CLASS 11-840 DRIVE

FOR TWO SPEED REVERSING MOTORS

SYSTEMS TESTS AND ADJUSTMENTS

A. Initial Adjustments

Prior to actual operation, certain tests and adjustments are recommended before the equipment is put into service. Although this equipment has been factory tested and adjusted, it is well worth the time spent on the job site to run through the tests and adjustments as outlined in this section.

The equipment is not complex but neither is it a linestarter, where all that is required is to apply power and move the master switch out of Off.

The adjustments recommended will not be time-consuming; and if done properly will insure longer periods of trouble-free operation.

1. Supply Power OFF
   a. Open main disconnect removing all power.
   b. Hand operate relays and contactors to check for freedom of movement.
   c. Check all connections for tightness.
2. Supply Power ON
   a. Close main disconnect
   b. Pushbuttons or master switch in OFF.
   MR relay picks up and seals in providing the overload relay contacts are closed. The drive is now ready for use.

B. Starting the Drive

1. Motor Direction

If the motor runs in the opposite direction to that desired, reverse the two main lines at the incoming supply.

Overload Relays

Motor overload relays are sized for ultimate trip of 140% of motor rated amps. The overload relay is set to automatically reset after a fault has cleared.

2. Brake

The brake will release when the pushbutton or master switch is moved out of the Off position and will set when the control is returned to Off.

3. Limit Switches - If used

a. Up limit switch for hoist drives. Run the hook into the up stop limit limit switch. Return the pushbutton or master switch to Off to reset the drive. The drive should de-energize if the control is moved in the hoist direction but should power out of the limit if moved in the lower direction.
b. Down limit switch. Operation of the Down Limit switch is the same as the Up Stop Limit switch except in the opposite direction. The drive will not be energized if master switch or pendant is moved in the lower direction, but will power out of the overtravel when control is moved in hoist direction.
c. Forward and Reverse Limit switches for travel drives. These limit switches will operate the same as Up and Down Limit Switches described above.

4. Protective Features

Master relay MR will drop out on motor overloads. The pushbutton or master switch will have to be returned to Off to reset the control.

DESCRIPTION OF OPERATION

A. Preliminary Operation

In order to place the equipment in a standby condition ready for operation, certain preliminary functions must be performed prior to actual operation in order to energize the equipment. These operations are as follows, beginning with the assumption that the equipment is completely de-energized; the pushbuttons or master switch in the "Off" position

Apply all necessary power to the drive.

With the overload relay contacts closed and the control "Off", the master relay MR coil is energized. An MR contact closes to seal around the control contacts and extend 115 volt a-c power through the control circuitry.

The drive is now considered to be ready for operation.

B. Up or Forward Operation

If the pushbutton or master switch is moved in the Up or Forward direction, directional contactor "U" or "F" is energized. An interlock of "U" or "F" closes and sets up circuitry to rest of control circuit. Electrical and mechanical interlocks prevent action of the opposing "D" or "R" contactor.

Contactor "SS" is energized, thereby closing its main contacts. The drive will now operate at slow speed.

An interlock of "SS" closes to energize the time delay relay "BR". BR contacts close and release the brake.

When timing relay completes its time cycle, its contact closes and sets up circuitry to relay "CR".

In second point "Up" or "Forward" relay "CR" is energized. A contact of "CR" opens de-energizing "S", and another contact closes energizing contactor "FS". Main contacts of "FS" close, and the drive will run at high speed.

Moving the master switch or pushbuttons to the Off position at any time de-energizes the speed relays, directional contactors and brake relays to stop the drive.

Some drives will employ resistance starting. In this case an additional timer is used to control time on resistance before accelerating contactor is energized. Timer for high speed operation is energized when accelerating contactor is picked up.

C. Down or Reverse Operation

Down or Reverse operation is identical to Up or Forward except that the opposite movement of the pushbutton or master switch energizes contactor "D" or "R" instead of the contactor "U" or "F".

D. Limit Switch Operation - If used

Limit switches may provide to completely stop the drive movement by dropping out the appropriate directional relay and contactor when limit switch is tripped.

Assume the Hoist (Forward) limit switch is tripped, contactor "U" ("F") drops out to de-energize BR and remove power from motor. The motor is now de-energized and the brake set to stop the drive.

E. Protective Features

Overload protection has been designed into the equipment by the presence of overload relays SOL and FOL. If a motor overload should occur, contacts of these relays will open, de-energizing the master relay MR, shutting the drive down. Restarting is possible only after the pushbutton or master switch is returned to the "Off" position and the overload fault has been cleared.

F. Brake Operation

When a pushbutton or master switch is moved away from OFF, a direction contactor will pick up to energize the brake contactor BR. Two contacts of BR close to energize the brake contactor BR. Two contacts of BR close to energize the brake.

Returning the pushbutton or master switch to Off drops out the directional contactor which de-energizes the brake contactor BR to set the brake.

TROUBLESHOOTING

A. Main Circuits

If motor amperes are appreciably different from normal, check motor circuit wiring for completeness and agreement with the schematic diagram.

B. Control Circuits

If contactors and relays do not operate, check for complete circuit wiring and that power is on.

C. Brake Control

If the brake does not release, check for mechanical binding and coil excitation when the brake contactor is picked up.

D. General

If the drive is malfunctioning from none of the above causes, it is recommended that the adjustment procedure outlined above be followed in detail.

RAMP FUNCTION GENERATOR
456A359 G01

DESCRIPTION

This ramp function generator can best be described by dividing it into three basic parts; the regulated DC power supply, two constant current generators operating alternately for acceleration, and deceleration, and a power amplifier. Refer to circuit on page 1 of this leaflet.

REGULATED POWER SUPPLY

The zener reference and power supply consists of two separate supply circuits. The reference supply provides regulated 15 volts D.C. which is used primarily as the reference source for the ramp function generator. A regulated 24 volts D.C. is provided for application to the same ramp function generator - as the power source. The two supply circuits are isolated from each other by means of transformer windings and each uses zener diodes for regulation of their rectified secondary outputs. The required package input is obtained from a transformer having three secondary windings. The reference voltage supply is rated at 50 milliamperes, and the power supply at 200 milliamperes.

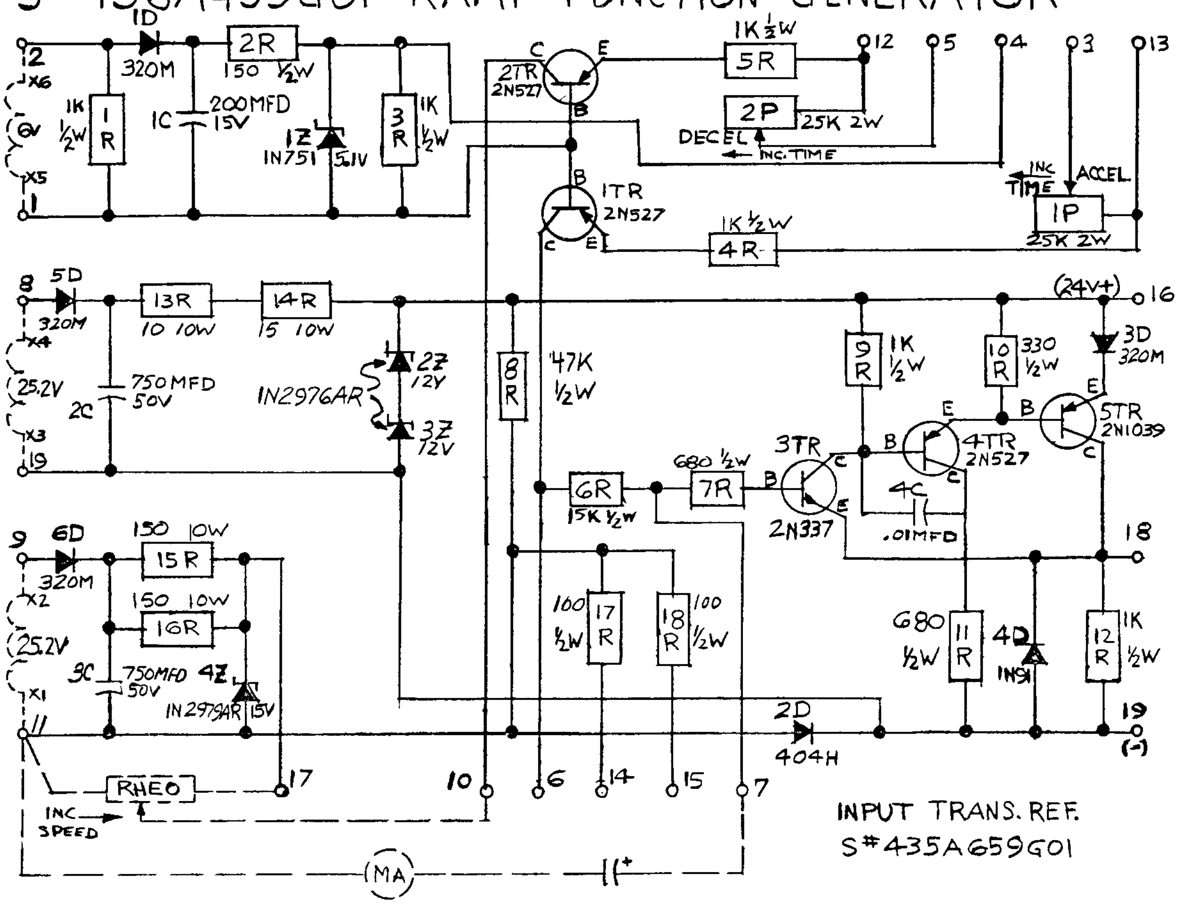
The 25.2 volt A.C. output of the secondary of the reference supply transformer winding is half wave rectified by diode 6D, to place approximately 32 volts D.C. across the capacitor 3C. With no load across terminals 11 and 17, the capacitor voltage is applied across the 15R, 16R resistor network and zener diode breaks down when current flows thru it, and maintains a constant voltage of approximately 15 volts D.C. When a 50 milliampere load is connected, some current is shunted away from the zener diode, but the reference voltage is maintained at approximately the same level.

The 24 volts power supply operates on the same principle with two 12 volt zener diodes series connected to provide approximately 24 volts across terminals 16 and 11 with up to maximum load of 200 milliamperes.

ACCELERATION-DECELERATION FUNCTION

The purpose of this ramp function generator is to convert a step or abrupt input voltage change into a linear and gradual output change. This is accomplished by charging a capacitor combination with a constant flow of current to or from it.

S# 456A439G01 RAMP FUNCTION GENERATOR



Operation of the timing circuit begins when a change in reference voltage is made. Assume that the slider on the reference potentiometer is moved towards the positive end. This will create a potential difference between the reference voltage, and the voltage across the timing capacitor combination selected. As a result of this difference, current will flow from the collector of transistor 2TR to its base. (The collector to the base function may be considered at this point as a diode allowing current to flow). The current flow continues from the base through the bias circuit. Zener diode 1Z, or resistor 3R, through potentiometer 1P, and resistor 4R to the emitter of transistor, 1TR. Transistor 1TR is permanently biased so that its emitter is positive with respect to its base. The flow of current through the resistor and potentiometer, 4R and 1P, will increase this bias to regulate current flow at a constant rate from the emitter, through the collector, to the capacitor combination.

The amount of current which is permitted to flow is controlled by potentiometer, 1P. As the resistance of 1P is increased, less current flows and the capacitor charging time increases. Conversely, a reduction in the resistance, 1P, allows the capacitors to charge at a faster rate. While this current is flowing, the emitter of transistor, 1TR is made less positive with respect to the base. The decrease is proportional to the amount of current flow and results in a self biasing circuit. This tends to regulate the flow of current, and maintain a nearly constant value regardless of the magnitude of the existing potential difference between the reference and capacitor voltages.

The current flow continues until the capacitors are fully charged and the voltage across them is equal to the applied reference voltage.

Deceleration operation is similar to acceleration except the capacitor combination voltage is higher than the reference voltage. The capacitors discharge causing current to flow back to the reference. The functions of 1TR, 2TR, 1P, 2P, and 5R are reversed.

POWER AMPLIFIER FUNCTION

Transistors, 3TR, 4TR and 5TR form a three (3) stage power amplifier which follows the charging and discharging of the capacitors. The voltage change across the load is proportional to the changes in voltage across the capacitor. The load may be a control winding of a magnetic amplifier, trinistor gating amplifier, or a resistor across the input of an amplifier.

During steady state conditions, the base of transistor, 3TR is at the same potential as the capacitors at terminal 7. As the capacitors are charged, the base of 3TR is biased positive with respect to the emitter. The positive collector of the transistor, 3TR will therefore draw its current through the resistor, 9R, and through the emitter - base junction of transistor 4TR. This small current produces a junction voltage drop between the emitter and base of 4TR permitting a heavier current to flow through transistor, 4TR, from emitter to collector. The heavier current through transistor, 4TR is supplied through resistor, 10R, and through the emitter - base junction of transistor, 5TR. This current produces a junction voltage drop between the emitter and base of 5TR permitting the load current to flow through transistor 5TR, from emitter to collector, and then through the load. The voltage appearing across the load will very nearly equal the voltage across the capacitor combination.

In order for transistor 3TR to conduct, a small voltage drop, in the order of 0.4 volts must exist across its emitter (-) to base (+) junction. This voltage drop is balanced out by the drop across the diode, 2D which is forward biased by resistor, 8R. Hence, the capacitor combination is returned to the negative load terminal, through diode 2D. The base of transmitter, 3TR is effectively forward biased by the voltage drop across the diode, 2D which is also in the order of 0.4 volts. The total offset between the load voltage and the capacitor combination voltage will then be less than 0.1 volt.

This three stage amplifier permits the capacitor combination to act as an input signal without losing its charge because transistor, 3TR, represents a very high impedance and blocks any appreciable current flow from the capacitors.

When the capacitor combination has been fully discharged, due to deceleration requirements, the base of transistor, 3TR, will be nearly zero and the voltage measured across the load will be nearly zero; hence, there will be no self biasing effect obtained from the load. The small current which had been flowing through resistor, 9R, transistor, 3TR, and then through the load is stopped because 3TR is no longer conducting as its base to emitter voltage is nearly zero. When 3TR is no longer conducting transistors, 4TR and 5TR are cut off. To insure that the voltage is nearly zero across the load, diode, 4D is in parallel with the load, and in series with 5TR. This diode has a low impedance to the leakage current through 5TR, and thus the load is kept at nearly zero volts. Diode, 3D, is a self biasing diode for 5TR. Also, it tends to reduce leakage along with 4D.

When the 24V D.C. power is removed, if the capacitor combination is at full charge, resistor, 7R, and transistor, 3TR, become the discharge path for the current. Resistor 7R is of high enough impedance that no damage to 3TR will result. This is a safety feature to prevent damage to 3TR. If either or both the 15V D.C. reference or 6V A.C. bias supply are removed, the capacitor combination will slowly discharge through 7R, 3TR, and the internal leakage of the capacitors. No damage will result from this, even if the reference input is removed completely. The function of capacitor, 4C is for amplifier stability.

TEST INFORMATION

Transformer S#435A659G01 is required.
Capacitor S#417A746H03 - 600 MFD 40V is required.

Test the reference and power supply circuits as follows:

1. Check the wiring carefully before proceeding with testing.
2. Connect a 0-20 VDC voltmeter to terminals 17(+) and 11(-).
   Connect a 0-30 VDC voltmeter to terminals 16(+) and 19(-).
3. Connect a 115 VAC, 60 cycle power supply through a variac to terminals H1 & H2 of transformer S#435A659G01.
   Connect transformer secondary windings to terminals 2 & 1, 8 & 19, 9 & 11.
4. Energize 115VAC power supply and set voltage at 115V. Check and record the DC voltages on both voltmeters of step 2. Voltage on terminal 17 and 11 should be 15VDC ±10%. Voltage on

terminal 16 and 19 should be 24VDC ± 10%.

5. Check and record per step 4 the voltages 5 minutes after circuit is energized. Also, after 10 minutes, voltages should have increased 0.5 to 1.0 volt after 10 minutes.
6. Leaving circuit energized, apply 50 millamp load to terminals 17 and 11, and apply 200 MA load to terminals 16 & 19. Check and record voltages. Wait 10 minutes and check and record the voltages again. Regulation on terminals 17 & 11 should be approximately 2%. Regulation on terminals 16 & 19 should be approximately 8%.
7. With the load still connected, change variac 115 VAC supply to 100VAC, wait 10 minutes, and check and record the voltages on terminals 17 & 11, and 16 & 19. Regulation on terminals 17 & 11 should be approximately 2%. Regulation on terminals 16 & 19 should be approximately 6%, but should not go below 20VDC.
8. Repeat step 7, except change supply to 130 VAC. Regulation should be same as step 7.
9. Return input voltage to 115VAC and remove load. Check and record the following, using a calibrated oscilloscope.

   (A) D.C. voltage on capacitor 3C should be 32 V ±10%.
   (B) Ripple voltage on cap. 3C should be 4 V ± 20%, peak to peak or less.
   (C) Ripple voltage on terminals 17 & 11 should be .05 volts ±20% or less peak to peak.
   (D) D.C. voltage on capacitor should be 32 V ±10%.
   (E) Ripple voltage on cap. 2C should be 4V ±20% or less, peak to peak.
   (F) Ripple voltage on terminal 16 & 19 should be 0.5 volts ±20% or less peak to peak.

RAMP FUNCTION GENERATOR CIRCUIT

10. Test the ramp function generator circuit as follows:
11. Check the wiring carefully before proceeding with testing.
12. Connect terminal 6 to 7. Connect the 600 MFD capacitor and a milliamp meter to terminal 11 & 7 per sheet 1 of this drawing.
13. Connect terminals 3 to 4 to 5.
14. Connect a 1000 to 1500 ohm rheostat across terminals 17, 10 & 11 per sheet 1 this drawing. Apply A.C. 60 source to terminals 2 & 1, 8 & 19, 9 & 11 - use transformer S#435A659G01.
15. Put reference rheostat at zero volts and put 1P and 2P at minimum.
16. Check voltage on terminal 4 (+) to 1 (-). This should be 5.1 VDC 10% with 300 MV maximum ripple peak to peak.
17. Check voltage on terminals 18 (+) to 19 (-). This should be 0 to 50 MV maximum.
18. Move reference rheostat to 100%, and check and record the following:

    (A) Charging current*
    During build-up 5MA ±20%
    (B) Build-up time (0 to 15V)
    T = .005 x C (MFD) ± 20%

19. Move reference rheostat to 0% and check and record the following:

    (A) Charging current*
    During discharge 5MA ± 20%
    (B) Delay time (15V to 0)
    T = .005 x C (MFD) ± 20%

20. Set 1P & 2P at maximum, and repeat test of step 8 & 9 and check and record.

    (A) Charge and discharge current *0.2 MA ± 20%.
    (B) Build-up and delay time
    T = 0.1 C (MFD) ± 20%

21. Connect 100 MA load to terminals 18 and 19, and repeat test 8, 9 and 10.
22. Set 1P and 2P to minimum, and turn reference rheostat to 100%. Record time. It should be between 1 to 4 sec. (0 to 15V). Set reference rheostat to 0%. Time should be the same (15 to 0). Check and record.
23. Set 1P and 2P to maximum, and turn reference rheostat to 100%, then to 0%. Times should be (0 to 15 to 0V) 60 sec. ± 20%. Check and record.
24. Return wiring on terminals to original connections per wiring diagram.

*Note: Current to be constant ±1.5% during build-up or delay.