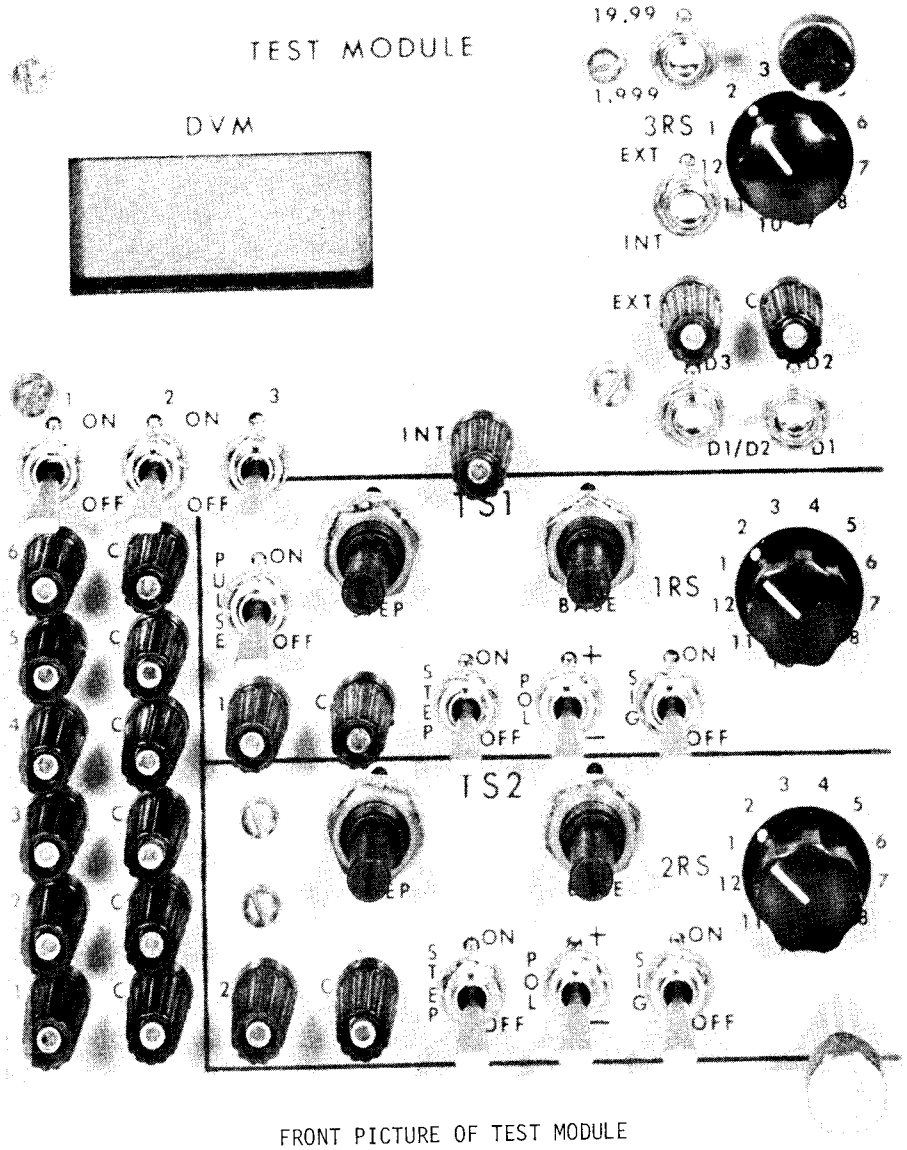
TEST MODULE

I. INTRODUCTION

The Test Module S# 1943A23G01 is a tool designed to assist factory testing, drive start-up and drive maintenance. A front picture of the module is shown in Figure 1. Figure 2 is a side picture of the assembled unit showing the various assemblies in the normal mounted fashion.

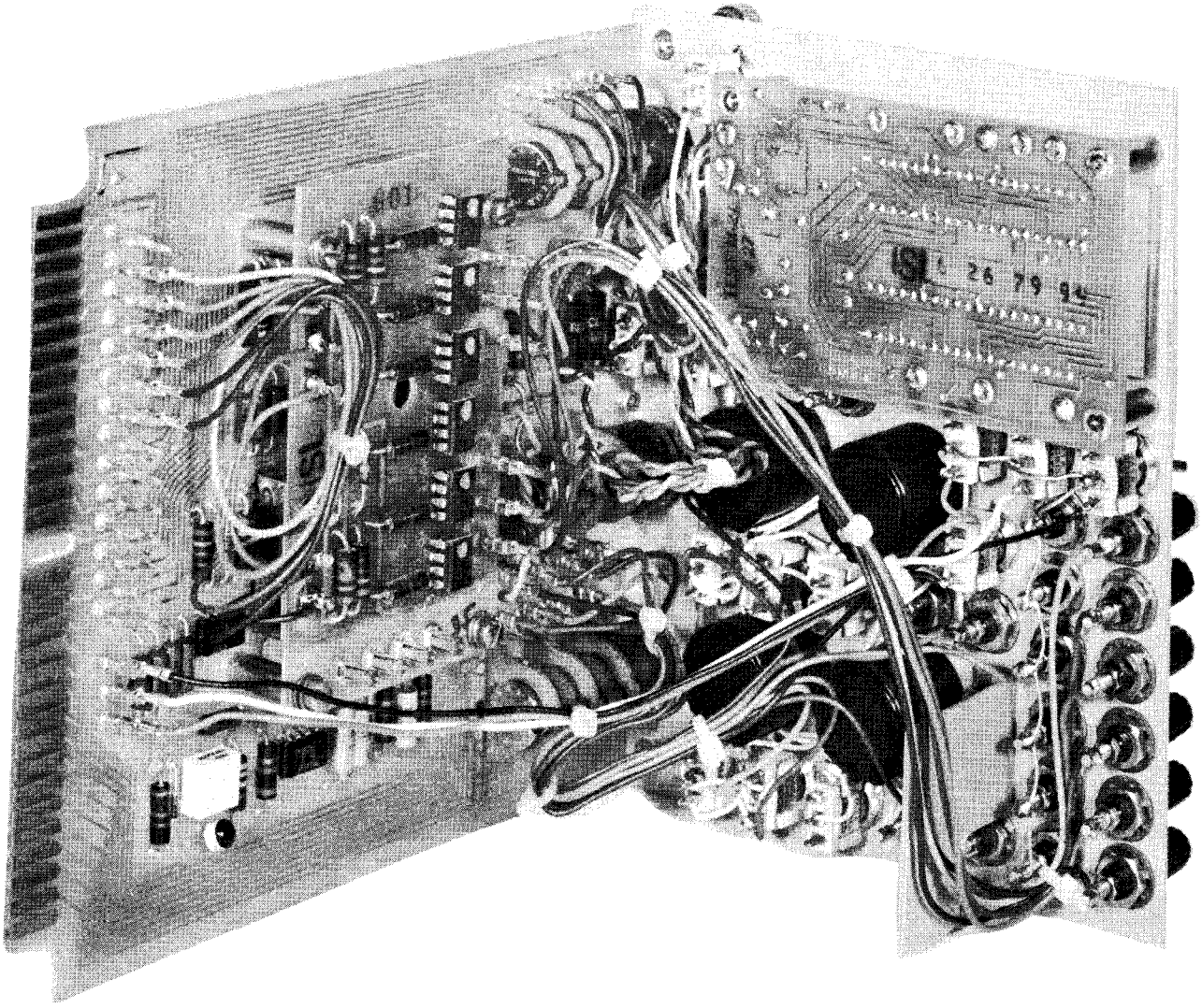
This module will plug in a standard 60 pin edge connector which must be wired with the appropriate test points which are to be monitored or into which various test signals are to be inserted.



FRONT PICTURE OF TEST MODULE

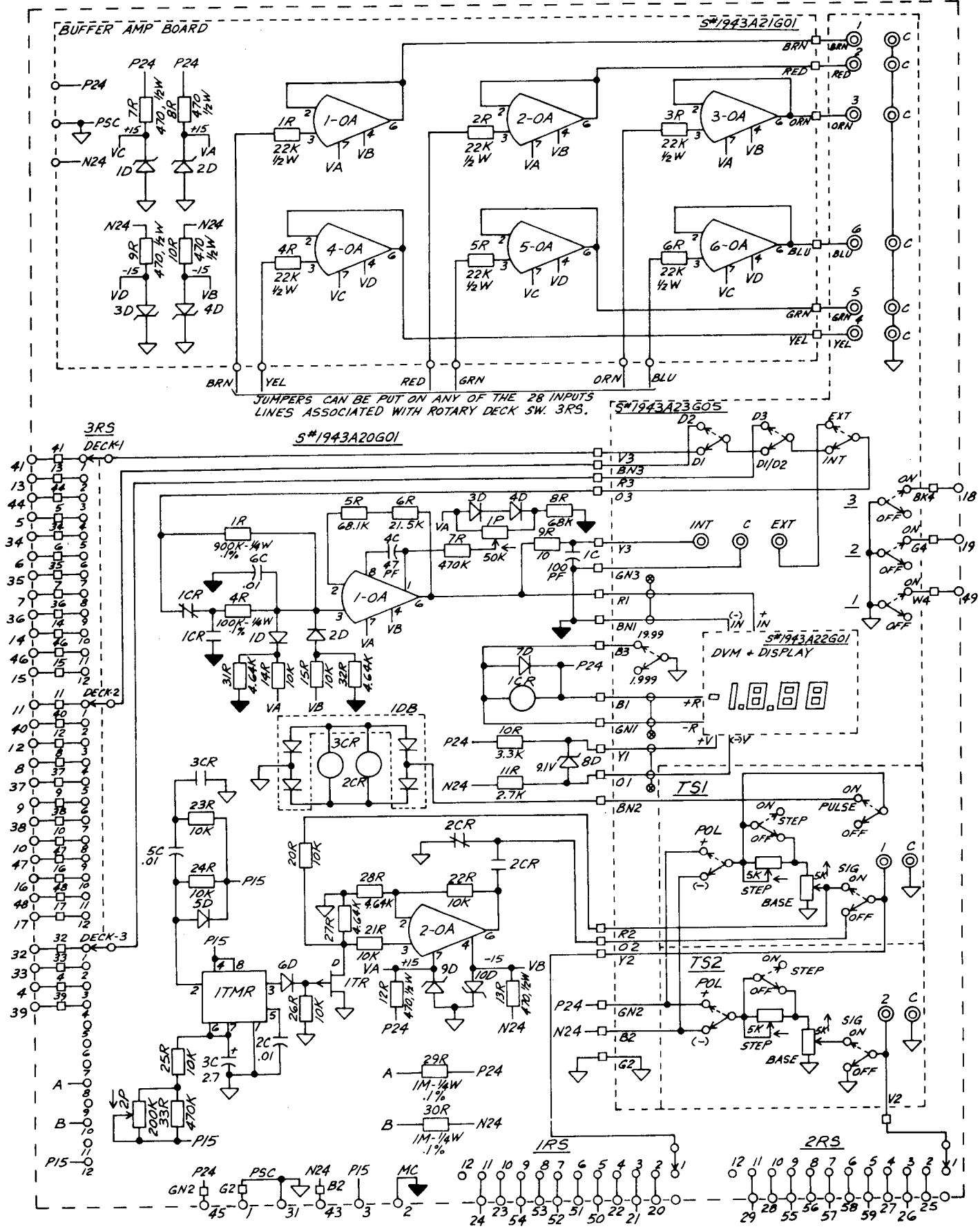
FIGURE 1

EFFECTIVE DATE: OCT 1979



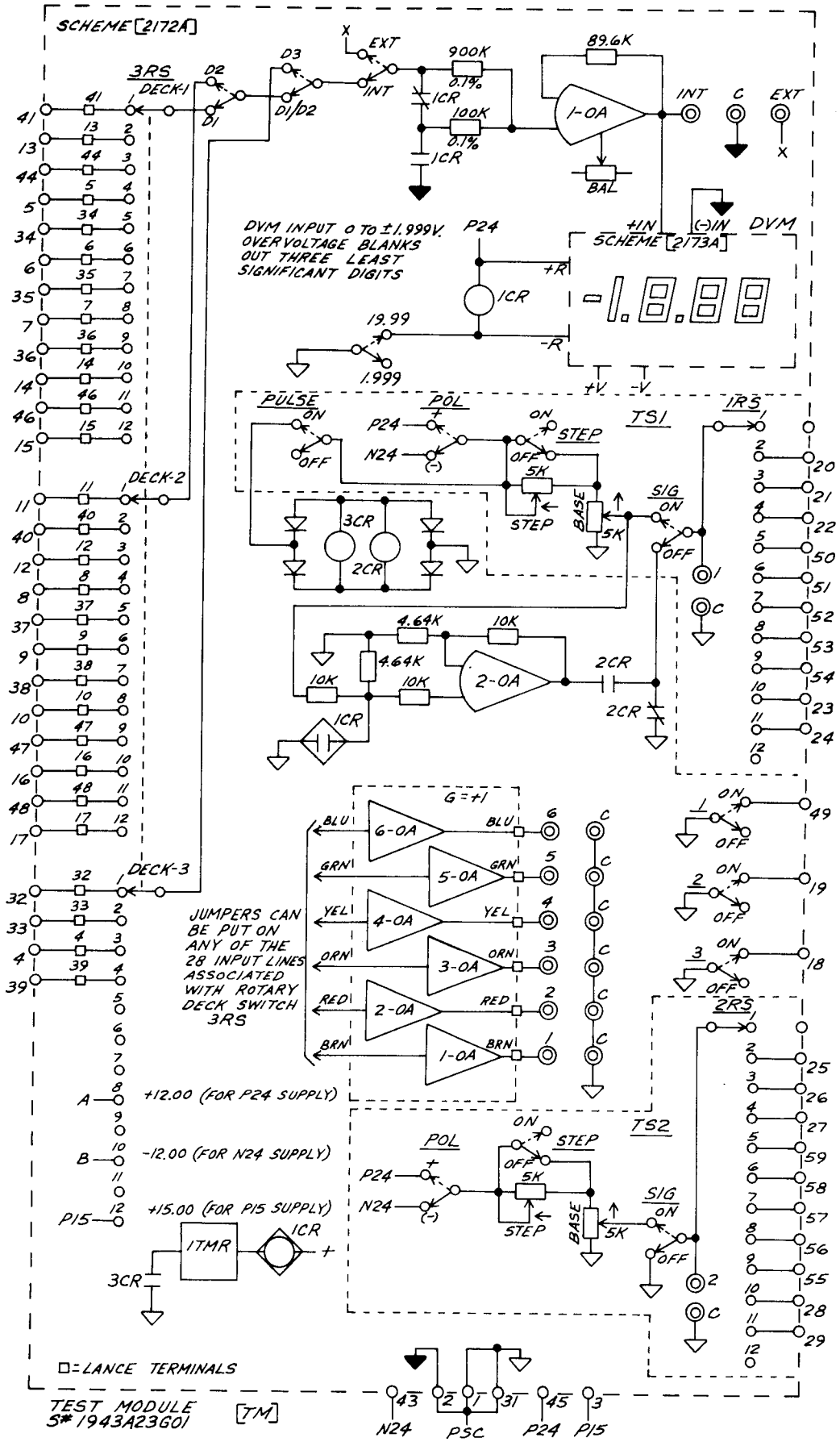
PICTURE OF ASSEMBLED TEST MODULE

FIGURE 2



DETAILED SCHEMATIC OF TEST MODULE

FIGURE 3



SIMPLIFIED SCHEMATIC OF TEST MODULE

FIGURE 4

II. FUNCTIONS PROVIDED

A. DIGITAL VOLTMETER

A 3 1/2 digit LCD (liquid crystal display) digital voltmeter with selectable ranges of 0 to 2 volts or 0 to 20 volts is part of the assembly. The range select switch in the upper right hand corner of the assembly is marked 19.99-1.999. Input resistance is greater than 5M ohm in the 2 volt range and is 1M ohm in the 20 volt range. No polarity indication implies that the monitored signal is positive. For a negative signal a minus sign is displayed. Any overrange on the meter causes the three least significant digits to blank out.

The DVM is protected against normal overvoltages and a blanking indication will be observed as already mentioned when this occurs. If the DVM is open circuited (no connection to input terminal) in the 2V range, the indication will show an increasing drifting reading until an overrange is indicated. In this open circuited mode, changing the range select switch to 19.99 will cause the DVM reading to be zero.

The DVM monitors any of the regulator signals that are connected to the appropriate input terminals of rotary deck switch 3RS (see Figure 4). This switch is a 3 deck switch and the input signals monitored are selected by deck as follows:

Deck 1.	Select D1	D1/D2	INT
Deck 2.	Select D2	D1/D2	INT
Deck 3.	Select -	D3	INT

The three associated toggle switches are marked EXT-INT, D3-D1/D2 and D2-D1 and are in the upper right hand area of the assembly. When deck 3 of 3RS is selected, the DVM also monitors the input supply voltages to the assembly when the switch is in positions 8, 10 and 12. These positions monitor P24, N24 and P15 and the indicated readings are 12.00, -12.00 and 15.00 respectively. The $\pm$24 volt supplies were attenuated 50 percent in order to display a reading.

The DVM can also be connected to an external signal by selecting the external position of the EXT-INT toggle switch. The signal connected to the EXT banana jack is then displayed on the meter in the appropriate range as selected.

Banana jack INT monitors the input signal to the DVM subassembly. This signal should always be in the 0 to $\pm$2 volt range except for an overvoltage condition. As shown schematically, this point is the output of amplifier 1-0A and is either the same as the input voltage or one tenth the level of the input voltage. Range 19.99 sets the gain of this circuit to 0.1.

B. INSTRUMENTATION BUFFERS

Six unity gain non-inverting buffers are provided for instrumenting internal regulator signals while the drive is operational. The buffered signals are available at banana jack points one through six on the front of the module (lower left hand side). These buffers, which have an input impedance greater than 1MΩ, can be programmed to monitor any 6 of the 28 signals monitored by the input terminals of rotary deck switch 3RS. To change monitoring by the buffers, the Test Module must be removed from the cage and the associated six jumpers from the buffer card can be connected to any of the twenty-eight pins which are near the connector fingers. The appropriate jumper termination pins have the same identification number as the input terminal to which they are connected. The six jumper wires are color coded in the conventional fashion: brown for one through blue for six. These colors are also indicated on the schematic. Use of these buffers prevents instrumentation or lead loading from affecting the signal being monitored. These buffers also prevent the inputting of noise into the regulator which may be occurring because the leads used to monitor signals although primarily used for applying a signal to an instrument can also couple noise from an external noise source back into the regulator.

C. LOGIC SELECT SWITCHES

Three toggle switches numbered 1, 2 and 3 can be used for logic input signals if or as required by the particular system in which the assembly is used. These switches when OFF (down) leave the appropriate output lines floating (a logic one) and when ON (up) connect the appropriate output lines to PSC (a logic zero).

D. TEST VOLTAGES

There are two independent test voltages available from the module. The two test voltages are controlled by the hardware shown within the box designated TS1 and within the box designated TS2. See Figures 1, 3 and 4.

The two test signals have the same control and adjustment procedure except that the TS1 test signal can be operated in a pulse mode. Refer to the TS2 section of the schematic of Figure 4. The SIG ON/OFF switch ties the output line to PSC or to the BASE pot wiper. The BASE pot with the STEP switch in the OFF position can adjust the output signal from 0 to 24 volts. Polarity of the output voltage depends upon the position of the polarity (POL) switch. With the STEP switch in the ON position, the output signal is reduced as the STEP pot is rotated clockwise. When using this step function which is actually a reduction in output voltage, the signal may have to be precalibrated before use in a particular circuit so that the correct levels are generated. If the actual circuit requires a step increase in voltage then after initial calibration, the STEP switch can be put in the OFF position to generate the required signal increase. With two test signals available, one circuit can generate a level and the other circuit can generate the step. This necessitates having two input terminals free for test purposes on the circuit being tested. The TS1 and TS2 circuits can produce the type of output voltage level just discussed.

The DVM on the assembly can be used to check the level(s) of the test voltage by connecting a jumper between banana jack EXT and the appropriate output point from the test circuit (either banana jack 1 in TS1 or banana jack 2 in TS2). With the DVM switch set to EXT, the test voltage is displayed on the DVM and the appropriate levels can be checked or set as required.

The TS1 circuitry is also capable of automatically producing a pulsed output. The following refers to various controls within the TS1 set. With the SIG switch OFF (down) and the BASE pot at some voltage, setting the PULSE switch to the ON (up) position will generate an output voltage pulse which goes from zero to the level of the base pot and then back to zero. The output level and polarity are determined by what is on the base pot wiper. The zero level is not quite zero due to the finite "ON" resistance of static relay 1CR. Only one pulse is produced. To repeat the pulse, the PULSE switch must be set to OFF and then back to ON. Alternating polarity pulses can be generated after the PULSE switch is in the ON position by changing the position of the POL (polarity) switch. Each time this switch is repositioned, a pulse is generated which is opposite in polarity to the prior one generated. In the pulsing mode, the use of amplifier 2-0A restricts the output pulse amplitude to approximately $\pm$12 volts.

III. APPLICATION INFORMATION

A. PHYSICAL REQUIREMENTS

The Test Module is an option and cage space can be allocated for the assembly so that during test and start-up a unit can be plugged into the appropriate position in the cage. A total of seven (7) cage slots (0.75 inch centers) is required for the unit with a 60 pin edge connector wired in the right most position.

B. SCHEMATIC INFORMATION

The job schematics should show either an outline block only for the assembly so that the appropriate wiring can be made to the edge connector or simplified MIC sheet #2339A can be used with an appropriate note indicating that the unit is for test and start-up only and is not being supplied as permanent hardware with the job. If supplied as a part of the job then the note would not be pertinent.

In some basic regulators, this assembly is a pre-engineerd option which has already been designed into the hardware. In other regulators, the design engineer will have to implement the integration of the Test Module into the hardware package.

C. EXTERNAL EXPANSION

Although there are a limited number of input terminals to which signals can be wired, the Test Module can be used in conjunction with the Interconnect Board S#1640A22G01 . An external jumper can be used either to monitor voltages using the external feature of the DVM or to input test voltages at selected circuit points. The banana jacks on both the Test Module and the Interconnect Board will accept 0.080 inch test pins. Jumpers can be used from the front of the Test Module to the front of the Interconnect Board to interconnect the desired points.

D. POWER REQUIREMENTS

Supply voltages of plus and minus 24 volts and plus 15 volts are required to operate the Test Module. These are the standard voltages supplied in the regulator cages. Current requirements on the +24, -24 and +15 supplies are 121, 97 and 20 milliamps respectively. The power supply common is interconnected to the backplane PSC bus via terminals 1 and 31. An instrumentation common is connected to terminal 2 and this terminal should be wired to the common PSC bus on the backplane (terminal 2 to terminal 1).

E. PULSE CIRCUIT

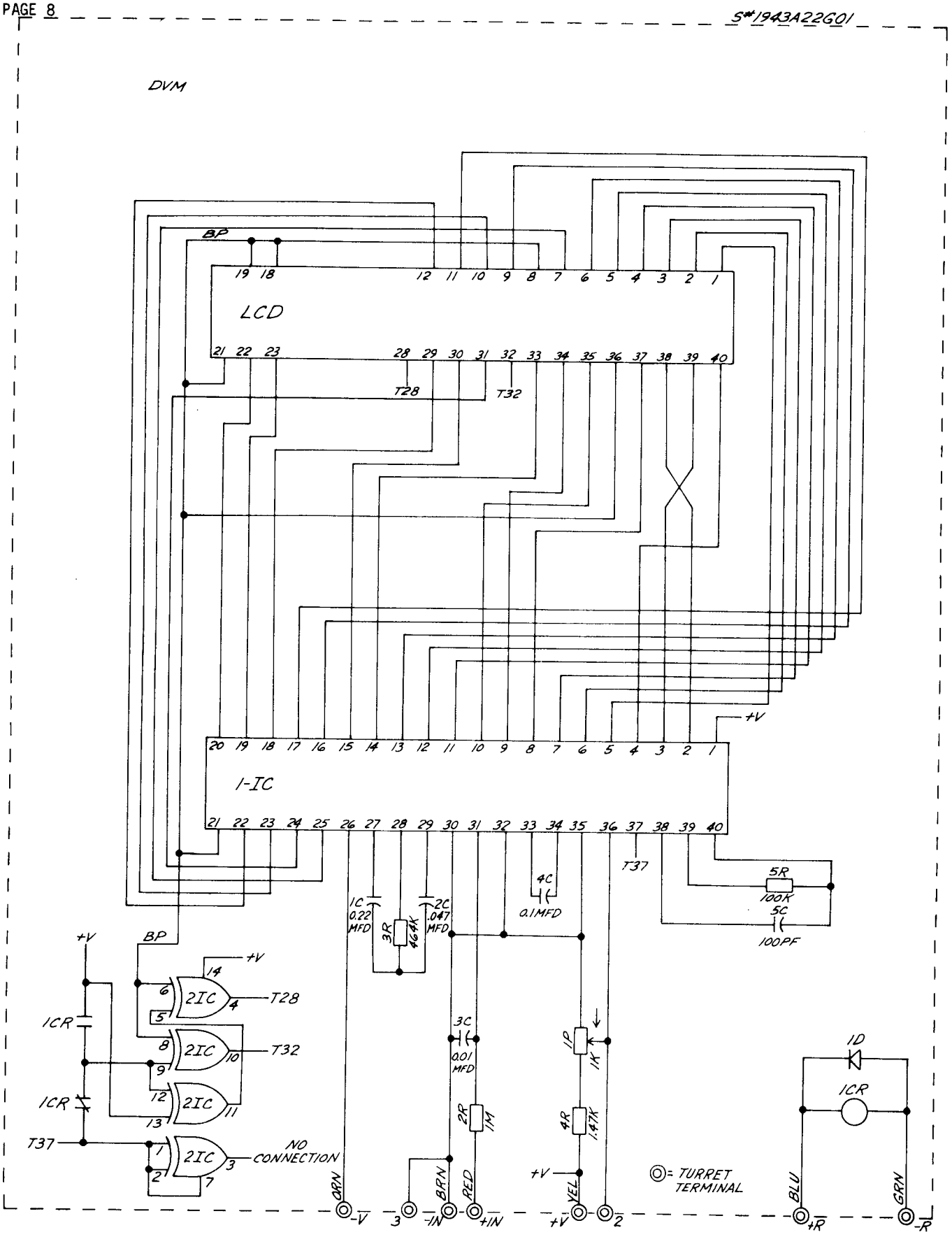
The pulse circuit was designed to provide a test signal for checking armature current in the stall mode without having to block the rotor. The pulse circuitry applies an output pulse only for a short time period. At lower current levels unidirectional current pulses can be applied to a stalled motor without turning the rotor but at higher current levels with residual flux from the stator, the rotor will probably turn and in order to prevent this, alternate polarity current pulses can be applied to keep the rotor at rest. In the Basic Regulators, the current regulators can be set to produce rated current (100%) in 20 to 50 milliseconds. Since as much as 300% current can be generated for some applications, the timing of the pulse has been set for 400 milliseconds which will allow the regulator to reach a stable level of current before the reference is returned to zero. When pulsing a stalled rotor, normal precautions against runaway of the motor and overheating of the commutators must still be observed.

F. DESIGN AND USE CONSIDERATIONS

If the toggle switches and test voltages are wired into a system, the three toggle switches should be set to OFF and the two rotary deck switches 1RS and 2RS should both be set to position 1 before the system is made operational. These switches should not be changed when the system is running as signals may be inadvertently injected which may create system problems.

If the Test Module is to be used for start-up then the assembly would be removed from the cage. If the Test Module is to be left in the cage, then one way of preventing this signal injection is to allocate a extra cage slot (8 instead of 7) with two adjacent edge connectors with the right most edge connector wired for start-up test and the connector immediately to the left wired for DVM monitoring only. Following test, the Test Module assembly can be then moved one position to the left which would eliminate the signal injection problem.

In a drive system which may include both a basic and a variable regulator, the Test Module can be shifted from one cage to the other as required during test or startup. Multiple Test Modules are not required as the assembly can be moved to the appropriate area being worked on or Interconnect Boards can be used to provide access to the appropriate points in the other regulator.



DETAILED SCHEMATIC OF THE DVM CARD
FIGURE 5