INSTALLING, OPERATING AND
MAINTAINING

THE MODEL D1028

COMPUTER INPUT
BI-DIRECTIONAL
GENERATOR FIELD REGULATOR

INSTRUCTION MANUAL # S-225

INSTALLING, OPERATING AND MAINTAINING

THE MODEL D1028

BI-DIRECTIONAL GENERATOR

FIELD REGULATOR

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SECTION ONE
GENERAL INFORMATION

INTRODUCTION

Thank you for purchasing an ***IPC*** **Automation** elevator control.

At ***IPC*** we are committed to designing and manufacturing high quality controls that meet or exceed our customers needs. This manual provides the information you will need in order to properly install, operate and troubleshoot the **Model D1028 Bi-Directional Field Regulator**. It provides a general overview of the operation of the control, along with detailed descriptions of the diagnostic indicators, status indicators, adjustments and connections. Also included is a step by step start-up procedure, troubleshooting information, and applications. Please read this manual completely before attempting to install or operate the **Model D1028.**

Please feel free to call ***IPC*** **Automation** with any questions you may have **BEFORE** performing installation or start-up.

IPC **Automation**
4615 West Prime Parkway
McHenry, IL 60050

Phone:(815) 759-3934
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1.1 SAFETY

There are certain fundamental warnings, which must be kept in mind at all times. These include:

WARNING **THE BI-DIRECTIONAL FIELD REGULATOR SHOULD BE INSTALLED, ADJUSTED AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL EQUIPMENT IN THE ELEVATOR SYSTEM, PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY OCCUR IF INDIVIDUALS ARE NOT FAMILIAR WITH THE HAZARDS RESULTING FROM IMPROPER OPERATION.**

WARNING **CONTROLLER EQUIPMENT IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED AND INTERNAL CAPACITORS REMAIN CHARGED AFTER POWER IS REMOVED FROM THE BI-DIRECTIONAL FIELD REGULATOR. IT IS IMPORTANT THAT AC POWER IS REMOVED FROM THE UNIT FOR A MINIMUM OF FIVE MINUTES BEFORE IT IS SAFE TO TOUCH THE INTERNAL PARTS OF THE CONTROL. PERSONAL INJURY MAY RESULT UNLESS POWER IS REMOVED.**

WARNING **THE USER IS RESPONSIBLE FOR CONFORMING TO THE NATIONAL ELECTRICAL CODE WITH RESPECT TO MOTOR, CONTROLLER AND OPERATOR DEVICE INSTALLATION, WIRING AND START-UP. THE USER IS ALSO RESPONSIBLE FOR UNDERSTANDING AND APPLYING ALL OTHER APPLICABLE LOCAL CODES, WHICH GOVERN SUCH PRACTICES AS WIRING PROTECTION, GROUNDING, DISCONNECTS AND OVER CURRENT PROTECTION.**

WARNING **THE FAULT CIRCUITS DESCRIBED IN SECTION 3.3 ARE DESIGNED TO PROTECT THE CIRCUITRY AND PROVIDE INDICATION OF RELIABLE OPERATION OF THE CONTROLLER. THE FAULT CIRCUITS SHOULD NOT BE USED AS A SAFETY DEVICE FOR PROTECTING PERSONNEL. THE FAULT CIRCUITS IN THE CONTROL ARE NOT REDUNDANT CIRCUITS; THEY MAY RELY UPON THE OPERATION OF THE CONTROL TO INDICATE FAULTY OPERATING CONDITIONS. THEREFORE, THE ELEVATOR COMPANY SHOULD ALWAYS USE REDUNDANT SAFETY DETECTORS AND BACK-UP DEVICES TO PROVIDE SAFETY FOR PERSONNEL. THE FAULT CIRCUITS ARE NOT INTENDED TO MEET ELEVATOR CODE FOR THE PROTECTION OF PERSONNEL AND SHOULD NOT BE USED TO MEET ELEVATOR CODES.**

1.2 WARRANTY

Standard conditions of sale for the company include a Statement of Warranty, which covers the control equipment. This Statement of Warranty covers all new equipment.

The Model D1028 Bi-Directional Field Regulator has been designed as a standard product to meet the general criteria for controlling a motor-generator set in conjunction with an elevator. IPC does not warrant that the Model D1028 will meet all application requirements, codes and safety standards.

1.3 Q.C. TESTING

Quality is an important factor of each phase of the manufacturing and development process. Each unit must pass rigorous quality tests as well as static and dynamic performance checks and a final inspection for quality of workmanship. A unit is allowed to ship only after acceptance of all aspects of Q.C. testing and inspection. This assures that you receive only those controls that meet our demanding quality standards.

1.5 STORAGE

Please take the following precautions if it should be necessary to store the control for any length of time.

☞ Store the control in a clean, dry (non-corrosive) environment that is protected from sudden variations in temperature and high levels of moisture, shock and vibration.

☞ The ambient temperature where the control is stored should be maintained between zero (0) and 65 degrees Centigrade.

☞ The control should be stored in the original package in order to protect from dust and dirt contamination.

SECTION TWO
PRODUCT SPECIFICATIONS

2.1 GENERAL DESCRIPTION

The Model D1028 Bi-Directional Field Regulator was designed to control the Generator Field of a motor generator-driven geared or gearless Hoist Motor. Tachometer feedback is used to provide a closed loop speed regulated system. Armature feedback is used to provide fast response and added stability. The computer input allows a computer generated reference pattern to control the output. These all combine to provide a high gain fast response system to precisely control armature voltage. The net result is precise control of the generator field current that will provide speed regulation to within point five percent (0.5%) of contract speed.

2.2 CONTROL SPECIFICATIONS

TRANSFORMER INPUT SUPPLY:	208/220 VAC 50/60 HZ
CONTROL INPUT SUPPLY:	208/220 VAC 50/60 HZ single phase 5 AMP Selected by minilink jumper located below F1 (lower PC board)
FIELD POWER SUPPLY (ACF-ACF) ISOLATED:	Adjustable at Transformer Secondary 110/130/150/165 VAC 7.5 AMP
FIELD POWER OUTPUT:	Zero (0) to ± 230 VDC 7.5 AMP
SPEED RANGE**:**	Greater than 500:1
SPEED REGULATION:	0.5% of contract speed (Subject to tachometer specifications and RPM)
RESPONSE TIME:	One millisecond (1 ms)

2.3 CONTROL FEATURES OVERVIEW

The key features of the Model D1028 Bi-Directional Field Regulator are summarized here. Like all IPC Automation Bi-Directional Regulators, the D1028 offers superior control of the elevator's speed.

- ✓ Fully isolated control and power sections
- ✓ Set Up Mode switch
- ✓ Four-turn potentiometer adjustments for accuracy
- ✓ Indicator lights for all diagnostics
- ✓ Fault protection including independent indicators for each of the following:

  Tach loss
  Over Speed trip
  Over Current trip
  Direction fault
  Power Relay failure
  Leveling limit speed trip

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SECTION THREE
THE FRONT PANEL

3.1 DIAGNOSTIC INDICATORS

The Model D1028 features a variety of color-coded indication lights to allow a quick assessment of control performance and status. Green lights indicate normal functionality and show the normal operating status of the control. Yellow lights indicate an area of concern such as an out of regulation condition, or a relevel limit. Red lights indicate a fault or trip condition where the control is shut down.

3.2 STATUS INDICATORS

CONTROL POWER (GREEN):	Indicates the control power is on and that there is sufficient power to operate the control.
FIELD POWER (GREEN):	Indicates that the CR1 Field Power relay is pulled in and the secondary voltage ACF is being applied at TB5 to the field power bridge.
RUN INPUT (GREEN):	Indicates that the control has a run contact input. Field power output is now enabled.
OUT OF REG(YELLOW):	Indicates that the tachometer voltage is not equal to the reference voltage. Required speed cannot be maintained when the control is producing full output.
LEVEL LIMIT (YELLOW):	Indicates that the releveling over speed circuit is enabled and the over speed trip limit is set to 10% of contract speed.

3.3 FAULT CONDITIONS

The control monitors certain conditions that may cause faulty operation of the machine. An instantaneous shut down will occur when a fault condition is detected. To aid in set up and troubleshooting, the fault circuits will latch. You may reset the control after a trip condition has occurred by dropping the RUN input or by disconnecting the control power. The DIRECTION, TACH LOSS and OVERSPEED trips can be disabled by placing a jumper across the trip disable test points during set up.

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IT IS DANGEROUS TO RUN WITH THE DISABLE TESTPOINTS JUMPERED. REMOVE THE DISABLE JUMPER BEFORE PUTTING THE CAR IN SERVICE.

DIRECTION (RED): Indicates and disables the control when the tachometer's direction is different from the direction called for by the computer input signal. A direction fault trip will occur if, for example, the input signal is polarized for the UP direction and the car should move at more than 10% of contract speed in the DN direction.

TACH LOSS (RED): The Tach Loss circuit is designed to detect a complete loss of tachometer feedback voltage when the armature voltage is approximately equal to contract loop voltage. Problems that will not be detected by this circuit such as slippage of the Tach or other Tach malfunctions may cause a reduction in tach feedback voltage causing an overspeed condition. This circuit relies on proper setting of the armature feedback. The tach loss circuit is designed to shut down the control in case of zero tachometer voltage as long as the armature voltage exceeds ± 3 volts at the ARM FEEDBACK testpoint.

OVER SPEED (RED): The over speed trip is set at 110% of the speed reference or at 10% of the speed reference when the LL contact is pulled in. The over speed circuit will latch if the tachometer feedback exceeds the speed reference by 1.00 volt. During re-leveling, when the "LL" contact is pulled in, the over speed circuit will latch if the scaled tachometer feedback exceeds 1.00 volt.

OVER CURRENT (RED): The control will trip instantaneously on over current if the output exceeds the control rating by more than 50%. The maximum output of the control should never exceed the output rating of the control (7.5 Amps) during normal operation.

POWER RELAY FAILURE (RED): Indicates that the CR1 field power relay has failed. The CR1 relay disconnects the AC power from the field Power Bridge while in its normally open state. The control will not be enabled the next time the RUN contact is pulled in if the CR1 relay should weld closed. When this fault exists the FIELD POWER and POWER RELAY FAILURE lights will indicate a welded relay.

CAUTION: The CR1 relay is a secondary field power disconnect relay. Any fault condition will drop out the enable relay and the CR1 field power relay to disconnect AC field power. The CR1 relay should not be used as a primary field power "make" contact. **The RUN contact should always be energized before the customer AC power relay is energized in order to protect the CR1 relay.**

NOTE: POWER RELAY FAILURE is NOT resettable. The CR1 Field Power Relay must be replaced if this fault should occur.

3.4 ADJUSTMENTS

ARM FEEDBACK (P1)

The armature feedback signal is used for stability. The ARM FEEDBACK potentiometer should be adjusted for 7.5 volts (measured at the ARM FB testpoint) when the car is running at contract speed. The system may be sluggish if there is too much armature feedback and over responsive if there is too little armature feedback. The armature feedback should never be set above 10 volts or below 4 volts when running at contract speed.

CAUTION: A setting below ± 4V at contract speed can cause the tach loss circuit to become inoperative. Do not set the ARM FB testpoint below ± 4V at contract speed.

LOOP GAIN (P2)

The LOOP GAIN setting determines how quickly the control will correct for errors in the speed feedback loop (TACH vs. REF OUT). The LOOP GAIN adjustment should be used to fine-tune the system for regulation and stability. If the system tends to be too responsive the LOOP GAIN should be reduced by turning the potentiometer counterclockwise (CCW). If the control is slow to respond then the LOOP GAIN should be increased by turning the potentiometer clockwise (CW).

CONTRACT SPD (P3)

The CONTRACT SPD potentiometer scales the amount of tachometer feedback, which the control uses to regulate the speed of the car. The CONTRACT SPD potentiometer must be adjusted to obtain contract speed. This adjustment ensures proper calibration of the tachometer signal to the reference signal.

Note: The REF OUT and TACH testpoints **must** measure approximately 10V at contract speed for proper operation of the control.

FIELD CURRENT (P4)

This potentiometer sets the range of current that the control can regulate. It should be adjusted just high enough to assure that contract speed is obtained under all load conditions. Full speed may not be obtained due to current limiting if the FIELD CURRENT potentiometer is set too low. Instability in the system could also occur if the FIELD CURRENT potentiometer is set too low.

The adjustment of the FIELD CURRENT potentiometer is outlined in section five. However, some suggestions may be helpful.

1. The control cannot provide more current than the resistance of the load and bus voltage will permit. As shown by the following formula:

I (max) = [E (field power) x 1.4] / R (field)

Example: My AC Secondary Voltage (E field power) while using the X1 to X2 tap is 110 VAC. The resistance of my field (R field) is 40 Ohms. The maximum current (I max) the control can provide with this configuration is (110 VAC x 1.4) / 40 Ohms which equals 3.85 Amps

2. The control is current limited at 7.5 amps. This current limit point is determined by the setting of the CURRENT potentiometer (full clockwise equals' current limiting at 7.5 amps).

3. Field connections are important to the response of the system. The lower the inductance of the field usually means the faster the response of the system. Parallel field connections are therefore desirable. However, paralleling the field windings decreases the resistance of the generator field and increases the field current for a given maximum field voltage. This may cause the current requirements of the generator field to exceed the maximum current rating of the control. MG sets with four fields should be connected in a series parallel configuration for best results.

4. Field voltage directly affects the field current. The maximum field voltage will be 1.4 times the secondary voltage of the field power isolation transformer connected to TB5. This voltage should be enough to supply adequate field current. If an insufficient amount of field current is supplied, you will not be able to obtain contract speed at full load.

5. The current required for contract speed can be determined during set up and initial test runs under **full load**. Calculate the secondary voltage for the AC Field Power Supply by using the following formula:

E (field power) = [I (max) x R (field)] / 1.414

Example: The maximum current I require with a fully loaded car going down is five amps (5A). The resistance of my generator field is 34 Ohms. I calculate my required secondary voltage to be: 5 Amps x 34 Ohms, which equals 170 volts DC. I calculate my AC voltage as 170 VDC / 1.4 which equals 120.2 VAC

The secondary voltage should be adjusted to select the nearest value transformer tap. This keeps the maximum DC field voltage within the calculated range and makes the system safer by limiting the maximum field current. In cases where the transformer tap falls between the calculated AC voltage, the next higher tap must be used to achieve the contract speed under all conditions. When this is the case, a resistance should be added in series with the shunt field to limit the field current, as shown in the hook up as R3. In the example above, the required secondary voltage is 120.2 volts AC. The isolation transformer has taps for 110 volts AC and 130 volts AC. In this case I will want to use the 130-volt AC tap. This tap can be used safely by adding a resistance (R3) in series with the field. This resistance should be sized to limit the maximum field current to the value necessary to reach contract speed. The total resistance may be calculated by the following formula:

R(total) = [E(secondary tap voltage) x 1.4] - E (field power) /I(max)

Example: Since I have chosen to use the 130-volt AC transformer tap, I will first calculate the DC equivalent voltage as follows. 130 volts AC x 1.414 equals 183.82 volts DC. Next, I subtract the DC field power voltage from the available DC voltage (from the transformer tap chosen). This voltage must now be dropped across the resistor I will add 183.82 volts DC minus 170 volts DC equals 13.82 volts DC. I then divide this voltage by my maximum field current of 5 Amps. 13.82 volts DC/5 Amps equals 2.76 Ohms. This is the value of the resistor that I should put in series with the generator field.

5. The field voltage and any added resistance will definitely affect the system performance. While it is good practice to limit the AC voltage to be just high enough to reach contract speed at full loads, the performance may be limited under certain conditions. A low line voltage may prevent the machine from reaching contract speed. Low line voltage may also prevent fast acceleration ramps and round off the top of the curve. This low line voltage will limit the maximum current to the field, which will limit the maximum loop voltage and ultimately limit the system torque at higher speed. On the other hand, if the voltage is too high, the control must limit the current and this can cause system instability. ***The AC voltage tap selected on the transformer should never exceed the calculated value by more than 30%.***

STABILITY (P5)

The stability gain setting determines how quickly the control will correct for changes in the armature feedback signal versus changes in the reference signal (change in ARM FEEDBACK vs change in REF OUT). This adjustment should be used to fine tune the stability of the system after the armature feedback signal has been properly adjusted. The system may be sluggish if the STABILITY is set too high and unstable if the STABILITY is set too low.

SIG IN GAIN (P6)

The SIG IN GAIN potentiometer allows the input signal from the computer to be scaled up or down to the appropriate levels for controlling the D1028. The D1028 uses positive 10 volts as a *full on* (contract speed) signal in the UP direction.

3.5 TEST POINTS

Test points are available as aids for set up and adjustment of the control.

FIELD CURRENT

The FIELD CURRENT testpoint monitors field current and is calibrated so one (1) volt is equal to one (1) amp of field current. Like all of the other testpoints the voltage will be positive in the UP direction and negative in the DN direction.

ARM FEEDBACK

This testpoint is used to set the scale of the armature feedback used in the stability circuits. The armature feedback should be set to positive 7.5 volts while running at contact speed in the UP direction. The armature feedback may be fine-tuned for maximum stability of the system after the elevator system is fully functional. It is important that the armature feedback signal is positive in the UP direction and negative in the DN direction.

CAUTION: The armature feedback voltage should never be set for less than 4 volts at contract speed. The tach loss circuit may become inoperative if the armature feedback is set too low.

REF OUT

This testpoint monitors the scaled signal from the computer-input reference. This is the ultimate signal the system will follow. This testpoint is used to monitor the reference pattern on an oscilloscope.

COMMON

All of the measurements made during the set up and adjustment of the control should be referenced to this testpoint unless otherwise noted. The negative lead of the multimeter should be connected to this testpoint for all measurements.

TRIP DISABLE

The TRIP DISABLE testpoint is available for use by the set up person to aid in the initial set up and inspection of the control. A clip lead placed from the TRIP DISABLE testpoint to the COMMON testpoint will prevent a control shut down caused by the DIRECTION, TACH LOSS and OVER SPEED faults. The fault condition indicators will still be functional to aid in detecting and adjusting for faults during set up.

When setting up the control, two misadjustments that commonly cause the unit to trip are:

- ✓ Pulling in the leveling contact too early
- ✓ Rapid reversing of the UP and DN inputs before the car has stopped.

The control will trip on OVER SPEED if the LL contact is pulled in prior to reaching a leveling speed. It is important to note that the over speed trip point is preset to 10% of contract speed when the LL contact is pulled in.

The control will trip on a DIRECTION fault if there is a rapid reversal of the UP and DN inputs before the car has stopped. Releveling before stopping will cause a direction fault trip.

WARNING: IT IS DANGEROUS TO OPERATE THE CAR WITH THE DISABLE TEST POINTS JUMPERED AND SAFETY SHUT DOWNS DISABLED. THE DISABLED JUMPER MUST BE REMOVED BEFORE PUTTING THE CAR INTO SERVICE.

THE JUMPER ACROSS THE DISABLE TEST POINTS SHOULD BE USED IN THE SET UP MODE BY AN AUTHORIZED SERVICE PERSON AND <u>MUST</u> BE REMOVED BEFORE THE CAR IS PUT INTO SERVICE.

TACH

This testpoint monitors the tachometer feedback. The tachometer feedback should be set to positive 10.00 volts while running at contract speed in the UP direction. This testpoint is also used to monitor the tachometer pattern on an oscilloscope.

3.6 AUTO/SET UP SWITCH

The AUTO/SET UP switch is used as a set up and troubleshooting aid. During normal operation of the control, the switch should be left in the AUTO position. Setting the switch to the SET UP position allows the elevator to run without using the tachometer feedback signal to regulate speed. When the control is in the SET UP mode the speed regulation will be poor, all of the fault trips will be operational except for TACH LOSS. This will allow you to troubleshoot tachometer signal problems, which may be the cause of poor regulation, or fault trip problems.

WARNING: THE ELEVATOR SYSTEM SHOULD NEVER BE PUT IN SERVICE WITH THE D1028 IN SET UP MODE. THE TACH LOSS CIRCUIT IS INOPERATIVE IN THE SET UP MODE. THE AUTO/SET UP SWITCH MUST BE SET TO AUTO BEFORE THE CAR IS PUT IN SERVICE.

3.7 AUTO/MANUAL RESET SWITCH (SW2)

The SW2 switch sets the D1028 reset mode. When the switch is in the AUTO position, the D1028 can be reset by dropping the RUN command for approximately two seconds. When SW2 is in the MAN position, a fault trip must be reset by removing control-input power. The manual reset position is useful for troubleshooting intermittent faults because the fault indicators latch until the control power is cycled on and off.

NOTE: a POWER RELAY FAILURE fault trip is not resettable. The CR1 relay must be replaced if this fault occurs

SECTION FOUR
INSTALLATION INSTRUCTIONS

4.1 CONTROL INPUTS

The control circuitry is fully isolated from the input contact circuitry making the D1028 highly immune to external noise. The contact circuitry operates from 24 volts DC supplied from the V+ terminal on TB3. The contacts are low voltage and conduct approximately 0.01 amps. Fully enclosed relays with good wiping action are suggested for selection contacts, to protect against malfunctions due to dirt or dust.

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RUN CONTACT

The RUN contact at TB3 must be closed in order to enable the control. The control's output will be immediately disabled if the RUN contact is opened. The RUN contact must be closed before the customer AC power relay is pulled in. **The RUN contact should be opened whenever the car is stopped or the doors are opened.**

L.L.

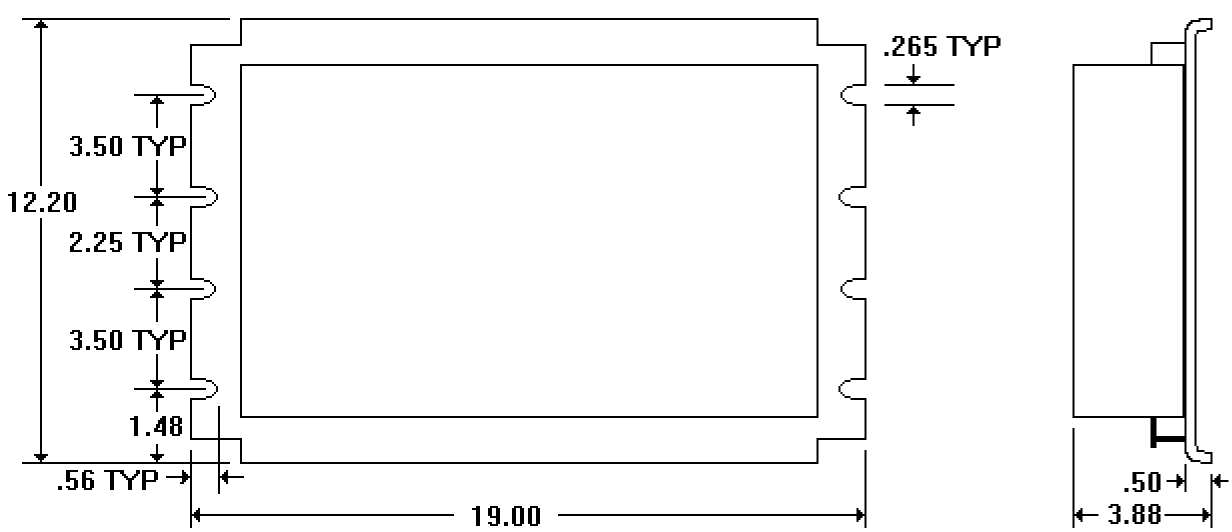
The Leveling Limit contact will scale the over speed trip point to 10% of the initial trip point setting. This is provided so that an over speed condition can be detected during leveling when speeds are typically 10% of contract speed.

TACHOMETER

The control will accept a clean tachometer signal from 15 to 150 volts DC at full speed. The tachometer-input signal must be free of noise to get acceptable regulation. For best results, the tachometer should be coupled directly with the hoist motor shaft and properly aligned for minimal noise. It is also important to shield the tachometer wire at the D1028 control end only.

Note: It is not advisable to use any material that is flexible, such as rubber or soft plastics when coupling the tachometer to the motor shaft. These materials tend to create a noise or oscillation problem in the car by introducing ripple on the tachometer signal

REGULATOR PHYSICAL DIMENSIONS



Length: 19.00 inches **Width:** 12.20 inches **Height:** 3.88 inches

4.2 POWER CONNECTIONS

The following section describes the connections to be made in order to properly connect the control to the elevator system power connections.

OVER VOLTAGE BUSS RESISTOR

A 50 Ohm 250 Watt resistor (typically supplied by IPC) must be connected to the terminals marked RES on TB2. This resistor protects the D1028 field power buss from over voltage conditions, which are caused by sudden power loss or a drastic change in direction.

WARNING: THE OVER VOLTAGE RESISTOR MUST BE INSTALLED AT ALL TIMES DURING OPERATION OF THE CONTROL OTHERWISE, SEVERE DAMAGE TO THE CONTROL WILL OCCUR.

F+ F-

Connect the positive side of the generator field to the F+ terminal on TB2. Connect the negative side of the generator field to the F- terminal on TB2. If these connections are reversed the direction of the car will usually reverse. Damage to the control could possibly occur from an improper connection.

A+ A-

Connect the positive motor armature feedback lead to the A+ terminal of TB1. Connect the negative motor armature feedback lead to the A- terminal of TB1. The connections should be polarized so a positive voltage appears on the ARM FEEDBACK testpoint when running in the UP direction. Improper connection will cause oscillation and fault trips to occur.

AC CONTROL POWER

Connect one lead of the 208 or 220 volt AC supply to the terminal marked AC on TB1. Connect the other lead to the appropriate AC terminal (208VAC or 220 VAC) according to the input line voltage. This is the AC power input for the control circuitry on the D1028. The control may not function properly if the AC connections are made improperly. Please note that there is one terminal for 208-volt connection and one terminal for 220-volt connection. This input is not phase sensitive.

FIELD AC POWER

The connections to the AC1 and AC2 terminals on TB2 are from the customer's AC field power relays. These relays are attached to the secondary taps on the field power isolation transformer (typically supplied by IPC). These connections supply the AC power for the output section of the D1028. The maximum output voltage and current are determined by the secondary tap connections to the AC1 and AC2 terminals. The AC3 terminal is not used on the standard D1028.

SECTION FIVE
SET UP PROCEDURE

WARNING: THE BI-DIRECTIONAL FIELD REGULATOR SHOULD BE INSTALLED, ADJUSTED AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL EQUIPMENT IN THE ELEVATOR SYSTEM; PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY OCCUR IF INDIVIDUALS ARE NOT FAMILIAR WITH THE HAZARDS RESULTING FROM IMPROPER OPERATION.

WARNING: THE BI-DIRECTIONAL FIELD REGULATOR IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED AND INTERNAL CAPACITORS REMAIN CHARGED AFTER POWER IS REMOVED FROM THE UNIT. IT IS IMPORTANT THAT AC POWER IS REMOVED FROM THE UNIT FOR A MINIMUM OF FIVE MINUTES BEFORE TOUCHING THE INTERNAL PARTS OF THE REGULATOR. PERSONAL INJURY MAY RESULT UNLESS POWER IS REMOVED AND TIME IS ALLOWED FOR DISCHARGE.

WARNING: THE USER IS RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE WITH RESPECT TO MOTOR, CONTROLLER AND OPERATOR DEVICE INSTALLATION, WIRING AND START-UP. THE USER IS ALSO RESPONSIBLE FOR UNDERSTANDING AND APPLYING ALL OTHER APPLICABLE LOCAL CODES WHICH GOVERN SUCH PRACTICES AS WIRING PROTECTION, GROUNDING DISCONNECTS AND OVERCURRENT PROTECTION.

WARNING: THE MACHINE SHOULD NEVER BE USED "IN SERVICE" WHILE IN THE SET UP MODE. THE SPEED WILL NOT BE ACCURATELY REGULATED AND THE TACH LOSS CIRCUIT IS DISABLED. WHILE RUNNING THE CAR IN THE SET UP MODE, KEEP A SAFE DISTANCE FROM THE TERMINAL LANDINGS, VISUALLY OBSERVING THE CAR AT ALL TIMES.

NOTE: All adjustment potentiometers have a range of four (4) turns with a clutch (audible "click") at the end of the range to ensure accurate adjustment of the bi-directional field regulator.

5.1 STATIC TESTS: (*MG SET NOT RUNNING*)

In this section, an estimate of the armature voltage and the output voltage of the regulator will be calculated for several speeds. This will help to ensure a proper set up and calibration of the regulator.

5.1.1. Measure the generator field resistance attached to **F+** and **F-**. Check the fields for grounds with a megger or other instrument for this purpose. No grounds should occur in the field circuit.

Write measured resistance of the generator field here _____________ (ohms).

5.1.2. Use the table below to select the appropriate transformer secondary tap. Select the lowest AC tap available for the resistance you measured.

GENERATOR FIELD RESISTANCE	TRANSFORMER SECONDARY TAP	MAXIMUM DC FIELD VOLTAGE AVAILABLE
20 To 150 Ohms	**X1 To X2** 110 Volts AC	156 Volts DC
25 To 162 Ohms	**X1 To X3** 130 Volts AC	184 Volts DC
28 To 210 Ohms	**X1 To X4** 150 Volts AC	212 Volts DC
30 To 250 Ohms	**X1 To X5** 165 Volts AC	233 Volts DC

TABLE ONE

5.1.3. Change your selection only if you know that the DC field voltage available is not enough to reach contract speed.

A. **Write transformer tap you selected here:** ___________.

B. **Write the maximum DC field voltage available here:** ___________**VDC**

5.1.4. Table Two displays the relationship between the voltage at the REF OUT testpoint in relation to the ARM FEEDBACK voltage and the speed of the car.

CONTRACT SPEED IN FEET PER MINUTE

% Of Contract Speed	250	300	350	400	450	500	550	600	700	800	Speed Setting (Volts)	Arm FB Setting (Volts)
5.00%	13	15	18	20	23	25	28	30	35	40	0.50	0.38
10.00%	25	30	35	40	45	50	55	60	70	80	1.00	0.75
15.00%	38	45	53	60	68	75	83	90	105	120	1.50	1.13
20.00%	50	60	70	80	90	100	110	120	140	160	2.00	1.50
25.00%	63	75	88	100	113	125	138	150	175	200	2.50	1.88
30.00%	75	90	105	120	135	150	165	180	210	240	3.00	2.25
35.00%	88	105	122	140	158	175	193	210	245	280	3.50	2.63
40.00%	100	120	140	160	180	200	220	240	280	320	4.00	3.00
45.00%	113	135	158	180	203	225	248	270	315	360	4.50	3.38
50.00%	125	150	175	200	225	250	275	300	350	400	5.00	3.75
55.00%	138	165	193	220	248	275	303	330	385	440	5.50	4.13
60.00%	150	180	210	240	270	300	330	360	420	480	6.00	4.50
65.00%	163	195	228	260	293	325	358	390	455	520	6.50	4.88
70.00%	175	210	245	280	315	350	385	420	490	560	7.00	5.25
75.00%	188	225	263	300	338	375	413	450	525	600	7.50	5.63
80.00%	200	240	280	320	360	400	440	480	560	640	8.00	6.00
85.00%	213	255	298	340	383	425	468	510	595	680	8.50	6.38
90.00%	225	270	315	360	405	450	495	540	630	720	9.00	6.75
95.00%	238	285	333	380	428	475	523	570	665	760	9.50	7.13
100.00%	250	300	350	400	450	500	550	600	700	800	10.00	7.50

TABLE TWO

Table Two will now be used to help determine the various voltage settings you will need to setup the control for your elevator.

A. Write the contract speed here: _____________FPM.

B. Write the inspection speed here: _____________FPM.

Find your contract speed in the first row of table two. Now read down the column that you just located until you find your inspection speed. Now read across the row to the right to the first shaded column. This is the speed reference voltage that you will need to see at the REF OUT testpoint during an inspection speed run.

C. Write the REF OUT voltage here: ____________VDC.

Now read the rightmost shaded column. This is the Armature Feedback voltage setting.

D. Write the armature feedback voltage here: ____________VDC.

Now read across the row, which contains the inspection speed to the leftmost shaded column. This is the percentage of the contract speed or inspection speed percentage.

E. Write the inspection speed percentage here: ___________%.

5.1.5. The above procedure may be repeated for any other speed settings

5.1.6. Find the resistance value of the field (measured in step 1) in the first column of Table Three Read across to the column with the transformer tap you selected in step 5.1.3 to determine the estimated field current required for contract speed.

Write estimated field current here ___________AMPS.

ESTIMATED FIELD CURRENT (AMPS)

FIELD RESISTANCE IN OHMS	X1 TO X2 110 VAC	X1 TO X3 130 VAC	X1 TO X4 150 VAC	X1 TO X5 165 VAC
20	7.78	×	×	×
23	6.76	7.99	×	×
25	6.22	7.35	×	×
28	5.56	6.57	7.58	×
30	5.18	6.13	7.07	7.78
40	3.89	4.60	5.30	5.83
50	3.11	3.68	4.24	4.67
80	1.94	2.30	2.65	2.92
100	1.56	1.84	2.12	2.33
125	1.24	1.47	1.70	1.87
150	1.04	1.23	1.41	1.56
175	0.89	1.05	1.21	1.33
200	0.78	0.92	1.06	1.17
225	0.69	0.82	0.94	1.04

TABLE THREE

YOU ARE NOW READY TO BEGIN SET UP

5.2 SET UP: (*MG SET NOT RUNNING*)

The following section will adjust the D1028 to the settings determined in the previous section.

5.2.1. Connect the regulator to system. Typical connections are shown in the hook-up print. See warnings on page one.

5.2.2. Switch the regulator to the **SET UP** mode; with the **MG set stopped**.

5.2.3. Turn all potentiometers on the front panel fully counter clockwise for minimum settings.

5.2.5. Attach the positive lead of a digital voltmeter to the **REF OUT** testpoint. Attach the negative lead of the voltmeter to the **COMMON** testpoint.

5.2.6. Apply power to the control. **Note:** The RUN contact at TB3 does not have to be closed.

5.2.7. Adjust the **SIG IN GAIN** potentiometer so that the REF OUT testpoint measures 10 volts when a full speed signal is called for at the computer. This is a one-time adjustment!

5.2.8. Call for a run at inspection speed. Measure the voltage at the REF OUT testpoint. Compare the value to the expected value in Table Two.

5.2.9. Turn the **CURRENT** potentiometer two turns clockwise to mid-range. Turn the **CONTRACT SPD** potentiometer two turns clockwise to mid range. Turn the **ARM FEEDBACK** potentiometer two turns clockwise to mid range.

5.2.10. Turn the tachometer by hand in the direction that the tachometer will rotate while the car is traveling in the UP direction. Note the polarity of the tachometer signal.

5.2.11. Connect the positive lead of the tachometer to the **+UP** terminal of the D1028. Connect the negative lead of the tachometer to the **-UP** terminal on the D1028. Connect the shield of the tachometer cable to the **COM** terminal on the D1028.

Note: The shield of the tachometer cable should be connected to the D1028 only. Do **<u>not</u>** connect the shield at the tachometer side.

5.3 SET-UP (*MG SET RUNNING*)

The following steps are to be performed with the elevator car in the middle of the shaft way. The D1028 should be in **SET UP** mode (**AUTO/SET UP** switch to the **SET UP** position). The Motor Generator set should be running and the car should be prepared to call for a run at inspection speed.

The proper sequencing of contact closure is essential for proper operation of the D1028. The following sequence is recommended:

1. AC control power is applied to the D1028.
2. The **RUN** contact is closed at TB3 of the D1028. Customer RUN contacts may also close at this time.
3. Customer's AC field power contacts are closed, applying secondary voltage from the isolation transformer to the D1028 **AC1** and **AC2** Field Power terminals.
4. Call for a speed and direction by applying an input signal to the **+UP** and **-UP** terminals on the D1028.

WARNING: THE FOLLOWING STEPS SHOULD BE ACCOMPLISHED IN THE SET UP MODE WITH THE SW1 SWITCH IN THE SET UP POSITION. DO NOT ATTEMPT THIS PROCEDURE IN THE NORMAL RUNNING OR AUTO MODE.

5.3.1. Call for a run at inspection speed in the **UP** direction.

5.3.2 Determine the actual speed of the car with a hand-held tachometer.

5.3.3. Call for a run at inspection speed in the **DN** direction. Adjust the inspection speed by turning the **FIELD CURRENT** potentiometer, P4, clockwise until the speed is approximately equal to the speed in the UP direction.

5.3.4. Call for a run at inspection speed. Monitor the tachometer feedback voltage by placing the positive lead of a multimeter on the **TACH** testpoint and the negative lead of the multimeter on the **COMMON** testpoint. Adjust the **CONTRACT SPD** potentiometer until the voltage is equal to the voltage at the **REF OUT** testpoint.

5.3.5. Move the positive lead of the multimeter to the **ARM FB** testpoint. Call for a run in the **UP** direction at inspection speed. ***The voltage at the ARM FB testpoint <u>must</u> be positive***. If the voltage is negative, you must reverse the leads to **A+** and **A-** on TB1.

5.3.6. Adjust the **ARM FEEDBACK** potentiometer until the voltage is equal to the voltage value selected in step **5.1.4 D**. This voltage should be equal to the voltage at the **REF IN** testpoint multiplied by 0.75.

5.4 NORMAL RUNNING MODE

In this section, the D1028 will be put into the **AUTO** mode. The tachometer feedback and armature feedback voltages will be fine-tuned to achieve complete closed loop operation. The following steps require the use of a dual trace storage oscilloscope for maximum precision.

5.4.1. Open the customer RUN contacts. Open the customer AC Field Power contacts. Open the **RUN** contact at TB3 on the D1028. Turn off the control AC power and switch **SW1** to the **AUTO** position.

5.4.2. Turn the **LOOP GAIN** potentiometer, P2, two turns clockwise to the center position.

5.4.4. Set up the oscilloscope as follows:

- Connect scope gnd (floating) to the **COMMON** test point.
- Connect the Channel 1 probe to the **REF OUT** test point.
- Connect Channel 2 probe to the **TACH** test point.
- Set the Volts/Division to 2V/division for both Channel 1 and Channel 2.
- Set the Time base to 0.1 sec/div.
- Set the display mode to Dual Trace (Ch1 & Ch2).
- Set the Storage mode to roll.
- Set both traces at one division above bottom graticule.

CURRENT AND CONTRACT SPEED CALIBRATION

5.4.5. Call for a run at low speed in the **UP** direction. Observe the **REF OUT** and **TACH** signals on the oscilloscope. Both should be positive for the **UP** direction.

5.4.6. Call for a run at low speed in the **DN** direction. Observe the **REF OUT** and **TACH** signals on the oscilloscope. Both signals should be negative and of the same magnitude as in step 5.4.5.

5.4.7. Call for a run at high speed.

A. Monitor the **TACH** testpoint with a voltmeter.

B. Slowly adjust the **FIELD CURRENT** potentiometer clockwise (increasing the field current), until the voltage at the **TACH** testpoint stops increasing.

At this point the control is properly regulating speed and current. Turn the **CURRENT** potentiometer ½ turn more clockwise for headroom.

C. The signal at the **TACH** testpoint should now be equal in amplitude to the signal at the **REF OUT** testpoint at all speeds.

D. Using a hand-held tachometer, measure the actual speed on the sheave. The voltage at the **TACH** testpoint should be equal to 10 volts and the car should be running at contract speed.

E. Readjust the **CONTRACT SPD** potentiometer, P3, to obtain the exact contract speed equal to 10V at the **TACH** testpoint, if necessary.

F. Check the **ARM FEEDBACK** testpoint and verify that the voltage reading is 7.5V at contract speed.

5.4.9. The following oscilloscope plots show the **TACH** (channel 2) and **REF OUT** (channel 1) testpoint signals. An ideal trace occurs when the tachometer and the reference signals track on top of each other over the entire run.

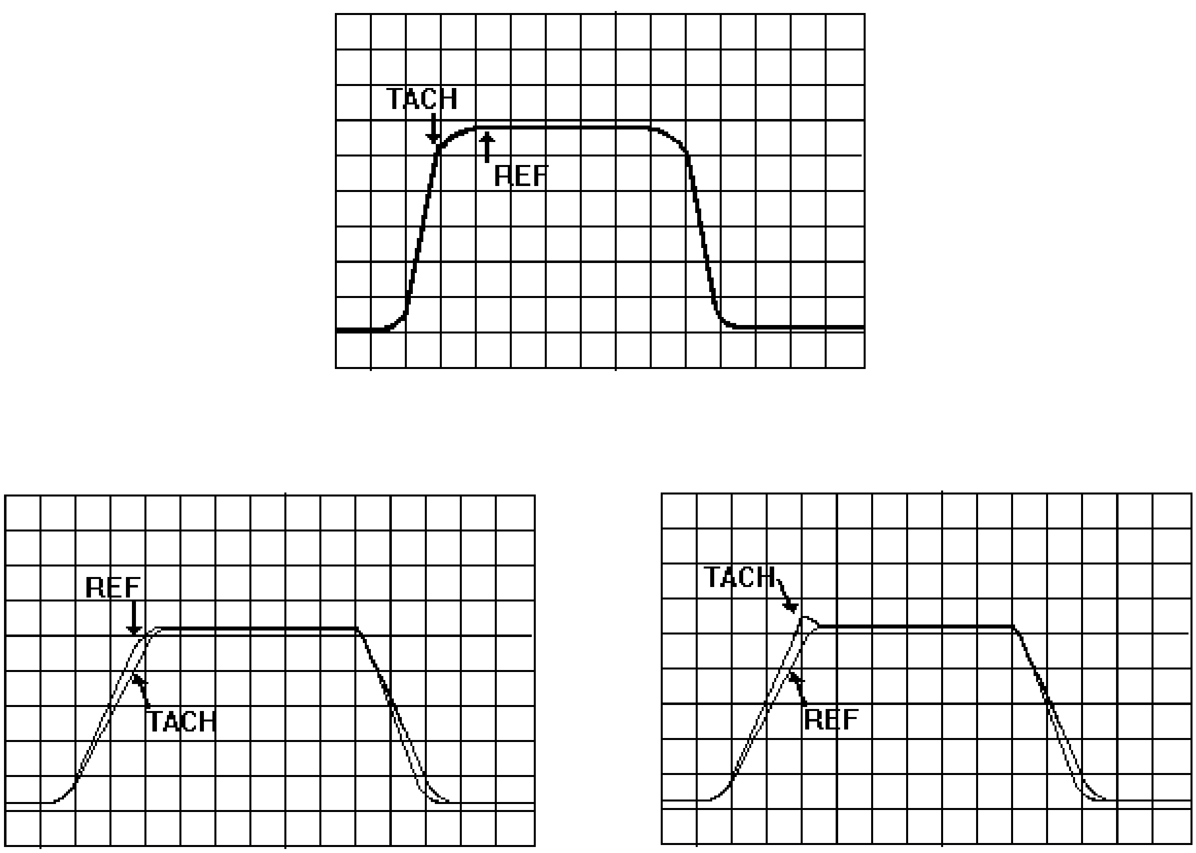


FIGURE TWO

5.5. FINE TUNING ADJUSTMENTS

Fine tuning the performance of the D1028 requires a good deal of trial and error. The following suggestions are to be used only as a guide. There are often many combinations of acceleration and deceleration settings as well as **LOOP GAIN, ARM FEEDBACK**, and **STABILITY** settings that will produce a properly regulated **TACH** vs. **REF OUT** pattern.

SLUGGISH RESPONSE

The **TACH** signal is lagging far behind the **REF OUT** signal. This is causing an **OUT OF REG** (out of regulation) condition. The elevator is slow reaching top speed and may take too long to reach the floor during deceleration.

TUNING PROCEDURE FOR SLUGGISH/SLOW RESPONSE:

1. Check and adjust the acceleration and deceleration rates because they may be too long.

2. Increase the **LOOP GAIN** potentiometer clockwise as required, observing the pattern.

3. If the **LOOP GAIN** potentiometer is full clockwise and the response is still sluggish reset the **LOOP GAIN** potentiometer to the center position.

4. Monitor the **ARM FEEDBACK** testpoint with a voltmeter.

5. Decrease the **ARM FEEDBACK** potentiometer by turning the pot counterclockwise slightly (½ volt on the **ARM FEEDBACK** testpoint), observing the pattern.

6. Increase the **STABILITY** potentiometer clockwise if the pattern becomes unstable.

7. Repeat steps 4 through 6 as required.

CAUTION: **AN ARMATURE FEEDBACK SETTING BELOW ± 4.0V AT CONTRACT SPEED CAN CAUSE THE TACH LOSS CIRCUIT TO BE INOPERATIVE DO NOT SET THE ARMATURE FEEDBACK TESTPOINT BELOW ± 4.0V AT CONTRACT SPEED.**

OVERSHOOT/INSTABILITY

In this case the **TACH** signal is often leading the **REF OUT** signal or oscillating around it. The control is correcting too quickly for changes causing the elevator to be unstable.

TUNING PROCEDURE FOR OSCILLATING/OVER RESPONSE

1. Check and adjust the acceleration rates because they may be too short.

2. Decrease the **LOOP GAIN** potentiometer counterclockwise as required, observing the pattern.

3. If the **LOOP GAIN** potentiometer is fully counterclockwise and the response is still too fast, reset the **LOOP GAIN** potentiometer to the center position.

4. Increase the **STABILITY** potentiometer clockwise, observing the pattern.

5. If the **STABILITY** potentiometer is fully clockwise and the response is still unstable reset the **STABILITY** potentiometer fully counterclockwise.

6. Monitor the **ARM FEEDBACK** testpoint with a voltmeter.

7. Increase the **ARM FEEDBACK** potentiometer clockwise slightly, (½ volt on the **ARM FEEDBACK** testpoint), observing the pattern.

8. Increase the **STABILITY** potentiometer clockwise if the pattern becomes unstable.

9. Repeat steps 4 through 8 as required.

CAUTION: **THE ARM FEEDBACK TESTPOINT SHOULD NEVER BE GREATER THAN ±10 VOLTS AT CONTRACT SPEED.**

5.6. SELECTING A HIGH SPEED CURRENT LIMITING RESISTOR

The maximum speed of the elevator is dependent on the amount of current available to the generator field. By limiting the amount of current available to the generator field, we can limit the maximum speed of the elevator. There are two methods of limiting the maximum current available. The first method is to select a tap of the Field Power Isolation Transformer (typically supplied by IPC) which supplies just enough voltage to the field and allows the car to attain contract speed in a worst case high speed run (empty car down or full car up). The second method is necessary when you must move to a higher tap on the transformer and now have more than enough voltage/current available and can exceed the contract speed in a worst case high speed run. When this is the case, you must insert a resistor in series with the generator field to limit the maximum current available.

The following pages contain tables, which will be used to determine the value of the HIGH SPEED CURRENT, **LIMITING RESISTOR** you must use to safely limit the current. In order to use the tables you will need to know the following:

A. The Field Power Isolation Transformer secondary tap selected in step 5.1.3 A.

B. The Generator Field Current at contract speed. This may be determined by placing the positive lead of a voltmeter on the **FIELD CURRENT** testpoint and measuring the voltage during a worst case high speed run. The field current is equal to the voltage measured at the testpoint (1V = 1A).

C. The Maximum DC Field Voltage at contract speed. This may be measured at the **F+** and **F-** terminals during a worst case high speed run.

After you have selected the proper table, read down the left-hand column and find your field current at contract speed. Next, read across to the column that indicates your field voltage at contract speed. The value listed at the cell you just located is the resistance for the **HIGH-SPEED CURRENT LIMITING RESISTOR (R3)** (See Figure 1). This value should be adjusted as necessary to make sure you still reach contract speed and to account for a drop in line voltage.

If your transformer tap is **X1** to **X2** **USE TABLE FOUR**

If your transformer tap is **X1** to **X3** **USE TABLE FIVE**

If your transformer tap is **X1** to **X4** **USE TABLE SIX**

If your transformer tap is **X1** to **X5** **USE TABLE SEVEN**

DETERMINE THE VALUE OF THE HIGH SPEED CURRENT LIMITING RESISTOR
ISOLATION TRANSFORMER TAPS X1 TO X2 (110 VAC)

	FIELD VOLTAGE AT CONTRACT SPEED (Volts DC)										
FIELD I(Amps)	**100**	**105**	**110**	**115**	**120**	**125**	**130**	**135**	**140**	**145**	**150**
1.00	55.54	50.54	45.54	40.54	35.54	30.54	25.54	20.54	15.54	10.54	5.54
1.25	44.43	40.43	36.43	32.43	28.43	24.43	20.43	16.43	12.43	8.43	4.43
1.50	37.03	33.69	30.36	27.03	23.69	20.36	17.03	13.69	10.36	7.03	3.69
1.75	31.74	28.88	26.02	23.17	20.31	17.45	14.59	11.74	8.88	6.02	3.17
2.00	27.77	25.27	22.77	20.27	17.77	15.27	12.77	10.27	7.77	5.27	2.77
2.25	24.68	22.46	20.24	18.02	15.80	13.57	11.35	9.13	6.91	4.68	2.46
2.50	22.22	20.22	18.22	16.22	14.22	12.22	10.22	8.22	6.22	4.22	2.22
2.75	20.20	18.38	16.56	14.74	12.92	11.11	9.29	7.47	5.65	3.83	2.01
3.00	18.51	16.85	15.18	13.51	11.85	10.18	8.51	6.85	5.18	3.51	1.85
3.25	17.09	15.55	14.01	12.47	10.94	9.40	7.86	6.32	4.78	3.24	1.70
3.50	15.87	14.44	13.01	11.58	10.15	8.73	7.30	5.87	4.44	3.01	1.58
3.75	14.81	13.48	12.14	10.81	9.48	8.14	6.81	5.48	4.14	2.81	1.48
4.00	13.89	12.64	11.39	10.14	8.89	7.64	6.39	5.14	3.89	2.64	1.39
4.25	13.07	11.89	10.72	9.54	8.36	7.19	6.01	4.83	3.66	2.48	1.30
4.50	12.34	11.23	10.12	9.01	7.90	6.79	5.68	4.56	3.45	2.34	1.23
4.75	11.69	10.64	9.59	8.53	7.48	6.43	5.38	4.32	3.27	2.22	1.17
5.00	11.11	10.11	9.11	8.11	7.11	6.11	5.11	4.11	3.11	2.11	1.11
5.25	10.58	9.63	8.67	7.72	6.77	5.82	4.86	3.91	2.96	2.01	1.06
5.50	10.10	9.19	8.28	7.37	6.46	5.55	4.64	3.73	2.83	1.92	1.01
5.75	9.66	8.79	7.92	7.05	6.18	5.31	4.44	3.57	2.70	1.83	0.96
6.00	9.26	8.42	7.59	6.76	5.92	5.09	4.26	3.42	2.59	1.76	0.92
6.25	8.89	8.09	7.29	6.49	5.69	4.89	4.09	3.29	2.49	1.69	0.89
6.50	8.54	7.78	7.01	6.24	5.47	4.70	3.93	3.16	2.39	1.62	0.85
6.75	8.23	7.49	6.75	6.01	5.27	4.52	3.78	3.04	2.30	1.56	0.82
7.00	7.93	7.22	6.51	5.79	5.08	4.36	3.65	2.93	2.22	1.51	0.79
7.25	7.66	6.97	6.28	5.59	4.90	4.21	3.52	2.83	2.14	1.45	0.76
7.50	7.41	6.74	6.07	5.41	4.74	4.07	3.41	2.74	2.07	1.41	0.74

TABLE FOUR

**DETERMINE THE VALUE OF THE HIGH SPEED CURRENT LIMITING RESISTOR
ISOLATION TRANSFORMER TAPS X1 TO X3 (130 VAC)**

	FIELD VOLTAGE AT CONTRACT SPEED (Volts DC)										
FIELD I(Amps)	130	135	140	145	150	155	160	165	170	175	180
1.00	53.82	48.82	43.82	38.82	33.82	28.82	23.82	18.82	13.82	8.82	3.82
1.25	43.06	39.06	35.06	31.06	27.06	23.06	19.06	15.06	11.06	7.06	3.06
1.50	35.88	32.55	29.21	25.88	22.55	19.21	15.88	12.55	9.21	5.88	2.55
1.75	30.75	27.90	25.04	22.18	19.33	16.47	13.61	10.75	7.90	5.04	2.18
2.00	26.91	24.41	21.91	19.41	16.91	14.41	11.91	9.41	6.91	4.41	1.91
2.25	23.92	21.70	19.48	17.25	15.03	12.81	10.59	8.36	6.14	3.92	1.70
2.50	21.53	19.53	17.53	15.53	13.53	11.53	9.53	7.53	5.53	3.53	1.53
2.75	19.57	17.75	15.93	14.12	12.30	10.48	8.66	6.84	5.03	3.21	1.39
3.00	17.94	16.27	14.61	12.94	11.27	9.61	7.94	6.27	4.61	2.94	1.27
3.25	16.56	15.02	13.48	11.94	10.41	8.87	7.33	5.79	4.25	2.71	1.18
3.50	15.38	13.95	12.52	11.09	9.66	8.23	6.81	5.38	3.95	2.52	1.09
3.75	14.35	13.02	11.69	10.35	9.02	7.69	6.35	5.02	3.69	2.35	1.02
4.00	13.46	12.21	10.96	9.71	8.46	7.21	5.96	4.71	3.46	2.21	0.96
4.25	12.66	11.49	10.31	9.13	7.96	6.78	5.60	4.43	3.25	2.08	0.90
4.50	11.96	10.85	9.74	8.63	7.52	6.40	5.29	4.18	3.07	1.96	0.85
4.75	11.33	10.28	9.23	8.17	7.12	6.07	5.01	3.96	2.91	1.86	0.80
5.00	10.76	9.76	8.76	7.76	6.76	5.76	4.76	3.76	2.76	1.76	0.76
5.25	10.25	9.30	8.35	7.39	6.44	5.49	4.54	3.58	2.63	1.68	0.73
5.50	9.79	8.88	7.97	7.06	6.15	5.24	4.33	3.42	2.51	1.60	0.69
5.75	9.36	8.49	7.62	6.75	5.88	5.01	4.14	3.27	2.40	1.53	0.66
6.00	8.97	8.14	7.30	6.47	5.64	4.80	3.97	3.14	2.30	1.47	0.64
6.25	8.61	7.81	7.01	6.21	5.41	4.61	3.81	3.01	2.21	1.41	0.61
6.50	8.28	7.51	6.74	5.97	5.20	4.43	3.66	2.90	2.13	1.36	0.59
6.75	7.97	7.23	6.49	5.75	5.01	4.27	3.53	2.79	2.05	1.31	0.57
7.00	7.69	6.97	6.26	5.55	4.83	4.12	3.40	2.69	1.97	1.26	0.55
7.25	7.42	6.73	6.04	5.35	4.66	3.98	3.29	2.60	1.91	1.22	0.53
7.50	7.18	6.51	5.84	5.18	4.51	3.84	3.18	2.51	1.84	1.18	0.51

TABLE FIVE

DETERMINE THE VALUE OF THE HIGH SPEED CURRENT LIMITING RESISTOR
ISOLATION TRANSFORMER TAPS X1 TO X4 (150 VAC)

FIELD VOLTAGE AT CONTRACT SPEED (Volts DC)

FIELD (Amps)	160	165	170	175	180	185	190	195	200	205	210
1.00	52.10	47.10	42.10	37.10	32.10	27.10	22.10	17.10	12.10	7.10	2.10
1.25	41.68	37.68	33.68	29.68	25.68	21.68	17.68	13.68	9.68	5.68	1.68
1.50	34.73	31.40	28.07	24.73	21.40	18.07	14.73	11.40	8.07	4.73	1.40
1.75	29.77	26.91	24.06	21.20	18.34	15.49	12.63	9.77	6.91	4.06	1.20
2.00	26.05	23.55	21.05	18.55	16.05	13.55	11.05	8.55	6.05	3.55	1.05
2.25	23.16	20.93	18.71	16.49	14.27	12.04	9.82	7.60	5.38	3.16	0.93
2.50	20.84	18.84	16.84	14.84	12.84	10.84	8.84	6.84	4.84	2.84	0.84
2.75	18.95	17.13	15.31	13.49	11.67	9.85	8.04	6.22	4.40	2.58	0.76
3.00	17.37	15.70	14.03	12.37	10.70	9.03	7.37	5.70	4.03	2.37	0.70
3.25	16.03	14.49	12.95	11.42	9.88	8.34	6.80	5.26	3.72	2.18	0.65
3.50	14.89	13.46	12.03	10.60	9.17	7.74	6.31	4.89	3.46	2.03	0.60
3.75	13.89	12.56	11.23	9.89	8.56	7.23	5.89	4.56	3.23	1.89	0.56
4.00	13.03	11.78	10.53	9.28	8.03	6.78	5.53	4.28	3.03	1.78	0.53
4.25	12.26	11.08	9.91	8.73	7.55	6.38	5.20	4.02	2.85	1.67	0.49
4.50	11.58	10.47	9.36	8.24	7.13	6.02	4.91	3.80	2.69	1.58	0.47
4.75	10.97	9.92	8.86	7.81	6.76	5.71	4.65	3.60	2.55	1.49	0.44
5.00	10.42	9.42	8.42	7.42	6.42	5.42	4.42	3.42	2.42	1.42	0.42
5.25	9.92	8.97	8.02	7.07	6.11	5.16	4.21	3.26	2.30	1.35	0.40
5.50	9.47	8.56	7.65	6.75	5.84	4.93	4.02	3.11	2.20	1.29	0.38
5.75	9.06	8.19	7.32	6.45	5.58	4.71	3.84	2.97	2.10	1.23	0.37
6.00	8.68	7.85	7.02	6.18	5.35	4.52	3.68	2.85	2.02	1.18	0.35
6.25	8.34	7.54	6.74	5.94	5.14	4.34	3.54	2.74	1.94	1.14	0.34
6.50	8.02	7.25	6.48	5.71	4.94	4.17	3.40	2.63	1.86	1.09	0.32
6.75	7.72	6.98	6.24	5.50	4.76	4.01	3.27	2.53	1.79	1.05	0.31
7.00	7.44	6.73	6.01	5.30	4.59	3.87	3.16	2.44	1.73	1.01	0.30
7.25	7.19	6.50	5.81	5.12	4.43	3.74	3.05	2.36	1.67	0.98	0.29
7.50	6.95	6.28	5.61	4.95	4.28	3.61	2.95	2.28	1.61	0.95	0.28

TABLE SIX

DETERMINE THE VALUE OF THE HIGH SPEED CURRENT LIMITING RESISTOR ISOLATION TRANSFORMER TAPS X1 TO X5 (165 VAC)

FIELD VOLTAGE AT CONTRACT SPEED (Volts DC)

FIELD(Amps)	190	195	200	205	210	215	220	225	230
1.00	43.31	38.31	33.31	28.31	23.31	18.31	13.31	8.31	3.31
1.25	190.00	30.65	26.65	22.65	18.65	14.65	10.65	6.65	2.65
1.50	43.31	25.54	22.21	18.87	15.54	12.21	8.87	5.54	2.21
1.75	190.00	21.89	19.03	16.18	13.32	10.46	7.61	4.75	1.89
2.00	43.31	19.16	16.66	14.16	11.66	9.16	6.66	4.16	1.66
2.25	190.00	17.03	14.80	12.58	10.36	8.14	5.92	3.69	1.47
2.50	43.31	15.32	13.32	11.32	9.32	7.32	5.32	3.32	1.32
2.75	190.00	13.93	12.11	10.29	8.48	6.66	4.84	3.02	1.20
3.00	43.31	12.77	11.10	9.44	7.77	6.10	4.44	2.77	1.10
3.25	190.00	11.79	10.25	8.71	7.17	5.63	4.10	2.56	1.02
3.50	43.31	10.95	9.52	8.09	6.66	5.23	3.80	2.37	0.95
3.75	190.00	10.22	8.88	7.55	6.22	4.88	3.55	2.22	0.88
4.00	43.31	9.58	8.33	7.08	5.83	4.58	3.33	2.08	0.83
4.25	190.00	9.01	7.84	6.66	5.48	4.31	3.13	1.96	0.78
4.50	43.31	8.51	7.40	6.29	5.18	4.07	2.96	1.85	0.74
4.75	190.00	8.07	7.01	5.96	4.91	3.85	2.80	1.75	0.70
5.00	43.31	7.66	6.66	5.66	4.66	3.66	2.66	1.66	0.66
5.25	190.00	7.30	6.34	5.39	4.44	3.49	2.54	1.58	0.63
5.50	43.31	6.97	6.06	5.15	4.24	3.33	2.42	1.51	0.60
5.75	190.00	6.66	5.79	4.92	4.05	3.18	2.31	1.45	0.58
6.00	43.31	6.39	5.55	4.72	3.89	3.05	2.22	1.39	0.55
6.25	190.00	6.13	5.33	4.53	3.73	2.93	2.13	1.33	0.53
6.50	43.31	5.89	5.12	4.36	3.59	2.82	2.05	1.28	0.51
6.75	190.00	5.68	4.93	4.19	3.45	2.71	1.97	1.23	0.49
7.00	43.31	5.47	4.76	4.04	3.33	2.62	1.90	1.19	0.47
7.25	190.00	5.28	4.59	3.90	3.22	2.53	1.84	1.15	0.46
7.50	43.31	5.11	4.44	3.77	3.11	2.44	1.77	1.11	0.44

TABLE SEVEN

5.7. SELECTING A LEVELING/RE-LEVELING CURRENT LIMITING RESISTOR

A LEVELING/RE-LEVELING CURRENT LIMITING RESISTOR is absolutely necessary to ensure safe performance of the elevator. The purpose of this resistor is to limit the maximum speed that the elevator could reach while leveling/re-leveling if the control was to fail in a fully on state. This resistor is labeled **R1** on the hook-up print. ***Without a* LEVELING/RE-LEVELING CURRENT LIMITING RESISTOR, *If the D1028 was to fail fully on, the elevator car would take-off and run at full (contract) speed.***

The following pages contain tables which will be used to determine the value of the **LEVELING/RE-LEVELING CURRENT LIMITING RESISTOR** you must use to safely limit the current. In order to use the tables you will need to know the following:

A. The Field Power Isolation Transformer secondary tap selected in step 5.1.3 A.

B. The Generator Field Current at leveling/re-leveling speed. This may be determined by placing the positive lead of a voltmeter on the **FIELD CURRENT** testpoint and measuring the voltage for a worst case run during leveling. The field current is equal to the voltage measured at the testpoint (1V = 1A).

C. The Maximum DC Field Voltage at leveling speed. This may be measured at the **F+** and **F-** terminals during a worst case leveling speed run.

After you have selected the proper table, read down the left-hand column and find your field current at contract speed. Next, read across to the column that indicates your field voltage at contract speed. The value listed at the cell you just located is the resistance for the **LEVELING/RE-LEVELING CURRENT LIMITING RESISTOR (R3)** (See Figure Six). This value should be adjusted as necessary to make sure you still reach leveling speed and to account for a drop in line voltage.

If your transformer tap is **X1** to **X2** **USE TABLE EIGHT**

If your transformer tap is **X1** to **X3** **USE TABLE NINE**

If your transformer tap is **X1** to **X4** **USE TABLE TEN**

If your transformer tap is **X1** to **X5** **USE TABLE ELEVEN**

DETERMINE THE LEVELING SPEED CURRENT LIMITING RESISTOR (Ohms)
FOR ISOLATION TRANSFORMER TAPS X1 TO X2 (110 VAC)

FIELD VOLTAGE AT LEVELING SPEED (Volts DC)

FIELD(Amps)	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00
0.05	3010.8	2990.8	2970.8	2950.8	2930.8	2910.8	2890.8	2870.8	2850.8	2830.8	2810.8
0.08	2007.2	1993.9	1980.5	1967.2	1953.9	1940.5	1927.2	1913.9	1900.5	1887.2	1873.9
0.10	1505.4	1495.4	1485.4	1475.4	1465.4	1455.4	1445.4	1435.4	1425.4	1415.4	1405.4
0.13	1204.3	1196.3	1188.3	1180.3	1172.3	1164.3	1156.3	1148.3	1140.3	1132.3	1124.3
0.15	1003.6	996.93	990.27	983.60	976.93	970.27	963.60	956.93	950.27	943.60	936.93
0.18	860.23	854.51	848.80	843.09	837.37	831.66	825.94	820.23	814.51	808.80	803.09
0.20	752.70	747.70	742.70	737.70	732.70	727.70	722.70	717.70	712.70	707.70	702.70
0.23	669.07	664.62	660.18	655.73	651.29	646.84	642.40	637.96	633.51	629.07	624.62
0.25	602.16	598.16	594.16	590.16	586.16	582.16	578.16	574.16	570.16	566.16	562.16
0.28	547.42	543.78	540.15	536.51	532.87	529.24	525.60	521.96	518.33	514.69	511.05
0.30	501.80	498.47	495.13	491.80	488.47	485.13	481.80	478.47	475.13	471.80	468.47
0.33	463.20	460.12	457.05	453.97	450.89	447.82	444.74	441.66	438.58	435.51	432.43
0.35	430.11	427.26	424.40	421.54	418.69	415.83	412.97	410.11	407.26	404.40	401.54
0.38	401.44	398.77	396.11	393.44	390.77	388.11	385.44	382.77	380.11	377.44	374.77
0.40	376.35	373.85	371.35	368.85	366.35	363.85	361.35	358.85	356.35	353.85	351.35
0.43	354.21	351.86	349.51	347.15	344.80	342.45	340.09	337.74	335.39	333.04	330.68
0.45	334.53	332.31	330.09	327.87	325.64	323.42	321.20	318.98	316.76	314.53	312.31
0.48	316.93	314.82	312.72	310.61	308.51	306.40	304.29	302.19	300.08	297.98	295.87
0.50	301.08	299.08	297.08	295.08	293.08	291.08	289.08	287.08	285.08	283.08	281.08
0.53	286.74	284.84	282.93	281.03	279.12	277.22	275.31	273.41	271.50	269.60	267.70
0.55	273.71	271.89	270.07	268.25	266.44	264.62	262.80	260.98	259.16	257.35	255.53
0.58	261.81	260.07	258.33	256.59	254.85	253.11	251.37	249.63	247.90	246.16	244.42
0.60	250.90	249.23	247.57	245.90	244.23	242.57	240.90	239.23	237.57	235.90	234.23
0.63	240.86	239.26	237.66	236.06	234.46	232.86	231.26	229.66	228.06	226.46	224.86
0.65	231.60	230.06	228.52	226.98	225.45	223.91	222.37	220.83	219.29	217.75	216.22
0.68	223.02	221.54	220.06	218.58	217.10	215.61	214.13	212.65	211.17	209.69	208.21
0.70	215.06	213.63	212.20	210.77	209.34	207.91	206.49	205.06	203.63	202.20	200.77

TABLE EIGHT

DETERMINE THE LEVELING SPEED CURRENT LIMITING RESISTOR (Ohms)
FOR ISOLATION TRANSFORMER TAPS X1 TO X3 (130 VAC)

FIELD VOLTAGE AT LEVELING SPEED (Volts DC)

FIELD(Amps)	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
0.05	3516.4	3496.4	3476.4	3456.4	3436.4	3416.4	3396.4	3376.4	3356.4	3336.4	3316.4
0.08	2344.3	2330.9	2317.6	2304.3	2290.9	2277.6	2264.3	2250.9	2237.6	2224.3	2210.9
0.10	1758.2	1748.2	1738.2	1728.2	1718.2	1708.2	1698.2	1688.2	1678.2	1668.2	1658.2
0.13	1406.6	1398.6	1390.6	1382.6	1374.6	1366.6	1358.6	1350.6	1342.6	1334.6	1326.6
0.15	1172.1	1165.5	1158.8	1152.1	1145.5	1138.8	1132.1	1125.5	1118.8	1112.1	1105.5
0.18	1004.7	998.97	993.26	987.54	981.83	976.11	970.40	964.69	958.97	953.26	947.54
0.20	879.10	874.10	869.10	864.10	859.10	854.10	849.10	844.10	839.10	834.10	829.10
0.23	781.42	776.98	772.53	768.09	763.64	759.20	754.76	750.31	745.87	741.42	736.98
0.25	703.28	699.28	695.28	691.28	687.28	683.28	679.28	675.28	671.28	667.28	663.28
0.28	639.35	635.71	632.07	628.44	624.80	621.16	617.53	613.89	610.25	606.62	602.98
0.30	586.07	582.73	579.40	576.07	572.73	569.40	566.07	562.73	559.40	556.07	552.73
0.33	540.98	537.91	534.83	531.75	528.68	525.60	522.52	519.45	516.37	513.29	510.22
0.35	502.34	499.49	496.63	493.77	490.91	488.06	485.20	482.34	479.49	476.63	473.77
0.38	468.85	466.19	463.52	460.85	458.19	455.52	452.85	450.19	447.52	444.85	442.19
0.40	439.55	437.05	434.55	432.05	429.55	427.05	424.55	422.05	419.55	417.05	414.55
0.43	413.69	411.34	408.99	406.64	404.28	401.93	399.58	397.22	394.87	392.52	390.16
0.45	390.71	388.49	386.27	384.04	381.82	379.60	377.38	375.16	372.93	370.71	368.49
0.48	370.15	368.04	365.94	363.83	361.73	359.62	357.52	355.41	353.31	351.20	349.09
0.50	351.64	349.64	347.64	345.64	343.64	341.64	339.64	337.64	335.64	333.64	331.64
0.53	334.90	332.99	331.09	329.18	327.28	325.37	323.47	321.56	319.66	317.75	315.85
0.55	319.67	317.85	316.04	314.22	312.40	310.58	308.76	306.95	305.13	303.31	301.49
0.58	305.77	304.03	302.30	300.56	298.82	297.08	295.34	293.60	291.86	290.12	288.38
0.60	293.03	291.37	289.70	288.03	286.37	284.70	283.03	281.37	279.70	278.03	276.37
0.63	281.31	279.71	278.11	276.51	274.91	273.31	271.71	270.11	268.51	266.91	265.31
0.65	270.49	268.95	267.42	265.88	264.34	262.80	261.26	259.72	258.18	256.65	255.11
0.68	260.47	258.99	257.51	256.03	254.55	253.07	251.59	250.10	248.62	247.14	245.66
0.70	251.17	249.74	248.31	246.89	245.46	244.03	242.60	241.17	239.74	238.31	236.89

TABLE NINE

DETERMINE THE LEVELING SPEED CURRENT LIMITING RESISTOR (Ohms)
FOR ISOLATION TRANSFORMER TAPS X1 TO X4 (150 VAC)

FIELD VOLTAGE AT LEVELING SPEED (Volts DC)

FIELD(Amps)	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00
0.05	4022.0	4002.0	3982.0	3962.0	3942.0	3922.0	3902.0	3882.0	3862.0	3842.0	3822.0
0.08	2681.3	2668.0	2654.7	2641.3	2628.0	2614.7	2601.3	2588.0	2574.7	2561.3	2548.0
0.10	2011.0	2001.0	1991.0	1981.0	1971.0	1961.0	1951.0	1941.0	1931.0	1921.0	1911.0
0.13	1608.8	1600.8	1592.8	1584.8	1576.8	1568.8	1560.8	1552.8	1544.8	1536.8	1528.8
0.15	1340.7	1334.0	1327.3	1320.7	1314.0	1307.3	1300.7	1294.0	1287.3	1280.7	1274.0
0.18	1149.1	1143.4	1137.7	1132.0	1126.3	1120.6	1114.9	1109.1	1103.4	1097.7	1092.0
0.20	1005.5	1000.5	995.50	990.50	985.50	980.50	975.50	970.50	965.50	960.50	955.50
0.23	893.78	889.33	884.89	880.44	876.00	871.56	867.11	862.67	858.22	853.78	849.33
0.25	804.40	800.40	796.40	792.40	788.40	784.40	780.40	776.40	772.40	768.40	764.40
0.28	731.27	727.64	724.00	720.36	716.73	713.09	709.45	705.82	702.18	698.55	694.91
0.30	670.33	667.00	663.67	660.33	657.00	653.67	650.33	647.00	643.67	640.33	637.00
0.33	618.77	615.69	612.62	609.54	606.46	603.38	600.31	597.23	594.15	591.08	588.00
0.35	574.57	571.71	568.86	566.00	563.14	560.29	557.43	554.57	551.71	548.86	546.00
0.38	536.27	533.60	530.93	528.27	525.60	522.93	520.27	517.60	514.93	512.27	509.60
0.40	502.75	500.25	497.75	495.25	492.75	490.25	487.75	485.25	482.75	480.25	477.75
0.43	473.18	470.82	468.47	466.12	463.76	461.41	459.06	456.71	454.35	452.00	449.65
0.45	446.89	444.67	442.44	440.22	438.00	435.78	433.56	431.33	429.11	426.89	424.67
0.48	423.37	421.26	419.16	417.05	414.95	412.84	410.74	408.63	406.53	404.42	402.32
0.50	402.20	400.20	398.20	396.20	394.20	392.20	390.20	388.20	386.20	384.20	382.20
0.53	383.05	381.14	379.24	377.33	375.43	373.52	371.62	369.71	367.81	365.90	364.00
0.55	365.64	363.82	362.00	360.18	358.36	356.55	354.73	352.91	351.09	349.27	347.45
0.58	349.74	348.00	346.26	344.52	342.78	341.04	339.30	337.57	335.83	334.09	332.35
0.60	335.17	333.50	331.83	330.17	328.50	326.83	325.17	323.50	321.83	320.17	318.50
0.63	321.76	320.16	318.56	316.96	315.36	313.76	312.16	310.56	308.96	307.36	305.76
0.65	309.38	307.85	306.31	304.77	303.23	301.69	300.15	298.62	297.08	295.54	294.00
0.68	297.93	296.44	294.96	293.48	292.00	290.52	289.04	287.56	286.07	284.59	283.11
0.70	287.29	285.86	284.43	283.00	281.57	280.14	278.71	277.29	275.86	274.43	273.00

TABLE TEN

DETERMINE THE LEVELING SPEED CURRENT LIMITING RESISTOR (Ohms)
FOR ISOLATION TRANSFORMER TAPS X1 TO X5 (165 VAC)

FIELD VOLTAGE AT LEVELING SPEED (Volts DC)

FIELD(Amps)	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00
0.05	4366.2	4346.2	4326.2	4306.2	4286.2	4266.2	4246.2	4226.2	4206.2	4186.2	4166.2
0.08	2910.8	2897.5	2884.1	2870.8	2857.5	2844.1	2830.8	2817.5	2804.1	2790.8	2777.5
0.10	2183.1	2173.1	2163.1	2153.1	2143.1	2133.1	2123.1	2113.1	2103.1	2093.1	2083.1
0.13	1746.5	1738.5	1730.5	1722.5	1714.5	1706.5	1698.5	1690.5	1682.5	1674.5	1666.5
0.15	1455.4	1448.7	1442.1	1435.4	1428.7	1422.1	1415.4	1408.7	1402.1	1395.4	1388.7
0.18	1247.5	1241.7	1236.1	1230.3	1224.6	1218.9	1213.2	1207.5	1201.8	1196.1	1190.3
0.20	1091.6	1086.6	1081.6	1076.6	1071.6	1066.6	1061.6	1056.6	1051.6	1046.6	1041.6
0.23	970.27	965.82	961.38	956.93	952.49	948.04	943.60	939.16	934.71	930.27	925.82
0.25	873.24	869.24	865.24	861.24	857.24	853.24	849.24	845.24	841.24	837.24	833.24
0.28	793.85	790.22	786.58	782.95	779.31	775.67	772.04	768.40	764.76	761.13	757.49
0.30	727.70	724.37	721.03	717.70	714.37	711.03	707.70	704.37	701.03	697.70	694.37
0.33	671.72	668.65	665.57	662.49	659.42	656.34	653.26	650.18	647.11	644.03	640.95
0.35	623.74	620.89	618.03	615.17	612.31	609.46	606.60	603.74	600.89	598.03	595.17
0.38	582.16	579.49	576.83	574.16	571.49	568.83	566.16	563.49	560.83	558.16	555.49
0.40	545.78	543.28	540.78	538.28	535.78	533.28	530.78	528.28	525.78	523.28	520.78
0.43	513.67	511.32	508.96	506.61	504.26	501.91	499.55	497.20	494.85	492.49	490.14
0.45	485.13	482.91	480.69	478.47	476.24	474.02	471.80	469.58	467.36	465.13	462.91
0.48	459.60	457.49	455.39	453.28	451.18	449.07	446.97	444.86	442.76	440.65	438.55
0.50	436.62	434.62	432.62	430.62	428.62	426.62	424.62	422.62	420.62	418.62	416.62
0.53	415.83	413.92	412.02	410.11	408.21	406.30	404.40	402.50	400.59	398.69	396.78
0.55	396.93	395.11	393.29	391.47	389.65	387.84	386.02	384.20	382.38	380.56	378.75
0.58	379.67	377.93	376.19	374.45	372.71	370.97	369.23	367.50	365.76	364.02	362.28
0.60	363.85	362.18	360.52	358.85	357.18	355.52	353.85	352.18	350.52	348.85	347.18
0.63	349.30	347.70	346.10	344.50	342.90	341.30	339.70	338.10	336.50	334.90	333.30
0.65	335.86	334.32	332.78	331.25	329.71	328.17	326.63	325.09	323.55	322.02	320.48
0.68	323.42	321.94	320.46	318.98	317.50	316.01	314.53	313.05	311.57	310.09	308.61
0.70	311.87	310.44	309.01	307.59	306.16	304.73	303.30	301.87	300.44	299.01	297.59

TABLE ELEVEN

5.7. SUICIDE CIRCUIT

The suicide circuit disconnects the generator field from the controller and places the field across the Hoist Motor Armature. During the opening of the field contacts, any current flowing through the generator field must continue to flow. This will cause the contacts to arc until the field current decays.

It is absolutely necessary that the arcing is extinguished and the field contacts are completely open before the suicide contacts close. Any overlapping of these contacts will cause damage to the control. Therefore, the suicide contacts must be delayed in closing even under power loss conditions.

The suicide contacts should not be back, or auxiliary, contacts of the **RUN** ***relay since there will not be a sufficient time delay between the contacts making/braking.***

The time delay will depend on the duration of the arc across the field contacts. For this reason, we have shown resistors **R2** and **R4** in the hook-up print, across the field contacts to permit some current flow during the opening of the **RUN** contacts. **R2** and **R4** will provide a discharge path through the control for the field current, preventing damage to the control caused by the closing of the suicide contact.

SECTION SIX
TROUBLESHOOTING

The following pages contain tables which list common problems that may be encountered during set up and operation of the model D1028 Bi-Directional Generator Field Control. The probable cause column contains the most likely reason for the problem. The corrective action column contains steps, which may be taken to correct the problem.

WARNING: THE BI-DIRECTIONAL FIELD REGULATOR SHOULD BE INSTALLED, ADJUSTED AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL EQUIPMENT IN THE ELEVATOR SYSTEM; PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY OCCUR IF INDIVIDUALS ARE NOT FAMILIAR WITH THE HAZARDS RESULTING FROM IMPROPER OPERATION.

WARNING: CONTROLLER EQUIPMENT IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED AND INTERNAL CAPACITORS REMAIN CHARGED AFTER POWER IS REMOVED FROM THE BI-DIRECTIONAL FIELD REGULATOR. IT IS IMPORTANT THAT AC POWER IS REMOVED FROM THE UNIT FOR A MINIMUM OF FIVE MINUTES BEFORE IT IS SAFE TO TOUCH THE INTERNAL PARTS OF THE CONTROL. PERSONAL INJURY MAY RESULT UNLESS POWER IS REMOVED.

WARNING: THE USER IS RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE WITH RESPECT TO MOTOR, CONTROLLER AND OPERATOR DEVICE INSTALLATION, WIRING AND START UP. THE USER IS ALSO RESPONSIBLE FOR UNDERSTANDING AND APPLYING ALL OTHER APPLICABLE LOCAL CODES WHICH GOVERN SUCH PRACTICES AS WIRING PROTECTION, GROUNDING, DISCONNECTS AND OVERCURRENT PROTECTION.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
CONTROL TRIPS ON DIRECTION FAULT	Tachometer wiring error	Check the tachometer wiring. The tachometer signal at the TACH testpoint should be positive when the car is traveling in the UP direction.
	Long delay between the Brake lifting and RUN signal application is causing the elevator to roll back before accelerating away from the floor.	Correct the controller logic to remove delays between the picking of the brake and the application of the RUN signal.
	Rapid reversal of the Elevator Car direction prior to stopping	Releveling before the car has stopped will cause a direction fault. Correct the controller logic as required.
CONTROL TRIPS ON TACH LOSS	Tachometer signal is not present or intermittent	Check the mechanical and electrical connections of the tachometer.
	The tachometer feedback signal is the wrong polarity or too small.	Spin the tachometer by hand and measure the voltage at the +UP and - terminals at TB2. The voltage should increase as the tach spins faster. The polarity of the tachometer voltage should reverse as the tach is spun in the opposite direction. Verify that the tachometer feedback signal at the TACH testpoint is positive in the UP direction and is 10 volts at contract speed.
	The Armature Feedback voltage is set too high.	Too much Armature Feedback will make the TACH LOSS circuit too sensitive. Re-adjust the Armature Feedback potentiometer for 7.5 volts on the ARM FB testpoint at contract speed.
	The picking of the brake is delayed during take off from the floor	If the Armature Feedback voltage is allowed to build up before the tachometer starts turning, the control will trip on tach loss. Check controller logic and brake release.

PROBLEM	**PROBABLE CAUSE**	**CORRECTIVE ACTION**
CONTROL TRIPS ON OVERSPEED	The Level Limit (LL) contact at TB3 is closed during a normal run	Make sure that the LL contact is open during a normal run and closes during leveling and releveling only.
	The tachometer feedback voltage has exceeded the reference voltage	Compare the signal at the TACH testpoint to the REF OUT testpoint. The TACH testpoint should never go higher than 10 volts and should not exceed the REF OUT voltage. Test in both UP and DN directions.
	Weak Hoist Motor Field	If you are using field weakening at contract speed, remove it and try running at contract speed. If no trip occurs, you are weakening too much. Also, the weakening of the field should occur after the REF OUT testpoint has passed the ACC END knee and leveled out, otherwise you may get a surge (bump) at the ACC END knee which will cause a trip.
	The CONTRACT SPD potentiometer is set too low	Adjust the CONTRACT SPD potentiometer to obtain contract speed exactly. The TACH testpoint should read 10 volts when running at contract speed.
	Loose tachometer connection or tach wheel is skipping / slipping.	Ensure that the tachometer is mounted securely. Check the coupling of the tachometer to the motor, or the connection to the roller wheel. Make sure that the surface that the roller wheel rides upon is smooth and free from bumps. Make sure that the tachometer mount places enough pressure on the roller wheel to keep it on the surface it is reading.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
CONTROL TRIPS ON OVERCURRENT AT CONTRACT SPEED	Output DC current is exceeding the control rating	Measure the field current at the FIELD CURRENT testpoint. The voltage should never exceed 7.5 volts during a worst case run.
CONTROL TRIPS ON OVERCURRENT AT CONTRACT SPEED	The Generator Field resistance is too low.	The minimum resistance of the generator field must be 21 ohms or greater (measured at F+ and F- on TB2). Run the car at a lower speed and see if the trip occurs. If the field resistance is too low, either rewire the fields or add resistance in series with the field. If possible step down to the next lower transformer tap.
	Contract speed is being exceeded	Measure the speed of the car with a hand held tach. Adjust the CONTRACT SPD pot as required. Adjust the FIELD CURRENT potentiometer as required.
CONTROL TRIPS ON OVERCURRENT AT LOW END OF A RUN	Insufficient delay exists when the suicide circuit closes.	Ensure that an adequate delay exists between the dropping of the RUN contacts and the making of the suicide contacts.
	Incorrect control or power wiring	Check all control and power connections against the hook-up diagram.
	Field wiring is shorted to ground	Check the Generator Field wiring for shorts to ground.
POWER RELAY FAILURE	The CR1 relay has failed	Disconnect power from the control. Remove the CR1 relay and inspect it for damage. Replace if necessary. If this problem re-occurs, check the controller logic to make sure that the CR1 relay is not being used to make or brake the full field voltage.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
	Field power is being applied before the RUN contact at TB1 is closed.	Change the controller logic so that the RUN contact at TB3 closes before the Field Power Relays close (see hook-up). The customer RUN contacts at R2 and R4 should also open before the RUN contact at TB3 opens during power down of the field.
NO OUTPUT FROM CONTROL	Input wiring error	Ensure that the proper control voltages exist at the D1028. Check all fuses.
	Bad connection at the Field Power connections.	If the Field Power indicator is not lit, check all connections that supply field power. Check the field power fuses, F3 and F4, on the D1028.
	The CR1 relay has failed	Check the CR1 relay. If the relay has failed, it must be replaced.
	A fault trip condition exists and the control is disabled.	Check the Fault Conditions indicators to see if a fault condition is present. Reset the control and correct the fault if it reoccurs.
	Wiring fault in the Generator	Measure the control output voltage at the F+ and F- terminals. If a voltage is present, the control is operating properly. Check for a voltage directly at the Generator Field.
CANNOT ACHIEVE CONTRACT SPEED	Too much series resistance (R3)	Lower the resistance of the high-speed current limiting resistor R3 (see hook-up).
	The field power transformer tap selected is not sufficient.	Move to the next higher tap on the field power transformer.
	Not enough current to the Generator field.	Increase the FIELD CURRENT potentiometer clockwise to provide more current to the Generator field.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
	Ripple/Noise on the tachometer signal.	Look at the signal at the TACH testpoint with an oscilloscope. The signal should be clean with no ripple at all. Any ripple shown indicates either electrical or mechanically induced noise. Check the tachometer connections, both electrical and mechanical for areas where noise could be introduced, such as improper alignment, tach wires next to power wires etc.
ELEVATOR IS UNSTABLE AT HIGH SPEED	Armature feedback is connected backwards	Check the voltage at the ARM FB testpoint. The voltage should be positive in the UP direction and negative in the DN direction. Reverse the leads at TB1 if the polarities are reversed (see hook-up).
	The armature feedback signal is misadjusted	Set the armature feedback signal to 7.5 volts at the ARM FB testpoint when the car is running at contract speed. If the car is still unstable, reduce the STABILITY GAIN potentiometer until the ride improves.
CAR OVERSHOOTS CONTRACT SPEED DURING ACCELERATION	Too much gain	Turn the LOOP GAIN potentiometer counterclockwise to reduce the gain
	Acceleration rates are set too fast	Reduce the acceleration rates.
	Motor field too weak	Weakening the motor field too much will cause the car to overshoot contract speed. Increase the motor field voltage
SLOW RESPONSE AT HIGH SPEED	Not enough gain	Increase the gain by turning the LOOP GAIN potentiometer clockwise.
	Too much stability gain	Reduce the stability gain by turning

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
		the STABILITY potentiometer counterclockwise
	Too much armature feedback	Reduce the armature feedback by turning the ARM FEEDBACK potentiometer counterclockwise
	Not enough current	Increase the available current by turning the FIELDCURRENT potentiometer clockwise. If the potentiometer is fully clockwise, step up to the next higher tap on the field power transformer.
UP AND DOWN SPEEDS ARE NOT EQUAL	The control is out of regulation in the slower direction due to insufficient current available.	Turn the FIELD CURRENT potentiometer clockwise to increase the current available. Reduce the series resistance, R3, to increase current to the generator field. If this does not work, step up to the next higher tap on the field power transformer.
	The control is in the SET UP mode	The UP and DN speeds will not be accurate when the control is in the SET UP mode because there is no tachometer feedback signal in this mode. Switch to AUTO mode (SW1).
OUT OF REGULATION LIGHT FLICKERS OR STAYS ON	Noise on the armature feedback or tachometer signals	Check the mechanical and electrical connections for both the tachometer and the armature feedback.
	The CONTRACT SPD potentiometer is misadjusted	Adjust the CONTRACT SPD potentiometer until the TACH testpoint reads 10 volts at contract speed
	Armature feedback signal is set too high	Ensure that the armature feedback signal never exceeds 10 volts at contract speed. Readjust the ARM

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
		FEEDBACK potentiometer as necessary
INSTABILITY AT LOW SPEED / DECELERATING INTO THE FLOOR	Deceleration rates are too fast	Decrease the deceleration rates.
	The stability gain is set too high	Reduce the stability gain by turning the STABILITY GAIN potentiometer counterclockwise. Reset to the previous setting if this has no effect
INSTABILITY AT LOW SPEED / DECELERATING INTO THE FLOOR	Armature feedback signal is set too high	Decrease the armature feedback signal by turning the ARM FEEDBACK potentiometer counterclockwise. Do not decrease the signal at the ARM FB testpoint below 4 volts. Increase the STABILITY GAIN potentiometer if high-speed instability occurs with the lowered armature feedback signal.
	The reference voltage is too far ahead of the tachometer feedback signal	Make sure that the motor field is not being forced too much. This will reduce the speed that the motor can spin at for a given voltage at the REF OUT testpoint. Remove field forcing to see if condition improves
THE CAR STOPS TOO HARD / OSCILLATES AROUND ZERO SPEED	The Hoist motor field is being weakened before reaching a complete stop	Make sure that the motor field is not weakened until the motor has completely stopped and the brake is set