STANDARD REGULATOR CARD 193X267B_G01

SCOPE:

The standard regulator card is normally used with either a one quadrant or four quadrant driver of a 3 phase, full wave, SCR Drive System but can be used otherwise.

FUNCTIONS:

Reference	Current limit
Feedback	Static relay
Regulating	Diagnostic

Reference Function

The operating system reference is applied at SR(25X). With tab (26X) connected to common, 20 volts at SR corresponds to maximum speed. With tab (26X) open, 10 volts at SR corresponds to maximum speed. With tab (26X) connected to SR, 3 volts corresponds to maximum speed. SR should be positive for forward direction. The signal from SR will be applied to the linear time section under the control of a static relay. (See Static Relay)

An auxiliary reference input is provided at AR(30X) with a scaling potentiometer APR. This auxiliary preset reference may be used as an input to the linear time section ("Thread") by connecting (29X) to (23X) or as an input directly into the regulator section ("Jog") by connecting (29X) to (24). If 20 volts is applied to AR, up to 35% of maximum speed may be obtained from this reference. The signal from APR is applied under control of a static relay. (See Static Relay)

A linear time section provides two independent slope adjustments. TIM+ adjusts the forward motor acceleration slope and TIM- adjusts the forward motor deceleration slope. The total ramp time from 0 to top speed is a linear function of potentiometer rotation and is adjustable in two ranges. With (20X) connected to (27X), ramp time is adjustable between .5 to 3 seconds. With (20X) connected to (28X) ramp time is adjustable between 3 and 30 seconds. With (20X) open, linear time is removed. For longer time ranges capacitance may be added between (29X) and TR(30) at the rate of 4 MF for each 30 seconds required. This additional capacitor must not be an electrolytic type. Mylar capacitors with at least a 200V DC rating are recommended.

The timed reference TR(30) will be at -10 volts when the drive is operating at maximum speed in the forward direction. The output of the switching amplifier, the timing integrator reference TIR(20), will be between 10 and 18 volts when ramping and may be used to drive additional circuitry.

When preconditioning is applied (see Static Relay) the output TR returns immediately to zero irrespective of the reference(s) applied.

Feedback Functions - System and Load

Either single ended to common or isolated, differential system feedback is usable. The feedback can be rectified for AC or bidirectional DC feedbacks by connecting card terminals 11 to 19. The isolation or rejection of common mode voltage is a function of voltage range selected and is limited as stated in Table 1 by "Peak Voltage to Common" for differential inputs. Output SFB, from an amplifier of the Regulator Card is a voltage equal to the product of feedback voltage and the "scale factor" of Table 1. DC feedback is connected with positive voltage to +FB, negative to -FB for forward motoring operation. Polarity is of no consequence for AC or DC feedbacks that are rectified.

TABLE 1 SYSTEM FEEDBACK DATA

	FEEDBACK VOLTAGE	CONNECTIONS			SCALE FACTOR	INPUT RES K TO COM	PEAK VOLTAGE	
		+FB	-FB	OTHER			TO COM	+ TO -
DIFFERENTIAL INPUTS	31 TO 62VDC 26 TO 48VAC*	13X- 14X	17-18		1/5.2	200	± 93	78
	57 TO 115VDC 48 TO 86VAC*	13X- 14X	17-18	14-C 18X-19X	1/9.5	200	± 157	142
	100 TO 200VDC 82 TO 152VAC*	13X	17	14X-C 18-C	1/16.7	400	± 298	250
	180 TO 390VDC 151 TO 275VAC*	13X	17	14-14X- C-18 18X-19X	1/30.5	400	± 505	457
SINGLE ENDED INPUTS	2.3 TO 4.6 VDC	14		17X-C 18X-C	2.6	87	6	
	4 TO 5VDC	14		17X-C 18X-19X	1.4	87	11	
	7 TO 15VDC	14		18X-C	.83	87	18	
	11 TO 22VDC	14		18X-C 17X-19X	.60	87	25	
	-(1.5 TO 3) VDC		17X		3.9	10	-4	
	-(2.8 TO 5.6) VDC		17X	18X-19X	2.1	10	-7	
	-(7 TO 15) VDC		18X		.83	47	-18	
	C = COMMON, VAC = RMS VOLTS, * CONNECT 11 TO 19							

Potentiometer, SMAX is adjusted in combination with connections of Table 1 to provide the design value of maximum speed. Preconditioning (see Static Relay) disconnects the feedback to the regulator.

Load regulation compensation is provided when (5X) is connected to the regulator junction RJ(12). Adjusting potentiometer COMP in a clockwise direction from center will increase the compensation, and courterclockwise from center will decrease the compensation. COMP is normally used to minimize the load regulation in voltage regulated drives or to compensate for a rising motor characteristic. It may also be used to provide compensation for a Motor Field Control, if used.

Regulating Function

The first stage amplifier sums the signals to TR(30), SFB(19X), tab (11), RJ(12), and (24X) and provides an output proportional to the regulator speed error, RERR (11X). RERR will be positive for forward acceleration. The RERR signal then passes thru a gain setting resistive divider network at tabs (7), (8) and (9).

Tab (9) is the input to a 160 radian per second noise filter and an integrator. The integrator rate is limited by the saturated voltage at (9) (normally 2.5 to 3.5 volts) and thus, rate of rise of motor voltage, and consequently motor current, is limited. The output of the integrator, DR(3), is positive for forward motoring. The integrator is non-inverting while the first stage amp is inverting. The transfer function is

$$\frac{V_{out}\ (3)}{V_{in}\ (30)} = \frac{-G(1 + RCJW)}{RCJW\ (1+.006JW)}$$ with no system feedback

RC may be adjusted with the response potentiometer RESP from .4 to .2 with tab (6) open, and .2 to .01 with tab (6) connected to common. Under normal conditions, RC is set equal to the mechanical time constant of the system. G is the voltage gain from tab (30) to (9) as established by jumpers between (8), (9), (10), (10X), (11X) and common and varies from about 0.9 to 3.4 as maximum base speed varies from 1 to 3.8.

With the switch connected to (3) closed, as for preconditioning and "Test" operation

$$V_{out}\ (3)/V_{in}\ (30) \simeq 1$$

When used with non-regenerative drives, the output, DR, of the integrator is usually prevented from going very negative by connecting (5) to (12).

The inputs to the DAMP potentiometer are the scaled current feedback signal at I+(7X) and the inverted current feedback at I-(3X). The output DJ(6X) is normally connected to the driver summing junction. With these connections, a minor current loop is developed around the driver voltage loop. The net effect of this loop is to increase or decrease the IR drop of the motor. As the IR drop or DAMP is increased, the damping factor of the motor and its connected load is increased similar to what a current rate feedback might accomplish. The per unit IR drop may be changed up to ±16% but normally a maximum of ±6% is required. A good initial setting is to set DAMP at 10 o'clock, which is approximately +3% compensation.

Current Limit Function

Signal CFB, proportional to armature current, is provided for an adjustable current limit section and can be utilized by connecting tab (9X) to common. Current limit may be varied from 5 to 200% with potentiometer ILIM. The current limit level may be dynamically programmed by connecting an appropriate network to tab (9X). When connected, the current limit section will limit the current level irrespective of any system commands, including preconditioning.

CFB is 2 to 3 volts at rated current on standard rated drives.

Static Relay Function (See Figure 1)

Switching functions of the standard regulator are accomplished with static switches. Figure 1 symbolizes the logic where conventional relays perform the logic stated in the left column when 60 volts is applied to the "coils".

System reference and auxiliary reference voltage are controlled by relays T501 and T500.

Coordinated shutdown and preconditioning logic is provided. Preconditioning is applied internal to the regulator and is not removed until ORR(24) (regulator run) is externally connected to -30 volts. When preconditioning is applied, the auxiliary reference static relay disables the auxiliary preset reference signal (29X), the linear time output TR is clamped to zero with a static relay, the system feedback signal is disabled and a unity gain loop is connected around the regulating section. An output ICST(21) will phase back, then inhibit, the output pulses to the SCR's whenever the regulator is preconditioned. The drive will be preconditioned irrespective of the status of ORR whenever 1PD(28), a signal usually received from a Driver function, is at +20 volts. This signal will be held high by a Driver only during the first 1/2 second after the 115V AC has been energized, but when preconditioning is applied, (ORR open) 1PD(28) is held high to precondition a Driver.

Diagnostic Function (See Figure 1)

Five inputs furnished for diagnostics are normally connected to the Diagnostic Card 193X524A_, when provided in the system. Isolation between logic signals is provided by diodes on the diagnostic card.

A local test reference may be applied at LR(21X). DC gain from LR to TR is minus one.

An input SRD(22) (system reference diagnostic) permits control of the system reference static relay. When +20 volts is applied to SRD(22) the system reference SR(25X) is unconditionally disconnected from the input to the linear time section.

An input APRD(27) (auxiliary preset reference diagnostic) permits control of the auxiliary preset reference static relay. When +20 volts is applied to APRD(27), the APR signal (29X) is unconditionally disabled.

The linear time preconditioning relay will be unconditionally open to remove preconditioning when -20 volts is applied to LTD(29) (linear time diagnostic).

The preconditioning relay which disables the signal from SFB (19X) and closes a unity gain feedback loop around the regulating section will be unconditionally closed (preconditioning applied) when +20 volts is applied to REGD(23) (regulating section diagnostic).

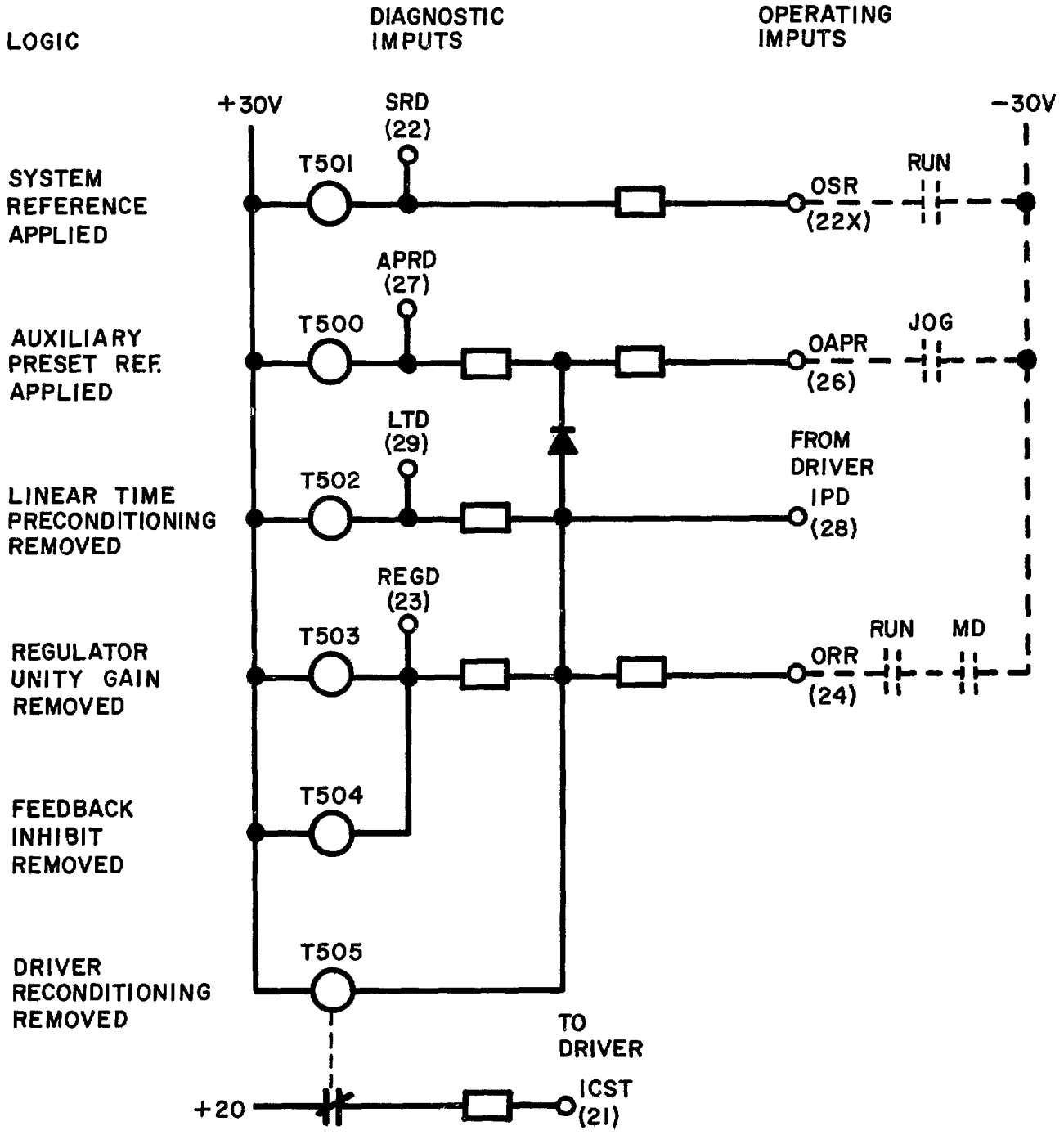


FIGURE 1 - REGULATOR SWITCHING

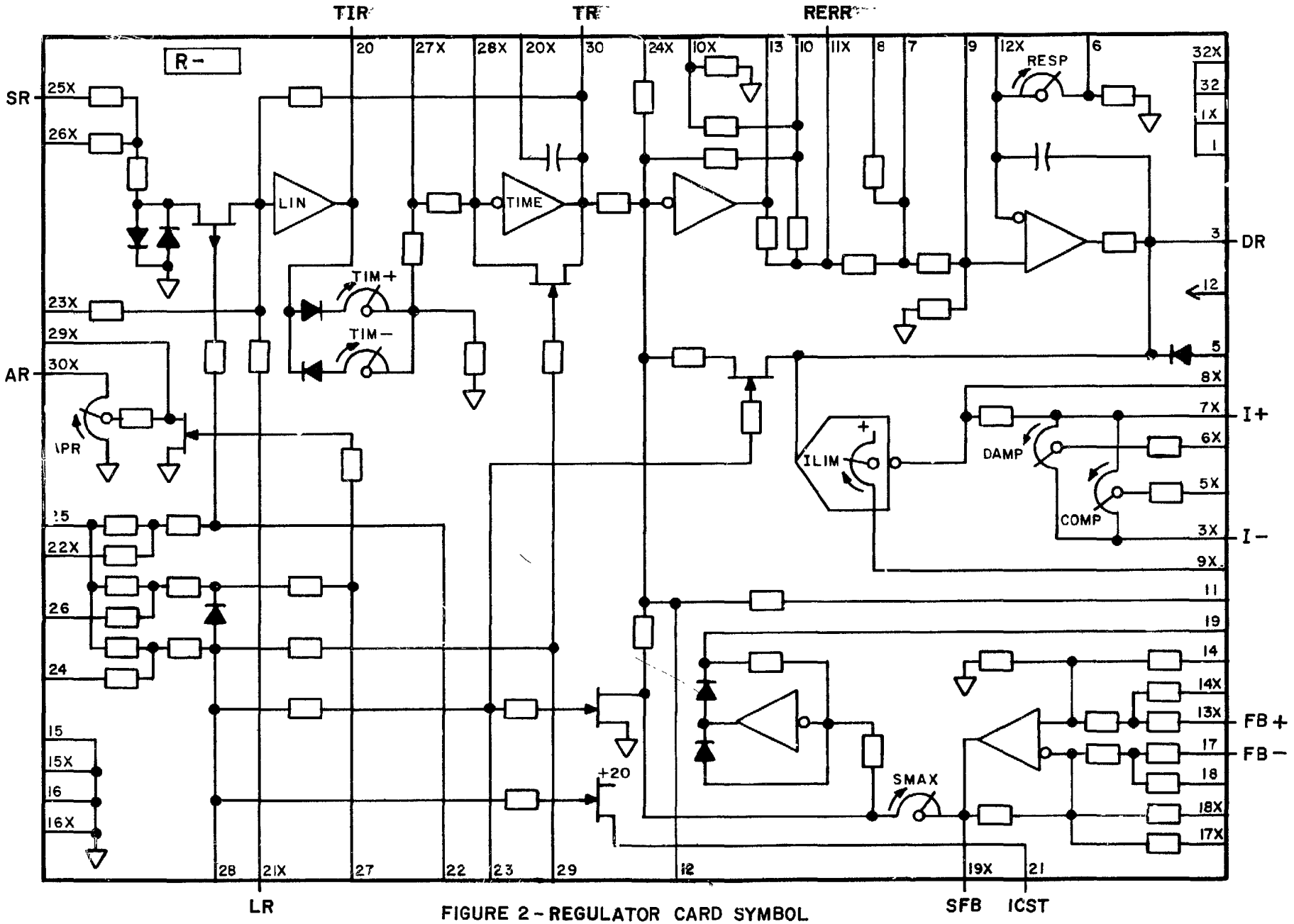
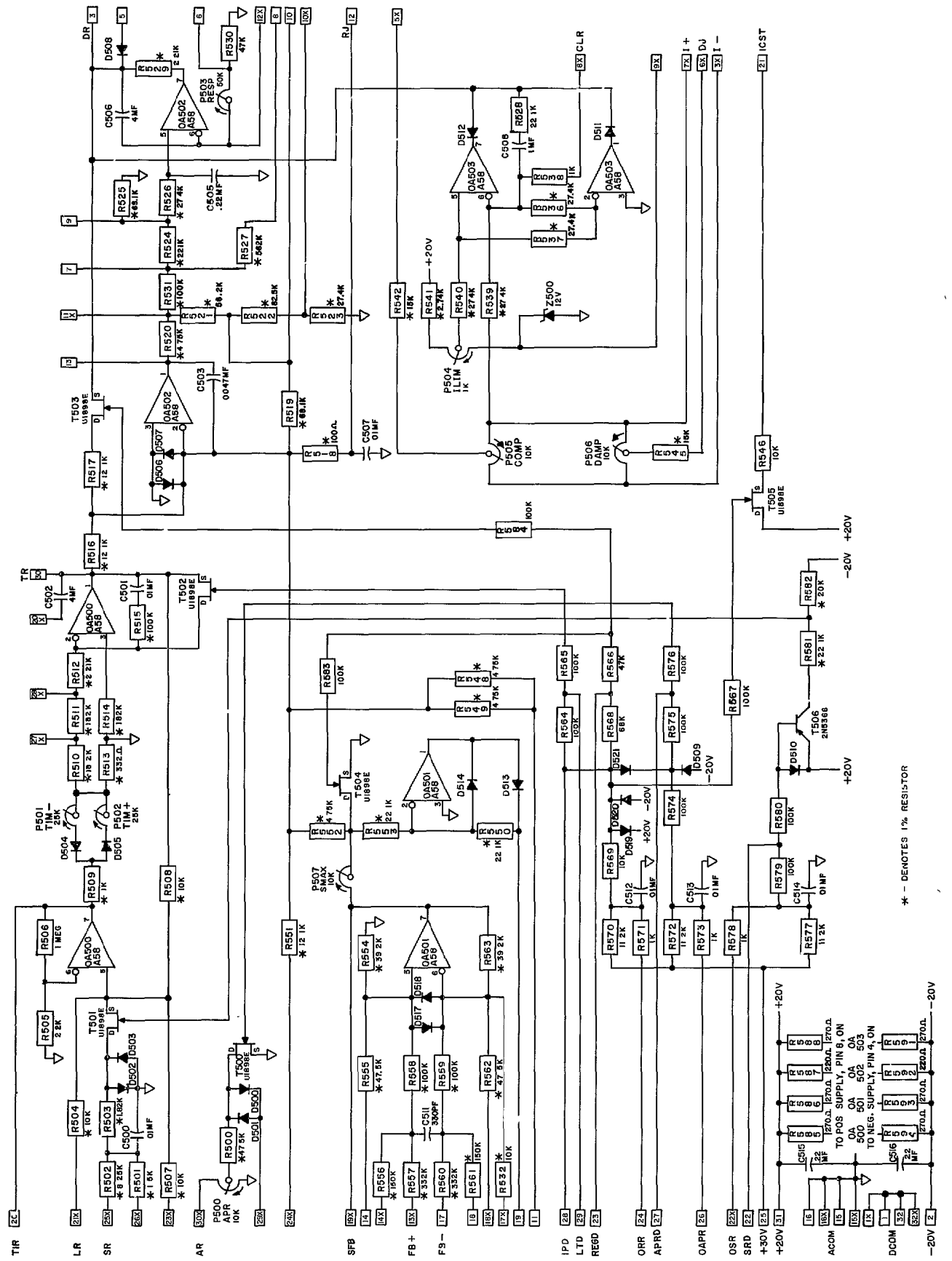
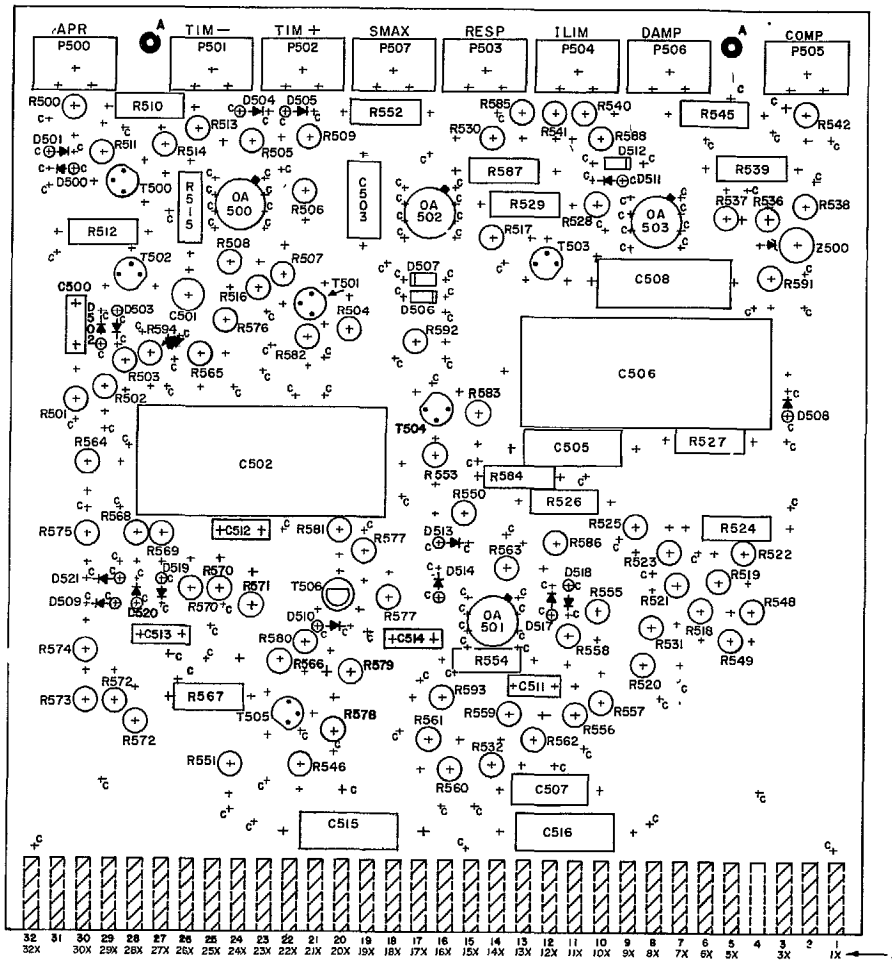


FIGURE 2 - REGULATOR CARD SYMBOL


* - DENOTES 1% RESISTOR



GROUP	KEY LOCATIONS			
01	4–5	12–13	30–31	

HOLE TABULATION

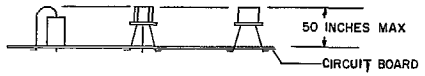
ALL HOLES 040 DIA EXCEPT THE HOLES TABULATED BELOW

LOC	DIA	QUAN
A	157	2
C	.032	152

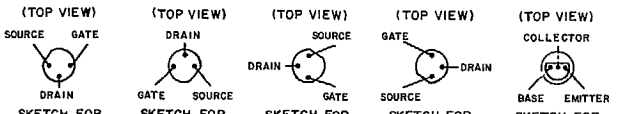
NOTES

1. INDICATED TAB NUMBERS CORRESPOND TO MATCHING RECEPTACLE NUMBERS
2. CROSS HATCHED TABS INDICATES TABS USED
3. CARD SIZE, $5.500^{+.000}_{-.010}$ X $5.130^{+.002}_{-.006}$
4. THIS CARD HAS GOLD PLATED TABS ON BOTH SIDES TABS 1 THRU 32 ARE LOCATED ON THE REVERSE SIDE TABS IX THRU 32X ARE LOCATED ON THE COMPONENT SIDE OF THE CARD TAB IX IS OPPOSITE TAB 1 AND ETC THE TAB NUMBERS SHOWN ARE THOSE USED ON THIS CARD
5. ALL TRANSISTORS, RESISTORS AND OP AMPS SHALL BE MOUNTED TO A .50 INCH MAXIMUM ABOVE THE CARD SURFACE AS SHOWN BELOW

RESISTOR (SIDE VIEW) TRANSISTOR (SIDE VIEW) OP AMP (SIDE VIEW)



TRANSISTOR LEAD SKETCHES



OP AMP LEAD SKETCH

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