



CLASS 6131 FRONTLINE® DC REVERSING PLUGGING SINGLE MOTOR CONTROLLER

INTRODUCTION

Class 6131 dc reversing plugging controllers described in this service bulletin are rated for use on 230 volt dc systems. They are used with dc series wound motors on crane bridge and trolley drives.

DESCRIPTION

The dc reversing plugging controller consists of the equipment listed below. Additional equipment may be supplied for a specific installation.

- 1 — Two pole unfused main line knife switch with padlock clip (LSW).
- 1 — Two pole fused control circuit knife switch with padlock clip (CSW).
- 4 — Single pole directional contactors with mechanical interlocks (1F, 2F, 1R, 2R).
- 3 — Single pole acceleration contactors including one for plugging (P, 1A, 2A).
- 2 — Static acceleration timers (1AR, 2AR).
- 1 — Undervoltage relay (UV).
- 1 — Rectifier plugging relay (PR).
- 2 — Magnetic overload relays — one instantaneous (1OL) and one inverse time (2OL).

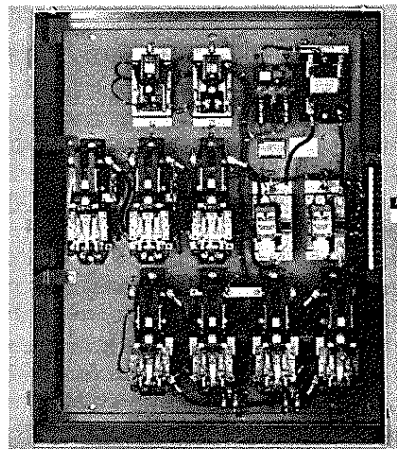
The following equipment is not supplied as part of the controller but is required for a complete set of control. They are for separate mounting:

- 1 — Set of Class 6715 TAB-WELD® acceleration resistors.
- 1 — Class 9004 master switch.
- 1 — Class 5010 series or shunt wound brake with resistor (if required).

PRECAUTIONS

The following list of recommended "PRECAUTIONS" must be studied and followed during installation, operation and servicing of the equipment.

WARNING: POWER MUST BE DISCONNECTED PRIOR TO PERFORMING ANY INSTALLATION. WHEN PERFORMING MAINTENANCE AND/OR TESTING ON THE CONTROLLER, EXTREME CAUTION MUST BE EXERCISED IN VIEW OF THE PRESENCE OF HAZARDOUS VOLTAGE. ALL METAL PARTS OF THE CONTACTORS, RELAYS AND OTHER DEVICES MAY BE AT LINE VOLTAGE. ALL POWER SHOULD BE DISCONNECTED WHEN CONNECTING METERS, MAKING INSPECTIONS OR PERFORMING OTHER PROCEDURES WHICH MAY EXPOSE PERSONNEL TO ACCIDENTAL CONTACT WITH LIVE ELECTRICAL PARTS.



NOTE: THIS SERVICE BULLETIN COVERS THE SERVICING OF BASIC CONTROLLERS. FOR CONTROLLERS HAVING VARIATIONS FROM THE BASIC CONTROLLERS, BE SURE TO REFER TO THE APPLICABLE CONTROLLER DRAWINGS TO DETERMINE HOW TO PROCEED SAFELY IN PERFORMING TROUBLESHOOTING AND MAINTENANCE.

1. Read this service bulletin prior to installing or operating the equipment.
2. If reversing plugging controllers are to be stored prior to installation, they must be protected from the weather and be kept free of condensation and dust.
3. Be sure all contactor arc chutes are in place before operating controller.
4. Only authorized personnel should be permitted to operate or service the controllers.

INSTALLATION

1. Unpack the controller carefully; check nameplate data for correct equipment.
2. Make a thorough inspection of all controller equipment to insure that all parts are undamaged. Remove shipping tape (if used).
3. Bolt the controller to the floor or to a vertical surface.
4. Master switch, acceleration resistors and brake with resistor (if required) should also be rigidly mounted after equipment is verified correct and undamaged.

WARNING: INCOMING LINE POWER TO THE CONTROLLER MUST BE DE-ENERGIZED BEFORE PROCEEDING.

5. Check that both the main line knife switch (LSW) and control circuit knife switch (CSW) in the controller are open. Wire all external circuits to the controller in accordance with the wiring diagram making sure to observe polarity shown.

START-UP AND ADJUSTMENTS

1. Check that both the main line knife switch (LSW) and control circuit knife switch (CSW) are open.

WARNING: WHEN OPENING THE KNIFE SWITCHES, ALWAYS OPEN THE CONTROL CIRCUIT KNIFE SWITCH (CSW) BEFORE OPENING THE MAIN LINE KNIFE SWITCH (LSW). NEVER OPEN LSW IF CSW IS CLOSED. WHEN CLOSING THE KNIFE SWITCHES, FIRST CLOSE THE MAIN LINE KNIFE SWITCH (LSW) AND THEN CLOSE THE CONTROL CIRCUIT KNIFE SWITCH (CSW). NEVER CLOSE LSW IF CSW IS CLOSED.

2. Refer to the wiring diagram and check that all external circuits and devices (master switch, resistor, etc.) have been properly wired to the controller.
3. Check that all parts of the controller are firmly attached and undamaged. Then check that no wires or leads are broken, loose or short-circuited as a result of shipment. Check all terminals for loose connections.
4. Check that the inverse time overload relay has oil in the dashpot.
5. Manually operate the contactors and relays. Check each device for free movement without binding.
6. Operate the master switch and check for easy movement without binding. Return the master switch to the off position.
7. Check that the brake has been properly installed and adjusted in accordance with the manufacturer's instructions.
8. Energize incoming line power to the controller.

CAUTION: BE SURE INCOMING LINE VOLTAGE AND POLARITY ARE CORRECT BEFORE ENERGIZING CONTROLLER.

9. With the main line knife switch (LSW) open, close the control circuit knife switch (CSW) and check that the undervoltage relay (UV) is energized. Each controller is checked at the factory prior to shipment. However, the check at the time of installation will call attention to any faulty external connections or any damage sustained during shipment.
10. Open the control circuit knife switch (CSW).
11. Move the master switch from the off position to the last speed point forward.
12. With the main line knife switch (LSW) open, close the control circuit knife switch (CSW) and check that the coil of the undervoltage relay (UV) is not energized.
13. Move the master switch from the last speed point forward to the off position and check that the undervoltage relay (UV) does not energize until the master switch is returned to the off position.
14. Move the master switch from the off position to the first speed point forward or reverse. Check that the closed contactor power tips match that of the contactor sequence table on the controller wiring

diagram. Then check that the closed contactor power tips match that of the contactor sequence table in the other speed points both forward and reverse. An X in the contactor sequence table on the wiring diagram denotes a closed contactor power tip.

15. If the controller sequences properly, open the control circuit knife switch (CSW).
16. Close the main line knife switch (LSW). Then close the control circuit knife switch (CSW).

WARNING: WHEN CLOSING THE KNIFE SWITCHES, FIRST CLOSE THE MAIN LINE KNIFE SWITCH (LSW) AND THEN CLOSE THE CONTROL CIRCUIT KNIFE SWITCH (CSW). NEVER CLOSE LSW IF CSW IS CLOSED. WHEN OPENING THE KNIFE SWITCHES, ALWAYS OPEN THE CONTROL CIRCUIT KNIFE SWITCH (CSW) BEFORE OPENING THE MAIN LINE KNIFE SWITCH (LSW). NEVER OPEN LSW IF CSW IS CLOSED.

17. With no load on the crane, check for proper rotation of the motor by jogging the master switch. If the motor rotates in the wrong direction, first open the control circuit knife switch (CSW) and then open the main line knife switch (LSW). Proper motor rotation is obtained by interchanging armature connections A1 and A2.
18. With no load on the crane, check operation in the forward direction with the master switch in each speed point forward. Also move the master switch rapidly from the off point to the last speed point forward. Check that acceleration is rapid without being jerky and without wheel slippage.
19. With no load on the crane, check operation in the reverse direction with master switch in each speed point reverse. Also move the master switch rapidly from the off point to the last speed point reverse. Check that acceleration is rapid without being jerky and without wheel slippage.
20. Open the control circuit knife switch (CSW). Then open the main line knife switch (LSW).

OPERATION

The class 6131 dc reversing plugging controller connects the dc series motor as a series motor in both the forward and reverse directions. It is supplied with four speed points on controllers rated up to 55 horsepower at 230 volts dc for use on crane bridge and trolley drives.

STATIC ACCELERATION TIMERS

The controller is supplied as standard with Class 7001 Type ST-1 static acceleration timers for control of acceleration. The static acceleration timers are wired in series with the acceleration contactor coils and appear as normally open timed closed contacts. Voltage applied across terminals 1 (+) - 3 (-) initiates a 0.6 second time delay whereas voltage applied across terminals 2 (+) - 3 (-) initiates a 1.2 second time delay. Upon completion of the timing cycle the device appears as a contact closure and allows energization of the contactor coil.

PLUGGING RELAY

When the master switch is moved rapidly from any speed point of one direction to any speed point of the opposite direction a form of retardation referred to as plugging is effected. Plugging occurs when reverse power is applied to a rotating motor. The plugging system used on Class 6131 dc reversing plugging controllers includes a single coil relay with a rectifier in series with the operating coil. The voltage rating of the relay coil is one-half of the rated line voltage. The plugging relay coil and rectifier are connected across the motor armature as shown on the typical elementary diagram in this service bulletin.

If the master switch is moved rapidly from the fourth speed point forward to the fourth speed point reverse, all contactors de-energize and then contactors 1R and 2R close. The plugging relay (PR) is energized by the

voltage generated at the motor terminals. This voltage (counter electromotive force or CEMF) is due to the rotation of the motor and is approximately proportional to the motor speed at the instant of plugging. When energized, the plugging relay prevents energization of the plugging contactor. As the CEMF decreases and the motor speed approaches standstill, the plugging relay is de-energized. This allows energization of the plugging contactor and normal acceleration to take place.

SEQUENCE OF OPERATION

The sequence of contactor operation for the standard four speed point reversing plugging controller is basically the same in both the forward and reverse direction. The description of operation shown below applies regardless of how the master switch is operated.

ACCELERATION

SPEED POINT	OPERATION OF CONTACTORS	PURPOSE
1	1F & 2F close or 1R & 2R close	Motor connected as a series motor. Slow speed with all resistance in the circuit.
2	P closes	Reduces amount of resistance in series with the motor. Motor voltage, torque and speed increases.
3	After 1AR closes, 1A closes	
4	After 2AR closes, 2A closes	

If the master switch is moved rapidly from the off point to the fourth speed point, the directionals close instantly followed by P without any time delay. Contactors 1A and 2A close in timed sequence under control of the acceleration timers 1AR and 2AR.

DECELERATION

SPEED POINT	OPERATION OF CONTACTORS	PURPOSE
4th to 3rd 3rd to 2nd 2nd to 1st	2A opens 1A opens P opens	To reduce voltage applied to motor.
1st to off	Directionals open	To disconnect motor from line.

If the master switch is moved rapidly from the fourth speed point to the off point, all of the above happens simultaneously.

RESISTORS

Bridge and trolley performance is affected by changing the ohmic values of the resistance steps. Consideration should be given to the overall effects on both the acceleration and plugging operations that are caused by changing ohmic values. In no instance should the ohmic values of any given step or steps be changed by more than 10% of the original design values. If resistance changes greater than these are required, consult your local Square D Field Office.

The table below shows how the bridge and trolley performance characteristics are affected by changing the resistor values.

NO. OF SPEED POINTS	STEP	INCREASING OHMIC VALUE	DECREASING OHMIC VALUE
4	R1 - R4	Reduces first point current, torque and speed. Reduces plugging torque and current.	Increases first point current, torque and speed. Increases plugging torque and current. If decreased too much, wheel slip-page may occur.
4	R2 - R4	Reduces second point current, torque and speed. Increasing the value of any section reduces the current, torque and speed for any point having that section in the circuit.	Increases second point current, torque and speed. Decreasing the value of any section increases the current, torque and speed for any point having that section in the circuit.

TROUBLESHOOTING

WARNING: WHEN PERFORMING MAINTENANCE AND/OR TESTING ON THE CONTROLLER, EXTREME CAUTION MUST BE EXERCISED IN VIEW OF THE PRESENCE OF HAZARDOUS VOLTAGE. ALL METAL PARTS OF THE CONTACTORS, RELAYS AND OTHER DEVICES MAY BE AT LINE VOLTAGE. ALL POWER SHOULD BE DISCONNECTED WHEN CONNECTING METERS, MAKING INSPECTIONS OR PERFORMING OTHER PROCEDURES WHICH MAY EXPOSE PERSONNEL TO ACCIDENTAL CONTACT WITH LIVE ELECTRICAL PARTS.

Trouble in a controller can be located most efficiently if it is done in a systematic manner. Experience has shown that reported symptoms may not be accurate. Therefore, first check with the operator. Then, if the drive can be operated, personally observe the trouble. Locate the operational problem in the table and follow the troubleshooting instructions in sequence from left to right; performing all steps described in each instruction.

OPERATIONAL PROBLEMS

WARNING: WHEN OPENING THE KNIFE SWITCHES, ALWAYS OPEN THE CONTROL CIRCUIT KNIFE SWITCH (CSW) BEFORE OPENING THE MAIN LINE KNIFE SWITCH (LSW). NEVER OPEN LSW IF CSW IS CLOSED. WHEN CLOSING THE KNIFE SWITCHES, FIRST CLOSE THE MAIN LINE KNIFE SWITCH (LSW) AND THEN CLOSE THE CONTROL CIRCUIT KNIFE SWITCH (CSW). NEVER CLOSE LSW IF CSW IS CLOSED.

When an operational problem cannot be defined in the table below, check equipment as outlined in the START-UP AND ADJUSTMENTS section (steps 1 through 15) of this service bulletin.

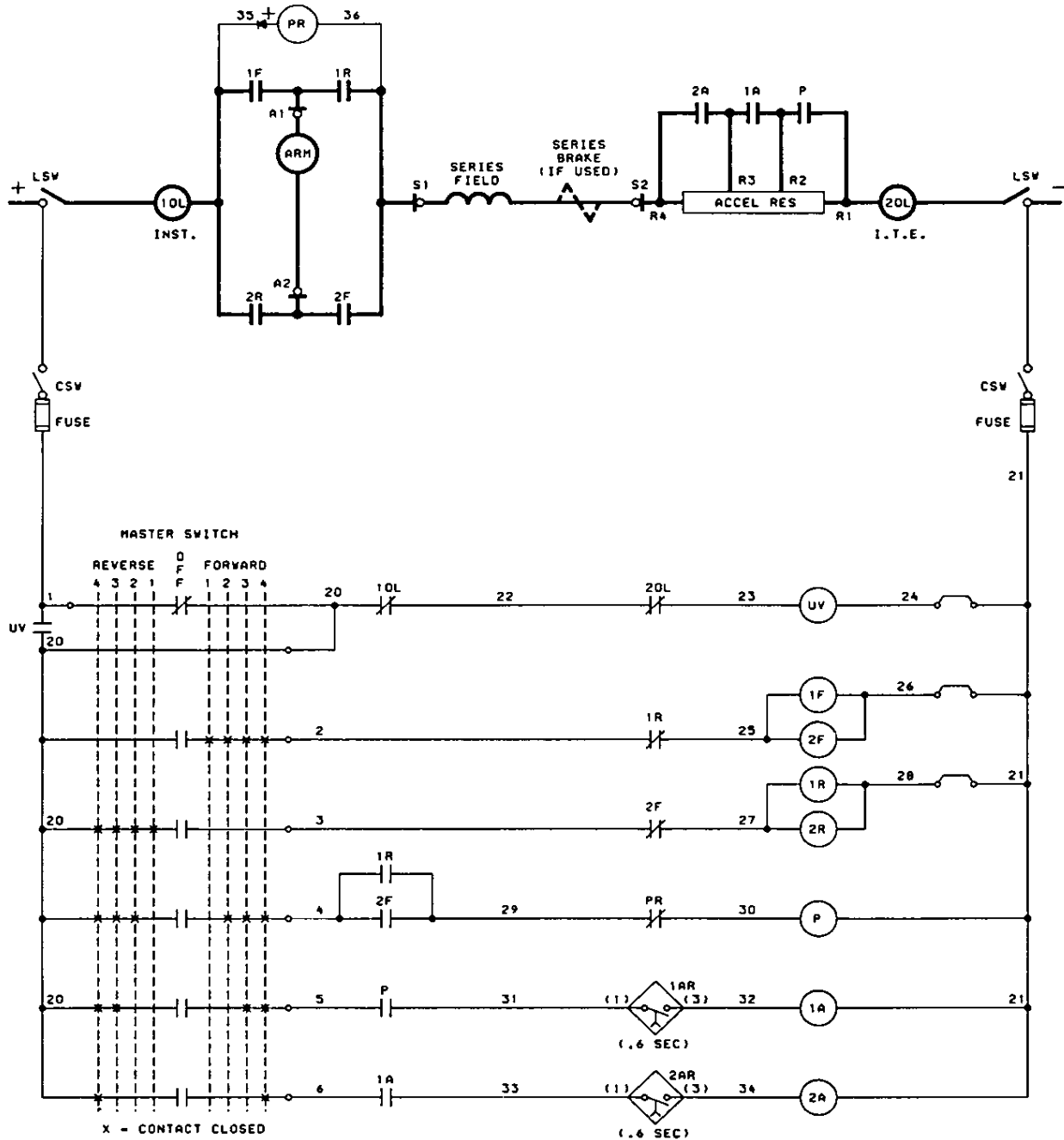
OPERATION PROBLEM	TROUBLESHOOTING INSTRUCTIONS				
	A	B	F		
1 Drive will not move in either direction	A	B	F		
2 Drive will move in one direction only	A	F			
3 Drive travels in wrong direction	A	E	F		
4 Jumpy operation	A	B	C	F	
5 Sluggish operation	A	B	C	F	
6 Overloads tripping	A	B	C	D	F

- A. 1. Check equipment as outlined in the START-UP AND ADJUSTMENT section (steps 9 through 15) of this service bulletin.
2. If the problem can be isolated to a contactor not operating in a specific speed point or speed points, connect a voltmeter across the contactor coil and then close the control circuit knife switch (CSW). Check the voltage across the coil of the contactor in that particular speed point or points.
 - a. If the voltage across the coil is the same as the line voltage, open the control circuit knife switch (CSW) and refer to the TROUBLESHOOTING section in the contactor service bulletin.
 - b. If the voltage across the coil is less than the line voltage, open the control circuit knife switch (CSW).
 - 1) Visually check all electrical interlocks and any static acceleration timer in series with the coil for burned or broken parts, connectors and wires.
 - 2) Visually inspect any master switch contact in series with the coil and check for proper operation in that speed point or speed points.
 - 3) If the visual check does not isolate the problem, place a jumper wire across the terminals of any static acceleration timer in series with the contactor coil. Close the control circuit knife switch (CSW) and check the contactor operation in the various speed points.
 - a) If the contactor operates properly, replace the static acceleration timer.
 - b) If the contactor fails to operate and the voltage across the coil is the same as the line voltage, refer to the

TROUBLESHOOTING section in the contactor service bulletin.

- c) If the contactor fails to operate and the voltage across the coil is less than the line voltage, check for discontinuity in the circuit by checking the voltage from the coil through each device in the circuit in sequence. Replace any defective wiring, connections or devices.
 - 4) Open the control circuit knife switch (CSW) and remove the acceleration timer jumper wire.
- B.
- 1. With the main line knife switch (LSW) and control circuit knife switch (CSW) open, visually inspect the acceleration resistors. Replace any burned or broken connectors, wires or resistor sections.
 - 2. Check resistor units for continuity and proper ohmic value using an ohmmeter.
 - 3. The values of resistance in the circuit can be adjusted by moving the taps on the resistor units. Refer to the OPERATION section of this service bulletin.
- C.
- 1. With the control circuit knife switch (CSW) open, disconnect the wire from terminal 3 on each static acceleration timer. Connect meter negative input to timer terminal 3 and meter positive input to timer terminal 1 or 2. Check that the resistance across each of the timers is at least 20K ohms. If the resistance is less, the static acceleration timer should be replaced.
- D.
- 1. Close the main line knife switch (LSW). Then close the control circuit knife switch (CSW).
 - 2. With the master switch in the last point forward, quickly move the master switch to the last point reverse. Check that the plugging relay is energized and remains energized until the drive approaches zero speed. This can be checked by placing a voltmeter across the coil of the plugging relay and checking that the relay de-energizes at near zero volts. (NOTE: Plugging relay (PR) is polarity sensitive and the (+) lead must be connected as shown on the wiring diagram.)
 - 3. Open the control circuit knife switch (CSW), then open the main line knife switch (LSW).
- E.
- 1. Check the equipment as outlined in the START-UP AND ADJUSTMENT section (steps 16 through 17) of this service bulletin.
 - 2. Open the control circuit knife switch (CSW) and then open the main line knife switch (LSW).
- F.
- 1. If the problem cannot be isolated by any of the preceding procedures, the problem is not in the control. Check the integrity of all external circuits, connectors, wiring and devices.
- 2. The timing period of the static acceleration timer can be changed by changing the connection. Refer to the OPERATION section of this service bulletin.

CLASS 6131 DC REVERSING-PLUGGING CONTROLLER ELEMENTARY DIAGRAM FOR A FOUR SPEED POINT REVERSING-PLUGGING CONTROLLER



CONTACTOR SEQUENCE X=POWER TIPS CLOSED		REVERSE				O	FORWARD			
		4	3	2	1	F	1	2	3	4
DEVICE										
1F						X	X	X	X	
2F						X	X	X	X	
1R	X	X	X	X						
2R	X	X	X	X						
P	X	X	X	X		X	X	X	X	
1A	X	X					X	X		
2A	X							X	X	

CONTACTORS 1F & 1R,
1R & 2F, 2F & 2R, ARE
MECHANICALLY
INTERLOCKED

