TRANE® AIR CONDITIONING

FILE INFORMATION:

DIVISION TAB-TRANE REFRIGERATION PRODUCTS
PRODUCT TAB-LIQUID CHILLERS-CENTRIFUGAL
CenTraVac
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LITERATURE ITEM-SERVICE BULLETIN

LITERATURE FILE NO.

CTV-SB-22 B

GENERAL SERVICE BULLETIN

2/25/83
SUPERSEDES CTV-SB-22A
DATED 10/5/81

SUBJECT: CENTRAVAC SOLID STATE MOTOR PROTECTION MODULE - OPERATION, CALIBRATION AND TROUBLESHOOTING

INTRODUCTION:

The purpose of this Service Bulletin is to discuss the operating characteristics of the Trane Motor Protection Module (MPM) and to outline the correct procedures for calibration and troubleshooting. The module is presently supplied on all Air Cooled CenTraVacs and Water Cooled CenTraVacs equipped with the new Trane Unit-Mounted Starter. In addition, it is also part of the new Motor Starter Protection System (MSPS) Retrofit Kit marketed by Service Products. This Bulletin also discusses the operation, calibration and troubleshooting procedure for the Motor Starter Protection System Retrofit Kit.

DISCUSSION:

Motor Protection Module (MPM) Features:

Listed below are the operational functions and features of the Motor Protection Module:

1. To provide precise compressor motor overload protection.
2. To protect against excessive locked rotor (in-rush) current draw.
3. To limit the length of time that in-rush current may be drawn.
4. To protect the unit from damage which can be caused by an electrical distribution fault.
   NOTE: A distribution fault is defined as a complete loss of line voltage for a period of less than 60 cycles.
5. The module initiates starter transition when the compressor reaches full speed.
6. To provide a DC voltage signal which is proportional to load.
7. It can be adjusted to compensate for high line voltage.
8. It is adjustable for 50 or 60 Hertz operation.

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Motor - Starter Protection System (MSPS) Features:

The Motor Starter Protection System Retrofit Kit consists of three modules. One is the Motor Protection Module previously discussed, another houses the fault indicator circuit breakers and the third contains the Starter Protection System. The features and functions of the starter protection system are listed below:

1. To protect against the effects of pilot relay contact welding.
2. To protect against the effects of the loose control wiring.
3. To protect against the effects of intermittent control voltage (ie., fluttering flow switches, etc.)
4. It incorporates an adjustable undervoltage lock out for the control circuit.
5. The circuits are wired to protect the transition Resistor against excessive operating time.

CALIBRATION PROCEDURES (MOTOR PROTECTION MODULE)

CAUTION: WHENEVER WORKING ON THE MPM, AS WITH ANY ELECTRICAL EQUIPMENT, STOP THE MOTOR AND DISCONNECT ALL POWER TO THE UNIT. FAILURE TO DO SO MAY RESULT IN ACCIDENTAL SHOCK OR DEATH BY ELECTROCUTION. PREVENT PERSONAL INJURY BY ALWAYS DISCONNECTING ELECTRICAL POWER BEFORE WORKING ON ELECTRICAL EQUIPMENT.

NOTE: On units equipped with the Distribution Fault function, a small circuit board mounted in the center of the MPM must be tilted outward to perform MPM calibration. This is done by gently pulling on the two black tabs, located on the top of the circuit board, and tilting it down on its hinges.

I. Line Frequency Adjustment:

The MPM can operate on either 50 or 60 Hertz electrical systems. The line frequency is set as follows:

A. The installation line frequency must first be determined. (60 Hertz for all U.S. installations.)
B. The frequency switch (see Figure 1) should then be set to the position which corresponds to the installation frequency (see Figure 2).
C. Write in the setting made on the MPM nameplate (see Figure 3).

II. Compressor Motor Overload Setup:

The overload is set by adjusting the resistance of the current calibrator. The MPM is designed so that with the current calibrator correctly set, the overload will trip at 107% of the motor rated load current. The use of a 107% trip point prevents nuisance full load trip outs while still protecting the compressor motor from potentially damaging overloads.

The correct procedure for setting the current calibrator is as follows:

A. Determine the Rated Load Current (RLA) and the current transformer ratio for the unit. Where the actual jobsite voltage is equal to or lower than the specified voltage rating shown on the unit nameplate, the current calibrator setting can be established based on the nameplate RLA.

When the actual voltage is higher than the specified voltage, see Section V (High Voltage Compensation).

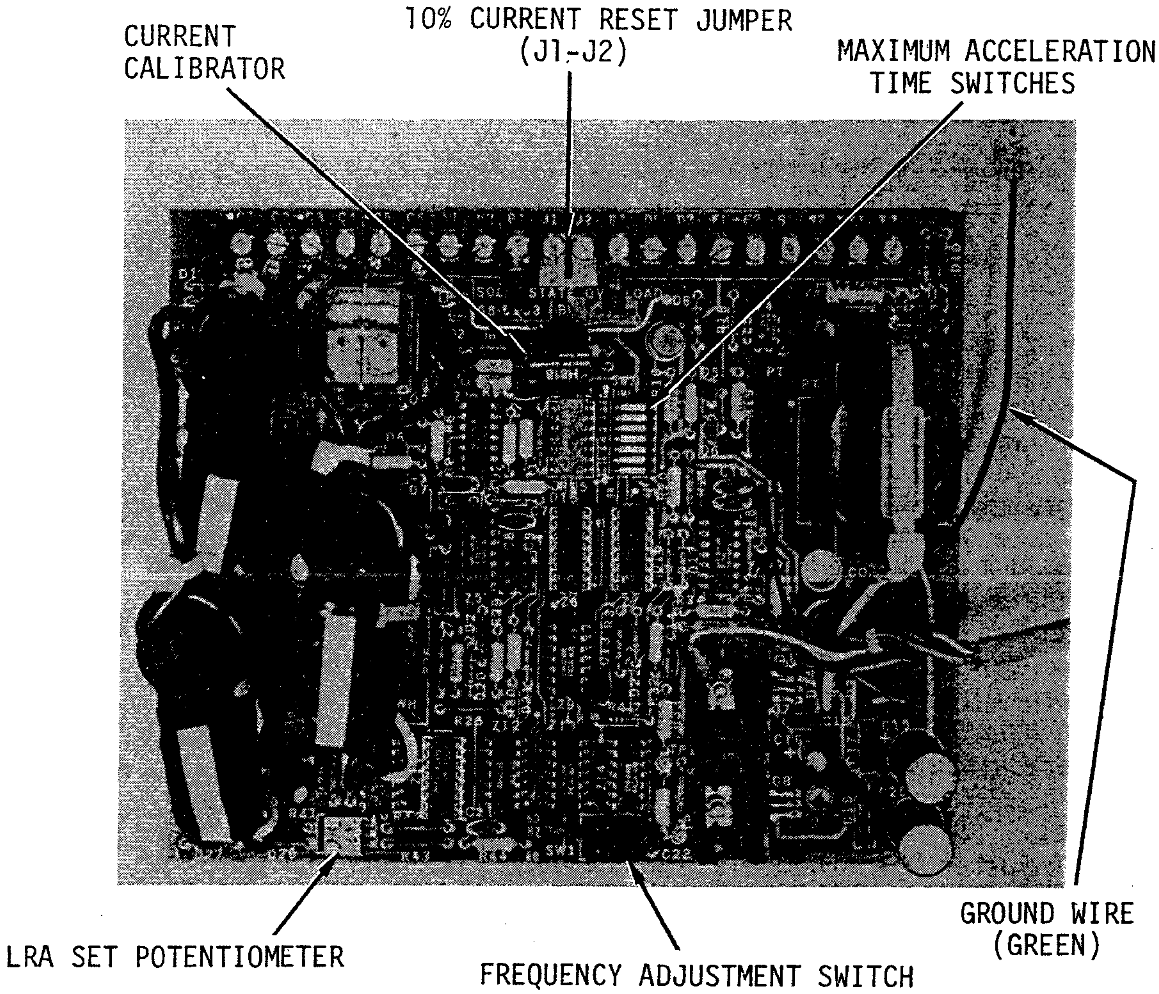
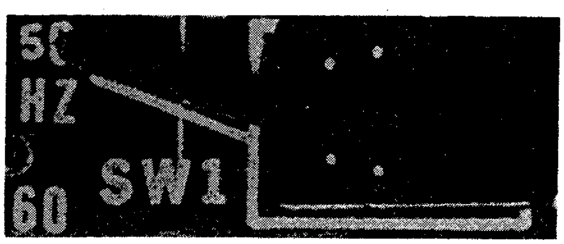
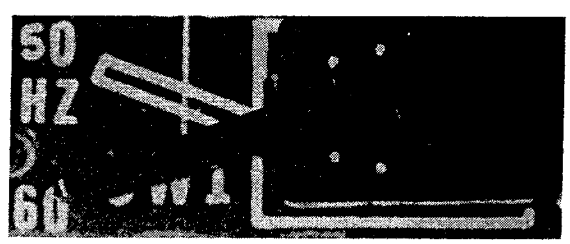


FIGURE 1 - MOTOR PROTECTION MODULE



50 Hz POSITION



60 Hz POSITION

FIGURE 2 - LINE FREQUENCY ADJUSTMENT SWITCH

TRANE NO.		
CALIBRATOR NO.		
CALIBRATOR OHMS	C.T. RATIO /5	
MOTOR LRA ______ MOTOR RLA ______	RATIO ____ %	
L.R. TRIP TIME SEC.	50 ☐	60 ☐ HZ

FIGURE 3 - MOTOR PROTECTION MODULE NAMEPLATE

If the unit is equipped with power factor correction capacitors which are connected on the load side of the overload current transformers, the RLA shown on the unit nameplate will have to be recalculated for the purpose of setting the overloads. On CenTraVacs shipped with factory installed power factor capacitors, the adjusted RLA should be shown on the electronic overload cover and the overload set accordingly. To determine the adjusted RLA on other units, the machine should be run to full load and amperage readings taken on the load and line sides of the capacitor terminal points. The nameplate RLA should be multiplied by the ratio of the current on the line side of the capacitors to current on the load side of the capacitors. This gives the adjusted RLA to be used to set the current calibrator. (See equation and example below.)

$$\text{Adjusted RLA} = \text{Nameplate RLA} \times \frac{\text{line side current}}{\text{load side current}}$$

Example: Motor Rating (RLA) = 100 amps
Current on line side of capacitors = 84 amps
Current on load side of capacitors = 92 amps

$$\text{Adjusted RLA} = 100 \text{ amps} \times \frac{84 \text{ amps}}{92 \text{ amps}} = 91 \text{ amps}$$

If the power factor capacitors are connected on the line side of the MPM current transformers or if the capacitor leads are run through the current transformers with the motor leads (Figure 4) the RLA must not be adjusted.

The motor nameplate RLA should be used to set the current calibrator in this case.

Refer to Engineering Bulletin EB-CTV-44 for additional information and recommendations concerning field addition of power factor correction capacitors.

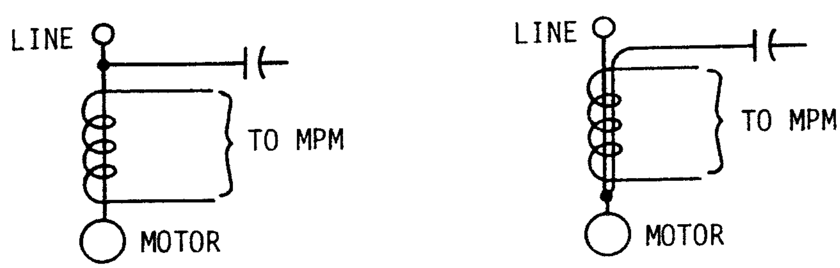


FIGURE 4 - Current Transformers

B. Once the correct RLA has been determined, the rated load secondary current (I_{sec}) from the current transformer can be determined. The value of I_{sec} at full load is dependent upon the location of the current transformers. The correct methods to determine I_{sec} are discussed below:

1. Current Transformer Monitoring Line Current
   If the current transformers are located to monitor line current, the value of the I_{sec} is determined by dividing the current transformer ratio into the RLA. (See the equation and example below.)

$$I_{sec} = RLA \div (CT\ ratio)$$

Example RLA = 91 amps

$$CT\ ratio = \frac{100}{5}$$

$$I_{sec} = \left(91 \div \frac{100}{5}\right)$$

$$I_{sec} = 4.55$$

2. Current Transformers Monitoring Phase Current
   If the current transformers are located in a star-delta starter in such a way that they monitor phase current, the value of I_{sec} is determined by dividing the current transformer ratio into the RLA and multipling this quantity by 0.58. (See the equation and example below.)

$$I_{sec} = RLA \div CT\ Ratio) \times 0.58$$

Example: RLA = 91 amps

$$CT\ Ratio = \frac{100}{5}$$

$$I_{sec} = (91 \div \frac{100}{5} \times 0.58$$

$$I_{sec} = 2.64$$

NOTE: *When donut-type current transformers are used, the wires passed through them are sometimes wrapped around and passed through more than once. When this is done, the CT ratio is effectively divided by the number of times the wire passes through the CT. This means a 200/5 CT with the wire passed through it twice should be treated as a 100/5 CT.*

C. With the I_{sec} value found above, use Table 1 to determine the correct current calibrator and its setting. For the above example in which the line current is being monitored (I_{sec} = 4.55), the correct current calibrator would be H818. The correct calibrator setting would be 82.6 ohms. With the calibrator setting adjusted in this manner, the overload trip point would be 107% of the nameplate RLA.

D. To set the current calibrator, it must be removed from the module. Using a digital ohmmeter (3-1/2 digit accuracy minimum) set the resistance of the calibrator to the value taken from Table 1.

E. Replace the current calibrator in the module. Write the calibrator number and setting on the MPM nameplate.

NOTE: *With the current calibrator set correctly and the unit operating at full load, a DC voltage of approximately 8.25 VDC should exist across terminals V1-V2 in the MPM.*

TABLE 1 - CURRENT CALIBRATOR TABLE

I SEC AMPERE RATING MIN.	I SEC AMPERE RATING MAX.	NUMBER ON CURRENT CALIBRATOR	POTENTIOMETER ADJUSTMENT RESISTANCE (OHMS)	I SEC AMPERE RATING MIN.	I SEC AMPERE RATING MAX.	NUMBER ON CURRENT CALIBRATOR	POTENTIOMETER ADJUSTMENT RESISTANCE (OHMS)
2.01	2.05	H816	185	3.51	3.55	H817	106
2.06	2.10	H816	180	3.56	3.60	H817	105
2.11	2.15	H816	176	3.61	3.65	H817	103
2.16	2.20	H816	172	3.66	3.70	H818	102
2.21	2.25	H816	168	3.71	3.75	H818	101
2.26	2.30	H816	165	3.76	3.80	H818	99.2
2.31	2.35	H816	161	3.81	3.85	H818	97.9
2.36	2.40	H816	158	3.86	3.90	H818	96.6
2.41	2.45	H816	155	3.91	3.95	H818	95.4
2.46	2.50	H816	151	3.96	4.00	H818	94.2
2.51	2.55	H817	148	4.01	4.05	H818	93.0
2.56	2.60	H817	146	4.06	4.10	H818	91.8
2.61	2.65	H817	143	4.11	4.15	H818	90.7
2.66	2.70	H817	140	4.16	4.20	H818	89.6
2.71	2.75	H817	138	4.21	4.25	H818	88.5
2.76	2.80	H817	135	4.26	4.30	H818	87.5
2.81	2.85	H817	133	4.31	4.35	H818	86.5
2.86	2.90	H817	130	4.36	4.40	H818	85.5
2.91	2.95	H817	128	4.41	4.45	H818	84.5
2.96	3.00	H817	126	4.46	4.50	H818	83.5
3.01	3.05	H817	124	4.51	4.55	H818	82.6
3.06	3.10	H817	122	4.56	4.60	H818	81.7
3.11	3.15	H817	120	4.61	4.65	H818	80.8
3.16	3.20	H817	118	4.66	4.70	H818	79.9
3.21	3.25	H817	116	4.71	4.75	H818	79.1
3.26	3.30	H817	114	4.76	4.80	H818	78.2
3.31	3.35	H817	113	4.81	4.85	H818	77.4
3.36	3.40	H817	111	4.86	4.90	H818	76.6
3.41	3.45	H817	109	4.91	4.95	H818	75.8
3.46	3.50	H817	108	4.96	5.00	H818	75.1

III. Locked Rotor Current Lockout Adjustment

The MPM protects the compressor motor from excessive LRA current draw during start-up. It does this by tripping the motor overload circuit breaker any time the set LRA is exceeded. The correct procedure for setting the LRA trip point is as follows:

A. The LRA current trip point setting is dependent upon the type of starter being used with the CenTraVac compressor motor.

B. The LRA current trip point is set using the LRA set potentiometer (Figure 1).

C. The correct setting position for the LRA set potentiometer as applied to different types of starters are shown in Figure 5.

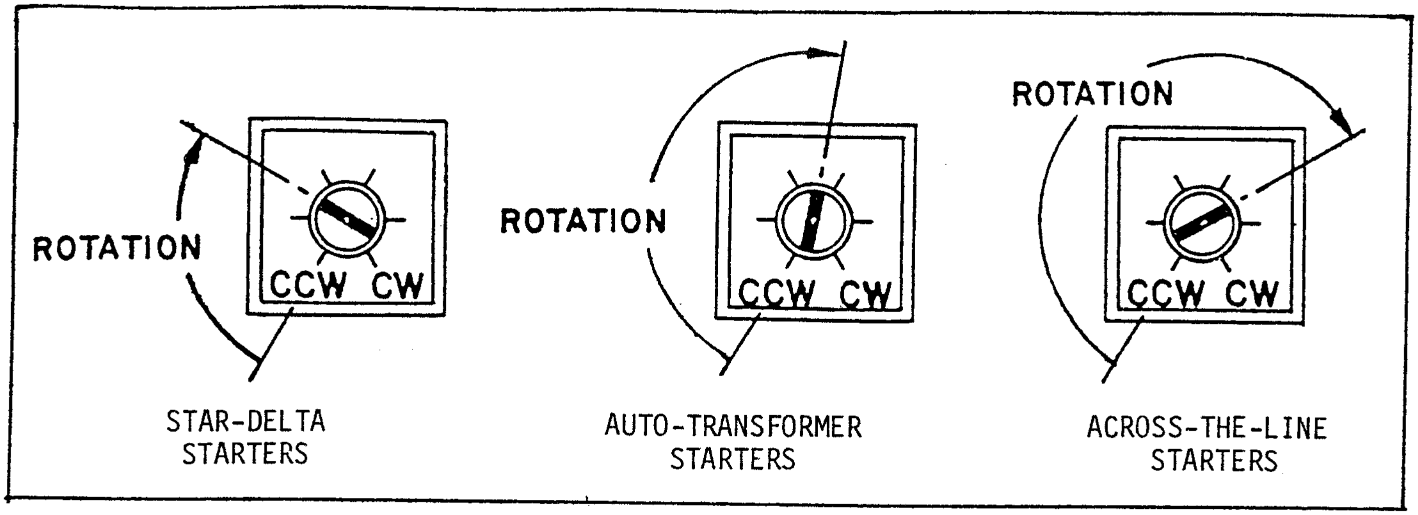


FIGURE 5 - LRA SET POTENTIOMETER POSITIONS FOR DIFFERENT TYPE STARTERS

D. To set the LRA set potentiometer, insert a screw driver in the adjusting slot and turn potentiometer to the fully counter-clockwise (CCW) stop. This establishes a reference position. From this point, the potentiometer should be rotated clockwise to the position, shown in Figure 5, which corresponds to the compressor motor starter being used.

E. As can be seen by the calibration markings on the LRA set potentiometer, this is a rough setting only. If it is found that the "motor overload" circuit breaker trips immediately (1 sec) upon energization of the starter, the LRA current trip point may have to be set higher. Doing this will not harm the operation of the MPM or the compressor motor.

F. Write the nameplate LRA and the nameplate RLA on the MPM nameplate. See Figure 3.

G. Calculate the "RATIO ___%" using the formula below. Write this on the nameplate. See Figure 3.

$$\text{Ratio \%} = \frac{\text{Motor LRA*}}{\text{Motor RLA}} \times 100\%$$

Example: Motor RLA - 100 AMPS

Motor LRA = 200 AMPS

$$\frac{200\ \text{AMPS}}{100\ \text{AMPS}} \times 100\% = \text{Ratio } 200\%$$

* Locked rotor amperes (LRA) is the reduced value obtained depending on the method of starting. See Table 2.

TABLE 2 STARTING CHARACTERISTICS FOR VARIOUS TYPES OF MOTOR STARTERS

TYPE OF STARTER	% TAP	STARTING CHARACTERISTICS - % OF RATED VALUE		
		MOTOR VOLTAGE	MOTOR LRA CURRENT	MOTOR TORQUE
Full Voltage Type Magnetic - X - Line	n/a	100	100	100
Reduced Voltage Types				
Auto-Transformer	80	80	64	64
	65	65	42	42
	50	50	25	25
Primary Reactor	80	80	80	64
	65	65	65	42
	50	50	50	25
Reduced - Inrush Types				
Star-Delta	n/a	100	33	33
Open or Closed Transition	n/a	100	33	33

IV. Maximum Acceleration Time Set

The MPM limits the maximum acceleration time the motor can undergo by tripping the "Motor Overload" circuit breaker, locking the machine off whenever the machine does not transition in the time period set on the acceleration time adjustment (Figure 1). This prevents the motor from drawing LRA for an excessive period of time and overheating the motor. The maximum acceleration time is set as follows:

A. Determine the desired maximum acceleration time (between 1 and 63 seconds) for the unit. Table 3 gives recommended settings for typical units. This setting may vary, depending on the type of unit, type of starter and jobsite conditions. It should be set, based on the typical acceleration time for the particular unit and jobsite conditions.

TABLE 3 - TYPICAL MAXIMUM ACCELERATION TIME SETTINGS

STARTER TYPE	RECOMMENDED MAXIMUM ACCELERATION TIME SETTINGS
Star-Delta	12 Seconds
Auto-Transformer	8 Seconds
Across-The-Line	4 Seconds

B. Once the desired value is known, the combination of switches on the LRA time adjustment which adds to this value should be switched to the "ON" position (see Figure 6).

NOTE: If none of the switches are in the "ON" position, the unit will not start. The MPM allows no acceleration time in this situation and the "Motor Overload" circuit breaker will trip immediately upon attempted start-up.

12 SECONDS = 8 + 4
TURN ON SWITCHES 3 & 4

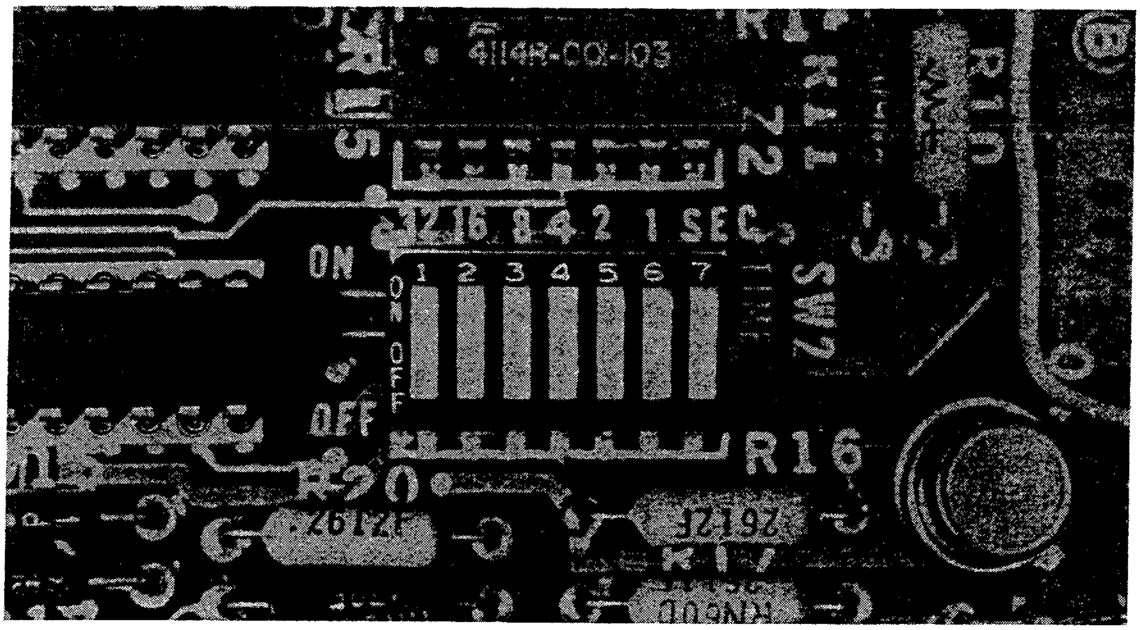


FIGURE 6 - MAXIMUM ACCELERATION TIME SWITCH

C. Write the LRA time adjustment setting on the MPM nameplate. See Figure 3.

'. <u>High Voltage Compensation:</u>

The RLA shown on the unit nameplate is based on original design conditions and the nominal voltage ordered. The actual jobsite voltage quite often varies from the nominal. Higher than nominal line voltage permits the motor to produce higher than rated horsepower without motor current draw in excess of nameplate. To prevent overloading of the motor due to higher than rated voltage, the MPM should be recalibrated. This can be done in either of two ways:

A. By removal of 10% current reset jumper from terminals J1 - J2 in the MPM (see Figure 1), the module is automatically recalibrated so that approximately 90% of the motor nameplate current rating is the new "rated" current for the application. The MPM should be setup normally, as removal of the jumper recalibrates all functions of the MPM.

B. The MPM can also be recalibrated to compensate for high voltage by resetting the current calibrator. The proper value is determined by multiplying the I_{sec} value, determined in the Compressor Motor Overload Setup section of this Service Bulletin, by the ratio of the rated voltage to the actual line voltage. (see the equation and example below.)

$$\text{New } I_{sec} = I_{sec} \times \frac{\text{rated voltage}}{\text{actual line voltage}}$$

Example: Original I_{sec} = 4.55
Rated Voltage = 460 volts
Actual line voltage = 485 volts

$$\text{New } I_{sec} = 4.55 \times \frac{460 \text{ volts}}{485 \text{ volts}} = 4.32$$

The new I_{sec} value is then used to enter Table 1 and determine a new current calibrator setting. The calibrator should be reset to this value. This will recalibrate all other MPM functions, compensating for the high voltage condition.

C. Whenever the MPM is recalibrated for high voltage, the LRA Potentiometer should be turned up one space higher than indicated on Figure 4 to prevent nuisance tripouts at start-up. The reason for this is that higher than nameplate LRA current draw would occur. This must be compensated for by turning up the LRA Potentiometer.

Any calibration of the module, such as removal of the J1 - J2 jumper or recalibration of the current calibrator should be noted on the MPM module cover along with the reason for recalibration.

NOTE: When any recalibration of the motor overload is performed on a water-cooled CenTraVac equipped with a pneumatic LLR, the LLR must be recalibrated just as the overload. If this is not done, nuisance overload tripouts will occur.

VI. CVAC Load Limiting Control Calibration

On CVAC's, the MPM controls the load limiting of the motor through a load proportional DC voltage which it sends to the vane control module. If the MPM has been calibrated correctly, the vane control module should start load limiting at 98% of RLA. The load proportional DC voltage can be measured across terminals V1 - V2 of the MPM. At rated load, this voltage will be -8.25 VDC. This voltage varies linearly with the machine running amperage.

Example: 100% RLA = (-)8.25 VDC
98% RLA = (-)8.25 x .98 = (-)8.09 VDC

VII. Vane Control Module Load Limit Calibration

A. The current calibrator must be correctly set before the control module load limiting can be calibrated.

B. The unit should then be started.

C. The voltage across terminals V1 - V2, in the control module, should be measured while the machine is being loaded. The control module current limiting calibrator should be set so the machine begins load limiting when the V1-V2 voltage reaches (-)8.09 volts DC. This corresponds to a machine load of 98% of FLA.

D. Manually unload and load the machine, rechecking to make sure load limiting begins at a V1-V2 signal voltage of (-)8.09 volts DC. The unload - load lights can be used to verify proper limiting as well as visually observing the damper motor.

E. The load limiting of the control module is now set correctly.

VIII. Dry Running Starters Equipped with the Motor Protection Module

Starters equipped with the Motor Protection Module can be dry run at startup in the same manner as starters not so equipped. There are two differences which should be noted.

A. Before the starter can be dry run, the Distribution Fault circuit Breaker must be disconnected. This can be done by simply removing a wire from the Distribution Fault Circuit Breaker. If this is not done, the starter will not sequence, but will lockout on distribution fault instantly upon initiation of the start.

This occurs because the distribution fault trip is initiated when the motor current drops below 20% of RLA with the M1 contactor energized. See the "Distribution Fault Trip Operation" section of this Bulletin for the reasoning behind this. The only time the above circumstances can occur, is during an actual distribution fault or a starter dry run.

B. The other difference which will be noticed, is that immediately upon energization of the dry run, the starter will go through transition.

This happens because the MPM initiates transition on the basis of motor current draw. During a normal startup, the vanes are closed which allows the motor current to drop from LRA to a value below RLA. When the motor current drops from LRA to 80% of RLA during start, the MPM initiates transition. During a dry run, there is no current draw, so the MPM, immediately (1 sec) initiates transition.

IX. Distribution Fault Circuit Breaker Operation

A distribution fault is defined as a loss of line voltage for less than 60 electrical cycles. This type of short duration power interruption can be damaging to many types of induction motor driven equipment.

The damage occurs because an induction motor acts as a generator for several seconds after power is disconnected. The voltage generated by the motor can hold in control relays and starter contactors when a voltage loss occurs. The period of time the contactors are held in, is approximately 60 electrical cycles or 1 second for a Water Cooled CenTraVac, and 20 cycles or 1/3 second, for an Air Cooled CenTraVac.

If line voltage is re-established during the period of time the contactors are being held in by the motor generated voltage, and the two voltages are out of phase, motor torques may occur which are 6 to 10 times normal running torques. These torques occur as the motor is pulled into phase and may be in either the forward or reverse direction. These high torques cause severe overloading of the impeller hub area, with resultant upsetting of the impeller keyway and in severe cases cracking or destruction of the impellers.

The Motor Protection Module detects a distribution fault by monitoring current draw and the M1 contactor. The tripping of the Distribution Fault Circuit Breaker is initiated based on the fact that, in normal operation, only during the occurrances of an actual distribution fault is it found that the motor current draw is less than 20% of RLA and the M1 contactor is energized at the same time. An induction motor will normally always draw over 20% of RLA, even when completely unloaded; and whenever the M1 contactor is energized, the motor is running. The only exceptions occur during a distribution fault or during a starter dry run.

The distribution fault lockout is initiated when the motor current drops below 20% of RLA with the M1 contactor energized. The motor Protection Module senses this set of conditions to be a voltage loss for the reasons explained in the previous two paragraphs. Tripping of the Distribution Fault Circuit Breaker is completed within 6 electrical cycles (1/10 of a second) of the time when the voltage loss occurs.

It should be noted that this provides a way to check for the proper operation of the distribution fault function of the Motor Protection Module. The Distribution Fault Circuit Breaker should trip instantly if it is left connected during a starter dry run.

CALIBRATION PROCEDURE (MOTOR STARTER PROTECTION RETROFIT KIT ONLY)

I. Low Voltage Lockout Calibration

The Motor-Starter Protection System Retrofit Kit incorporates an adjustment which allows the minimum operating control voltage to be set. If the unit experiences a control voltage below the setting of the low voltage lockout, the Starter Protection Module (SPM) locks the machine out with the "Starter Fault" circuit breaker. The low voltage lockout adjustment is on the outside of the Starter Protection Module. It is a slotted potentiometer type adjustment located on the side of the SPM module. (See Figure 7.) It can be set using the following guides:

A. Turning the low voltage set potentiometer fully counter-clockwise gives a trip point of 80 volts $\pm$ 10%.
B. Turning the low voltage set potentiometer fully clockwise gives a trip point of 108 volts $\pm$ 10%.
C. The nominal trip voltage can be adjusted to any value between these extremes by adjusting the low voltage set potentiometer. See the following equation:

Amount of potentiometer rotation required
(Desired Voltage - 80) ÷ 28 x 100% = Percent rotation

Example: Desired lockout voltage = 94 volts
(94 - 80) ÷ 28 x 100% = 50%

Turn the potentiometer 50% of the way from fully CCW to fully CW.

NOTE: A good nominal setting is 94 volts, or 50% rotation.

II. Start Circuit Protection

A "Starter Circuit" tripout will occur whenever the control circuit power to the starter is momentarily interrupted. Such interruptions could include a fluttering flow switch, loose wiring or a defective control. There is no calibration which can be performed on this circuit.

III. Transition Circuit Protection

A "Transition Circuit" tripout will occur if the transition resistors remain in the circuit for over one and a half seconds. This protects the resistors from conditions which will cause rapid burnout. There is no calibration which can be performed on this circuit.

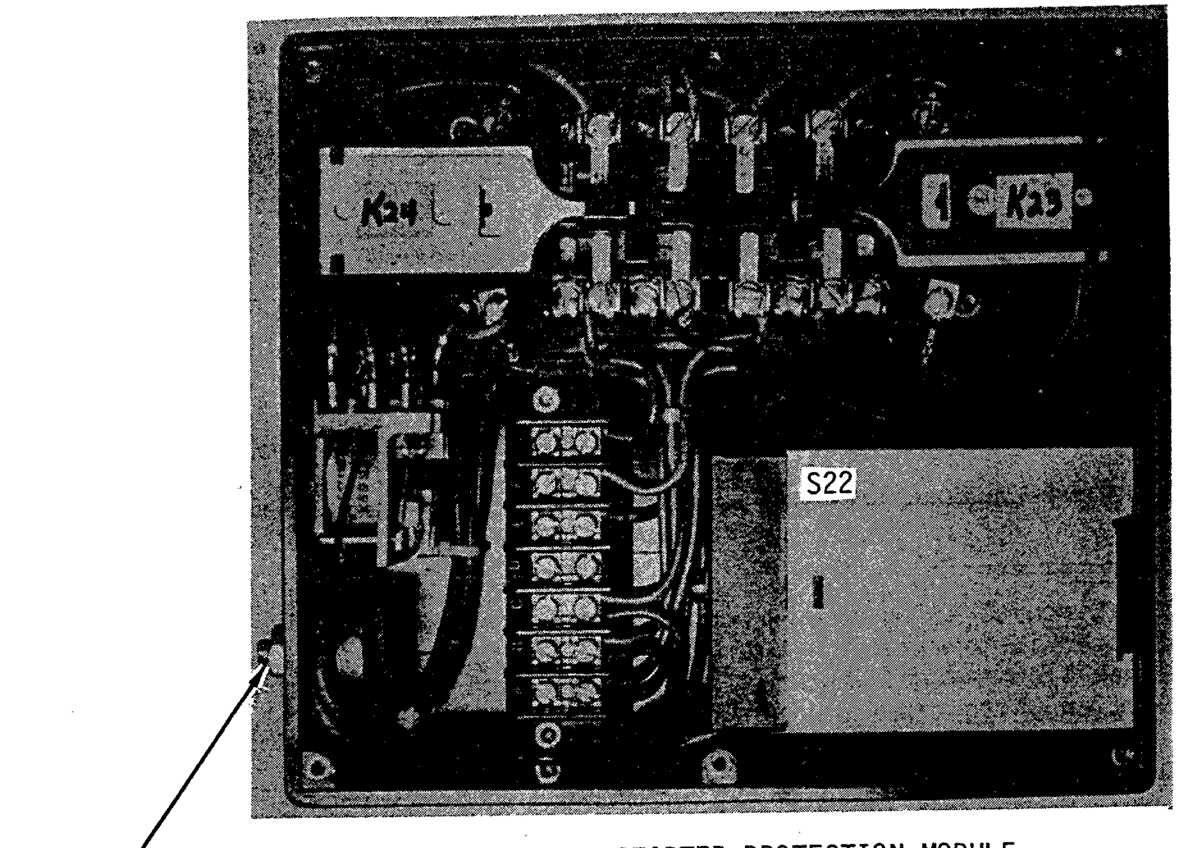


FIGURE 7 - STARTER PROTECTION MODULE

TROUBLESHOOTING MPM/MPS

The wiring diagrams on the following pages give typical wiring schemes for the Motor Protection Module and Motor Starter Protection System Retrofit Kit. Figure 8 shows the wiring of the MPM by description of the terminal board stud's interconnections. Figure 9 is a typical wiring diagram of a Unit Mounted Starter equipped with a MPM. Figure 10 is a typical wiring diagram of the Motor Starter Protection Retrofit Kit.

The charts on the following pages give troubleshooting sequences for the Motor Protection Modules. Problem symptoms are listed across the top of the chart, possible causes in the left hand columns and recommended solutions in the right hand column. The numbers in the columns under the problem symptoms indicate possible causes and solutions for those symptoms. The numbering indicates the probability of the corresponding cause/solution being the one which is causing the problem; 1 being the most likely, 2 the second most likely, and so on.

TROUBLESHOOTING NUISANCE TRIPPING

SYMPTOM/ POSSIBLE CAUSE	MOTOR OVERLOAD TRIPS	DISTRIBUTION FAULT TRIPS	STARTER FAULT TRIPS	TRANSITION FAULT TRIPS	RECOMMENDED ACTION
Incorrect Current Calibrator Adjustment or Installation	3				Determine proper setting, re-calibrate and install.
Incorrect LRA Trip Point Setting	4				Determine proper setting and re-calibrate LRA trip setting.
High Voltage Re-calibration Jumper Removed	7				Determine if jumper should be removed to compensate for high voltage.
Excessive Running Motor Current Draw	1				Check for faulty compressor motor.
Excessive LRA Motor Motor Current Draw	2				Check for faulty compressor motor.
Frequency Selector Switch Incorrectly Set	5				Check selector setting.
Motor Acceleration Time to Long	8				Contact La Crosse Service
Low Voltage To Unit			3**		Contact Power Company
Motor Current Drops Below 20% RLA		5			Contact La Crosse Service
Distribution Fault (complete voltage loss) Occurs For Over 1-1/2 Cycles.		1			Contact Power Company
Current Transformers Incorrectly Wired (dot polority incorrect)	9	2			Rewire Current transformers
Faulty Circuit Breaker - CB11	10				Replace circuit breaker.
1M (K27) Auxiliary Contactor Hanging In		4			Replace contactor.
Flow Switch or Similar Safety Device Fluttering			1**		Check water flows, check for air in system, check for correct installation.
Loose Control Circuit Wiring			2**		Check continuity of circuits to locate-tighten wiring
Low Voltage Trip 1 Misadjusted			4**		Readjust trip to desired value.

(Continued on Page 16)

TROUBLESHOOTING NUISANCE TRIPPING
(continued)

SYMPTOM/ POSSIBLE CAUSE	MOTOR OVERLOAD TRIPS	DISTRIBUTION FAULT TRIPS	STARTER FAULT TRIPS	TRANSITION FAULT TRIPS	RECOMMENDED ACTION
Chattering 2M (K28) Auxiliary or Main Contactor		3			Replace contactor
S-22 Timer Defective			7**		Replace contactor
Defective Circuit Breaker CB-13			8		Replace circuit breaker
Locked Rotor Trip Time Set Incorrectly	6				Consult La Crosse Service for proper setting
Defective Circuit Breaker CB-15				2**	Replace circuit breaker.
Transition Resistor Hanging In (K-26)			9*	1**	Replace contactor
Welded Pilot Relay Contacts (K23-K24)			5		Replace contactor
Defective Pilot Relay Coils (K23-K24)			6		Replace contactor coils
Defective MPM Module	11	6			Replace module

* Air Cooled and Unit Mounted Starters Only
** MSPS Retrofit Kit Only

UNIT WILL NOT FUNCTION

SYMPTOM POSSIBLE/ CAUSE	MOTOR OVER-LOAD WILL NOT TRIP	DISTRIB-UTION FAULT WILL NOT TRIP	STARTER FAULT WILL NOT TRIP	TRANSITION FAULT WILL NOT TRIP	STARTER WILL NOT TRANSITION	INCORRECT V1-V2 CONTROL VOLTAGE	RECOMMENDED ACTION
Verify 120 volts Across X1 and X2	1	1	1	1	1	1	Check Power Supply Wiring
Verify Correct Wiring & Closure on S1-S2 (K-27)	2	2					Check continuity of circuits to locate correct wiring or replace contactor as required.
Incorrect Current Calibrator Adjustment or Installation	3	3			2	2	Determine proper setting and recalibrate LRA trip setting.
Current Transformer Incorrectly Wired or Defective	4				3	3	Check continuity of circuits to locate correct wiring.
Faulty Circuit Breaker CB11	5						Replace circuit breaker.
Low Voltage Trip Misadjusted			2				Determine desired setting and recalibrate low voltage set potentiometer.
Defective Circuit Breaker CB13			5	2*			Replace circuit breaker
Defective Circuit Breaker CB14		4					Replace circuit breaker
Defective Circuit Breaker CB15				3**			Replace circuit breaker
Incorrect Wiring on V1-V2 Terminals						4	Check continuity of circuits to locate-correct wiring.
Auxiliary Contactor on K-26 Defective			4				Check continuity of circuits to locate-replace contactor
Auxiliary Contactor on K-23 and K-24 Defective			3				Check continuity of circuits to locate-replace contactor
Defective MPM Module	6	5					

* Air Cooled and Unit Mounted Starters Only

** MSPS Retrofit Kit Only

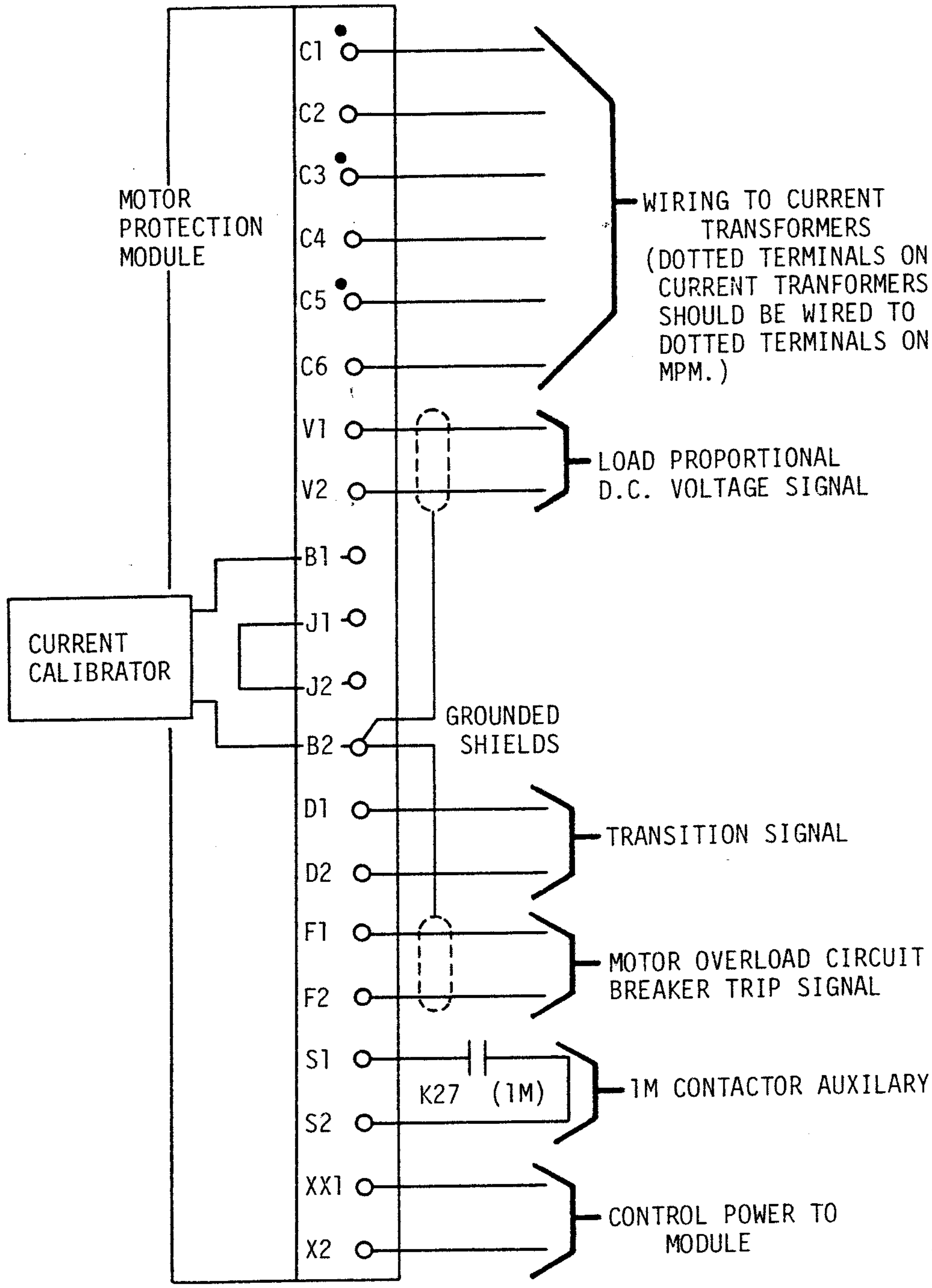
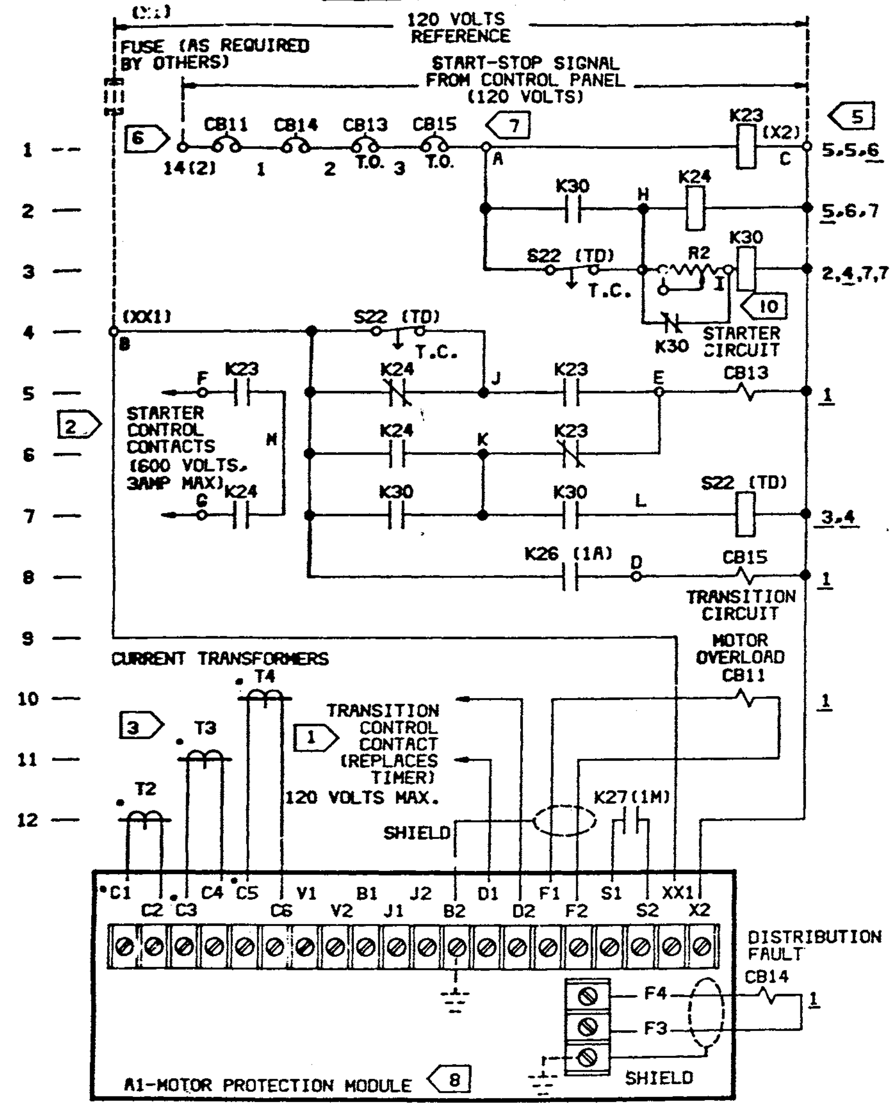


FIGURE 8 - MOTOR PROTECTION MODULE INTERCONNECTIONS

SCHEMATIC DIAGRAM



NOTES:

1. PRESENT TRANSITION TIMER SHALL BE REMOVED. IT'S CONTACT FUNCTION SHALL BE OBTAINED BY CONTACT PROVIDED (D1-D2). CAUTION MUST BE TAKEN TO PROVIDE ALL OTHER FUNCTIONS TO MAINTAIN PROPER OPERATION OF 1M, 2M, S AND 1A CONTACTORS AS ORIGINALLY DESIGNED.

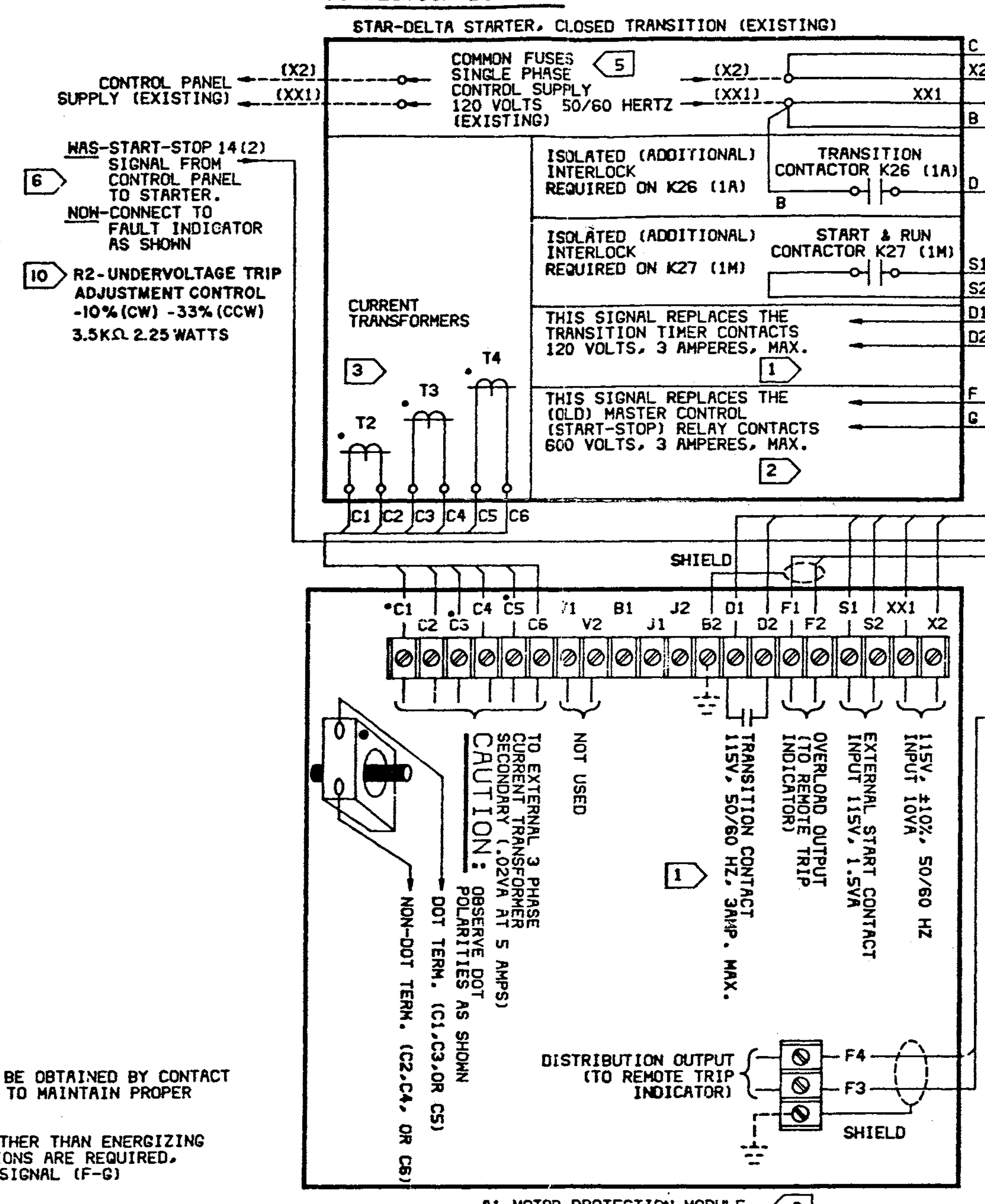
2. PRESENT MASTER CONTROL RELAY SHALL BE REMOVED IF ADDITIONAL FUNCTIONS OTHER THAN ENERGIZING THE MAIN STARTER CONTROL CIRCUIT ARE NOT REQUIRED. IF ADDITIONAL FUNCTIONS ARE REQUIRED, THE CONTACTS OF THE PRESENT MASTER CONTROL RELAY SHALL REMAIN AND THIS SIGNAL (F-G) SHALL ENERGIZE THE COIL OF THE 120 VOLT PRESENT MASTER RELAY.

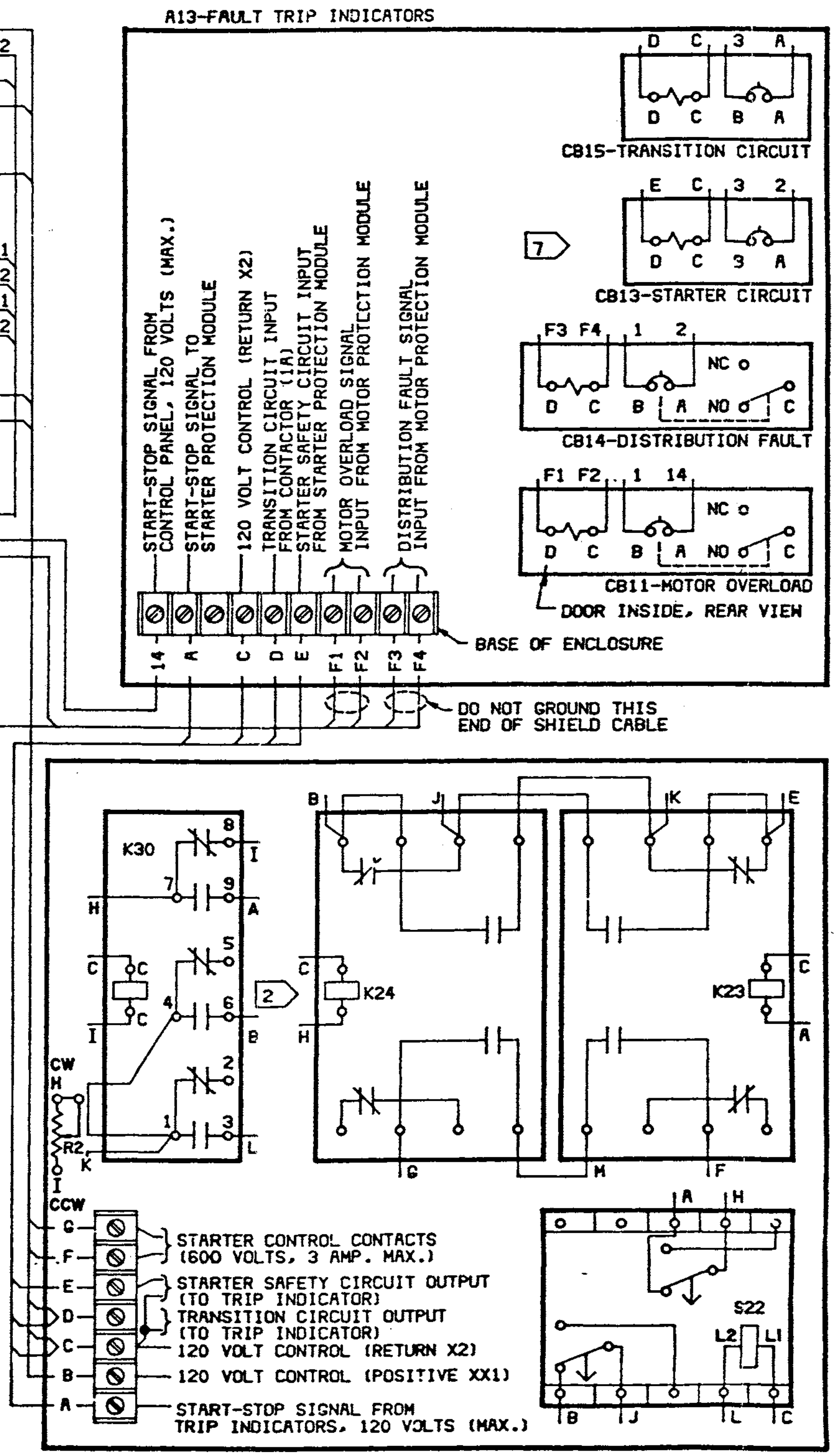
3. PRESENT CURRENT TRANSFORMERS SHALL BE USED. THEY MAY STAY INSTALLED IN THE LINE OR PHASE, AS DESIRED. CALIBRATION OF THE MOTOR PROTECTION MODULE SHALL BE ADJUSTED ACCORDINGLY (LINE OR PHASE). PRESENT MAGNETIC OVERLOAD RELAY SHALL BE REMOVED. IF TRANSFORMERS ARE NOT PRESENTLY USED, THEY MUST BE FURNISHED. OUTPUT RATING REQUIRED- 2.0 TO 5.0 AMPERES AT RATED LOAD, .02 V.A. BURDEN. THREE (3) IDENTICAL CURRENT TRANSFORMERS ARE REQUIRED. AMMETERS MAY BE INSTALLED IN SERIES WITH EACH CURRENT TRANSFORMER IF PROPER V.A. BURDEN IS PROVIDED.

WIRING WITHIN AN APPROVED METAL ENCLOSURE TO BE 16 GAUGE MINIMUM. INTERCONNECTING WIRING BETWEEN ENCLOSURES TO BE 14 GAUGE MINIMUM. (FOR EXAMPLE, THE WIRE BETWEEN THE CONTROL PANEL AND THE STARTER OR THE WIRE BETWEEN THE STARTER AND THE FAULT TRIP INDICATORS IF THE INDICATORS ARE MOUNTED REMOTELY SHOULD BE 14 GAUGE MINIMUM.) SHIELDED CABLE TO BE 18 GAUGE MINIMUM.

5. IF SUPPLY, 115/120 VOLT, SINGLE PHASE IS GROUNDED THE GROUND SHALL BE ON THE X2 TERMINAL.

CONNECTION DIAGRAM





A12-STARTER PROTECTION MODULE

6. WIRE TERMINAL NUMBER SHOWN THUS- 14(2) -WILL CHANGE DEPENDING ON MODEL OF UNIT.

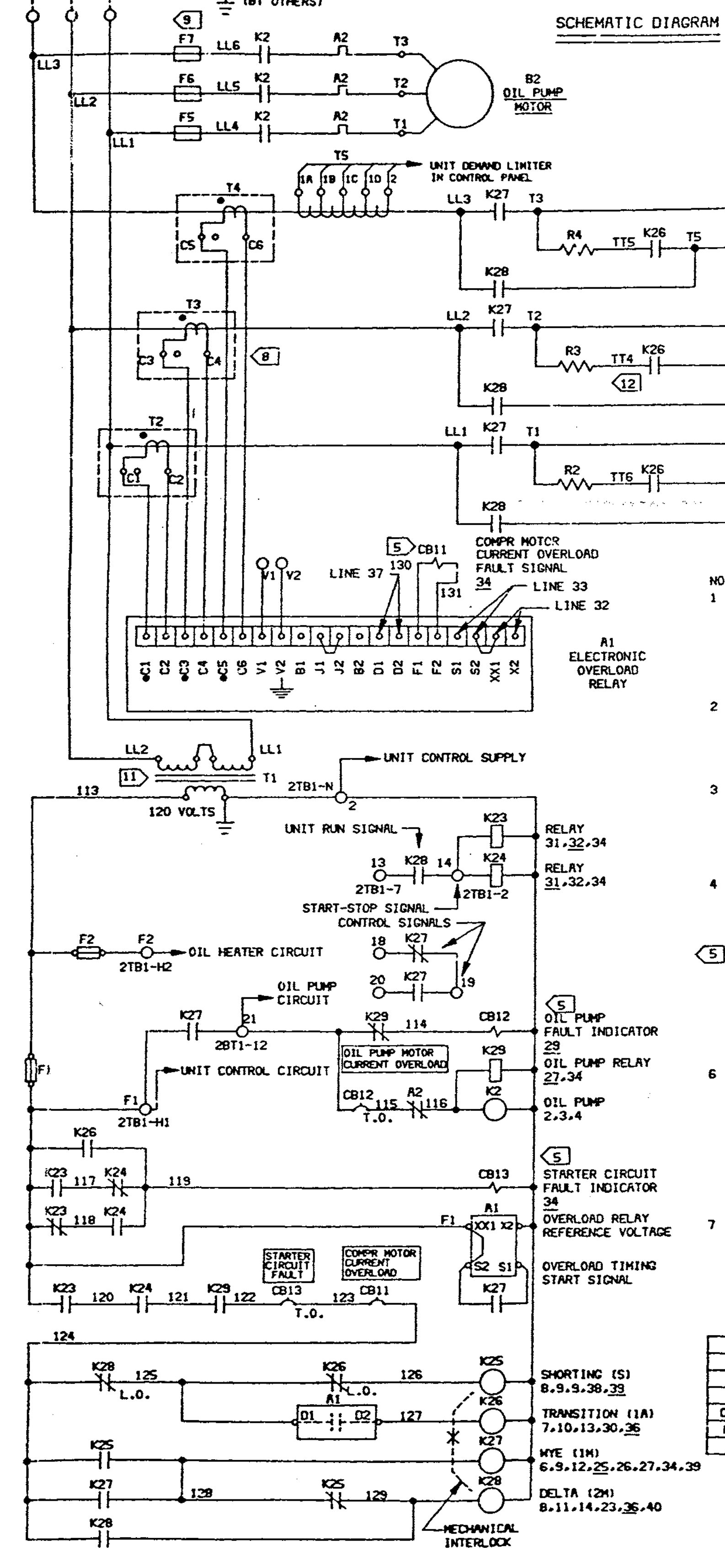
7. CIRCUIT BREAKERS CB11, CB13, CB14, AND CB15 EMPLOYED AS FAULT TRIP INDICATORS IN THE CONTROL CIRCUIT ARE DESIGNED TO BE SHUNT TRIP DEVICES NOT CURRENT. SENSITIVE DEVICES AS NORMALLY APPLIED.

8. MOTOR PROTECTION MODULE FUNCTION PER TRANE SES 14-18.05

9. DASHED LINES REPRESENT EXISTING WIRING. WIRING SHOWN IN SOLID INDICATES INTENDED FIELD WIRING.

FIGURE 10 - TYPICAL MOTOR-STARTER PROTECTION SYSTEM ELECTRICAL DIAGRAMS

NOTE: DESIGNED TO BE USED WITH CONTROL PANEL PER WIRING DIAGRAMS NO. EX39470241 & EX39470242



8. SALES OPTIONAL AMMETERS AND OR VOLTMETERS IN DOOR. WHEN AMMETERS ARE REQUIRED CONNECT IN SERIES WITH "CT'S" AND OVERLOAD RELAY (A1)

9. SALES OPTIONAL CIRCUIT BREAKER "CB10" REPLACES TERMINAL BOARD "TB2". FOUR STYLES OF CIRCUIT BREAKERS OFFERED:
   - STANDARD INTERRUPTING CAPACITY
   - HIGH INTERRUPTING CAPACITY
   - STANDARD INTERRUPTING CAPACITY WITH GROUND FAULT
   - HIGH INTERRUPTING CAPACITY WITH GROUND FAULT

A GROUND FAULT INDICATOR IN DOOR IS FURNISHED WITH A GROUND FAULT STYLE CIRCUIT BREAKER.

NOTES:

1. UNLESS OTHERWISE NOTED ALL SWITCHES ARE SHOWN AT 25°C (77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBERS. AND UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT.
4. MAXIMUM AMBIENT TEMPERATURE 50°C (120°F) AVERAGE AIR TEMPERATURE IN THE IMMEDIATE NEIGHBORHOOD OF THE CONTROL PANEL.
5. CIRCUIT BREAKERS CB11 - CB13 EMPLOYED AS FAULT INDICATORS IN THE CONTROL CIRCUIT ARE DESIGNED TO BE SHUNT TRIP VOLTAGE DEVICES (120 VAC AT ±15%) NOT CURRENT SENSITIVE DEVICES AS NORMALLY APPLIED.
6. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY. EXAMPLE: CANADA-SHALL COMPLY WITH CANADIAN STANDARDS ASSN. (CSA)
7. STARTER DESIGNED AT NEMA RECOMMENDED VOLTAGES AS FOLLOWS:

   200 VOLTS, 460 VOLTS, 575 VOLTS — ±15% 60 HERTZ

COMPONENT		
LAST USED		UNUSED
T5	R10	F3,F4
F7	A2	CB1 THRU CB9
CB13	B2	K1,K3 THRU K22
K29	DS9	R1
		DS1 THRU DS8

WIRE TERMINALS	
LAST USED	UNUSED
133	1,3 THRU 12
	15 THRU 17
	22 THRU 112

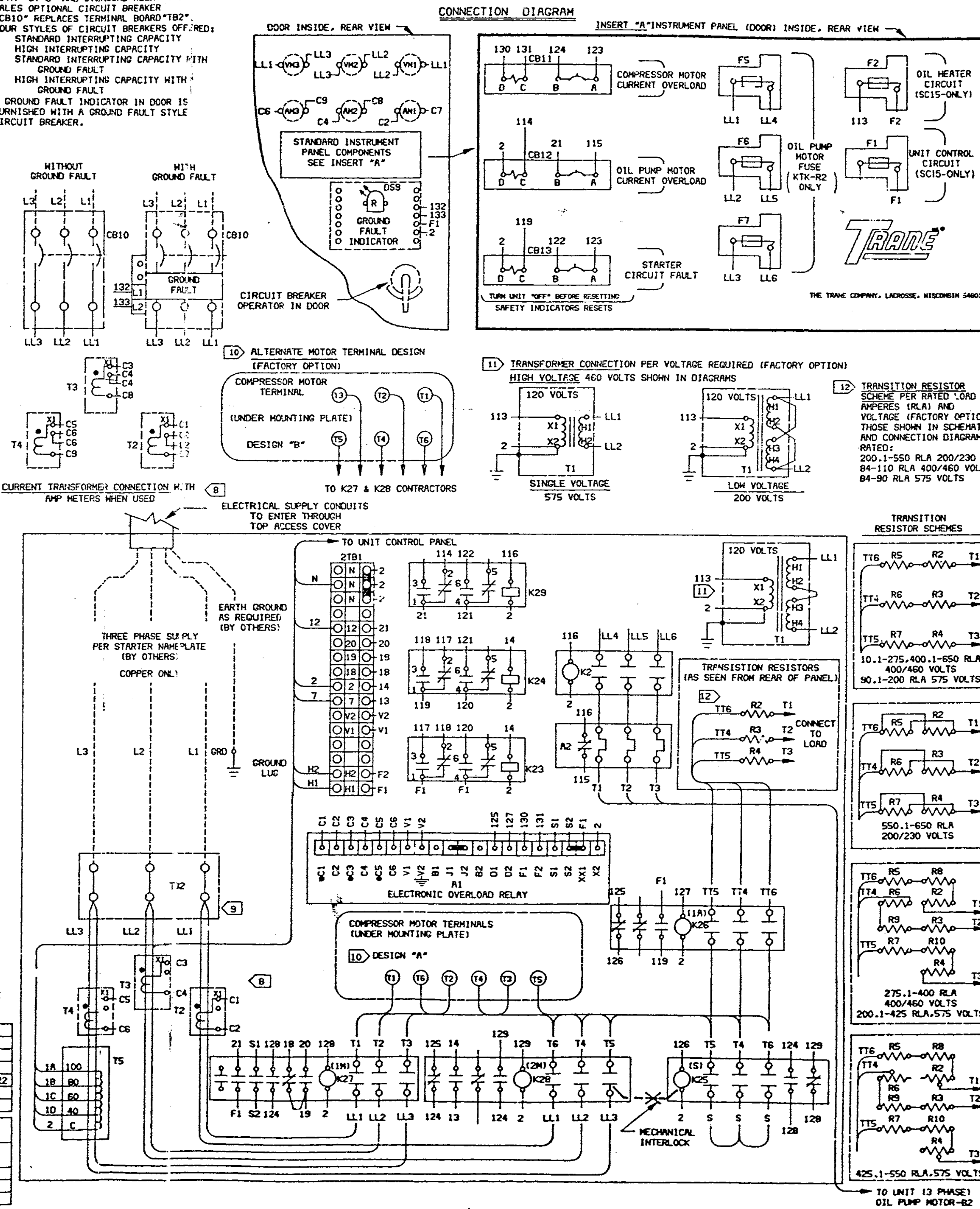


FIGURE 9 - TYPICAL UNIT MOUNTED STARTER ELECTRICAL DIAGRAMS