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Transistor Devices Inc.

POWER • MEASUREMENT • CONTROL

INSTRUCTION MANUAL

INSTRUCTION MANUAL
MODEL DLR 50-15-150A DYNALOAD

OCTOBER, 1980

274 S. Salem St., Randolph, New Jersey 07869

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ILLUSTRATION

1. INTRODUCTION

The Dynaload is a precision instrument which simulates electrical loads to test power supplies, generators, servo systems, batteries, and similar electrical power sources. It simulates, at the option of the user, resistive loads (amps/volt) or may be switched to a constant current load characteristic (current regulated at a pre-selected value) or a constant voltage type of load (similar to a battery or a zener diode). Provision is also made for external programming in automated test setups. The external programming voltage is from 0-6V with an input impedance of 12K minimum. Load current is directly proportional to programming voltage, and the sensitivity is adjustable with the front panel current adjustments.

2. SPECIFICATIONS

The following ratings apply:

Load Voltage: 0-50V

Load Current: 0-15A

Power Dissipation: 1-150W

Overload Rating: 10%

Self-Protection: Overvoltage---Less than 60V
Overcurrent---Less than 20A
Overpower---Less than 200W

Mode Selector Switch Positions:

Position 1: External modulation--Will program from 0-15A with 0-6V applied to the external modulation terminals (TB-1). Modulation sensitivity is directly adjustable by the front panel load adjust control.

Position 2: Constant current 0-15A as determined by the front panel load adjust.

Position 3: Constant current 0-3A as determined by the front panel load adjust.

Position 4: Off.

Position 5: Constant resistance 0-.5 A/V as determined by the front panel load adjust.

Position 6: Constant resistance 0-3 A/V as determined by the front panel load adjust.

Position 7: Constant voltage load. In this position, the load is similar to a battery being charged or a constant voltage zener diode; i.e., no current is drawn until the source voltage reaches the regulating voltage. The voltage at which the dynaload regulates is adjustable by the front panel load adjust.

Front Panel Controls:

S1: AC on-off switch

M1: Load voltage range as selected by the voltmeter range selector switch: 0-6V, 0-18V, or 0-60V.

M2: Load current range as selected by front panel current range selector switch: 0-1.8A, 0-6A, or 0-18A.

CAUTION: The meter range selector switch should always be maintained in the highest voltage or highest current position, except when readings are being taken; i.e., although the meters have high overload capacity, they may be damaged by overloads in the lower range positions.

CB-1: Load on-off circuit breaker. For absolute no-load tests, this circuit breaker should be opened; the circuit breaker will automatically open in the event of an overvoltage, overcurrent condition; i.e., the circuit breaker is rated at 15A and will open up if more than 15A is sustained through the Dynaload. In the event that an overvoltage condition is applied, an overvoltage SCR will fire, protecting the dynaload; and if the source has more than a 15A capability, the circuit breaker will open.

NOTE: When testing low current sources, it may be advisable to use an external fuse or circuit breaker to protect the source.

Rear Panel Connections:

E+: Plus Load--Connect to positive terminal of source to be tested.

E-: Minus Load--Connect to minus terminal of source to be tested.

TB1-1: 0 to +6V programming voltage.

TB1-2: Programming voltage return internally connected to the minus terminal of the Dynaload.

TB1-3: +6V which may be used as a source for programming. Also provided is a three-wire line cord Amphenol connector.

F1: AC line fuse 3A, slow blow.

3. OPERATING INSTRUCTIONS

The following procedure is recommended for hooking up the Dynaload.

The AC and DC Dynaload switches should be turned off so that the load is inherently disconnected. The meter range switches should be set in their maximum voltage and current positions, and the load adjustments, both coarse and fine, should be set in the counterclockwise position. The mode selector switch should be set to the appropriate mode to be used. The Dynaload should be plugged into standard 115V, 50-60 Hz, power, and connections should be made from the source to be tested to the appropriate load terminals of the Dynaload (E+ and E- on the rear of the unit).

If external modulation is to be used, the external programming voltage should also be connected. The AC-On switch should now be turned on. The DC-On circuit breaker should now be closed, and the front panel Dynaload voltmeter should indicate the source voltage. If the circuit breaker trips, or if there is no indication of source voltage, check the external hook-up wiring to see that it is of the proper polarity and that all connections are tight and secure. The load may now be increased by turning the load adjust controls slowly clockwise until the appropriate load is obtained. The meter range switches may be switched to the lower scale positions if greater accuracy is required, and external instrumentation may be used to obtain greater accuracy and eliminate the effects of leakage currents in the Dynaload, or of line voltage drops at high currents.

3.1 Constant Resistance Mode (Amps/Volt)

Two scales are provided: i.e., 0-.5 A/V and 0-3 A/V. Minimum resistance on the 0-.5 A/V scale is two ohms, and minimum resistance on the 0-3 A/V scale is .3 ohm. Let us assume that we wish to test a 12V battery with a 10 ohm resistive load. We would accordingly set the mode selector switch to the 0-.5 A/V position and connect the source as previously described.

After checking the initial readings of the meters, we would adjust the voltmeter to the 0-18V scale and the ammeter to the 0-1.8A scale. We would then slowly turn the coarse and fine load adjusts to obtain the 1.2A load, while monitoring the battery voltage on the front panel voltmeter. For precision settings at high load currents, it is desirable to use an external voltmeter connected at the source terminals to eliminate the effects of lead drops. Lead drops at 15A may well be .1 to .25V if substantial lead lengths are used, and there is a small voltage drop internal to the Dynaload due to the circuit breaker and internal power wiring. Similarly, it may be desirable to use external ammeters for particular tests to supplement the scales of the Dynaload or for use at very low currents. There are minor leakage currents of a few milliamps in the Dynaload ammeter (voltmeter current, voltage sensing network).

The resistive load characteristics of the Dynaload simulate a pure resistance down to approximately 1 to 2V input; i.e., for a given resistance setting, the current is directly proportional to the voltage over wide dynamic ranges. In the very low voltages, the power transistors will saturate.

3.2 Constant Current Position

Some power sources, such as variable power supplies, are rated at a fixed maximum load current and adjustable over a pre-determined voltage range: i.e., 5-10V @ 10A. If the resistive load characteristic were used for this type of test, it would be necessary to reset the load each time the power supply voltage were changed in order to maintain the full load current. Accordingly, the following procedure should be used.

With the load adjustments turned counterclockwise and the DC load switch off, and the Dynaload meters in their maximum voltage and current positions, switch the mode selector switch to the constant amperes position, 0-15A. Turn on the power source and the Dynaload and set the power source to the desired output voltage (Let us assume 10V.) Turn the load adjust until 10A of load current is achieved. The power supply may now be programmed from 5-10V, and the load current will be maintained constant at 10A. This constant current characteristic is maintained down to one or two volts.

It should be noted that many solid state power supplies are designed for short circuit protection by internal current limiting with foldback, and accordingly, may not start up into a constant current type of load. Accordingly, the constant resistance characteristic should be used as a load when simulating short circuit protection and recovery of most solid state power supplies unless otherwise specified by the manufacturer.

3.3 External Modulation

In the external modulation position, the Dynaload acts as a constant current load with the constant current proportional to the external voltage applied to TB1-1 and TB1-2. (TB1-2 is the return of the external modulating voltage and is internally connected to the negative lead of the Dynaload.)

The Dynaload will program from 0-15A as the external modulation voltage is programmed from 0-6V if the load adjustments are set in the maximum clockwise position. The programming sensitivity may be reduced proportionately by the front panel lead adjust controls; i.e., turning the load adjust counterclockwise reduces the programming sensitivity. The input impedance of the external modulation terminals is approximately 12K ohms.

The transient response of the Dynaload is determined by the feedback loop characteristics of the constant current regulator to achieve precision programming.

3.4 Constant Volts Position

In the constant volts position, the Dynaload acts as an adjustable power zener diode. The regulating voltage is programmable from approximately 2 through 50V by the front panel load adjust. The constant volts position is used to simulate a battery to a battery charger, or the Dynaload may also be used as a shunt voltage regulator for special applications.

3.5 Power Rating

The model DLR 50-15-150A will dissipate 150W continuously. In order to assure that overheating does not occur, the rear of the Dynaload should be clear for the air intake and the air exhaust; i.e., the cooling air enters and leaves from the rear. If there is a heavy dust accumulation, the Dynaload should periodically be checked, and if the Dynaload is run on a continuous basis, the cooling fan should be oiled at six-month intervals by removing the small plug on the inner surface.

3.6 Protective Circuits

The Dynaload has internal current limiting at approximately 18A maximum and also has a circuit breaker which disconnects at somewhat over 15A. The Dynaload also incorporates reverse voltage protection by reverse diode; i.e., if the input is hooked up backwards, the source will be shorted, and the circuit breaker will trip, if the source current capability is sufficient. In the event that an overvoltage is applied to the Dynaload (approximately 55V), an overvoltage SCR will crowbar across the Dynaload, thereby protecting all internal circuits. If the source current should be damaged by a 15A load or is not short-circuit-proof, it may be desirable to incorporate an external fuse or circuit breaker to protect the source.

The voltage current product is also monitored to prevent an over-power condition from happening. Accordingly, the current limit characteristics are set at approximately 18A, and are maintained to approximately 8.5V, at which time the current limit characteristic is reduced as the input voltage is increased, thereby limiting the maximum power which may be programmed into the Dynaload.

3.7 Special Applications

The Dynaload may be used for AC load testing within its ratings by the use of an external bridge rectifier, so that the Dynaload sees pulsating DC, but the AC source sees an AC load. The effect of the rectifier is to slightly distort the Dynaload characteristics at low voltages and currents. The Dynaload is normally recommended for testing AC sources above 60 cycles, due to its limited speed of response, unless the user specifically recognizes the load characteristics at high frequencies.

The Dynaload may also be used as a current or voltage regulator rather than a load for special applications, as illustrated as Section 5.3.

4. CALIBRATION PROCEDURES

4.1 Voltmeter Calibrate

With the Dynaload set for no load, place an external calibrated voltmeter across the input terminals of the Dynaload and program the input voltage to obtain 5, 15, and 50V, respectively. With the voltmeter range selector switch S2 in the 6V position, and 5V applied, adjust resistor R32 so that the front panel voltmeter reads "5." With the meter selector switch in the 18V position, and 15V applied, adjust resistor R34 until the front panel voltmeter reads "15." With the meter range selector switch in the 60V position, and 50V applied, adjust resistor R36 until the front panel reads "50."

4.2 Ammeter Calibrate

Use an external 5V source and an external ammeter for calibration. Turn the Dynaload adjust fully counterclockwise and set the mode selector switch to the constant current on 0-15A position. With the ammeter range selector switch at 1.8A, increase the load until the external ammeter is at 1A. Adjust resistor R38 so that the front panel ammeter is also at 1A. Switch the ammeter selector switch to 6A and adjust the load current until the external ammeter reads "4." Adjust resistor R40 until the front panel ammeter also reads "4." With the ammeter range selector switch set at 15A, increase the load current to 10A as indicated on the external ammeter and adjust resistor R42 until the front panel ammeter also reads "10."

4.3 Ampères Per Volt Calibrate

With the Dynaload in the 0-.5 A/V position, and the load adjust in the maximum clockwise postion, apply a voltage of 5V to the input terminals of the Dynaload and adjust the A/V calibrate potentiometer R54 so that between 2.5 and 3A of load current is obtained.

With the Dynaload in the 0-3 A/V position, and the load adjust in the maximum clockwise postion, apply a voltage of 5V to the input terminals of the Dynaload and adjust the 3 A/V calibrate potentiometer R30 so that between 15 and 20A of load current is obtained. (NOTE: Make sure that the current limit setting is not interacting in any way.)

4.4 Current Calibrate

Set the mode selector switch to the 0-3A constant current position. Using a 5V source, turn the load potentiometer in the maximum clockwise postion and adjust resistor R56 to obtain between 3 and 3.5A.

Set the mode selector switch to the 0-15A constant current position. Using a 5V source, turn the load potentiometer in the maximum clockwise postion and adjust resistor R19 to obtain between 15 and 20A. (NOTE: Make sure that the current limit setting is not interacting in any way.)

4.5 Current Limit Calibrate

Place the Dynaload in the 0-3 A/V position. Using a 10V source, increase the load current to approximately 18A or until current limiting is achieved. Readjust resistor R50 as appropriate.

4.6 Overpower Protection

Apply a 50V source to the Dynaload and increase the load current either to its maximum counterclockwise postion or 4A, whichever occurs first. Adjust R7, the bendback resistor, to limit the current at 50V to between 3.5 and 4A.

5. THEORY OF OPERATION

5.1 Input Circuits

Refer to the schematic diagram shown below. AC power is applied through the line cord, through fuse F101 and AC on-off switch S104, to blower B101, and the primary of transformer T1 through CB101 when in ON position. The secondary of T1 is rectified and filtered in both the positive and negative directions compared to the center tap, generating approximately +25V and -25V on capacitors C1 and C2, respectively. The negative voltage is regulated to 5.6V by constant current source transistor Q5 and associated components R12, VR7, R13, and zener diode VR6. The +25V is regulated to +16V by constant current source transistor Q1 and its associated components R1, VR5, and R2, and zener diodes VR2 and VR3, which generate +16 and +8V, respectively.

5.2 Constant Current Operation

Position 2 of switch S1 places the Dynaload in the 0-15A constant current mode. An internal voltage reference is generated by series dropping resistor R14 and zener diode VR8, which, in turn, is reduced by the voltage divider network R19 (0-15A current calibrated)-R20 and the front panel load adjust control R125. A portion of this voltage determined by the load and pots is fed into the non-inverting input of U1.

The Dynaload current is sensed by the voltage drop across SH101, which, in turn, is applied through switch S1B and R27 to the inverting input of U1. It will be noted that if the load current is less than the voltage reference set by the load controls, U1 will conduct heavily from V_c to V_{Out}, thereby turning on transistor Q101 and increasing the drive to Q102 through Q108 until the load current is increased to equilibrium in a regulatory fashion.

Position 1 provides for the use of an external voltage reference in place of zener diode VR8 when external modulation or programming of the Dynaload is desired. The load adjusts on the front panel can then be used to define the programming sensitivity of the external modulation signal.

Position 3 is a 0-3A constant current position, and R56-R21 simply reduce the voltage reference which is fed to the load adjust control.

Position 4 is the OFF position.

Position 5 is the 0-.5 A/V position. It will be noted that the input voltage is now used through resistive divider R24-R54 to create a voltage reference proportional to input voltage rather than a fixed voltage. Accordingly, as the input voltage is increased, the reference voltage will increase, and hence, the load current for equilibrium in the regulating loop will increase proportional to voltage.

Position 6 is an increased A/V sensitivity of 0-3 A/V which is created by a different divider ratio R23 and R30.

Position 7 converts the regulating loop into a constant voltage regulator at the input terminals similar to a shunt regulator or a zener diode.

The input voltage is applied through R23 and R30 and the load adjust to the non-inverting input of V1. A constant voltage reference is applied from resistive divider R17-R18 to the inverting input of U1, replacing the current feedback loop. Accordingly, if the input voltage tends to exceed the set voltage, U1 conducts more from V_c to V_{Out}, thereby turning on transistor Q101, which turns on Q102-Q108, and the Dynaload draws additional current, attempting to maintain constant voltage at the input.

5.3 Current Limit Protection

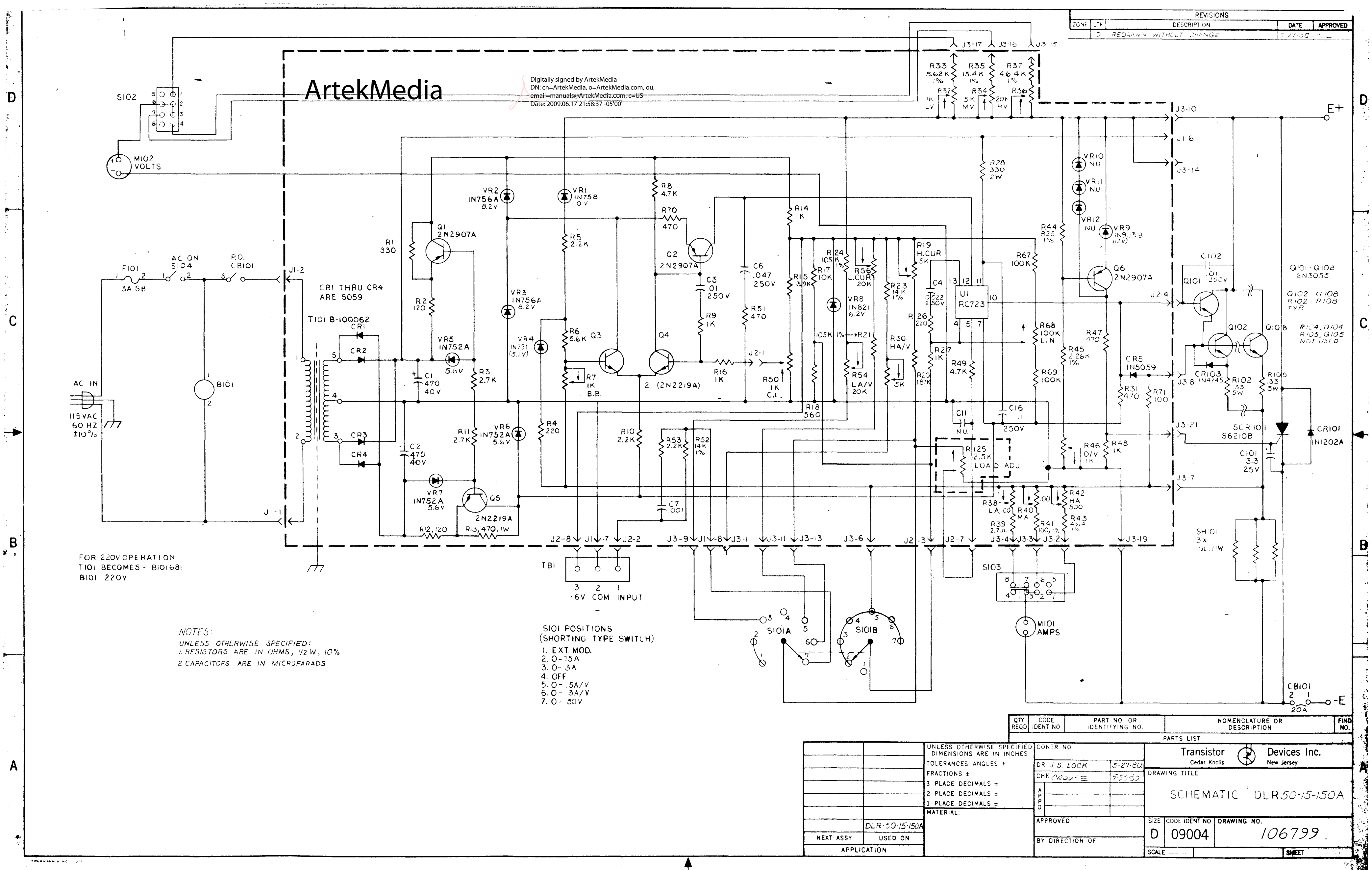
The voltage proportional to load current generated across SH101 is applied through R7 to the base of transistor Q3. The voltage reference generated by zener diode VR8 is reduced by divider network R15-R50 (current limit adjust) and applied to the base of transistor Q4. Accordingly, Q4 will normally conduct, thereby turning on transistor Q2 and permitting it to drive the Dynaload. When the load current reaches the current limit point, transistor Q3 conducts, thereby turning off transistor Q4, which turns off transistor Q2 and restricts the drive to the Dynaload in a constant current regulating characteristic. It should be noted that zener diode VR1 begins to conduct when the input voltage is approximately 10V, and accordingly, R5-R6-R7 divider network comes into play as the voltage is increased by adding a voltage to the current signal so that the current limit point is reduced as the input voltage rises. To make a more accurate constant power curve, VR4 is introduced when the voltage across R6-R7 reaches approximately 5.1V. This draws some of the introduced signal away from Q3, preventing excessive reduction in the current limit point at high voltages. This results in approximately a constant power limitation; i.e., the Dynaload is rated at 15A up to 10V and the bendback is normally set so that at 50V input, it is impossible to draw more than 4A.

5.4 Instrumentation Circuits

Range selector switches and calibrating resistors are provided for the front panel ammeter and voltmeter.

5.5 Overvoltage Protection

If the applied voltage exceeds approximately 55V, divider R44-R45-R46 (overvoltage adjust) causes Q6 to conduct, thereby firing SCR101, which crowbars the output and trips circuit breaker CB1. Reverse voltage protection is provided by rectifier CR101.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S102
M102 VOLTS
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P.O. CB101
F101 3A SB
CR1 THRU CR4 ARE 5059
T101 B-100062
AC IN
115VAC 60 HZ ±10%
B101
Q1 2N2907A
Q2 2N2907A
Q3
Q4
2 (2N2219A)
Q5 2N2219A
Q6 2N2907A
Q101-Q108 2N3055
Q102 Q108 R102 R108 TYP.
R104, Q104 R105, Q105 NOT USED
U1 RC723
SCR101 S6210B
CR101 IN1202A
C101 3.3 25V
SH101 3X .1Ω, 11W
R125 2.5K LOAD ADJ.
FOR 220V OPERATION T101 BECOMES - B101681 B101 - 220V
TB1
3 2 1
-6V COM INPUT
S103
M101 AMPS
S101A
S101B
CB101 20A
-E
NOTES:
UNLESS OTHERWISE SPECIFIED:
1. RESISTORS ARE IN OHMS, 1/2 W, 10%
2. CAPACITORS ARE IN MICROFARADS
S101 POSITIONS (SHORTING TYPE SWITCH)
1. EXT. MOD.
2. 0-.15A
3. 0-.3A
4. OFF
5. 0-.5A/V
6. 0-.3A/V
7. 0-.50V
QTY REQD CODE IDENT NO PART NO. OR IDENTIFYING NO. NOMENCLATURE OR DESCRIPTION FIND NO.
PARTS LIST
DLR-50-15-150A
NEXT ASSY USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
FRACTIONS ±
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
1 PLACE DECIMALS ±
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DRAWING NO. 106799
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