
R16
D11
D12
R17
R18
R19
D13
R24
R25
D14
R12
R13
R14
R15
C13
C16
C18
C19
IC6
C20
C22
C23
FU1
R23
C21
D15
D17
D19
D21
F1
1A
FNQ
OR EQ.
D16
D18
D20
D22
D4
T2
D6
SCR1BC
RED
C9
TDR1
SCR1BG
YEL
D5
D7
SCR1AC
RED
C10
SCR1AG
YEL
T3
C14
C17
R20
C4
1
CN1A
R21
R22
R26
R27
CAROTRON
R10
R11
A1
A2
L2
L1
FR3500-000
POWER BOARD ASSY
C12251-000


LINE ISOLATION BARRIER
230/ 460VAC INPUT
L1
L2
F1, 40A
F2, 40A
FIELD OUTPUT
F1
F2
240/ 500VDC ARM. INPUT
A1
A2
SCR1AC
SCR1AG
SCR1BC
SCR1BG
1N4007
C10 .1
C9 .1
C17 .1/1600V
R20 68 7W
T3
T2
D7
D6
D5
D4
+20V
LEM LA55-P
TDR1
35A=5.53V
13.3K R1
10K R2
6.65K R3
3.32K R4
10K R6
J1
35A
30A
25A
20A
15A
CURRENT RANGE
+15
-15
158 R5
2.37v=100%
SCR1 5
SCR2 6
UNSCALED IFB 7
IFB 8
L1 1
L2 2
A1 3
A2 4
CN1A
R21 4.5M 1W,1%
R22 4.5M 1W,1%
R10 4.5M 1W,1%
R11 4.5M 1W,1%
56,2W R27
56,2W R26
FU1
1A FNQ OR EQ
1N4007, 8EA
D15
D16
D21
D22
D18
D17
D20
D19
2EA 22,400 C23
120K,2W R25
120K,2W R24
C14 .1 630V
1N4007 D9
C15 47 35V
TRX2030-01
T1
1N4937 D8
C11 470 35V
1N4937-3EA
7815 IC2
20V, .11A
15V, .11A
12V, .11A
5V, .1A
-15V, .035A
-20V, .06A
N/C
7805 IC3
7915 IC1
C7 470UF 35V
C6 470UF 35V
C5 470UF 35V
C2 .1
C3 .1
C1 .1
R23 68K 2W
C21 .1 630VDC
1N4937 D14
2EA D13
C16 33K .01
R15
C19 .001
UC3844 IC6
C20 .1
R17 27,1/2W
Q1
BUP213
3.3K R18
1N4742 12V D12
1N4744 15V D11
270 R19
C18 .001
R16
7.5V 1N4737 D10
IC5
R13 10K
C12 .01
R12 10K
C13 .001
R14 2.2K
4N26
270 R9
C8 .1
IC4 TL431
R7 3.57K,1%
1K 1% R8
C4 .1 630V
REV. F ECO687, 3-26-04 ADD R27
REV E ECO643 MOVE J1 ON PCB
REV D ECO642 CHANGE R7 TO 3.57K FROM 3.9K
REV.G, ECO# 986, 03/09/17
DRAWN BY:
DATE:
APPROVED BY:
DATE:
TOLERANCES: ±
2 DEC. PL.
3 DEC. PL.
CAROTRON
Driven by Excellence
HEATH SPRINGS, SC
TEL 803-286-8614
FAX 803-286-6063
TITLE:
SCHEMATIC,
FIELD REGULATOR
POWER BOARD, 35A
SCALE:
DRAWING NUMBER:
C12250
REV. G
SH. 1 OF 1

GENERAL CONNECTIONS

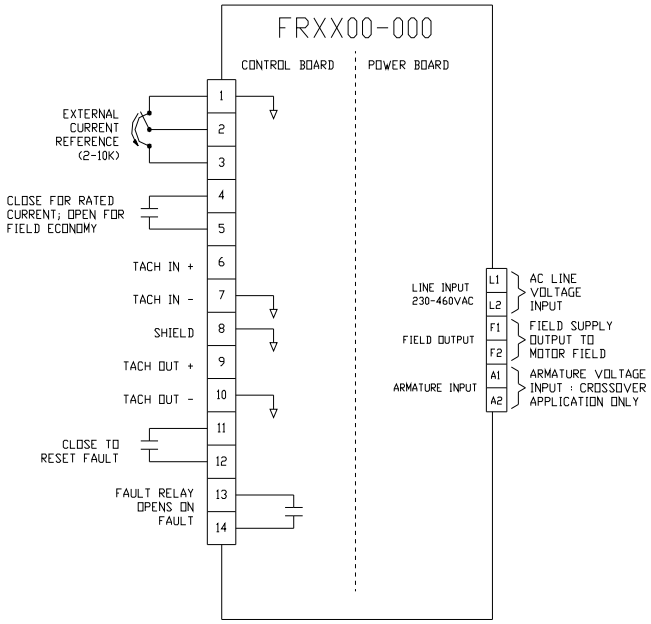
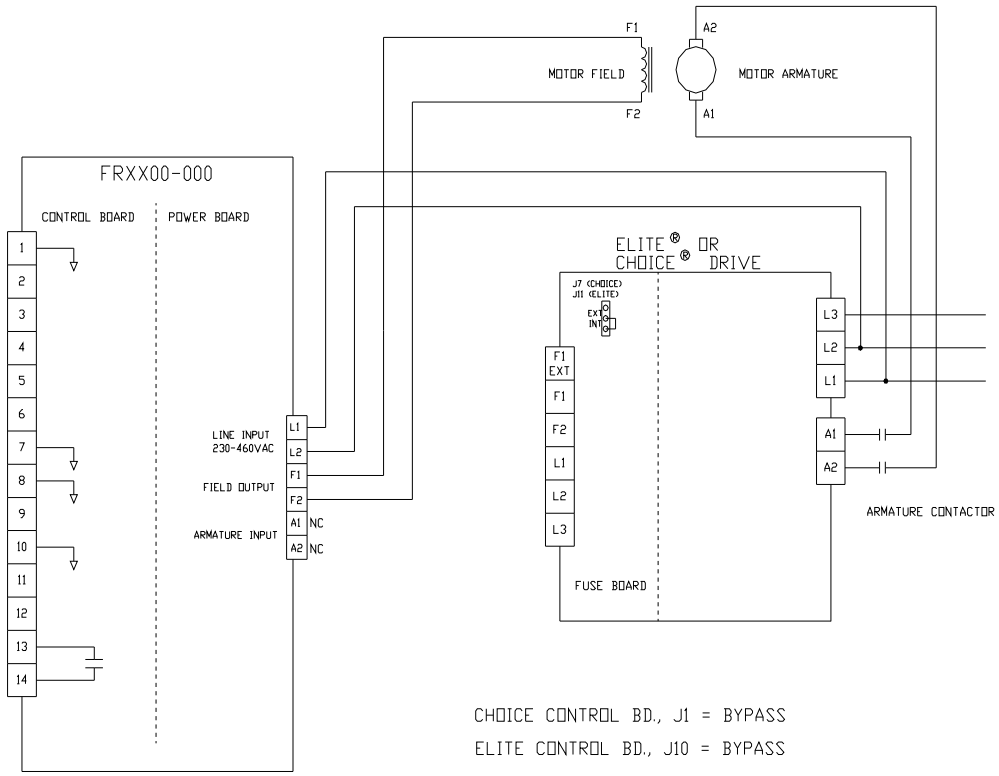


FIG 1

TYPICAL POWER BD. TB2 CONNECTIONS FOR CAROTRON ELITE OR CHOICE SERIES DRIVES AS FIXED FIELD SUPPLY

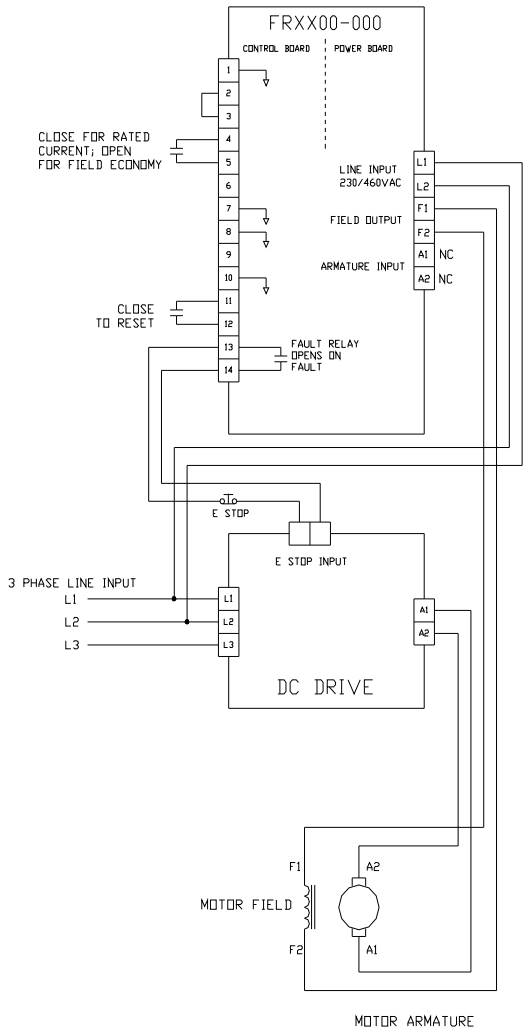


CHOICE CONTROL BD., J1 = BYPASS

ELITE CONTROL BD., J10 = BYPASS

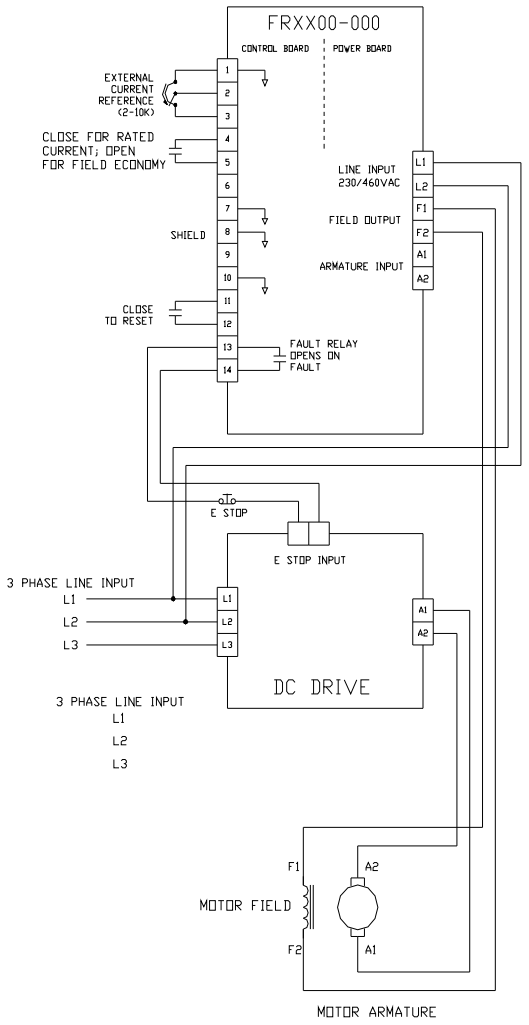
FIG2

DRAWN BY: DJS	DATE: 7-23-01	CAROTRON Driven by Excellence
APPROVED BY:	DATE:	HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
TOLERANCES: ± 2 DEC. PL. = .010" 3 DEC. PL. = .005"		TITLE: FR1000,3500 APPLICATIONS
SCALE:		
DRAWING NUMBER: D12506	REV. C	SH. 1 OF 2



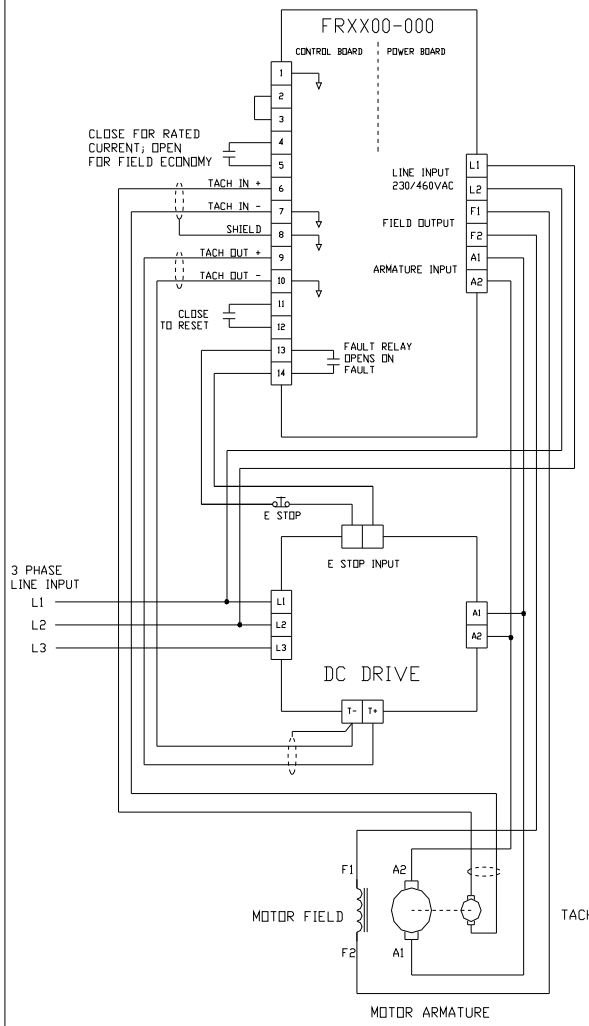
FIXED FIELD SUPPLY

FIG 3



VARIABLE FIELD SUPPLY

FIG 4



CROSSOVER FIELD SUPPLY

FIG 5

THESE ARE GENERAL DRAWINGS. REFER TO DC DRIVE MANUAL FOR SPECIFIC INFORMATION

DRAWN BY: DJS	DATE: 7-23-01	CAROTRON Driven by Excellence
APPROVED BY:	DATE:	HEATH SPRINGS, SC TEL 803-286-8614 FAX 803-286-6063
TOLERANCES: ± 2 DEC PL = .010" 3 DEC PL = .005"		TITLE: FR1000,3500 APPLICATIONS
SCALE:		
DRAWING NUMBER: D12506	REV. C	SH. 2 OF 2

9 Standard Terms & Conditions of Sale

1. General
The Standard Terms and Conditions of Sale of Carotron, LLC. (hereinafter called "Company") are set forth as follows in order to give the Company and the Purchaser a clear understanding thereof. No additional or different terms and conditions of sale by the Company shall be binding upon the Company unless they are expressly consented to by the Company in writing. The acceptance by the Company of any order of the Purchaser is expressly conditioned upon the Purchaser's agreement to said Standard Terms and Conditions. The acceptance or acknowledgement, written, oral, by conduct or otherwise, by the Company of the Purchaser's order shall not constitute written consent by the Company to addition to or change in said Standard Terms and Conditions.

2. Prices
Prices, discounts, allowances, services and commissions are subject to change without notice. Prices shown on any Company published price list and other published literature issued by the Company are not offers to sell and are subject to express confirmation by written quotation and acknowledgement. All orders of the Purchaser are subject to acceptance, which shall not be effective unless made in writing by an authorized Company representative at its office in Heath Springs, S.C. The Company may refuse to accept any order for any reason whatsoever without incurring any liability to the Purchaser. The Company reserves the right to correct clerical and stenographic errors at any time.

3. Shipping dates
Quotation of a shipping date by the Company is based on conditions at the date upon which the quotation is made. Any such shipping date is subject to change occasioned by agreements entered into previous to the Company's acceptance of the Purchaser's order, governmental priorities, strikes, riots, fires, the elements, explosion, war, embargoes, epidemics, quarantines, acts of God, labor troubles, delays of vendors or of transportation, inability to obtain raw materials, containers or transportation or manufacturing facilities or any other cause beyond the reasonable control of the Company. In no event shall the Company be liable for consequential damages for failure to meet any shipping date resulting from any of the above causes or any other cause.

In the event of any delay in the Purchaser's accepting shipment of products or parts in accordance with scheduled shipping dates, which delay has been requested by the Purchaser, or any such delay which has been caused by lack of shipping instructions, the Company shall store all products and parts involved at the Purchaser's risk and expense and shall invoice the Purchaser for the full contract price of such products and parts on the date scheduled for shipment or on the date on which the same is ready for delivery, whichever occurs later.

4. Warranty
The Company warrants to the Purchaser that products manufactured or parts repaired by the Company, will be free, under normal use and maintenance, from defects in material and workmanship for a period of one (1) year after the shipment date from the Company's factory to the Purchaser. The Company makes no warranty concerning products manufactured by other parties.

As the Purchaser's sole and exclusive remedy under said warranty in regard to such products and parts, including but not limited to remedy for consequential damages, the Company will at its option, repair or replace without charge any product manufactured or part repaired by it, which is found to the Company's satisfaction to be so defective; provided, however, that (a) the product or part involved is returned to the Company at the location designated by the Company, transportation charges prepaid by the Purchaser; or (b) at the Company's option the product or part will be repaired or replaced in the Purchaser's plant; and also provided that Cc) the Company is notified of the defect within one (1) year after the shipment date from the Company's factory of the product or part so involved.

The Company warrants to the Purchaser that any system engineered by it and started up under the supervision of an authorized Company representative will, if properly installed, operated and maintained, perform in compliance with such system's written specifications for a period of one (1) year from the date of shipment of such system.

As the Purchaser's sole and exclusive remedy under said warrant in regard to such systems, including but not limited to remedy for consequential damages, the Company will, at its option, cause, without charges any such system to so perform, which system is found to the Company's satisfaction to have failed to so perform, or refund to the Purchaser the purchase price paid by the Purchaser to the Company in regard thereto; provided, however, that (a) Company and its representatives are permitted to inspect and work upon the system involved during reasonable hours, and (b) the Company is notified of the failure within one (1) year after date of shipment of the system so involved.

The warranties hereunder of the Company specifically exclude and do not apply to the following:

a. Products and parts damaged or abused in shipment without fault of the Company.
b. Defects and failures due to operation, either intentional or otherwise, (l) above or beyond rated capacities, (2) in connection with equipment not recommended by the Company, or (3) in an otherwise improper manner.
c. Defects and failures due to misapplication, abuse, improper installation or abnormal conditions of temperature, humidity, abrasives, dirt or corrosive matter.
d. Products, parts and systems which have been in any way tampered with or altered by any party other than an authorized Company representative.
e. Products, parts and systems designed by the Purchaser.
f. Any party other than the Purchaser.

The Company makes no other warranties or representation, expressed or implied, of merchantability and of fitness for a particular purpose, in regard to products manufactured, parts repaired and systems engineered by it.

5. Terms of payment
Standard terms of payment are net thirty (30) days from date of the Company invoice. For invoice purposed, delivery shall be deemed to be complete at the time the products, parts and systems are shipped from the Company and shall not be conditioned upon the start up thereof. Amounts past due are subject to a service charge of 1.5% per month or fraction thereof.

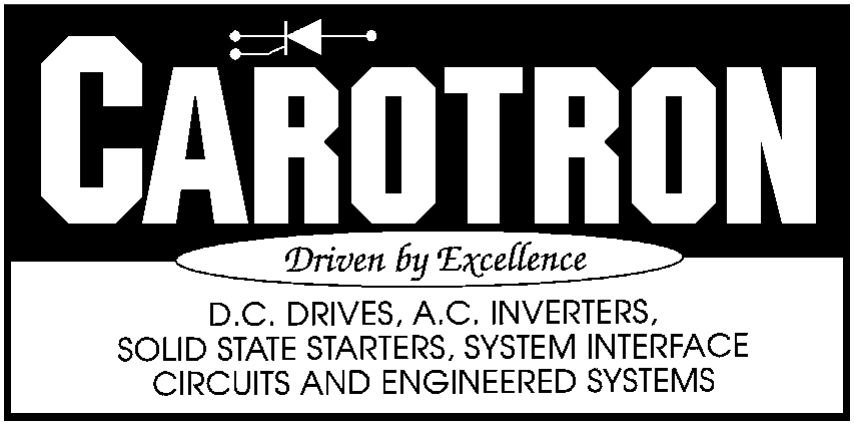
6. Order cancellation
Any cancellation by the Purchaser of any order or contract between the Company and the Purchaser must be made in writing and receive written approval of an authorized Company representative at its office in Heath Springs, S.C. In the event of any cancellation of an order by either party, the Purchaser shall pay to the Company the reasonable costs, expenses, damages and loss of profit of the Company incurred there by, including but not limited to engineering expenses and expenses caused by commitments to the suppliers of the Company's subcontractors, as determined by the Company.

7. Changes
The Purchaser may, from time to time, but only with the written consent of an authorized Company representative, make a change in specifications to products, parts or systems covered by a purchase order accepted by the company. In the event of any such changes, the Company shall be entitled to revise its price and delivery schedule under such order.

8. Returned material
If the Purchaser desires to return any product or part, written authorization thereof must first be obtained from the Company which will advise the Purchaser of the credit to be allowed and restocking charges to be paid in regard to such return. No product or part shall be returned to the Company without a "RETURNTAG" attached thereon which has been issued by the Company.

9. Packing
Published prices and quotations include the Company's standard packing for domestic shipment. Additional expenses for special packing or overseas shipments shall be paid by the Purchaser. If the Purchaser does not specify packing or accepts parts unpacked, no allowance will be made to the Purchaser in lieu of packing.

10. Standard transportation policy
Unless expressly provided in writing to the contrary, products, parts and systems are sold f.o.b. first point of shipment. Partial shipments shall be permitted, and the Company may invoice each shipment separately. Claims for non-delivery of products, parts and systems, and for damages thereto must be filed with the carrier by the Purchaser. The Company's responsibility therefor shall cease when the carrier signs for and accepts the shipment.



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Heath Springs, SC 29058
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MAN1042-00 Rev F
Issued 01-08-2020