H-616

JOSS CONSOLE INSTRUCTION MANUAL

PDP-6

DIGITAL EQUIPMENT CORPORATION • MAYNARD, MASSACHUSETTS

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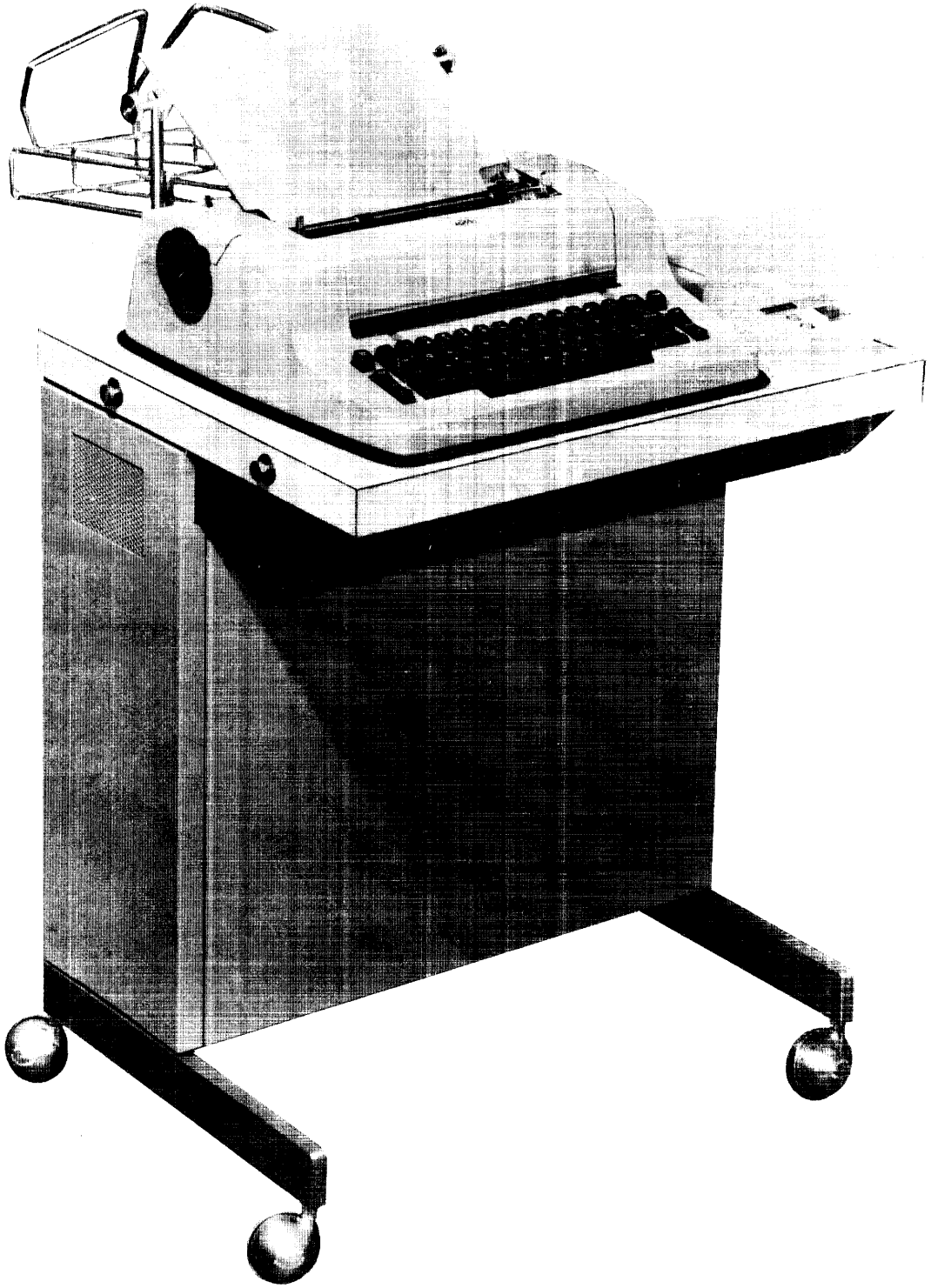


JOSS Console

CHAPTER 1
INTRODUCTION

1.1 FUNCTIONAL DESCRIPTION

The JOSS Console is a remote computer input/output communication station. The central element of the JOSS Console is an IBM Model 731 Selectric I/O writer, which can also be used in off-line mode as an office typewriter when desired. The typewriter is modified electrically, and mechanically, for PAGE GO and READY/HOLD signals, to provide a forms-feed mechanism to accommodate 8-1/2 by 11-inch pinfeed, fanfold paper. A control box permits operator control of the JOSS Console and reflects the status of the console and typewriter. The controls are a console POWER ON/OFF switch and an INTERRUPT switch to send a special signal.

When the power is turned on at the control box, an ON signal is sent to notify the computer of the power application. A CONSOLE POWER lamp on the control box illuminates to indicate that power has been successfully applied to the JOSS Console. The computer acknowledges receipt of the power-on signal by sending a system-turn-on signal to the JOSS Console. This signal illuminates the JOSS SYSTEM lamp on the control box and applies power to the typewriter. A short delay permits the typewriter motor to reach operating speed, after which the TYPEWRITER lamp on the control box lights and a READY signal informs the computer of the typewriter ready condition.

The JOSS Console has two control modes: red mode and green mode. Following power application, the JOSS Console is in the red mode. A red or a green lamp on the control box illuminates to indicated the mode of operation. During red mode, the computer controls the typewriter, and the typewriter keyboard is locked to the JOSS Console operator to prevent console-to-computer communication. During green mode, the user controls the typewriter and the system ignores all incoming characters and functions. JOSS Console electronics encode any characters typed on the typewriter or any operational functions executed on the typewriter (e.g. space, shift) and sents them to the computer.

Control of the operating mode is normally proprietary; i.e., the user relinquishes control by giving a CARR RTN or PAGE GO. The computer relinquishes control by sending a SYS RED. (The computer may preempt control by a switch to red, if necessary).

When power is turned off at the control box, a short delay occurs during which a signal (turn-off) informs the computer that power has been removed. After the delay, power is removed (turned off) from the JOSS Console.

An ON/OFF switch on the typewriter permits the operator to use the typewriter in off-line mode only when all console power has been removed. When the typewriter ON switch is depressed with console power removed, the typewriter is turned on. The typewriter then functions as an ordinary typewriter without the PAGE GO facilities.

1.2 PHYSICAL DESCRIPTION

The JOSS Console is a single console which contains the typewriter and the electronics necessary for input and output communications. The console is 29 inches high, 23 inches wide, and 19 inches deep. A removable shelf, on either the left or right side, provides adequate working area for the operator. A normal 120-vac 60-cycle outlet supplies power for the JOSS Console. External power is supplied to a rear panel circuit breaker which supplies power to the system.

1.3 APPLICABLE DOCUMENTS

Digital FLIP CHIP Modules Handbook, C-105
IBM Selectric Input/Output Writer.

CHAPTER 2
THEORY OF OPERATION

2.1 INTRODUCTION

All communication to and from the JOSS Console is via an 8-bit, 11-unit modified Teletype code. Four types of information are conveyed by this code:

a. Characters - Therefore are 44 character keys on the typewriter, each with an upper and lower case interpretation, totalling 88 printing characters.

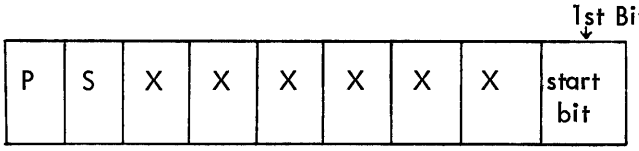
b. Functions - There are seven typewriter functions: shift up, shift down, space, backspace, tabulator, carriage return, and page (forms feed).

c. Signals - Signals to and from the JOSS Console control reflect the changing states of the JOSS Console. These states are described in this section.

d. Status Request/Report - The computer may at any time request a report of the status of the JOSS Console. To satisfy this, the console transmits a special status report code.

When in operation, the status of the JOSS Console is defined by the states of a number of flip-flops (see table 2-1). Lamps on the control panel indicate the power on, system on, ready, red/green, and interrupt-on states.

The 8-bit code format of the word used for data transmission is:



where P is the parity bit (odd) and S is the status request bit. The X bits comprise coded characters, signals, and machine functions as shown in table 2-2.

Power-on and power-off of the JOSS Console consist of a number of steps, performed in sequence. When power is turned on at the control box, the JOSS Console proceeds through a power-on sequence. Similarly, when power is turned off, the JOSS Console proceeds through a similar power-off sequence. These sequences and other operation features from initial application of power to power shut-down are illustrated in the operation flow diagram, figure 2-1.

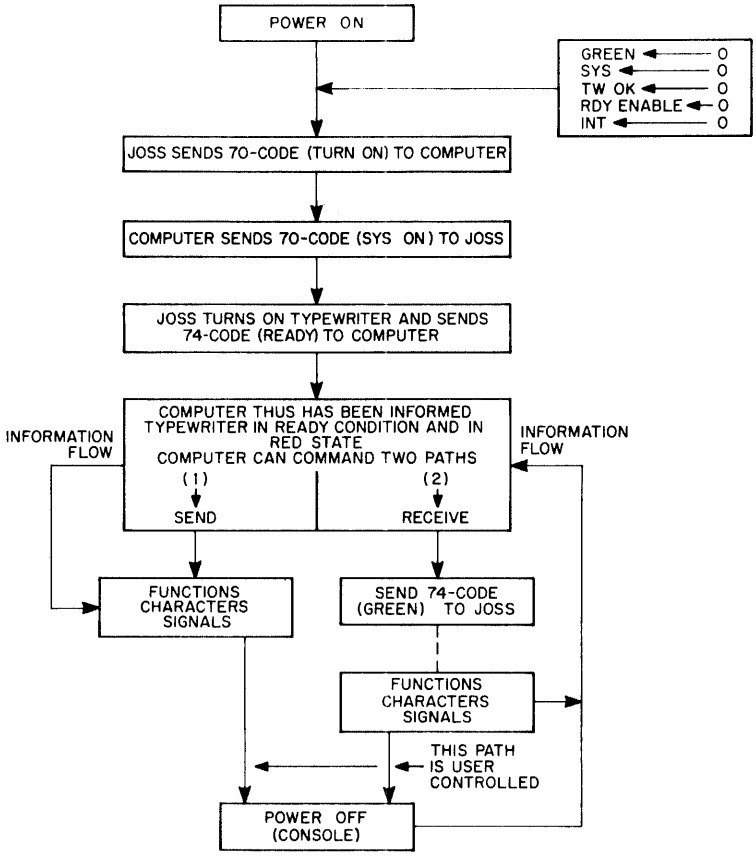


Figure 2-1 Operation Sequence

When power is applied to the JOSS Console, the power sequence applies power to the system, initiates a delay during which control flip-flops are cleared or normalized, and sends a TURN ON signal (70 code) to the computer to indicate that power has been applied to the system. The JOSS Console is not yet fully operational; it must wait for an enabling signal from the computer. The computer does this by sending a SYS ON signal (70 code) to turn on the JOSS Console. System turn-on applies power to the typewriter; however, a typewriter delay permits the typewriter motor to reach operational speed, after which the console sends a READY signal (74 code) to the computer to indicate that the typewriter is ready for operation.

The system is now active. Initial power turn-on placed the JOSS Console in the red state; thus, the computer can communicate with the JOSS Console by sending characters or typewriter machine functions. Each 8-bit word is transferred serially into the JOSS Console. The six bits of a character or

machine function are decoded to perform the specified typewriter operation. During the red state, the typewriter keyboard is locked to prevent the operator from typing which would send meaningless information to the computer.

TABLE 2-1 JOSS CONSOLE STATUS

True State	False State	Comments
Power on	Power off	Determines that electronic power has been applied and the console is ready to use in the on-line mode.
System on	System off	Controlled by the computer. A console is not fully operational until the SYSTEM light is turned on by the computer.
Green	Red	In the green state, the user has control of the typewriter; in the red state, the central processor has control. Transmission of a carriage-return or page-go function automatically sets the red state. It may be set to either state by the computer.
Ready enable	Not ready enable	Reflects the most recent setting of the typewriter ON-OFF switch.
Typewriter OK	Typewriter not OK	Typewriter is not OK if the motor is not up to speed, or if it is in the process of tab, page, or carriage-return functions. Completion of the process sets TYPEWRITER OK.
Ready	Not ready	The console is ready only if TYPEWRITER OK and READY ENABLE are active.
Interrupt on	Interrupt off	Controlled by the centeral processor.
Incoming parity error	No incoming parity error	Set by any incoming parity error; reset only when status report is sent.

TABLE 2-2 JOSS II CONSOLE CODES

	Tens \ Units	0	1	2	3	4	5	6	7
Characters (see note)	0	P p	E e	≠ =	≤ 5	: ;	D d	R r	< 7
	1	Q q	K k	I i	≥ 6	[,	C c	A a	> 8
	2	J j	T t	| •	Z z	G g	X x	M m	' 1
	3	* +	N n	] .	" 2	F f	U u	V v	# 3
	4	Y y	H h	S s	) 0	? /	L l	O o	$ 4
	5	_ -	B b	W w	(9				
Functions	6	SHIFT DOWN	BACK SPACE	TAB	SPACE	CARR. RETN.	PAGE	SHIFT UP	
Signals to Station	7	SYSTEM ON	SYSTEM OFF	INT. ON	INT. OFF	SWITCH to GREEN	SWITCH to RED	SOUND "BEEP"	NO OP
Signals from Station	7	TURN ON	TURN OFF	INT.		READY	HOLD	INT. + READY	INT. + HOLD

NOTE: Both upper case and lower case assignments are shown. Codes 54-57 are not generated by the typewriter; if received, they act as 20-23. The character codes are derived by ordering and interpreting the typewriter input/output lines as follows: $\overline{RT}$, R2, $\overline{R2A}$, R5, T1, T2. Note the negations of R1 and R2A.

During the red state, the operator can place the console in a not-ready condition in order to request the computer to stop sending characters, etc. This is done by depressing the typewriter OFF switch. When this is done, a HOLD signal is sent to the computer so that it is cognizant of the not-ready condition of the console. The computer will not communicate again with JOSS Console until it receives a READY signal. Depressing the typewriter ON switch initiates READY.

The computer can send a signal to the JOSS Console to switch it to the green state which permits JOSS Console-to-computer communications. In the green state, the typewriter keyboard is unlocked and the operator can use the typewriter on-line. For each typewriter character or machine function typed, the console control circuits assemble an 8-bit word and transfer it to the computer. When the operator executes a carriage-return or page-go machine function, the JOSS control automatically switches to the red state.

The computer at any time may request a status report, which the JOSS Console answers after changing state and after a character or signal request. In addition, a status report is initiated if an input parity error occurs, permitting immediate computer recognition of the parity error.

When power is turned off at the JOSS Console, a power-down sequence is performed. During the power-down sequence, a signal is sent to the computer so that it is aware of the power shut-down.

When, and only when the CONSOLE POWER lamp is off at the control panel, can the operator use the typewriter in off-line mode by pressing the typewriter ON switch. The rear-panel circuit breaker must be on and console power removed before off-line power can be applied to the typewriter. The typewriter can then be used as a standard office typewriter without the page-go facilities.

2.1.1 Stare Down

JOSS II was designed to minimize the probability of a "stare down problem"; i.e., a situation in which the console is in one state but the computer thinks it is in another state. For example, if the console is in the red state, but the computer thinks it is in the green state, each is waiting for the other to take some action.

To meet this criterion in the console there are several status toggles available for computer inspection:

a. On state

b. Red/green state

c. Ready/hold state

d. In-request state (This shows the state of a computer generated acknowledgment to an interrupt request by the user.)

The computer can send signals to the console and (optionally) request the state of the status toggles after completion of the action requested. The signals are:

a. NOP: no operation.

b. Set the on state on or off.

c. Set the red/green state to red or green.

d. Set the in-request state on or off.

2.2 DETAILED LOGIC DISCUSSION

The following paragraphs provide a detailed logic discussion of the JOSS Console. Frequent reference is made to the logic drawings in chapter 6. A particular circuit is referenced to a drawing by the last digits of identification followed by a colon and the coordinates of its location on the drawing. For example, the INC LINE signal which appears at coordinates C7 of drawing BS-D-616-0-17 is referenced as 17:C7.

2.2.1 Power-on Sequence

2.2.1.1 JOSS Sends 70 Code to Computer - When power is turned on at the control panel, the POWER CLEAR DLY intergrating one-shot multivibrator (18:B5) reverts to the 1 state. (A later section explains the ac power distribution.) The POWER CLR DLY signal enables the 10-kc clock (18:B5) to generate PWR CLR pulses which normalize control flip-flops in the control circuits. (Refer to timing diagram figure 2-2 and flow diagram figure 2-3.) After 500 msec the PWR CLR DLY one-shot reverts to the 0 state, and the transition sets the TURN ON flip-flop (18:B4). The TURN ON (1) signal enables the OUT SYNC pulse to set the SIGNAL RQST flip-flop (18:A7) and to initiate the 70-code transfer to the computer. The OUT SYNC pulse is the result of ANDing the OUT CLOCK pulse with the OUT DONE signal. The OUT DONE signal is 0v at this time because the initial POWER CLEAR pulses normalized its inputs (10:D1). The OUT CLOCK pulses are derived from a 6-stage counter (CLK0 through CLK5), which counts down the crystal clock frequency of 10.560 kc by a factor of 64. The CLK0 output generates the OUT CLOCK pulse; hence, the OUT CLOCK rate is 165 pulses per sec.

The SIGNAL RQST (1) enables the OSR SIGNALS pulse (18:B2) which is delayed from the OUT CLOCK pulse by 4 μsec. The OSR SIGNALS pulse sets the OUT ENB (output enable) flip-flop (10:A1) and strobes the input gates (10:B4 - 10:A7) to insert a 70 code into the OSR (output shift register).

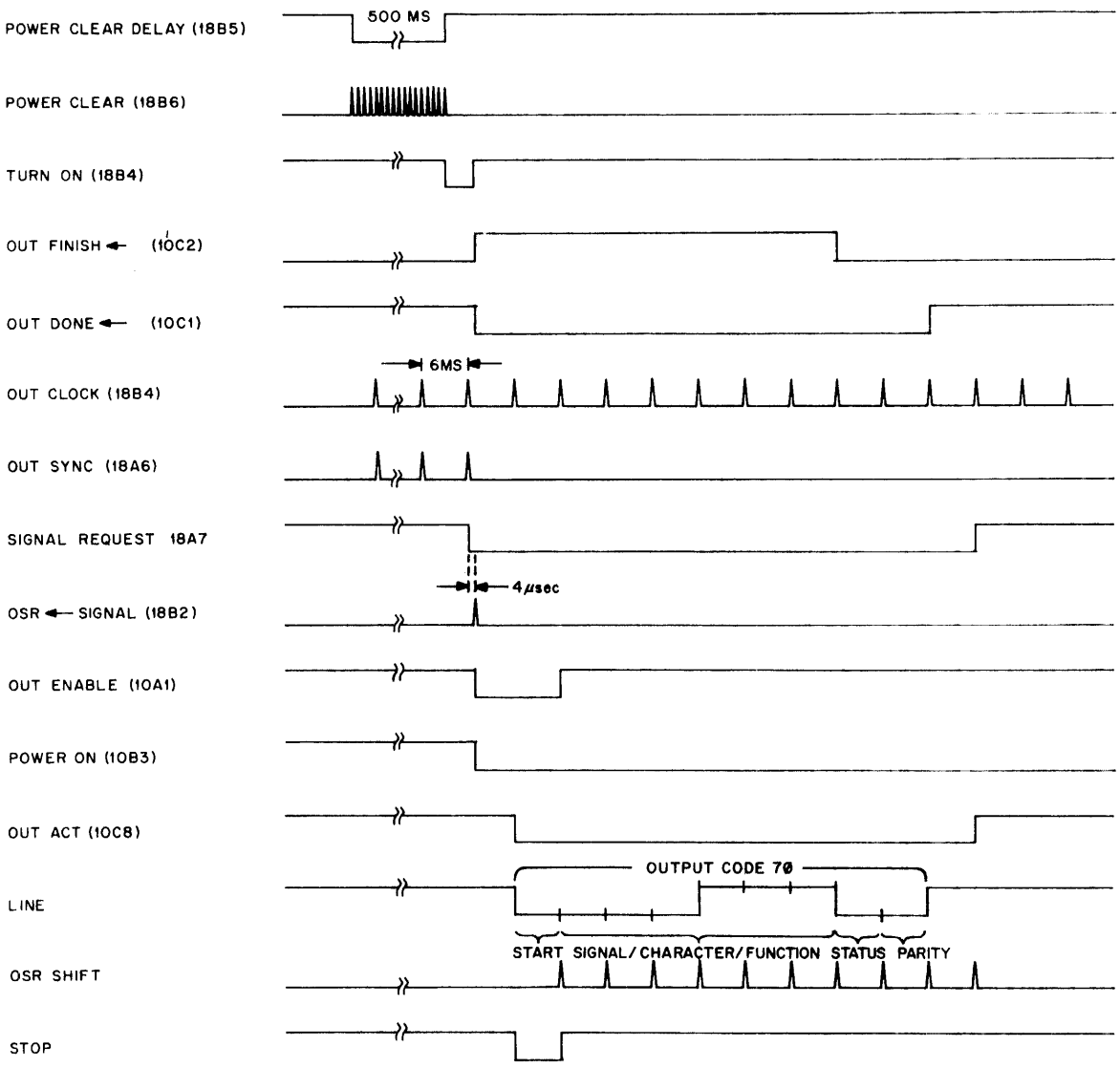


Figure 2-2 Output Timing Diagram

The OSR SIGNALS pulse also resets the TURN ON flip-flop (18:B4). The TURN ON (0) signal then sets the POWER ON flip-flop (18:B, C3) to enable the lamp driver (8:A, B4) which illuminates the POWER lamp. The POWER lamp signifies that power has been applied to the JOSS Console. The POWER ON (1) signal (18:C4) energizes the solenoid driver (TO POWER CONTACTOR) which energizes relay RY1 (refer to drawing PS-C-616-0-29). Relay RY1 holds power on until the power-off sequence is completed after the console ON/OFF switch is turned off.

The OUT ENB (1) signal enables the next OUT CLOCK pulse to set the OUT ACT (output active) flip-flop (10:C8). With the OUT ENB flip-flop set, the OUT FINISH (1) signal (10:C2) goes to 0v and the OUT DONE (0) signal goes to −3v. The OUT ACT (1) signals enables OUT CLOCK pulses to generate OSR SHIFT pulses (10:B1), which shift the contents of the OSR register. The first shift pulse resets the OUT ENB flip-flop and sets the STOP flip-flop (10:A2)l thereafter, the STOP flip-flop shifts 0s into the OSR. The initial 1 in the STOP flip-flop assures that OUT FINISH (1) remains at 0v until the 6-bit character has been shifted through the OSR.

At this point, the 70 code which has been inserted in the OSR is shifted through the LINE flip-flop and transferred to the receiving device. After the seventh shift pulse, OSR0 through OSR7 contain 0s; hence, the OUT FINISH (1) (10:C2) signal goes to −3v. The OUT FINISH (1) signal now enables the OUT PAR flip-flop to shift the parity through the LINE flip-flop (10:A, B8) and to the receiving device. The OUT PAR flip-flop is complemented for each 1 bit shifted through the OSR7 flip-flop to generate odd parity; the bits are odd for the 70 code; therefore, a 0 parity bit is generated.

After two more shift pulses, OSR5 and OSR6 contain 0s and the OUT DONE signal goes to 0v. The OUT DONE signal now enables the next OUT CLOCK pulse to reset OUT ACT (10:B8).

Since OUT ACT is reset, the OSR SHIFT pulses (10:B1) are terminated. The OUT DONE signal enables the OUT CLOCK to generate an OUT SYNC pulse, which resets the SIGNAL RQST flip-flop.

The operation described above sends the 70 code to the computer to signify that initial power has been applied to the JOSS Console. The computer, to turn on the console, now acknowledges this receipt by sending a 70 code to the console.

2.2.1.2 Computer Sends 70 Code to JOSS Console - The first bit (START) of the 70 code on the INC LINE (17:A3) is ANDed with INC CLOCK to set the INC ACT flip-flop. The INC CLOCK (18:B5) is derived from the CLK counter. The INC CLOCK is taken from the CLK3 bit; hence, its output frequency is 10560/8 or 1320 pulses per sec (refer to figures 2-4 and 2-5). The INC ACT signal generates an ISR ←(0) pulse which clears the ISR (input shift register) to prepare for the incoming signal. The INC ACT signal also enables the INC CLOCK to complement the INC CNT2 flip-flop which is the least significant digit of the 3-stage counter consisting of INC CNT2, through INC CNT0. The 3-stage counter produces an INC SHIFT pulse (17:B4) for every eight INC CLOCK pulses starting with the fourth INC CLOCK pulse following the first incoming bit.

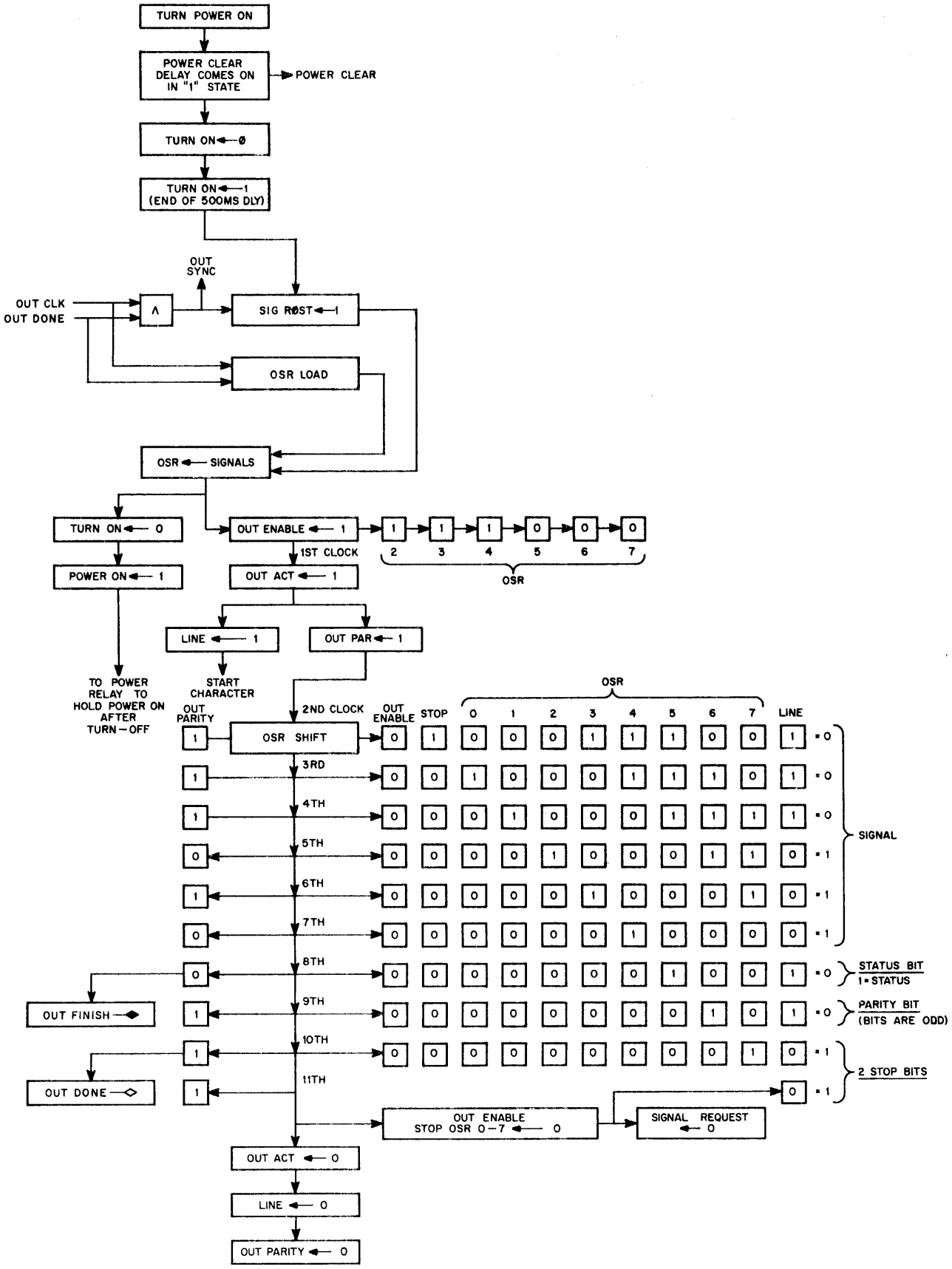


Figure 2-3 Flow Diagram, JOSS 70 Code to PDP-6

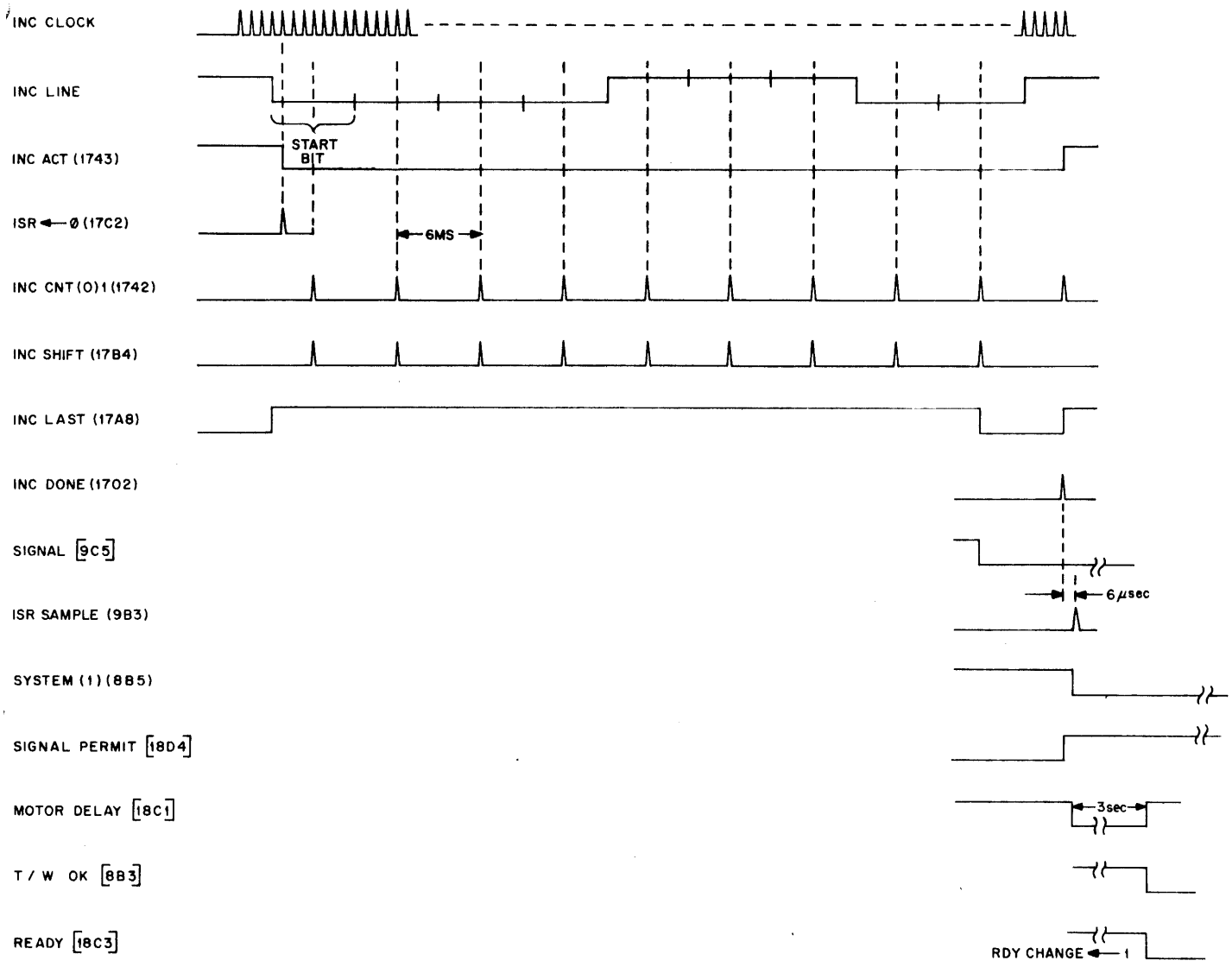


Figure 2-4 Input Timing Diagram

The INC SHIFT pulses start shifting the INC LINE bits into the ISR register. After nine shifts of the ISR register, the original start bit that initiated the incoming operation is in the INC LAST flip-flop (17:A8) and the complete word is assembled in the ISR register. The INC SHIFT pulses (17:B4) are terminated since INC LAST is set. The INC LAST signal enables the INC CNT0 (1) signal to generate an

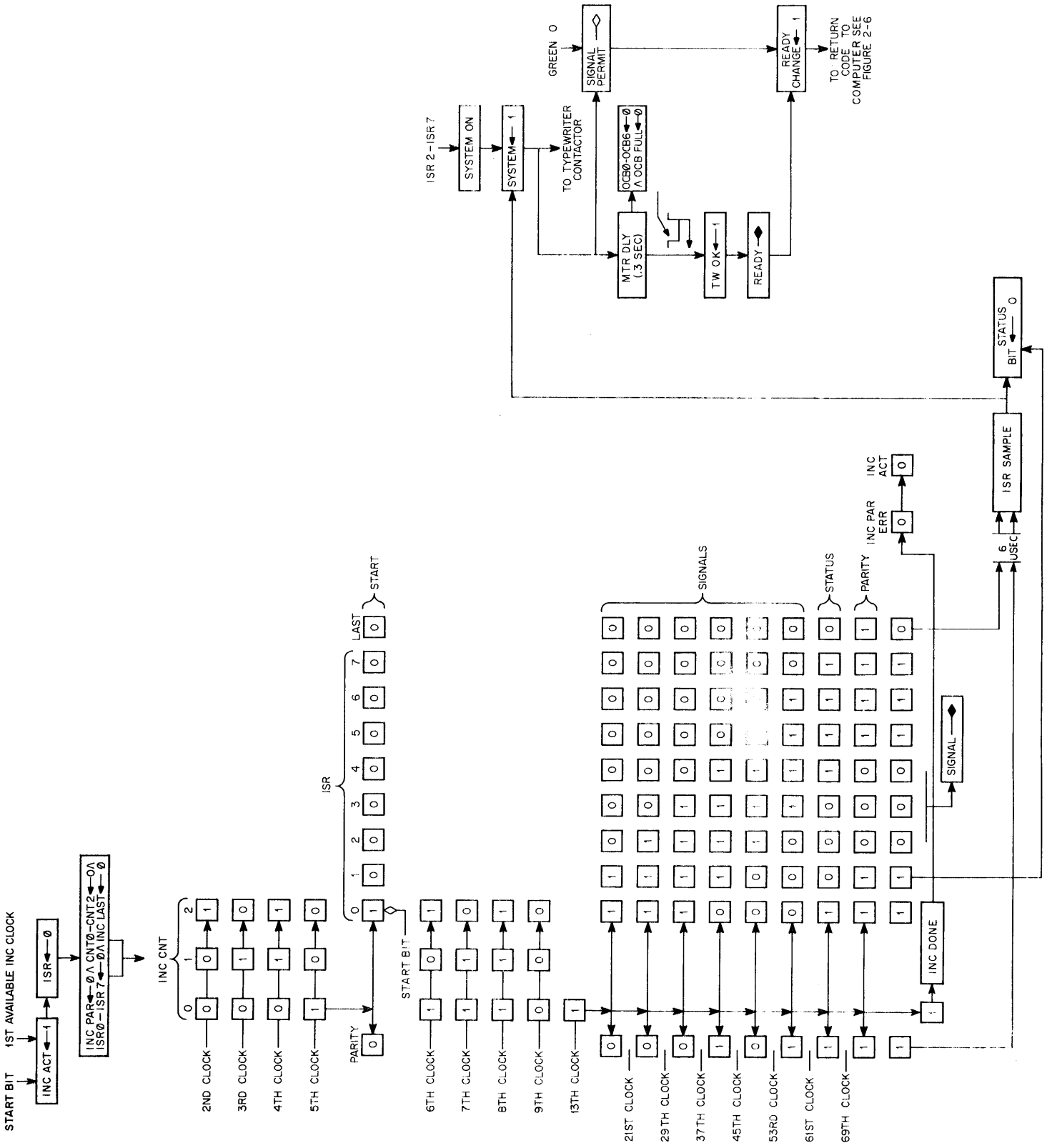


Figure 2-5 Flow, PDP-6 70 Code to JOSS

INC DONE pulse (17:D2), which resets the INC ACT to terminate the input operation by inhibiting the INC CNT counter. The input code is in the ISR register, and the next operation depends upon the ISR content; consequently, the ISR must be decoded.

The INC DONE pulse (9:C1) triggers both the 4-μsec and 6-μsec delays, or just the 6-μsec delay, depending on the contents of the ISR REGISTER. If the ISR contains a character or function (and ~ SIGNAL conditions are present), 4-μsec and 6-μsec delays are selected. At the end of the 4-μsec delay, ICB LOAD is generated and loads the ISR contents into the ICB BUFFER which previously was reset by the ICB ← (0) pulse. At the end of the 6-μsec delay, ISR SAMPLE is generated whose only purpose is to generate the ICB SAMPLE pulse 2-μsec after ICB LOAD (this 2-μsec difference assures that the logic is set up in case a function were present in the ICB). ICB SAMPLE puts the logic in not-ready condition when a long function is decoded. If the ISR contains a signal, the 4-μsec delay is disabled and the 6-μsec delay is selected. Note that ICB ← (0), ICB LOAD, and ICB SAMPLE pulses are also inhibited, preventing the contents of the ICB buffer from being changed while the logic is decoding a signal. This isolates the character and function decoding buffer from signals which enable another signal to be sent directly after a long function command without having the program wait for a READY condition. At the end of the 6-μsec delay, ISR SAMPLE is generated and decodes the signal in the ISR register. Since it is assumed that the input code is a 70, the signal (9:D6) will be a 1, denoting that a signal is being sent to the JOSS Console. The 70 code in the ISR is decoded by an R151 (9:C7) to activate the SYS ON signal. The SYS ON signal enables the ISR SAMPLE pulses to set SYS flip-flop (8:B5). The SYS flip-flop controls illumination of the SYSTEM lamp, which when lit signifies that the computer has acknowledged the initial power-on sequence and is in the process of applying ac power to the typewriter motor.

The SYS (1) signal enables the solenoid driver (8:B1) which applies power to the typewriter. The SD output energizes relay RY2 (drawing PS-C-616-0-29) to apply ac power to the typewriter motor. In addition, the SYS (1) signal triggers a 0.3-sec MOTOR-DELAY one-shot multivibrator (18:C1), which permits the typewriter motor to reach operating speed before the READY signal is sent to the computer. After the 0.3-sec interval, the MOTOR DELAY one-shot reverts to its normalized state, and the MOTOR DELAY (0) sets T/W OK (typewriter OK signal--8:B3). Since the READY came on, the JOSS Console sends the 74 code to indicate it is active.

2.2.1.3 JOSS Sends 74 Code (Typewriter OK) to Computer - The T/W OK signal is ANDed with RDY ENABLE (1) to generate the READY signal. The RDY ENABLE flip-flop (8:C5) was initially set by the PWR CLR and the absence of hold, paper out, or ready conditions. (The significance of these conditions is described later in this section.) Hence, the RDY ENABLE (1) enables the T/W OK signal to generate the READY signal.

The READY signal drives the lamp driver circuit (8:A3) that illuminates the TYPEWRITER lamp on the control panel. The READY signal transition enabled by SIGNAL PERMIT sets the RDY CHANGE (ready change) flip-flop (18:B7--refer to figure 2-6). The RDY CHANGE signal enables the next OUT SYNC pulse to set the RDY SYNC flip-flop (18:B6) and the SIGNAL RQST flip-flop (18:A7). The SIGNAL RQST signal gates on OSR LOAD (which is the OUT CLOCK AND OUT DONE delayed by 4-μsec) to generate the OSR ← SIGNALS pulse (18:B2).

The OSR ← SIGNALS pulse sets the OUT ENB flip-flop (10:A1) and inserts the 74 code into the OSR. The next OUT CLOCK pulse is enabled by OUT ENB to set the OUT ACT flip-flop (10:C8). The OSR shift pulses shift the OSR register. This operation is the same as previously described when the JOSS Console initially sent the 70 code (power-on) to the computer.

Under the described conditions, the computer is cognizant of the ready and red conditions of the JOSS Console. The computer may initiate one of two operations. It can communicate with the JOSS Console by sending character or machine functions to the typewriter, or it can send a 74 code (or 72, 74, 76, 77-status) to the JOSS Console to switch it to the green state so that the typewriter can transmit data to the computer.

2.3 COMPUTER TO JOSS CONSOLE COMMUNICATIONS (RED OPERATIONS)

During initial operations of the JOSS Console, the PWR CLR pulse resets the green flip-flop (8:B2) to put the console into the red state. In the red state, the typewriter keyboard is locked to prevent the operator from interfering with typewriter communications. The READY (0) and GREEN (0) signals are ANDed (9:B1) to drive the solenoid driver that locks the keyboard.

2.3.1 Characters

For purposes of explanation, assume that the computer is to send a character to the JOSS Console, and that the character is a small z, represented by a 23 code. The start bit of the 23-code on the INC LINE (17:C7) enables the INC CLOCK to set the INC ACT flip-flop (17:A3). The operation that shifts the 23 code into the ISR is similar to that explained previously for transferring the 70 code to the JOSS Console, with the exception that both the 4-μsec and 6-μsec delays are used. After the word is read into the ISR, the INC LAST (1) signal enables the INC CNT0 (1) pulse to generate the INC DONE pulse (17:D1,2). The INC DONE pulse generates the ICB ← (0) pulse (9:B6) to clear the ICB register (9:D2-4). The INC DONE pulse also triggers a 4-μsec delay (9:C1) which generates the ICB LOAD pulse. The ICB LOAD pulse transfers the contents of the ISR into the ICB register. The ICB SAMPLE pulse is generated but has no effect since the input code was neither a long function nor a page-go.

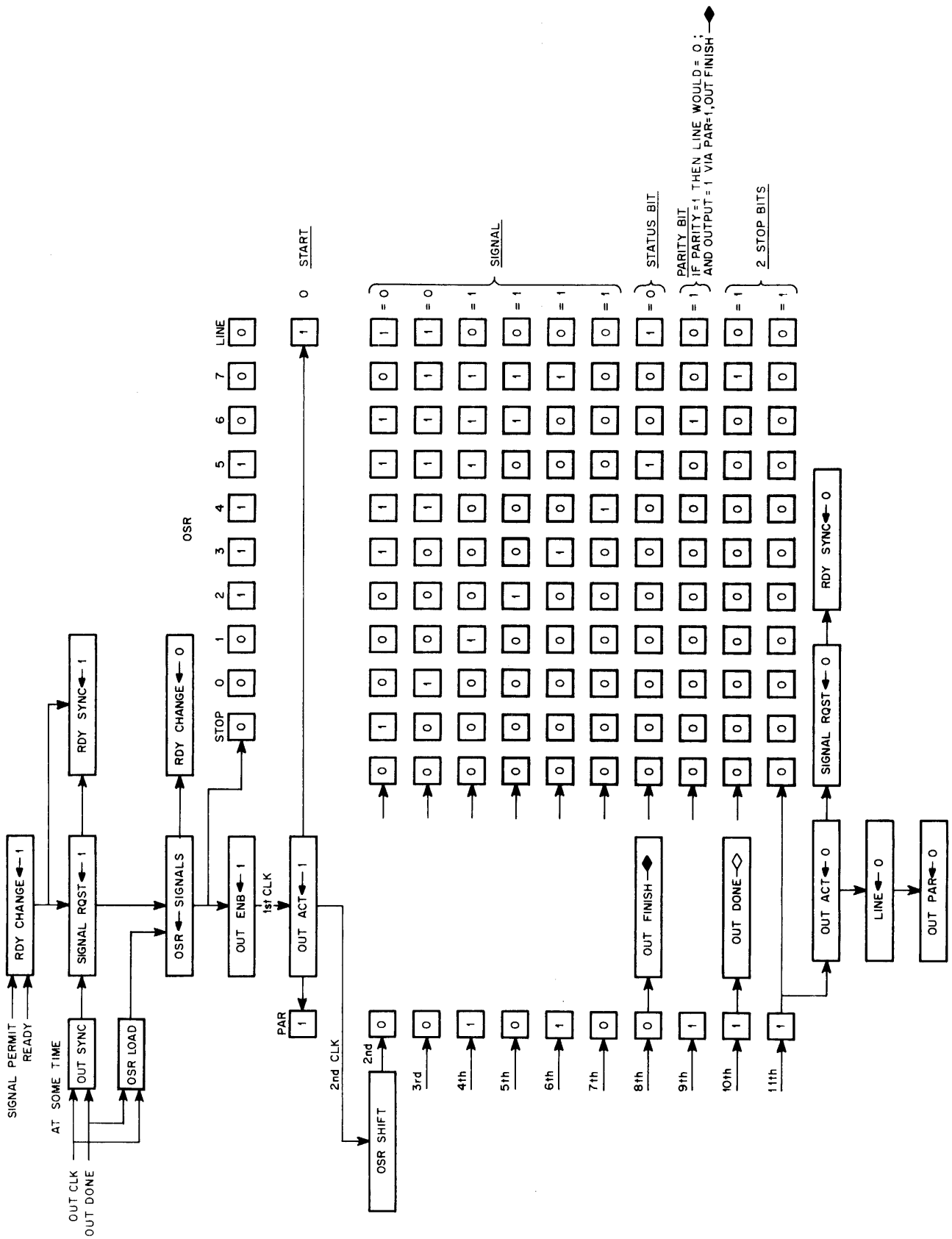


Figure 2-6 Flow, JOSS 74 Code to PDP-6

The ENERGIZE signal is ANDed with the function (ICB1(0)+ICB2(0)) and ~FEEDBACK at 9:B7 to enable one input to each of the solenoid drivers for R2A, R2, R1, R5, T1, T2, and CK. The R2A, R2, etc. designations are solenoids in the typewriter which, when energized by the proper code initiate the typing of the designated character. The JOSS codes for characters typed on the typewriter are codes 00_8 through 54_8; hence, the ICB1(0)+ICB2(0) inputs assure that the character solenoids are enabled only for characters. The additional gating with ~ FEEDBACK assures that the typewriter has completed the last function or character in the required amount of time. When the typewriter types the specified character, cam contacts C1 and C2 open after a delay. When C2 opens, it enables the Schmitt trigger (9:C1,2) to generate the FEEDBACK signal. The FEEDBACK signal resets the ENERGIZE flip-flop (9:D1) which removes the DRIVE signal from the solenoid drivers. The JOSS Console, which had been receiving the next character or machine function in the ISR register, is now ready to gate this into the ICB.

2.3.2 Machine Functions

Typewriter operational functions include lower case (LC), upper case (UC), carriage return (CR), back space (BSP), space (SP), tabulator (TAB), and page go (PG). The CR, PG, and TAB are special cases (long functions - LONG FCN) and require acknowledgment from the JOSS Console to notify the computer that the functions are complete.

As an example of the non-long functions, the back space (code 61) will be explained. The INC LINE (17:C7) initiates the input operation by enabling the INC CLOCK to set the INC ACT flip-flop. The operation of shifting the input into the ISR and then transferring the ISR contents into the ICB is the same as previously described for input operations. After the ICB is loaded, the R151 module (9:C8) decodes its contents to produce the BSP signal. The BSP and DRIVE signal are ANDed (9:A3) to enable the BSP solenoid driver, which energizes the BSP solenoid in the typewriter. The C5 cam contact in the typewriter opens after a delay permitting the C2 through C6 functions (9:C1) to generate the FEEDBACK signal. The FEEDBACK signal resets the ENERGIZE flip-flop to remove the drive source for the BSP solenoid driver. The JOSS Console which has been receiving the next character or function in the ISR register, is now ready to gate this into the ICB.

When a long machine function occurs, it is decoded by the R151 module to energize its respective solenoid driver as explained for the BSP machine function. However, the CR, PG, or TAB signal generates the LONG FCN signal (9:C4) which resets the T/W OK flip-flop (8:B3). The READY signal (18:C3) then becomes inhibited. The computer is cognizant of the not-ready condition and waits for a typewriter OK signal (74 code).

When the typewriter has finished the long machine function, the INTLK signal (11:B8) sets the T/W OK flip-flop (8:B3). The T/W OK and the RDY ENABLE (1) signal are ANDed to generate the READY signal (18:C3).

The READY signal is enabled by the SIGNAL PERMIT signal to set the RDY CHANGE flip-flop which in turn enables the OUT SYNC pulse to set the RDY SYNC flip-flop. The RDY CHANGE (1) signal also enables the OUT SYNC pulse to set the SIGNAL RQST flip-flop. This initiates the output transfer operation previously explained to transfer the 74 code to the computer.

2.3.3 Signals

The signals sent from the computer to the JOSS Console are SYS ON (system on), SYS OFF, IN ON (interrupt on), IN OFF, SG (system green), SR (system red), BEEP (energizes the audible alarm), and NOP (no operation). Operation of the computer sending signals to the JOSS Console was explained previously in section 2.2.1.2. The operation of the other signals is similar and therefore will not be explained. Note that the computer can send signals to the JOSS Console regardless of the status of the console.

2.3.4 Computer Request Status

The computer requests the status of the JOSS Console by inserting a 1 into the status bit position of the word sent to the JOSS Console. After the computer has loaded the ISR, if status bit ISR1 is 0v, the ISR1(0) signal enables the ISR SAMPLE pulse to set the STATUS BIT flip-flop (18:A1). The STATUS BIT (1) signal enables the OUT SYNC pulse to set the STATUS RQST flip-flop (18:A8). The STATUS RQST signal enables the 4-μsec-delayed OUT CLOCK pulse (OSR LOAD) to generate the STATUS SEND pulse (18:B3). The STATUS SEND pulse is delayed 1 μsec to generate the OSR STATUS pulse (10:B,C4). The OSR STATUS pulse sets the OUT ENB flip-flop (10:A1) and loads the status code into the OSR. Note that a single code is not allocated for a single status; rather, the status of each individual bit of OSR3 through OSR7 specifies the status of INC PAR ERR, GREEN/RED, READY, INT ON/OFF, and SYS ON/OFF, respectively. Note also that STATUS SEND (10:C3) sets OSR1 through OSR7 so that the OSR STATUS pulse can insert the proper code into the OSR register. Once OSR is loaded and the OUT ENB flip-flop is set, the operation that follows is similar to previously explained output operations.

2.3.5 Parity Error

When a parity error occurs during an input transfer operation, the INC PARITY flip-flop (17:A1) is in the 0 state when INC DONE occurs. INC PARITY (0) signal enables the INC DONE to set the INC PARITY ERROR flip-flop (17:A1). The INC PARITY (1) signal inhibits the ICB LOAD and ISR SAMPLE pulse (9:B, C1); consequently, the ISR register is disabled and input operation stops at this point. The INC PARITY signal also enables the OUT SYNC pulse to set the STATUS RQST flip-flop (18:A8) which

initiates a status transfer to the computer. Since parity is part of the status message, the computer knows that a parity error occurred on the last transfer. The computer can then take the necessary corrective action. The OSR STATUS pulse resets the INC PARITY ERROR flip-flop.

2.3.6 Interrupts

While the system is in red operation, the operator at the JOSS Console can initiate an interrupt by activating the INTERRUPT switch on the control panel. When depressed, the INTERRUPT button generates the INT SW signal (18:D8) which sets the INT KEY flip-flop (18:B8). The INT KEY signal enables the OUT SYNC pulse to set the INT SYNC and the SIGNAL RQST flip-flops. Setting the SIGNAL RQST initiates a signal transfer to the computer. The interrupt code (72) is inserted into the OSR, and the OSR contents are then transferred serially as explained previously. Note that the operator can initiate and transfer an interrupt code to the flip-flop regardless of the condition of the INT ON/OFF flip-flop. This is not a logical interrupt as recognized by the computer. It is an interrupt which is recognized by the software.

2.4 JOSS CONSOLE TO COMPUTER COMMUNICATIONS (GREEN OPERATIONS)

When GREEN flip-flop is in the set state, the operator at the JOSS Console can type characters or execute machine functions. The characters or machine functions are encoded and transferred serially to the computer.

2.4.1 Characters

When the operator types a character on the typewriter, the particular character code is shown in the selective closing of contacts R2A, R2, R1, R5, T1, and T2 in the typewriter. These contacts close and through switch filters enable gates which insert the character codes into the OCB (output control buffer) register (11:A).

The C1 cam in the typewriter closes to signify that a character has been typed. This generates the C1 CAM signal (11:A1). The C1 CAM signal is enabled by OCB FULL (0) and GREEN (1) to generate the OCB ←CHAR pulse, which strobes the input character (generated by R2A, R2, etc.) into the OCB register. The OCB ←CHAR pulse also sets the OCB FULL flip-flop (11:A8), which signifies that a character (or machine function) is in the OCB register and is ready to be sent to the computer.

The OCB FULL signal enables the OUT SYNC pulse to set the CHAR RQST (character request) flip-flop (18:A6). The CHAR RQST signal enables the 4-μsec-delayed OUT CLOCK to generate the OSR ←CHAR pulse (18:B2) which inserts the OCB contents into the OSR register (10:A). The OSR ←CHAR

pulse also resets the OCB to make it ready for the next input and sets the OUT ENB flip-flop (10:A1) to initiate the transfer of the OSR contents to the computer. The operation of transferring the OSR contents was explained previously.

2.4.2 Functions

For this example, assume that the space function is executed on the typewriter. When the space key is depressed, the contact closure applies +10v to the SF (switch filter, 11:D7) which provides a 0v SP KEY signal. The SP KEY signal generates the FCN KEY signal (11:D1), which in turn generates the FCN ENB (provided of course that the OCB is not full). The opening of the C5 cam in the C2-C6 chain produces the FEEDBACK signal (9:C3) which when enabled by ENERGIZED (0), PAGE GO (0), triggers a 10-msec delay (11:C2) to generate the OCB ← FCNS signal. The ENERGIZED (0) input inhibits OCB ← FCNS when the computer is typing a character on the typewriter, and the PAGE GO (0) signal inhibits the OCB ← FCNS during page-go operation.

After the 10-msec delay, the OCB FCNS gates the SP KEY code (code 63) into the OCB ← register. Not that the OCB FCNS signal unconditionally sets OCB0 and OCB1 and that OCB2 remains reset; this is because all function codes start with octal 6 as the most significant digit. (In a similar manner the LC KEY, UC KEY, BS KEY, and TAB KEY insert their codes into the OCB register.) The OCB ← FCNS pulse also sets the OCB FULL flip-flop, and the OCB FULL signal enables the OUT SYNC pulse to set the CHAR RQST flip-flop (18:A6) and this initiates the transfer to the computer. Note that the LC, UC, SP, BS, and TAB functions are all similar and the PG GO and CR (long functions) differ somewhat.

When the CR key (11:D4) is depressed, it energizes a Schmitt trigger to produce a CR KEY signal. The CR KEY signal resets the GREEN flip-flop (18:B2) to put the system into a red status. The CR KEY also sets the CR HOLD flip-flop (11:D3). The CR HOLD (1) signal enables the next OUT CLOCK to trigger the 2-μsec delay (11:C4). The 2-μsec output pulse is enabled by OCB FULL (0) to generate the OCB FCNS pulse, which inserts the carriage-return code into the OCB register and sets the OCB FULL signal to set CHAR RQST (18:A6) and initiate a character transfer. The OCB FCNS also resets the CR HOLD flip-flop.

When the operator depresses the PAGE key, a Schmitt trigger (11:D5) generates the PAGE KEY signal. The PAGE KEY signal triggers the 2-μsec one-shot multivibrator (11:C2) generating PG KEY DLY, which in turn generates the OCB ← FCNS. The PG KEY DLY also resets the GREEN flip-flop, putting the system into the red state. The OCB ← FCNS signal inserts the PAGE KEY code into the OCB and sets the OCB FULL flip-flop. OCB FULL enables the OUT SYNC pulse to se the CHAR RQST flip-flop and thus initiate the transfer.

The PG KEY DLY sets the PAGE GO flip-flop (9:B2) to drive the PG solenoid driver, which in turn energizes the PG solenoid to advance the paper in the typewriter. When the top of the next page is reached, the typewriter initiates a carriage return and the PAGE GO flip-flop is reset by the ensuing FEEDBACK signal.

2.5 CR HOLD FLIP-FLOP

The logic treats the CARR RTN (CR) function differently from all other characters or functions. The CR function sets a flip-flop to initiate its code. When a CR is initiated from the keyboard, CR HOLD is set, disabling all other function codes, and on the next available OUT CLK pulse allows the CR code to be read into the OCB buffers, thus disabling all character codes.

Since CR code always places the console into RED operation and signifies that an end-of-line transmission has occurred, no other information should be transmitted after this. Since CR KEY sets CR HOLD and prevents anything else from happening, a carr rtn takes precedent over a character or function struck simultaneously with it. This insures that the computer is aware of the change of state from green to red.

2.6 TYPEWRITER HOLD

When the operator wishes to put the typewriter in a not-ready condition, he depresses the typewriter OFF switch. The typewriter ON/OFF switch is labeled S1 on drawing SD-D-616-0-30; S1 has two sets of contacts. One set of contacts applies ac off-line power to the typewriter motor. The other set closes the HOLD contacts (8:D4), or READY (8:D5), which enables the SF (switch filter) to reset, or set, the RDY ENB flip-flop (8:C5). With RDY ENABLE reset, the READY signal is inhibited. The RDY ENABLE (0) generates a positive pulse (18:C6) which sets the RDY CHANGE flip-flop. The RDY CHANGE signal enables the next OUT SYNC pulse to insert the not-ready 75 code into the OSR and set the SIGNAL RQST flip-flop. The SIGNAL RQST initiates the transfer of the 75 code to the computer so that it is cognizant of the JOSS Console not-ready condition.

When the operator pushes the typewriter ON/OFF switch to the ON position, the typewriter is put back into ready operation (providing T/W OK is a 1). This sends a READY signal to the computer so that it knows of the ready condition. As the ON switch is activated, the C1 contacts of S1 generate a momentary 10v READY signal (8:D5), which sets the RDY ENABLE flip-flop. The RDY ENABLE signal generates READY (18:C3) which intitates a signal transfer to the computer to transfer the 74 (ready) code to the computer.

2.7 POWER-OFF SEQUENCE

When the POWER ON/POWER OFF switch on the control box is switched to the POWER OFF position, the POWER OFF contacts (8:A6) trigger the Schmitt trigger to generate the POWER DOWN signal. The POWER DOWN signal triggers the POWER OFF DLY (500 msec) one-shot multivibrator (8:C8) and sets the PWR OFF flip-flop, which generates the TURN OFF signal (8:B8). The TURN OFF signal enables the next OUT SYNC pulse to set the SIGNAL RQST flip-flop, which in turn enables the 4-μsec-delayed OUT CLOCK (OSR LOAD) to generate the OSR SIGNAL pulse (18:B2). The OSR SIGNAL pulse loads the OSR register with the 71 code (turn off) and sets the OUT ENB flip-flop (10:A1) to initiate the 71-code transfer to the computer. The OSR SIGNAL pulse (8:C2), enabled by TURN OFF, resets the SYS (system) flip-flop; this inhibits the SIGNAL PERMIT (18:D4) which prevents any further signal transfers, removes power from the typewriter (8:D2), and resets PWR OFF flip-flop, which terminates the TURN OFF signal so that it does not set the SIGNAL RQST flip-flop on the next OUT SYNC pulse.

After the 500 msec PWR OFF DLY, the PWR OFF DLY (0) signal resets the POWER ON flip-flop (18:B, C3) and triggers the PWR CLR DLY one-shot multivibrator (18:B, C5). The POWER ON (1) signal goes to 0v and disables SD (18:C4), which de-energizes RY1 (drawing PS-C-616-0-29) to remove power from the console. However, before console power is completely off, the PWR CLR DLY signal enables the 10-kc clock (18:B, C5) to generate PWR CLR pulses, which prevent any system operation while shutting off the console.

2.8 CHAR RQST/SIGNAL RQST/STATUS RQST

These three flip-flops are set whenever output action is initiated. However, they are gated with OSR LOAD so that a priority order is set up between them. This priority is set so that a CHAR RQST always is acknowledged first, a SIGNAL RQST second, and a STATUS RQST third.

CHAPTER 3
OPERATION

3.1 INTRODUCTION

Operation of the JOSS Console is controlled by the control box shown in figure 3-1. The controls and indicators of the JOSS Console control box are explained in table 3-1.

Figure 3-1 JOSS Console and Indicators

TABLE 3-1 OPERATING CONTROLS

Control or Indicator	Function
POWER ON/POWER OFF	Applies power to the JOSS Console/Removes power from the JOSS Console.
CONSOLE POWER	Indicates that the POWER ON control has successfully applied power to the JOSS Console.
JOSS SYSTEM	Indicates that the computer has acknowledged the TURN-ON signal; enables console functions, including typewriter.
TYPEWRITER	Indicates that on-line power has been applied to the typewriter.
Red lamp	Indicates that computer has control of the JOSS Console.
Green lamp	Indicates that user has control of the JOSS Console..
INTERRUPT	When illuminated, indicates that the software has acknowledged the interrupt. Indicates sending an interrupt signal to the computer. (red mode only)

3.2 OPERATING PROCEDURES

Operating procedures for the JOSS Console are explained in narrative form as follows: Depress the POWER ON button. This applies power to the JOSS Console and also sends a signal to the computer that indicates power application. If power has been successfully applied to the JOSS Console, the CONSOLE POWER lamp illuminates. If the computer successfully receives the power-on signal and is ready to communicate with the JOSS Console, the computer sends a system-on signal to the JOSS Console. The system-on signal illuminates the JOSS SYSTEM lamp. At the same time, the system-on signal applied to the typewriter initiates a short delay to permit the typewriter motor to reach operating speed. After the delay, the TYPEWRITER lamp lights to signify that the typewriter is operational. A signal goes to the computer which indicates the typewriter ready condition.

The JOSS Console is fully operational only when the JOSS SYSTEM, CONSOLE POWER, and the TYPEWRITER lamps are illuminated. Application of power places the JOSS Console in red mode of operation (computer has control); the typewriter keyboard is locked to the operator to prevent communication from the JOSS Console to the computer. The computer communicates to the JOSS Console by sending encoded signals which, when decoded, type or execute the specified machine function on the typewriter.

In addition to sending typewriter characters or functions, the computer can send signals to the JOSS Console to perform certain functions. These signals and their functions are explained in table 3-2.

TABLE 3-2 COMPUTER SIGNALS

Signals	Function
System on	Turns on "JOSS system" to notify operator that the computer is ready to communicate.
System off	Turns off "JOSS system" to notify operator that the computer is not ready to communicate.
Interrupt on	Illuminates the INTERRUPT lamp to indicate that the computer has acknowledged the interrupt.
Interrupt off	Turns off the INTERRUPT lamp.
System green	Illuminates the green lamp to indicate that the user has control of the JOSS Console. Each time the JOSS Console switches from red to green a short, soft beep occurs.
System red	Illuminates the red lamp to indicate that the computer has control of the JOSS Console.
Beep	Sounds the audible alarm. This is a long, loud beep, distinguishable from switching to green beep.
NOP	No operation (usually sent with STATUS REQUEST bit).

In the red mode (red lamp lit), the INTERRUPT button may be depressed to initiate a software interrupt. The computer interrupt must be enabled in the computer before the JOSS Console interrupt is processed. The programmer must make sure that the INTERRUPT lamp on the control box is turned on or off by the computer to signify the condition of the computer interrupt.

When the computer puts the console into green mode (illuminates the green lamp), the user has control of the JOSS Console. The keyboard is unlocked and the operator may communicate by typing on the keyboard.

The characters typed or the machine functions executed are encoded and sent to the computer. When the carriage-return or page-go machine functions are executed, the JOSS Console reverts to the red mode. The operator must wait for the computer to switch the JOSS Console back to green mode before resuming typing.

With console power removed the typewriter may be used in an off-line mode by depressing the typewriter ON control, which applies ac off-line power. If the typewriter OFF control is depressed, ac off-line power is removed. The only requirement for off-line use is that the rear-panel circuit breaker be on and the external ac source be turned on. While in off-line mode, if console power is applied, the typewriter is turned off (to await SYS ON).

CHAPTER 4
MAINTENANCE

4.1 MARGINAL CHECK FACILITY

Maintenance procedures for the JOSS Console consist of normal shop practices performed for normal digital circuits. In addition, the JOSS Console incorporates a marginal check facility. The marginal check facility permits the normal +10v or −15v, which is applied to the modules, to be varied over a small range. This aggravates borderline conditions within the logic to reveal observable faults. These conditions can be corrected during scheduled preventive maintenance to forestall possible future equipment failures. The check can also be used as a troubleshooting aid to locate marginal or intermittent components, such as deteriorating transistors. The checks are performed by operating the equipment logic circuits from an external, adjustable power source, such as the DEC Type 734 Variable Power Supply.

Marginal check terminals are provided on color-coded connectors which are connected in common to all racks. An external power supply can be connected to the 8-pin Jones plug (figure 4-1) which connects the external power supply to the marginal check terminals in each rack. The color coding of the terminals from top to bottom is as follows:

Orange, +10 vdc marginal-check supply

Red, +10 vdc internal supply

Black, ground

Blue, −15 vdc internal supply

Green, −15 vdc marginal-check supply

Pin 1 of the Jones plug connects to the orange terminal, pin 3 to the green terminal, and pin 7 to the black terminal. Two single-pole single-throw switches at the end of each rack of logic allow selection of either the normal internal power supply or the external marginal-check power supply for distribution to the logic. The top switch selects the +10v supply routed to all modules in that rack. In the down position the fixed internal +10v supply connected to the red terminal is supplied to the modules, and in the up position the marginal-check voltage supplied to the orange terminal is supplied to all modules in that rack. The bottom switch selects the −15v supply to be routed to all modules. In the down position the fixed −15v output of the internal power supply, received at the blue terminal, is supplied to the modules; while in the up position, the marginal-check voltage, connected to the green terminal, is supplied to all modules.

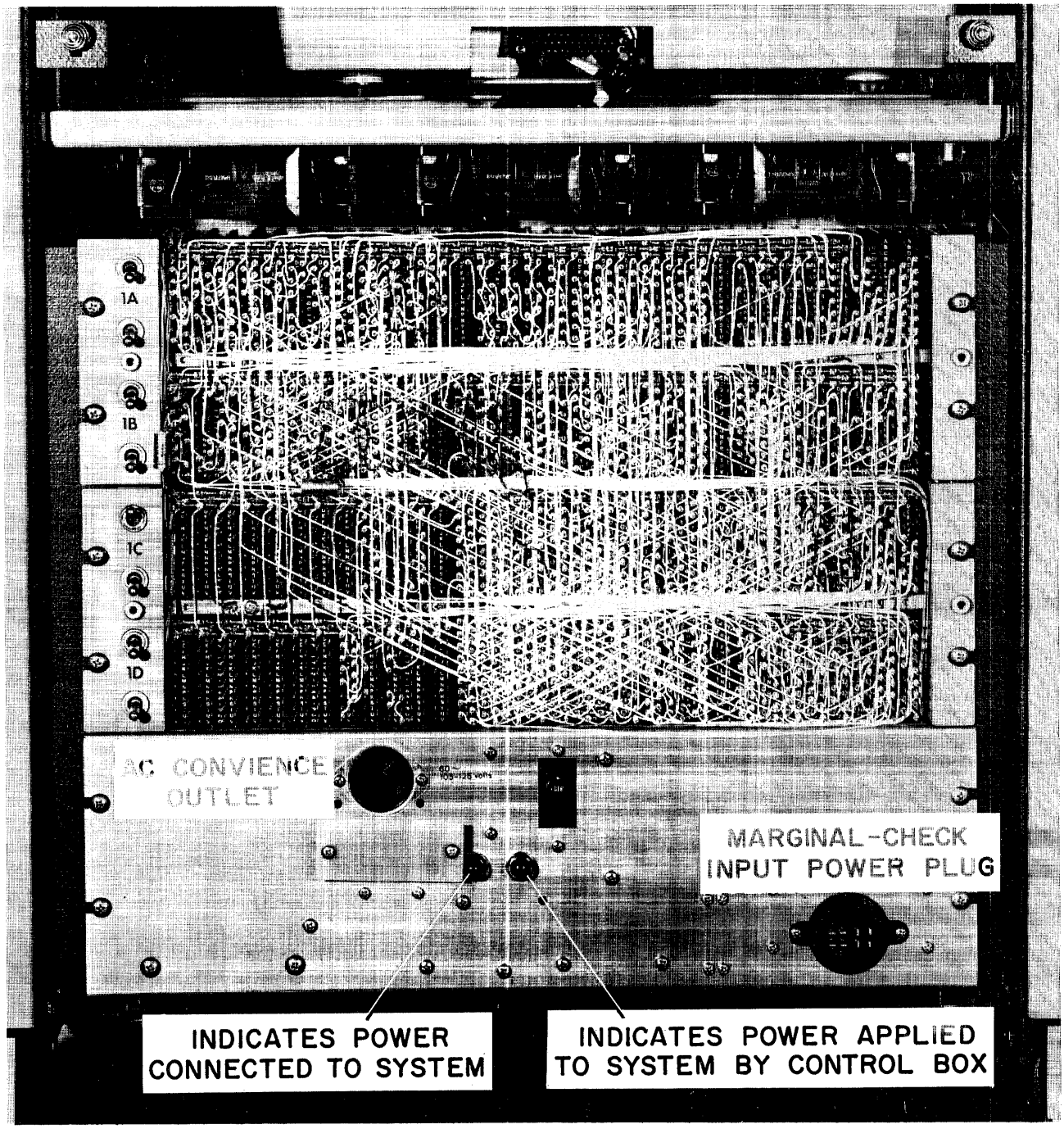


Figure 4-1 Power Indicators and Marginal Check Facilities

4.1.1 Marginal Check Procedure

To perform marginal checks, proceed as follows:

a. Connect the external power supply to the Jones plug with the variable +10v connected to pin 1, ground connected to pin 7, and the variable −15v connected to pin 3.

b. Energize the marginal-check power supply and adjust the +10v output to a nominal +10 vdc.

c. Set the top switch on the rack to be checked to the up position.

d. Start equipment operation in a routine which fully utilizes the circuits in the rack to be tested.

e. Lower the +10v marginal-check power supply until normal system operation is interrupted. Record the marginal-check voltage. At this point marginal modules may be replaced.

f. Start equipment operation. Then increase the +10v marginal-check supply until normal operation is interrupted, at which point record the marginal-check voltage. Marginal modules can again be located and replaced.

g. Stop operation and return the top switch to the down position.

h. Repeat steps b through g for the bottom switch on the logic rack being checked.

i. Repeat steps b through h for each rack or logic to be checked.

j. De-energize and/or disconnect the external marginal-check power supply.

CHAPTER 5
INSTALLATION AND INTERFACE

5.1 INTRODUCTION

The JOSS Console is a self-contained unit and the only installation requirements are input/output signal connections to the 10-pin Cinch-Jones plug (figure 5-1) and the external ac power connection. A normal 115-vac, 60-cps output can supply the ac input power for the JOSS Console. The input/output Cinch-Jones plug can accommodate three inputs and two outputs for Data Phone communication, or one TWP input and one TWP output for DEC 630 Data Communication Channel. Pin 2 and pin 10 of the external socket should be jumpered when connection is to DEC 630. Pins and uses are listed below:

Pin	Use
1	Output GND (630)--PROT. GND (D.P.)
2	Received Data (D.P.)
3	Data Terminal Ready (D.P.)
4	Output Data (630)
5	Clear to Send (D.P.)
6	Input Data (630)
7	Data Set Ready (D.P.)
8	Transmit Data (D.P.)
9	Input GND (630)--SIG. GND (D.P.)
10	GND

5.2 630 INTERFACE

Output signals from the console to the 630 are logic levels of ground and −3v and are transmitted via a single twisted pair (telephone pair) wire. These signals are driven by a R650 Bus Driver which is designed to avoid ringing on exceptionally long lines.

Input signals to the console from the 630 are logic levels of ground and −3v and are received via a single twisted pair (telephone pair) wire. These signals go directly into the input of a gatable inverter (R111) with the input SIGNAL line terminated. This input SIGNAL line terminator accomplishes two things: first, it damps out ringing on the line; second, it keeps the R111 output from turning on when the INPUT/OUTPUT connector is open or connected to other than a 630.

On input or output operations the first bit of any code is called the start bit and must be at −3v to initiate action.

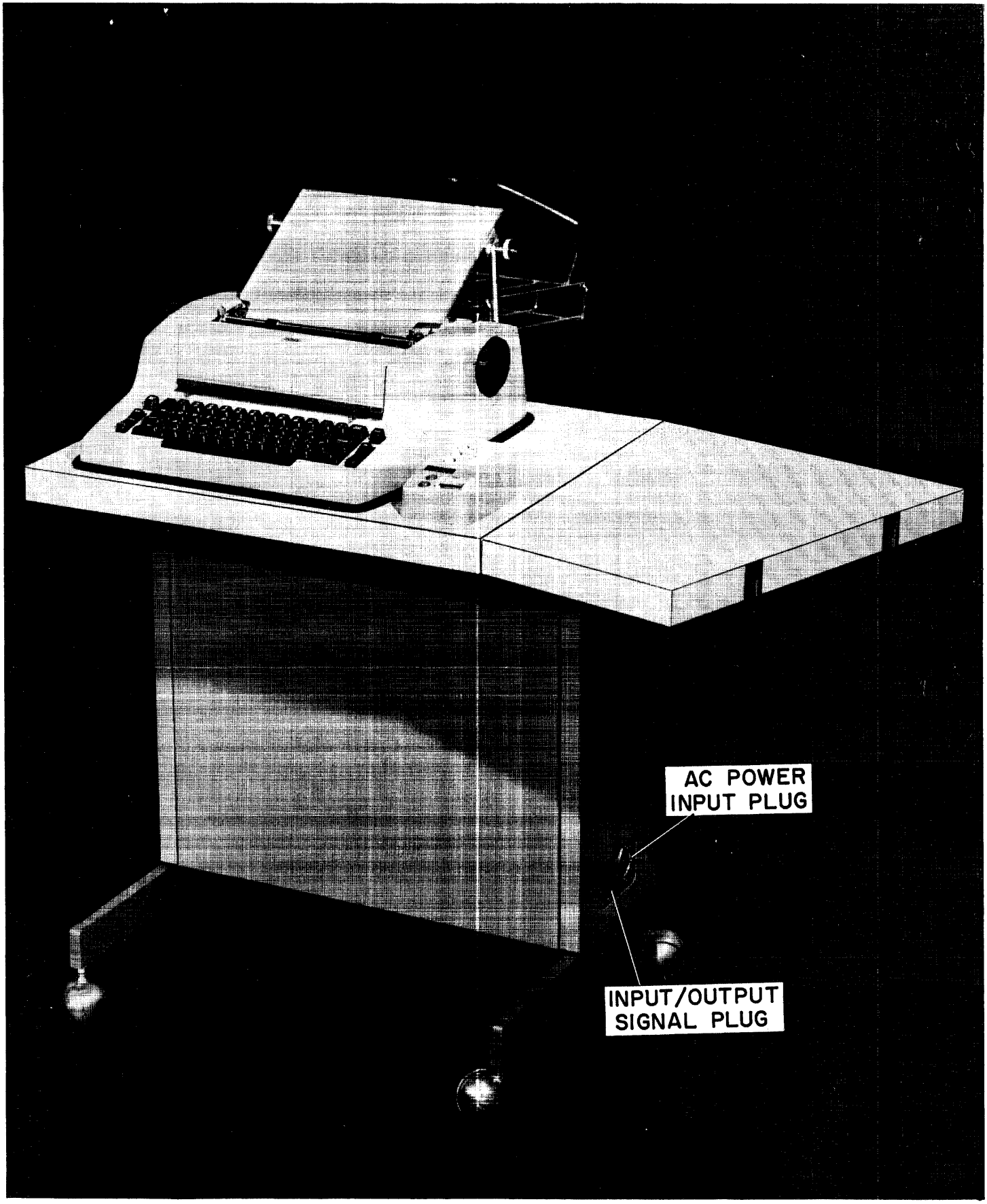


Figure 5-1 Power and I/O Signal Connections

5.3 DATA PHONE INTERFACE

Output signal from the console to the data phone are logic levels of +6v and −6v with all signals to the data phone transmitted on a single wire. Logic levels of ground and −3v go to W602 Level Converters which convert ground inputs to −6v and −3v inputs to +6v. Two signals are required for output operation to the data phone terminal:

TRANSMIT DATA	This is the actual line used to transmit output signal codes.
READY	This level is generated when power has been applied to the console and allows the data phone to enter and remain in the data mode.

Input signals to the console from the data phone are logic levels of +6v and −6v with all signals from the data phone received on a single wire. Logic levels of +6v and −6v go to W510 Level Converters which convert +6v inputs to −3v and −6v inputs to ground. Three signals are required for input operation to the console:

DATA SET READY	This indicates that data could be sent to the console.
RECEIVED DATA	This is the actual line used to receive input signal codes.
CLEAR TO SEND	This line causes DLY GO to change from ground to −3v when the data phone is ready to transmit or receive data. DLY GO going from ground to −3v allows the PWR CLR DLY to time out (500 msec) and thus start output and input operations. Should the data phone not be ready, DLY GO would remain at ground and thus constantly enable PWR CLR DLY.

CHAPTER 6
ENGINEERING DRAWINGS

6.1 INTRODUCTION

This chapter contains reduced copies of DEC block schematics, circuit schematics, and other engineering drawings necessary for understanding and maintaining this equipment. Only those drawings which are essential and are not available in the referenced pertinent documents are included.

6.2 DRAWING NUMBERS

DEC engineering drawing numbers contain five groups of information, separated by hyphens. A drawing number such as BS-D-9999-1-5 consists of the following information reading from left to right: a 2- or 3-letter code specifying the type of drawing (BS); a 1-letter code specifying the original size of the drawing (D); the type number of the equipment (9999); the manufacturing series of the equipment (1); and the drawing number within a particular series (5). The drawing type codes are:

BS, block schematic or logic diagram
CS, circuit schematic
RS, replacement schematic
SD, system diagram
UML, utilization module list
WD, wiring diagram

6.3 CIRCUIT SYMBOLS

The block schematics of DEC equipment are multipurpose drawings that combine signal flow, logical function, circuit type and physical location, wiring, and other pertinent information. Individual circuits are shown in block or semiblock form, using special symbols that define the circuit operation. These symbols are similar to those appearing in both the FLIP CHIP Module Catalog and the System Module Catalog, but are often simplified.

6.4 LOGIC SIGNAL SYMBOLS

DEC standard logic signal symbols are shown at the input of most circuits to specify the enabling conditions required to produce a desired output. These symbols represent either standard DEC logic levels, standard DEC pulses, standard FLIP CHIP pulses, or level transitions.

6.4.1 Logic Levels

The standard DEC logic level is either at ground (0 to −0.3v) or at −3v (−2.5 to −3.5v). Logic signals generally have mnemonic names which indicate the condition represented by assertion of

the signal. An open diamond (——◇) indicates that the signal is a DEC logic level and that ground represents assertion; a solid diamond (——◆) indicates that the signal is also a DEC logic level and that −3v represents assertion. All logic signals applied to the conditioning level inputs of capacitor-diode gates of diode-capacitor-diode gates must be present for a specified length of time (depending on the module used) before an input pulse will trigger operation of the gate.

6.4.2 FLIP CHIP Standard Pulses

FLIP CHIP circuit operation uses two types of pulses, R series and B series. The pulse produced by R-series modules starts at −3v, goes to ground (−0.2v) for 100 nsec, then returns to −3v. This pulse is shown in figure 6-1.

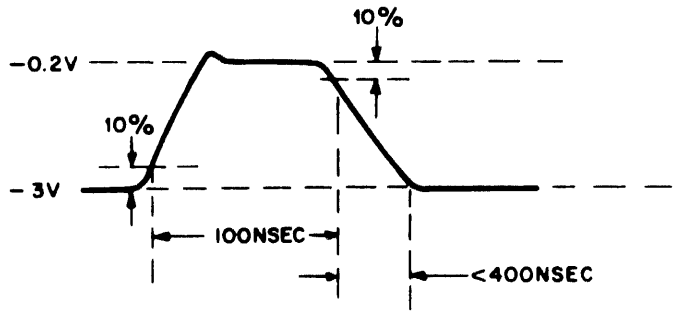


Figure 6-1 FLIP CHIP R-Series Pulse

The B-series negative pulse is 2.5v in amplitude and 40 nsec in duration and is shown in figure 6-2. If this pulse is applied to the base of an inverter, the inverter output will be a narrow pulse, similar in shape to the R-series standard pulse. The B-series positive pulse, which goes from ground to +2.5v, is the inverse of the B-series negative pulse.

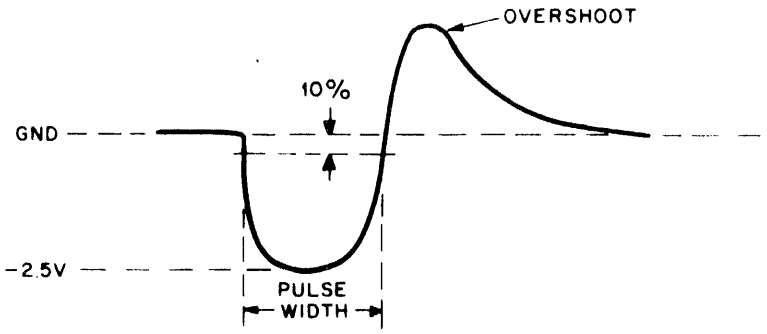


Figure 6-2 Standard Negative Pulse

6.5 COORDINATE SYSTEM

Each engineering logic drawing is divided into 32 zones (4 horizontal and 8 vertical) by marginal map coordinates. Figure references in the text are usually followed by a letter and a digit specifying the zone in which the referenced circuit is located. Physical reference to a drawing area such as "lower left" or "upper center" may also be used.

6.6 MODULE IDENTIFICATION

Two designations appear in or near each circuit symbol or inside the dotted line surrounding multiple circuit symbols shown on engineering drawings. The upper designation consists of four characters which specify the module type. Modules are identified by this designation in the Digital System Module Catalog while FLIP CHIP modules are described in the FLIP CHIP Module Catalog. Modules not described in the catalogs are described in this manual or in other referenced pertinent documents.

The lower designation is the module location code. The leftmost character of this designation is a number indicating the cabinet in which the module is located. The next character is a letter indicating the mounting panel in which the module is located. The last character consists of one or two numbers specifying the module location within the mounting panel. As an example, the designation 1A22 indicates that this module is mounted in location 22 of mounting panel A in cabinet 1. Terminal J of this module is designated at 1A22J.

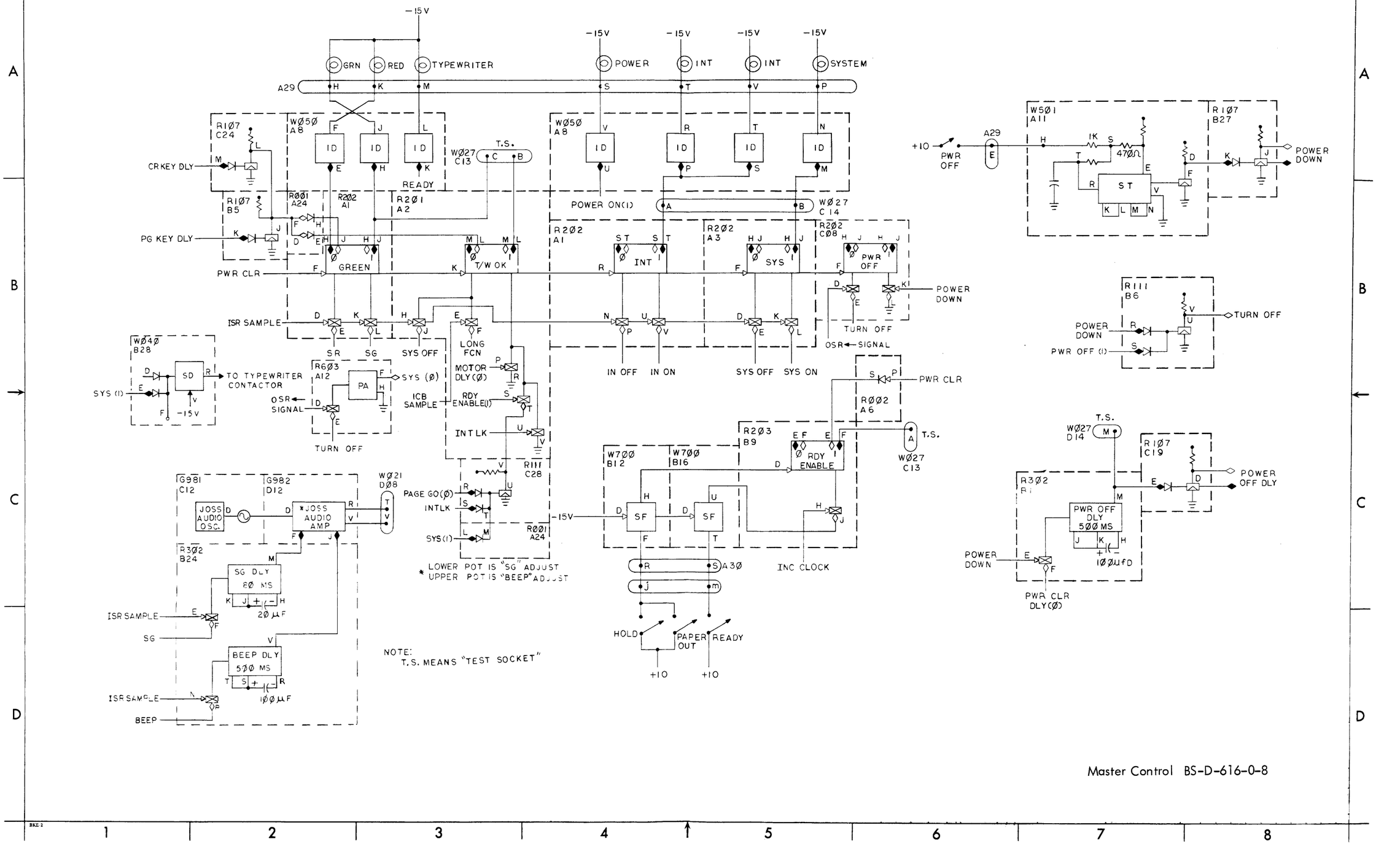
Module mounting panels which can accommodate more than one row of modules may be used in the construction of certain equipment. For this equipment, a letter is assigned to each row of modules within a mounting panel. When a particular device is contained within one cabinet, the number 1 may be omitted from the reference designations appearing on the associated drawing for that device.

6.7 SEMICONDUCTOR SUBSTITUTION

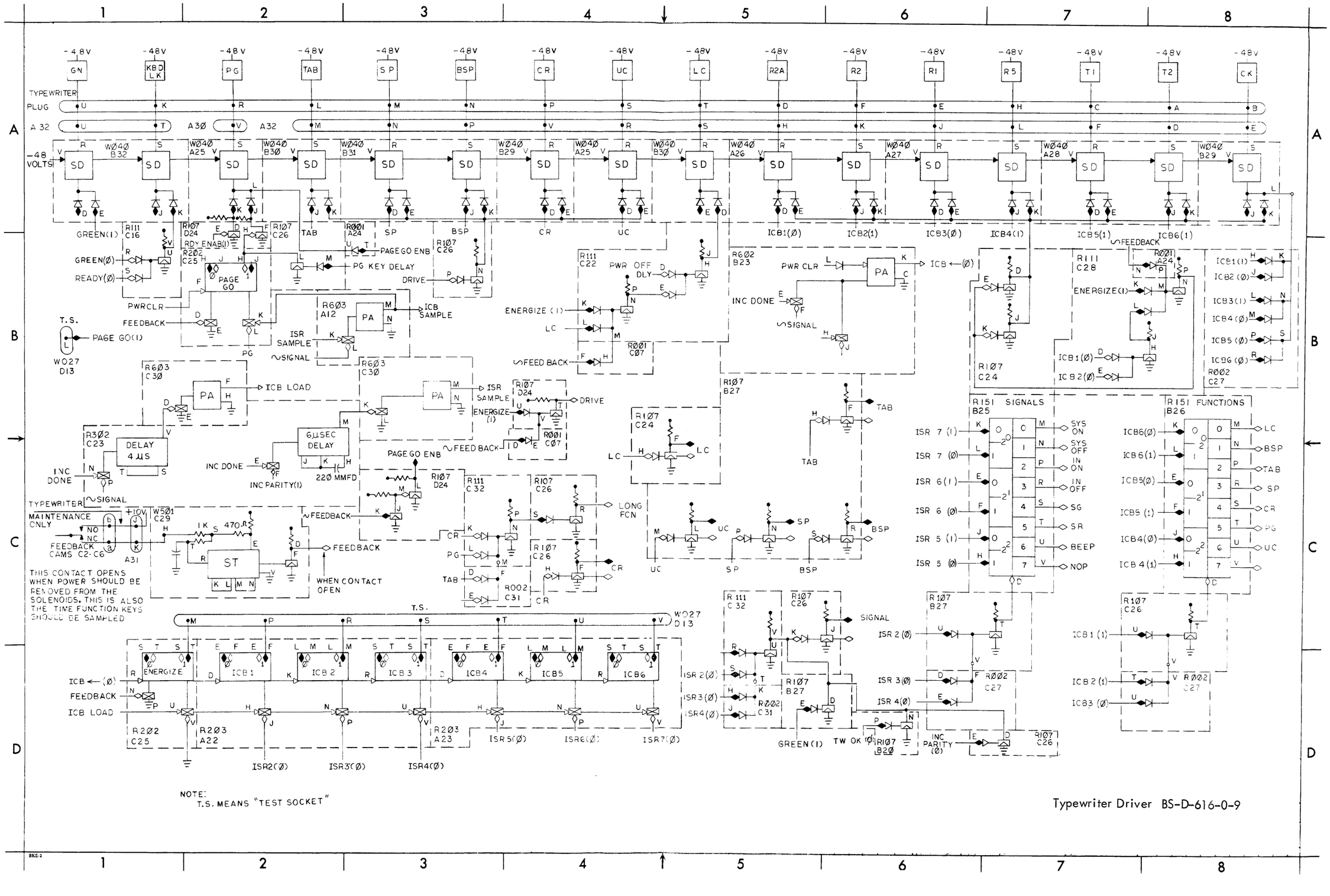
Standard EIA components specified in table 6-1 can replace most DEC semiconductors in modules of the JOSS Console, shown on the RS drawings for the console. Exact replacement is recommended for semiconductors not listed.

TABLE 6-1 SEMICONDUCTOR SUBSTITUTION

DEC	EIA	DEC	EIA
D-662	IN645	DEC 3639-0	2N3639
D-664	IN914	DEC 3639-2	2N3639-2
DEC 2219	2N2219	DEC 3790	2N3790
DEC 3009	2N3009	IN748	IN748 3.9v
DEC 3494	2N3494	MR2066	IN4003
DEC 3639	2N3639	4JXIC741	2N527

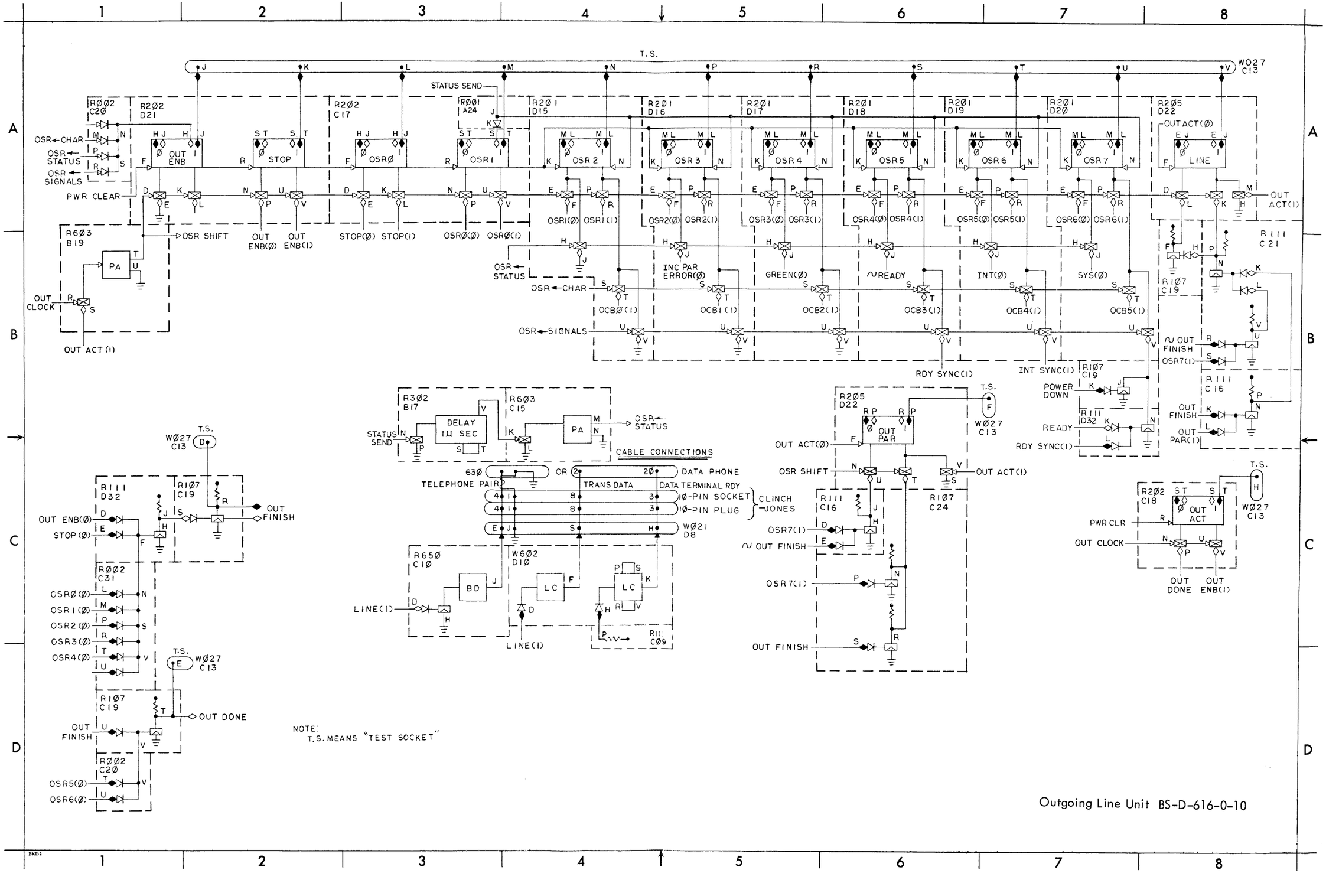


Master Control BS-D-616-0-8



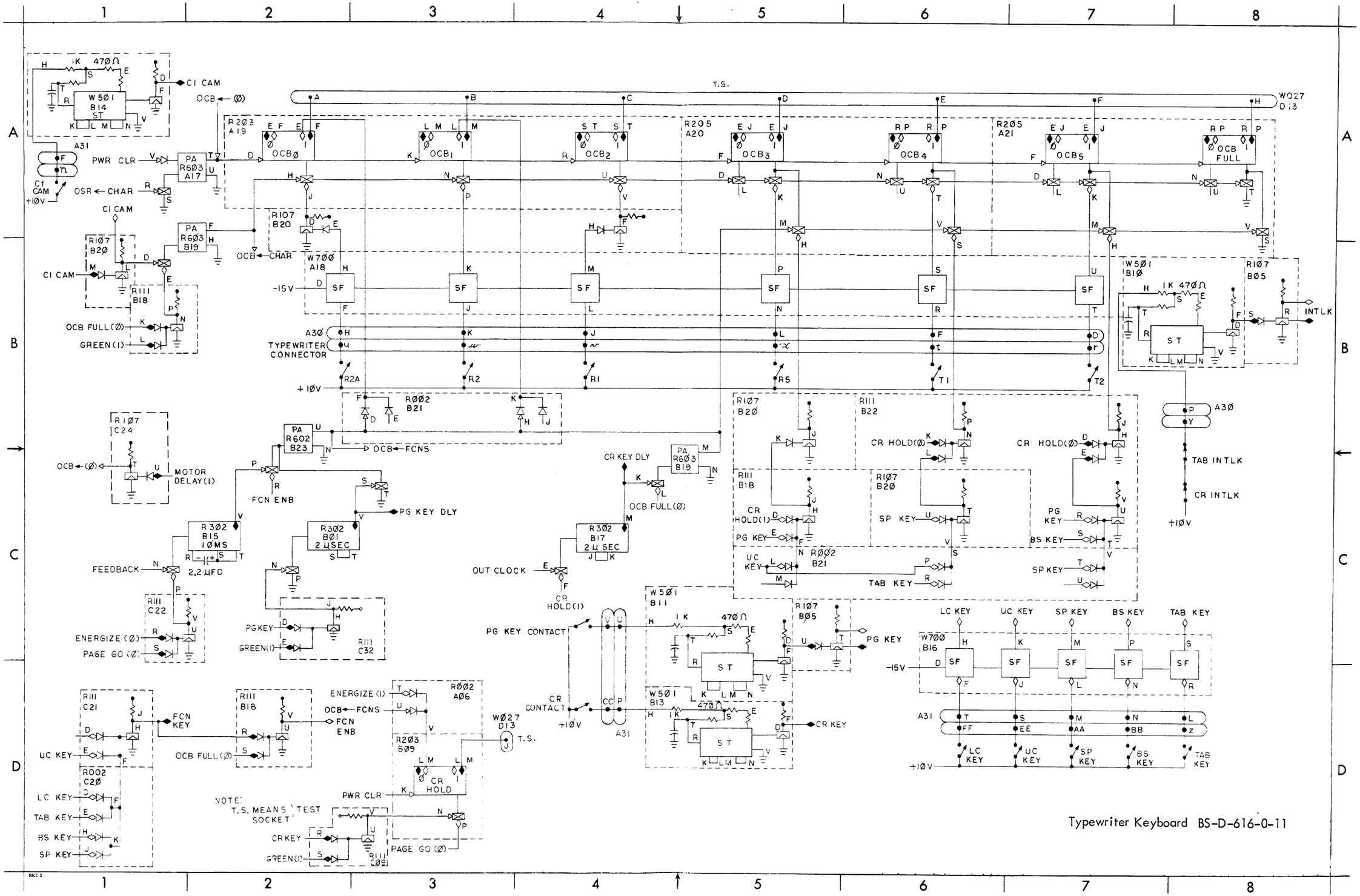
Typewriter Driver BS-D-616-0-9

BKE-2



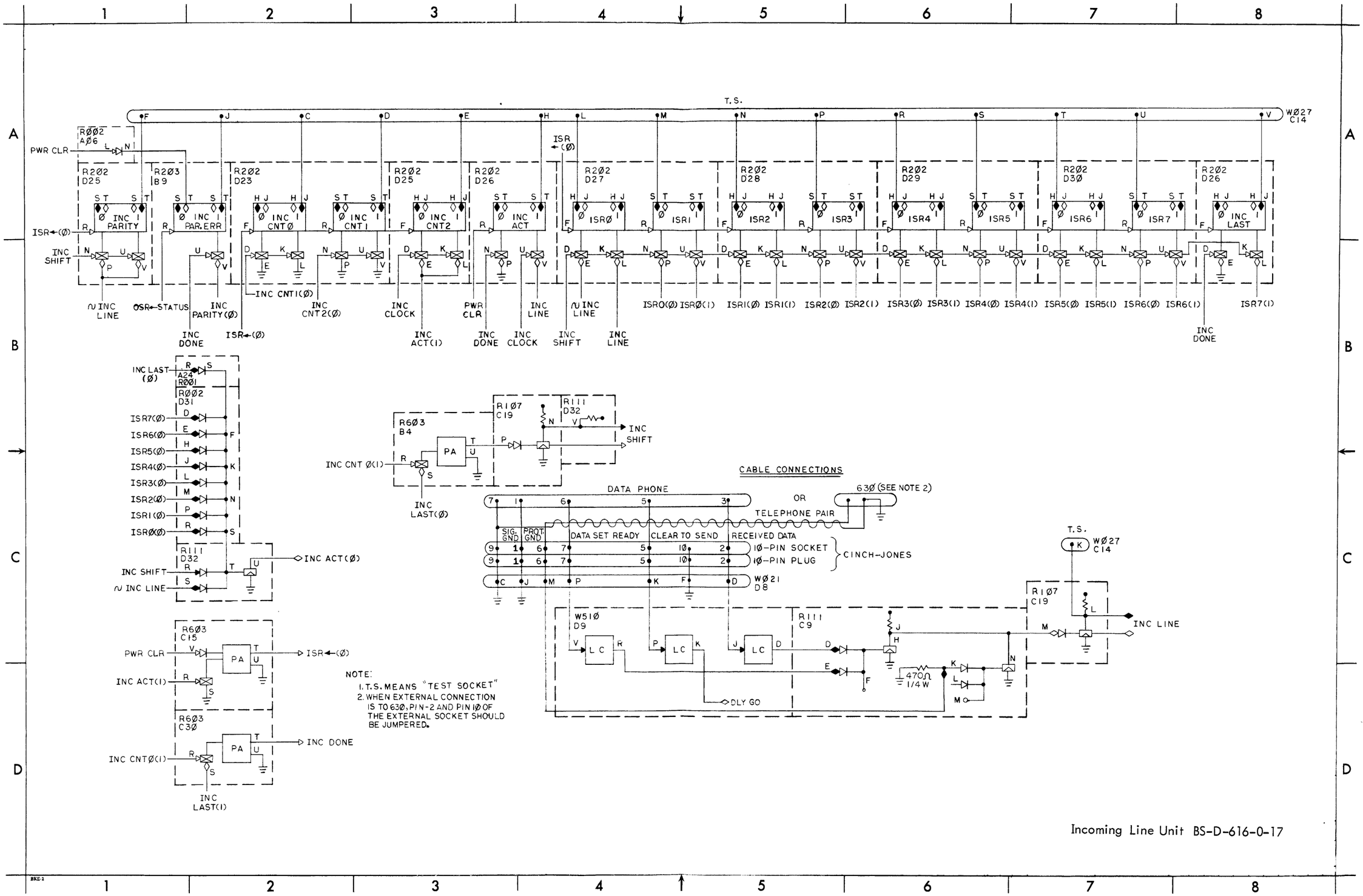
NOTE:
T.S. MEANS "TEST SOCKET"

Outgoing Line Unit BS-D-616-0-10

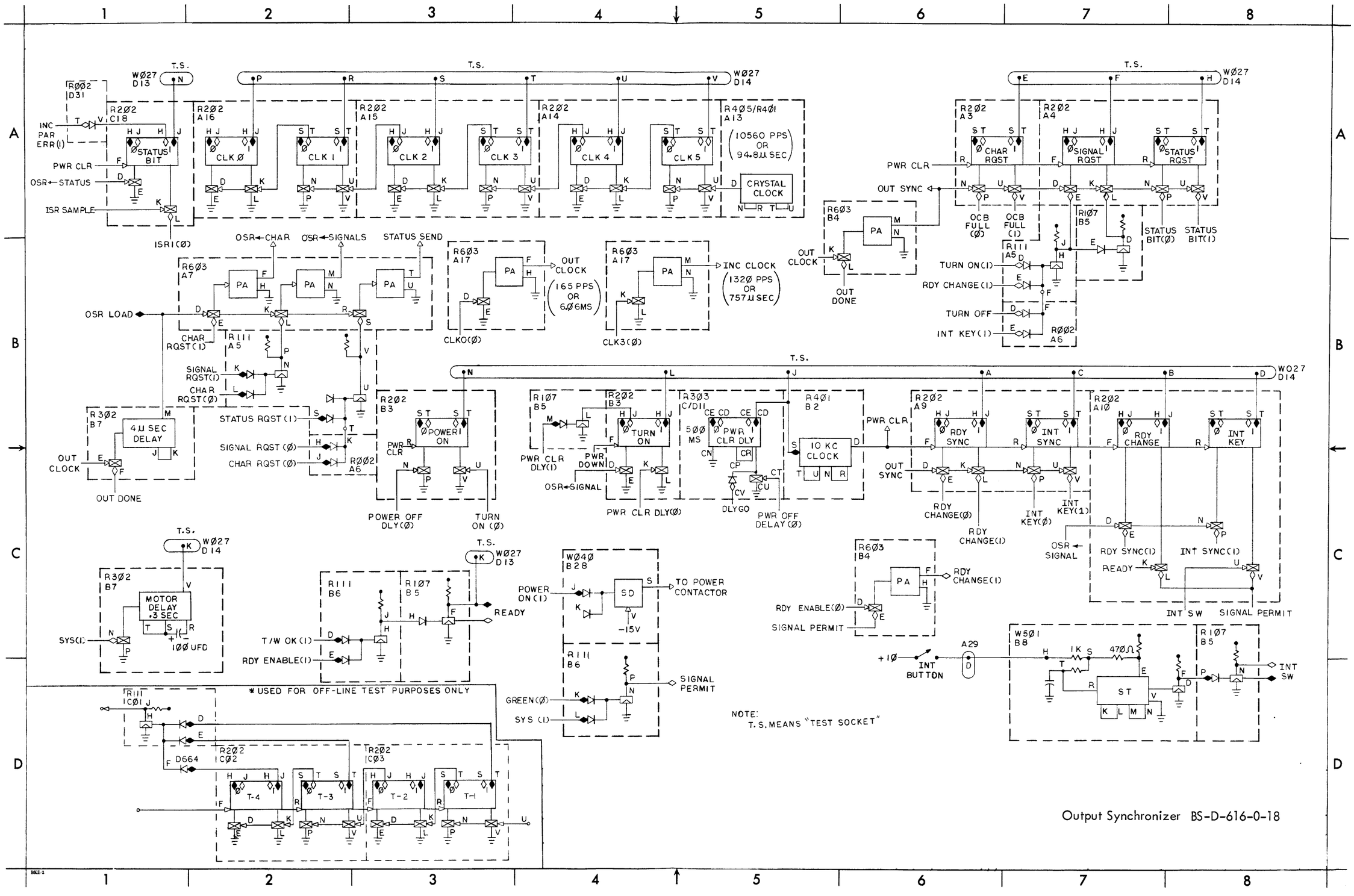


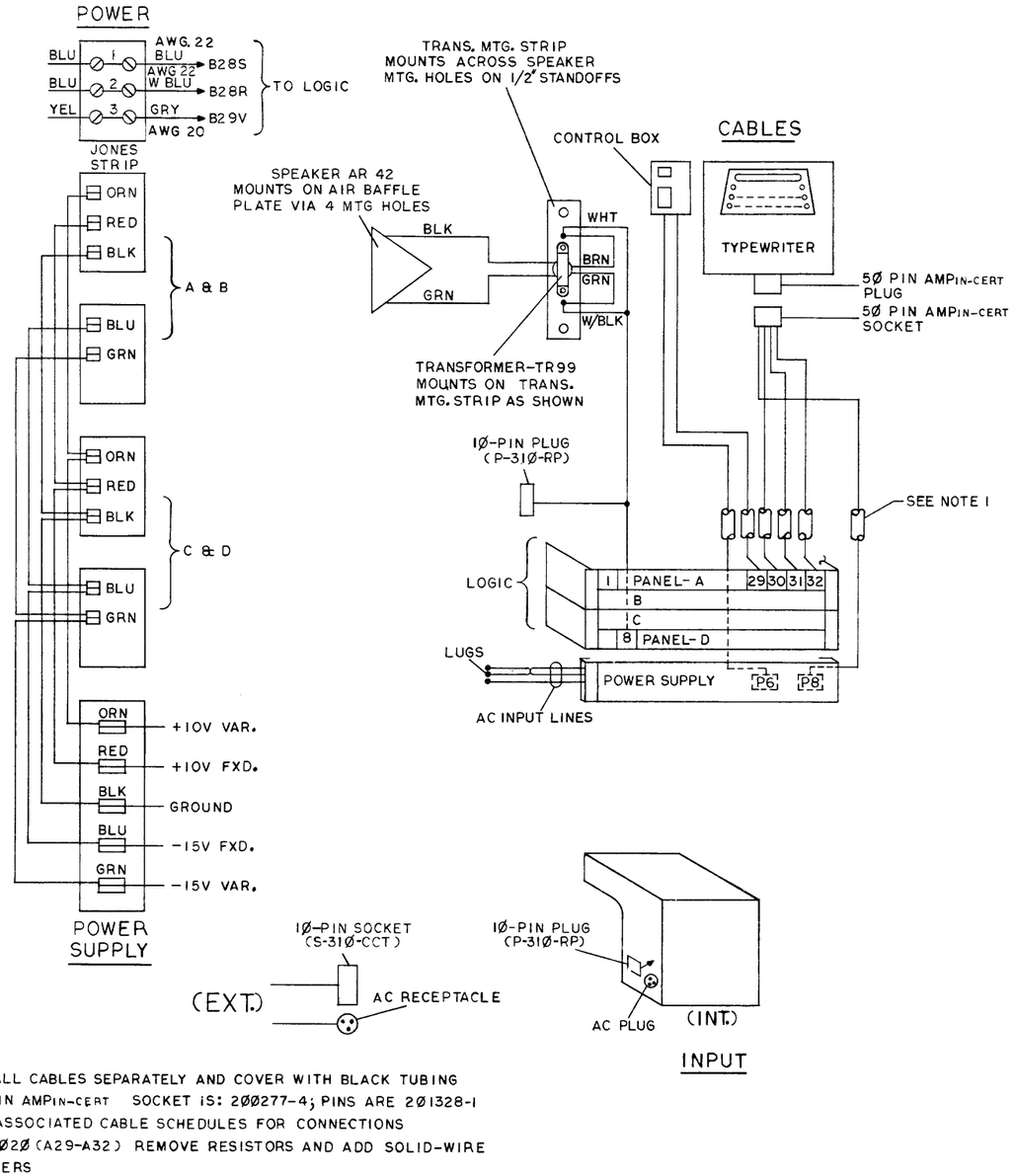
Typewriter Keyboard BS-D-616-0-11

Incoming Line Unit BS-D-616-0-17

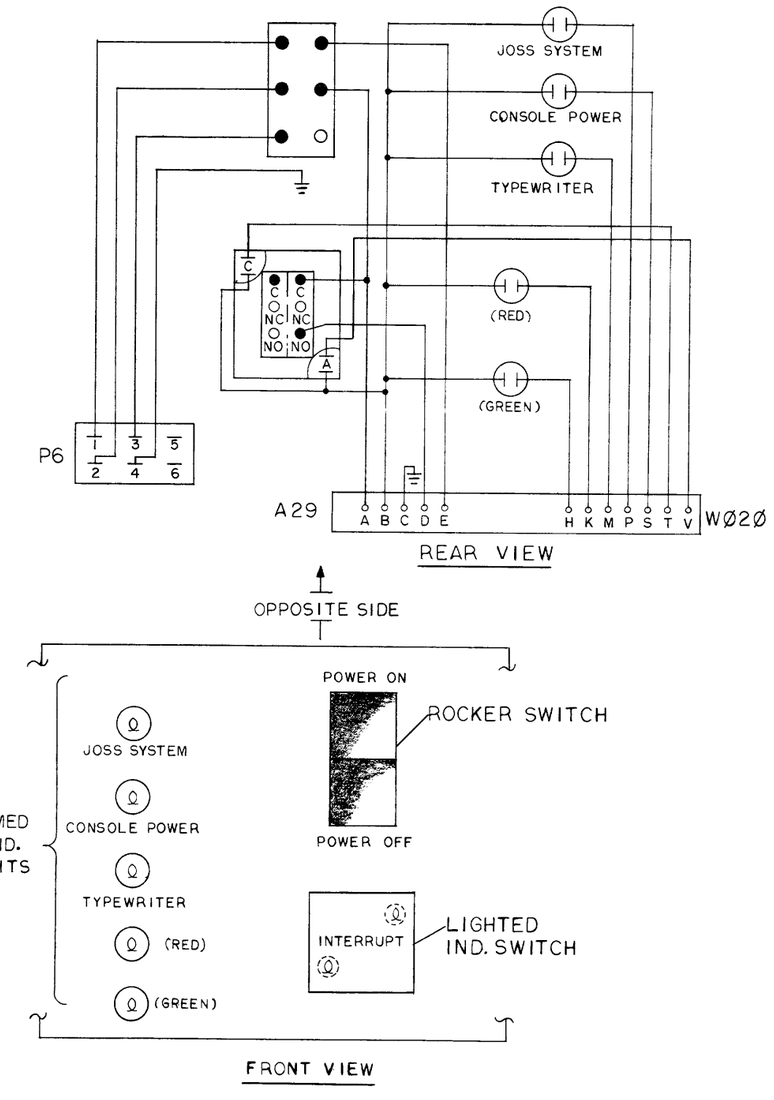


Incoming Line Unit BS-D-616-0-17


T.S.
W027 D13
W027 D14
R00Ø2 D31
R2Ø2 C18
R2Ø2 A16
R2Ø2 A15
R2Ø2 A14
R4Ø5/R4Ø1 A13
INC PAR ERR(1)
PWR CLR
OSR←STATUS
ISR SAMPLE
STATUS BIT
CLK Ø
CLK 1
CLK 2
CLK 3
CLK 4
CLK 5
(10560 PPS OR 94.8µ SEC)
CRYSTAL CLOCK
ISR1(Ø)
OSR←CHAR
OSR←SIGNALS
STATUS SEND
R6Ø3 A7
PA
OSR LOAD
CHAR RQST(1)
R111 A5
SIGNAL RQST(1)
CHAR RQST(Ø)
STATUS RQST(1)
SIGNAL RQST (Ø)
CHAR RQST (Ø)
R3Ø2 B7
4µ SEC DELAY
OUT CLOCK
OUT DONE
R00Ø2 A6
R2Ø2 B3
ØPOWER ON
PWR CLR
POWER OFF DLY(Ø)
TURN ON (Ø)
R6Ø3 A17
OUT CLOCK (165 PPS OR 6.Ø6MS)
CLKO(Ø)
INC CLOCK (132Ø PPS OR 757µ SEC)
CLK3(Ø)
R6Ø3 B4
OUT CLOCK
OUT DONE
R2Ø2 A3
R2Ø2 A4
PWR CLR
OUT SYNC
ØCHAR RQST
ØSIGNAL RQST
ØSTATUS RQST
OCB FULL (Ø)
OCB FULL (1)
STATUS BIT(Ø)
STATUS BIT(1)
RIØ7 B5
R111 A5
TURN ON(1)
RDY CHANGE(1)
TURN OFF
INT KEY(1)
R00Ø2 A6
W027 D14
RIØ7 B5
R111 B6
R3Ø3 C/D11
R4Ø1 B2
R2Ø2 A9
R2Ø2 AIØ
PWR CLR DLY(1)
PWR DOWN
ØTURN ON
500 MS
ØPWR CLR DLY
10 KC CLOCK
OSR←SIGNAL
PWR CLR DLY(Ø)
DLYGO
PWR OFF DELAY(Ø)
ØRDY SYNC
ØINT SYNC
ØRDY CHANGE
ØINT KEY
OUT SYNC
RDY CHANGE(Ø)
INT KEY(Ø)
RDY CHANGE(1)
INT KEY(1)
OSR ← SIGNAL
RDY SYNC(1)
INT SYNC(1)
READY
INT SW
SIGNAL PERMIT
R3Ø2 B7
MOTOR DELAY .3 SEC
100 UFD
SYS(1)
T/W OK(1)
RDY ENABLE(1)
READY
WØ4Ø B28
SD
POWER ON(1)
TO POWER CONTACTOR
-15V
R111 B6
GREEN(Ø)
SYS (1)
SIGNAL PERMIT
R6Ø3 B4
PA
RDY ENABLE(Ø)
SIGNAL PERMIT
RDY CHANGE(1)
+1Ø
INT BUTTON
A29
W5Ø1 B8
1K
47ØΩ
ST
INT SW
R111 IC01
R2Ø2 IC02
R2Ø2 IC03
D664
T-4
T-3
T-2
T-1
* USED FOR OFF-LINE TEST PURPOSES ONLY
NOTE:
T.S. MEANS "TEST SOCKET"
Output Synchronizer BS-D-616-0-18
BKE-1

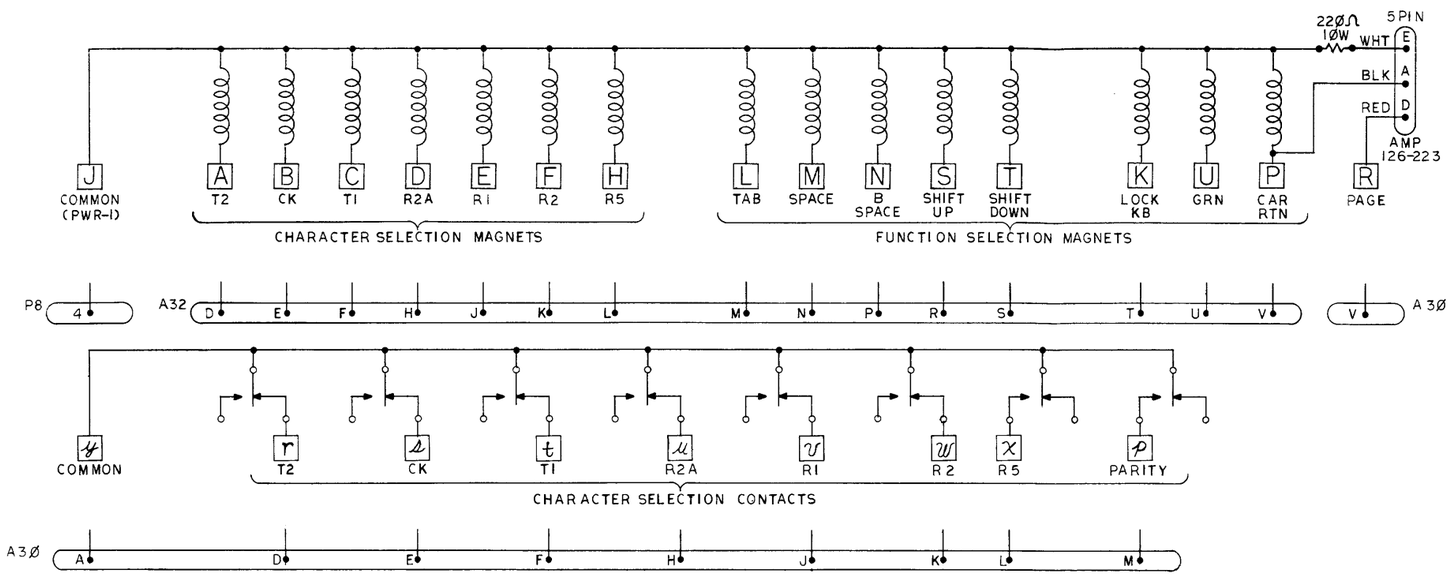


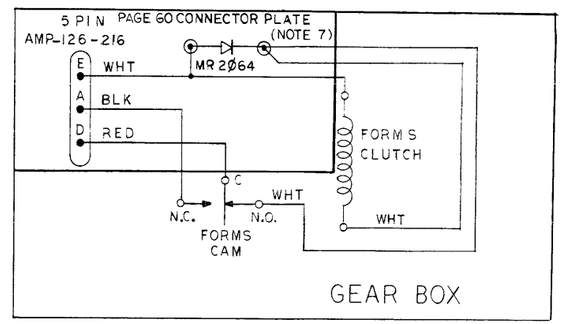
NOTES:
1. RUN ALL CABLES SEPARATELY AND COVER WITH BLACK TUBING
2. 50 PIN AMPIN-CERT SOCKET IS: 200277-4; PINS ARE 201328-1
3. SEE ASSOCIATED CABLE SCHEDULES FOR CONNECTIONS
4. ON WØ2Ø (A29-A32) REMOVE RESISTORS AND ADD SOLID-WIRE JUMPERS

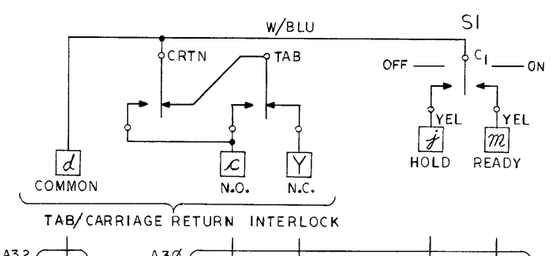


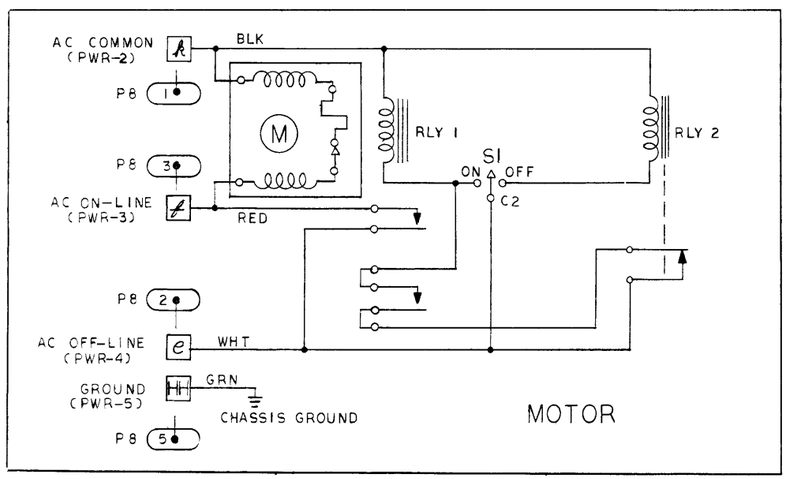
Console Connection, JOSS Console SD-D-616-0-23

Selectric I/O Typewriter (Sheet 1) SD-D-616-0-30





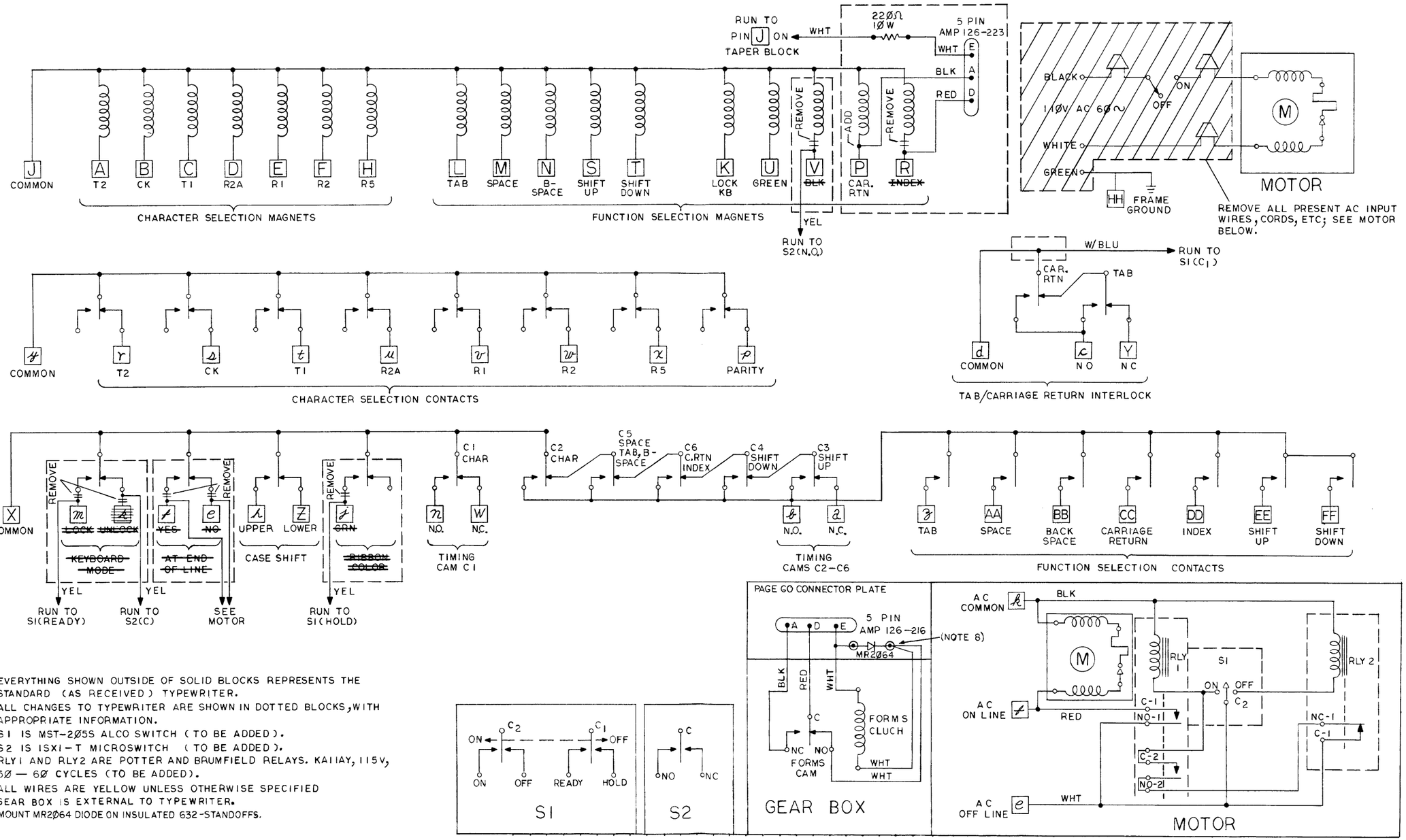




NOTES:

1. S1 IS MST-2Ø5S ALCO SWITCH.
2. S2 IS ISX1-T MICRO SWITCH.
3. RLY 1 AND RLY2 ARE POTTER & BRUMFIELD RELAYS, KA11AY, 115V, 5Ø–6Ø CYCLES.
4. ALL WIRES ARE YEL UNLESS OTHERWISE SPECIFIED.
5. SEE A-616-Ø-2Ø (4 PGS) FOR A3Ø, A31, A32 & P8 CABLES.
6. CABLES SHOWN ARE CONNECTED TO TERMINALS, TOWARDS WHICH WIRES ARE POINTING
7. MOUNT MR2Ø64 DIODE ON INSULATED 632-STANDOFFS.

Selectric I/O Typewriter (Sheet 2) SD-D-616-0-30



NOTES:

1. EVERYTHING SHOWN OUTSIDE OF SOLID BLOCKS REPRESENTS THE STANDARD (AS RECEIVED) TYPEWRITER.
2. ALL CHANGES TO TYPEWRITER ARE SHOWN IN DOTTED BLOCKS, WITH APPROPRIATE INFORMATION.
3. S1 IS MST-2Ø5S ALCO SWITCH (TO BE ADDED).
4. S2 IS ISX1-T MICROSWITCH (TO BE ADDED).
5. RLY1 AND RLY2 ARE POTTER AND BRUMFIELD RELAYS. KA11AY, 115V, 5Ø — 6Ø CYCLES (TO BE ADDED).
6. ALL WIRES ARE YELLOW UNLESS OTHERWISE SPECIFIED
7. GEAR BOX IS EXTERNAL TO TYPEWRITER.
8. MOUNT MR2Ø64 DIODE ON INSULATED 632-STANDOFFS.

Selectric I/O Typewriter (Sheet 2) SD-D-616-0-30

JACK [ ] PLUG [x] FEMALE [x] MALE [ ]	LOCATION, LENGTH, ROUTE 1½ FT. FROM REAR OF WØ2Ø TO AMP SOCKET. USE SINGLE TEFLON WIRE AND WRAP IN BLACK TUBING. REMOVE RESISTORS FROM WØ2Ø AND ADD SOLID WIRE JUMPERS.			
COLOR	PIN WØ2Ø	PIN	NAME	REMARKS
BLK	A	y	+10V ------- CHAR. SEL	
	B			NO CONNECTION
	C			NO CONNECTION
BRN	D	r	T2 ------- CONTACTS	
RED	E	s	CK	
ORN	F	t	T1	
YEL	H	u	R2A	
GRN	J	v	R1	
BLU	K	w	R2	
VIO	L	x	R5	
GRY	M	p	PARITY	
WHT	N	c	INTLK, N.O.	
W/BLK	P	Y	INTLK. N.C.	
W/BRN	R	j	HOLD	
W/RED	S	m	READY ------- CONTACTS	
	T			NO CONNECTION
	U			NO CONNECTION
W/ORN	V	R	PAGE -------- MAGNET	
	* ADD DECAL		A30 ON REAR OF WØ2Ø	

JACK ☐ PLUG ☒ FEMALE ☒ MALE ☐	LOCATION, LENGTH, ROUTE 1½ FT. FROM REAR OF WØ2Ø TO AMP SOCKET. USE SINGLE TEFLON WIRE AND WRAP IN BLACK TUBING. REMOVE RESISTORS FROM WØ2Ø AND ADD SOLID WIRE JUMPERS.			
COLOR	PIN WØ2Ø	PIN	NAME	REMARKS
BLK	A	X	+10V FUNCTION	
	B			NO CONNECTION
	C			NO CONNECTION
BRN	D	h	U.C. MODE --- CONTACTS	
RED	E	Z	L.C. MODE	
ORN	F	n	C1 N.O.	
YEL	H	W	C1 N.C.	
GRN	J	b	C2 - C6 N.O.	
BLU	K	a	C2 - C6 N.C.	
VIO	L	z	TAB	
GRY	M	AA	SPACE	
WHT	N	BB	BACK SPACE	
W/BLK	P	CC	CAR. RET.	
W/BRN	R	DD	INDEX	
W/RED	S	EE	SHIFT UP	
W/ORN	T	FF	SHIFT DOWN	
W/YEL	U	V	PAGE -------- CONTACTS	
	V			NO CONNECTION
	* ADD DECAL		A31 ON REAR OF WØ2Ø	

JACK ☐ PLUG ☒ FEMALE ☒ MALE ☐	LOCATION, LENGTH, ROUTE 1½ FT. FROM REAR OF WØ2Ø TO AMP SOCKET. USE SINGLE TEFLON WIRE AND WRAP IN BLACK TUBING. REMOVE RESISTORS FROM WØ2Ø AND ADD SOLID WIRE JUMPERS.			
COLOR	PIN WØ2Ø	PIN	NAME	REMARKS
BLK	A	d	+10V (CR,TAB,INTLK) CNTK	
	B			NO CONNECTION
	C			NO CONNECTION
BRN	D	A	T2 ---------- MAGNET	
RED	E	B	CK	
ORN	F	C	T1	
YEL	H	D	R2A	
GRN	J	E	R1	
BLU	K	F	R2	
VIO	L	H	R5	
GRY	M	L	TAB	
WHT	N	M	SP	
W/BLK	P	N	BSP	
W/BRN	R	S	UC	
W/RED	S	T	LC	
W/ORN	T	K	KBDLK	
W/YEL	U	U	GN	
W/GRN	V	P	CR ---------- MAGNET	
	* ADD DECAL		A32 ON REAR OF WØ2Ø	

JACK ☐ PLUG ☒	LOCATION, LENGTH, ROUTE 2½ FT. FROM 8-PIN JONES PLUG TO AMP SOCKET. USE SINGLE AWG #20 WIRE. WRAP IN BLACK TUBING. (FROM 5Ø PIN AMP TO POWER SUPPLY)
FEMALE ☒ MALE ☐	

COLOR	8-PIN PIN P-3Ø8-CCT	PIN	NAME	REMARKS
BLK	1	k	AC COMMON	
WHT	2	e	AC OFF-LINE	
RED	3	f	AC ON-LINE	
GRY	4	J	COMMON (-48V)	
GRN	5	HH	FRAME GROUND	
	6			NO CONNECTION
	7			NO CONNECTION
	8			NO CONNECTION

JACK ☐ PLUG ☒ FEMALE ☐ MALE ☒	LOCATION, LENGTH, ROUTE 3 FT. USE SINGLE TEFLON WIRE AND WRAP IN BLACK TUBING. ALLOW 4" OF WIRE TO EXTEND BEYOND TUBING. REMOVE RESISTORS FROM WØ2Ø AND ADD SOLID WIRE JUMPERS.			
COLOR	BOX PIN LOCATION	PIN	NAME	REMARKS
BLK	INT/PWR OFF	A	+10	
BRN	ALL LAMPS	B	-15V	
RED	BOX GND	C	GND	
ORN	INT (N.O.)	D	INTERRUP BUTTON	
YEL	PWR OFF	E	POWER-OFF SWITCH	
		F		NO CONNECTION
GRN	LAMP	H	RED LAMP	
		J		NO CONNECTION
BLU	LAMP	K	GREEN LAMP	
		L		NO CONNECTION
VIO	LAMP	M	T/W LAMP	
		N		NO CONNECTION
GRY	LAMP	P	SYSTEM LAMP	
		R		NO CONNECTION
WHT	LAMP	S	POWER LAMP	
W/BLK	LAMP	T	INT. LAMP	
		U		NO CONNECTION
W/BRN	LAMP	V	INT. LAMP	
	* ADD DECAL A29 ON REAR OF WØ2Ø			

Control Box Logic (Sheet 1) CL-A-616-0-21

JACK ☐ PLUG [X] FEMALE ☐ MALE [X]			LOCATION, LENGTH, ROUTE 4 FT. USE SINGLE TEFLON AWG.#18 WIRE. COVER WITH BLK TUBING AND ALLOW 4" OF WIRE TO EXTEND (FROM CONTROL BOX TO POWER SUPPLY)	
COLOR	BOX PIN LOCATION	PIN	NAME	REMARKS
WHT	PWR OFF	1	OFF	
RED	PWR COM	2	COMMON	
BLK	PWR ON	3	ON	
GRN	BOX GND	4	GROUND	
		5		NO CONNECTION
		6		NO CONNECTION

JACK [X] PLUG [ ] FEMALE [ ] MALE [X]			LOCATION, LENGTH, ROUTE 1 FT. FROM REAR OF WØ21 USE SINGLE TEFLON WIRE AND WRAP IN BLACK TUBING. (FROM LOGIC TO SIDE) ALLOW 2 1/2" OF WIRE TO EXTEND BEYOND TUBING	
COLOR	PIN WØ21	PIN	NAME	REMARKS
	A			NOT USED ON WØ21
	B			NOT USED ON WØ21
BLK	C	9	GROUND 7	
BRN	D	2	INC LINE 3	
RED	E	4	LINE (1)	
W/BRN	F	1Ø	GROUND	
ORN	H	3	PWR CLR DLY (Ø) 2Ø	
YEL	J	1	GROUND 1	
GRN	K	5	INC LINE 5	
	L			NO CONNECTION
BLU	M	6	INC LINE	
	N			NO CONNECTION
VIO	P	7	INC LINE 6	
	R			NO CONNECTION
GRY	S	8	LINE (1) 2	
WHT	T		TRANS. PRIMARY	PRIMARY BROWN
	U			NO CONNECTION
W/BLK	V		TRANS. PRIMARY	PRIMARY GREEN
	* ADD DECAL	D8 ON REAR OF WØ21.		
NOTE: WHEN MAKING CABLE LEAVE P-31Ø-RP CONNECTIONS HANGING.				

COLOR	NAME	PIN	PIN	REMARKS
	RES	A11H	A11S	1K ¼w
	RES	A11S	A11E	470 OHM ¼w
(TANT)	CAP	BØ1K(+)	BØ1H (-)	100 ufd
	RES	CØ9K	GND	470 OHM ¼w
	RES	C29H	C29S	1K ¼w
	RES	C29S	C29E	470 OHM ¼w
(TANT)	CAP	BØ7S(+)	BØ7R(-)	1ØØ ufd
	RES	BØ8H	BØ8S	1K ¼w
	RES	BØ8S	BØ8E	47Ø OHM ¼w
(TANT)	CAP	B15S(+)	B15R(-)	2.2 ufd
	RES	B14H	B14S	1K ¼w
	RES	B14S	B14E	47Ø OHM ¼w
	RES	B11H	B11S	1K ¼w
	RES	B11S	B11E	47Ø OHM ¼w
	RES	B13H	B13S	1K ¼w
	RES	B13S	B13E	47Ø ¼w
	RES	B1ØH	B1ØS	1K ¼w
	RES	B1ØS	B1ØE	47Ø OHM ¼w
	DIODE	CØ2J	CØ1F	D664
(TANT)	CAP	B24J(+)	B24H(-)	2Ø ufd
(TANT)	CAP	B24S(+)	B24R(-)	1ØØ ufd
	CAP	C23H	C23J	220 MMFD

COLOR	NAME	PIN	PIN	REMARKS
BLUE	RDY ENABLE(1)	C13A	BØ9F	
BLUE	T/W OK(1)	C13B	AØ2L	
BLUE	GREEN(1)	C13C	AØ1J	
WHITE	OUT FINISH—◆	C13D	C19R	
WHITE	∼OUT DONE —◆	C13E	C19T	
BLUE	OUT PAR(1)	C13F	D22P	
BLUE	OUT ACT(1)	C13H	C18T	
BLUE	OUT ENB(1)	C13J	D21J	
BLUE	STOP(1)	C13K	D21T	
BLUE	OSR 0(1)	C13L	C17J	
BLUE	OSR 1(1)	C13M	C17T	
BLUE	OSR 2(1)	C13N	D15L	
BLUE	OSR 3(1)	C13P	D16L	
BLUE	OSR 4(1)	C13R	D17L	
BLUE	OSR 5(1)	C13S	D18L	
BLUE	OSR 6(1)	C13T	D19L	
BLUE	OSR 7(1)	C13U	D2ØL	
BLUE	LINE(1)	C13V	D22J	
NOTE:				
1.	ALL CONNECTORS ARE WØ27.			

Inter-Panel Connector Typewriter Console (Sheet 1) WS-A-616-0-13

COLOR	NAME	PIN	PIN	REMARKS
BLUE	INT(1)	C14A	AØ1T	
BLUE	SYS(1)	C14B	AØ3J	
BLUE	INC CNT 0(1)	C14C	D23J	
BLUE	INC CNT 1(1)	C14D	D23T	
BLUE	INC CNT 2(1)	C14E	D25J	
BLUE	INC PARITY(1)	C14F	D25T	
BLUE	INC ACT(1)	C14H	D26T	
BLUE	INC PAR ERR(1)	C14J	B9T	
WHT	INC LINE—◆	C14K	C19L	
YEL	ISR 0(Ø)	C14L	D27H	
YEL	ISR 1(Ø)	C14M	D27S	
YEL	ISR 2(Ø)	C14N	D28H	
YEL	ISR 3(Ø)	C14P	D28S	
YEL	ISR 4(Ø)	C14R	D29H	
YEL	ISR 5(Ø)	C14S	D29S	
YEL	IST 6(Ø)	C14T	D3ØH	
YEL	ISR 7(Ø)	C14U	D3ØS	
BLUE	INC LAST(1)	C14V	D26J	

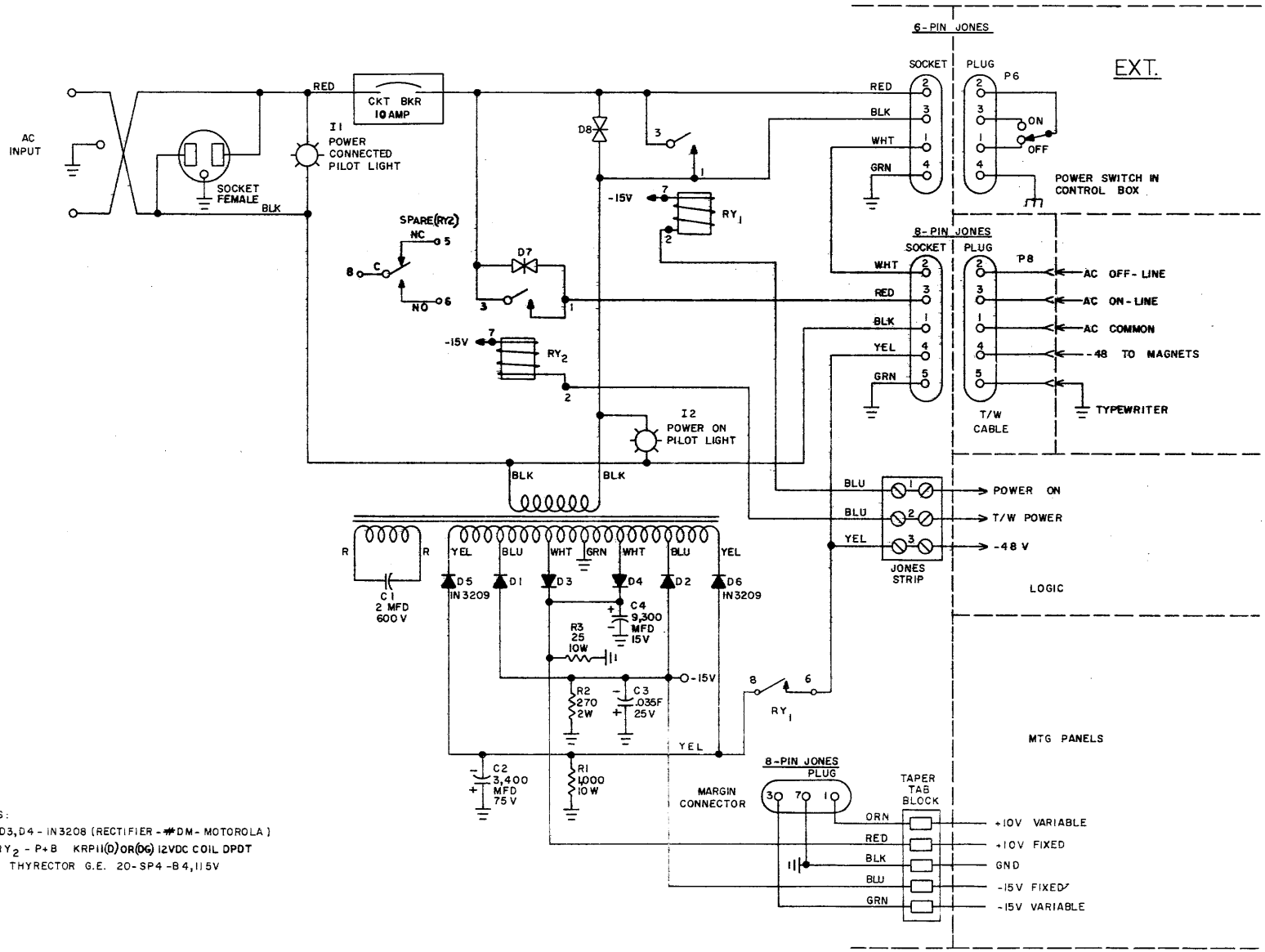
Inter-Panel Connector Typewriter Console (Sheet 2) WS-A-616-0-13

COLOR	NAME	PIN	PIN	REMARKS
BLUE	OCB 0(1)	D13A	A19F	
BLUE	OCB 1(1)	D13B	A19M	
BLUE	OCB 2(1)	D13C	A19T	
BLUE	OCB 3(1)	D13D	A2ØJ	
BLUE	OCB 4(1)	D13E	A2ØP	
BLUE	OCB 5(1)	D13F	A21J	
BLUE	OCB FULL(1)	D13H	A21P	
BLUE	CR HOLD(1)	D13J	BØ9M	
WHITE	READY——◆	D13K	BØ5F	
BLUE	PAGE GO(1)	D13L	C25J	
BLUE	ENERGIZE(1)	D13M	C25T	
BLUE	STATUS BIT(1)	D13N	C18J	
BLUE	ICB 1(1)	D13P	A22F	
BLUE	ICB 2(1)	D13R	A22M	
BLUE	ICB 3(1)	D13S	A22T	
BLUE	ICB 4(1)	D13T	A23F	
BLUE	ICB 5(1)	D13U	A23M	
BLUE	ICB 6(1)	D13V	A23T	

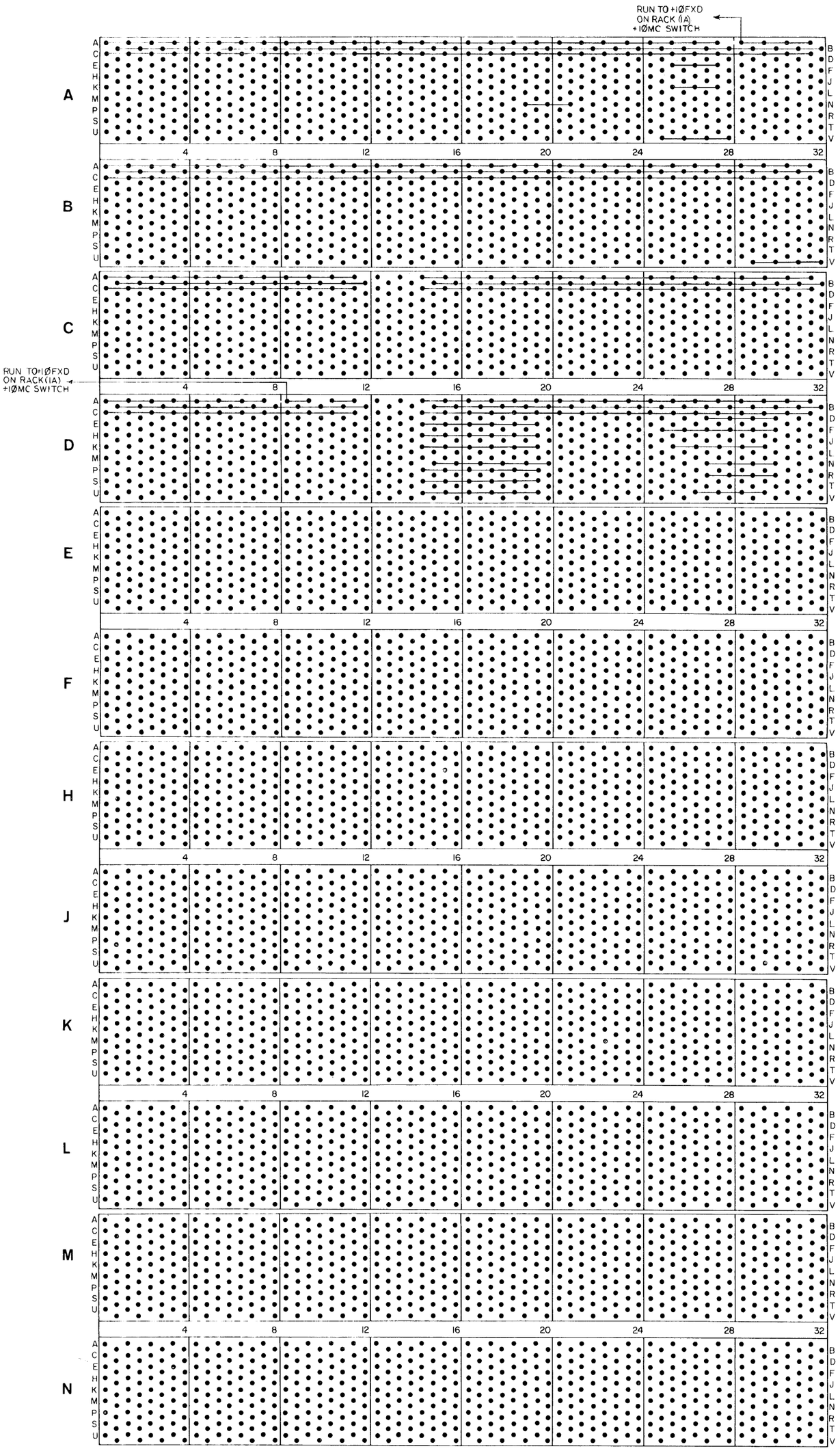
Inter-Panel Connector Typewriter Console (Sheet 3) WS-A-616-0-13

COLOR	NAME	PIN	PIN	REMARKS
BLUE	RDY SYNC(1)	D14A	AØ9J	
BLUE	RDY CHANGE(1)	D14B	A1ØJ	
BLUE	INT SYNC(1)	D14C	AØ9T	
BLUE	INT KEY(1)	D14D	A1ØT	
BLUE	CHAR RQST(1)	D14E	AØ3T	
BLUE	SIGNAL RQST(1)	D14F	AØ4J	
BLUE	STATUS RQST(1)	D14H	AØ4T	
WHITE	PWR CLR DLY—◆	D14J	D11S	
WHITE	MOTOR DLY——◆	D14K	BØ7V	
BLUE	TURN ON(1)	D14L	BØ3J	
WHITE	PWR OFF DLY—◆	D14M	BØ1M	
BLUE	POWER ON(1)	D14N	BØ3T	
BLUE	CLK 0(1)	D14P	A16J	
BLUE	CLK 1(1)	D14R	A16T	
BLUE	CLK 2(1)	D14S	A15J	
BLUE	CLK 3(1)	D14T	A15T	
BLUE	CLK 4(1)	D14U	A14J	
BLUE	CLK 5(1)	D14V	A14T	

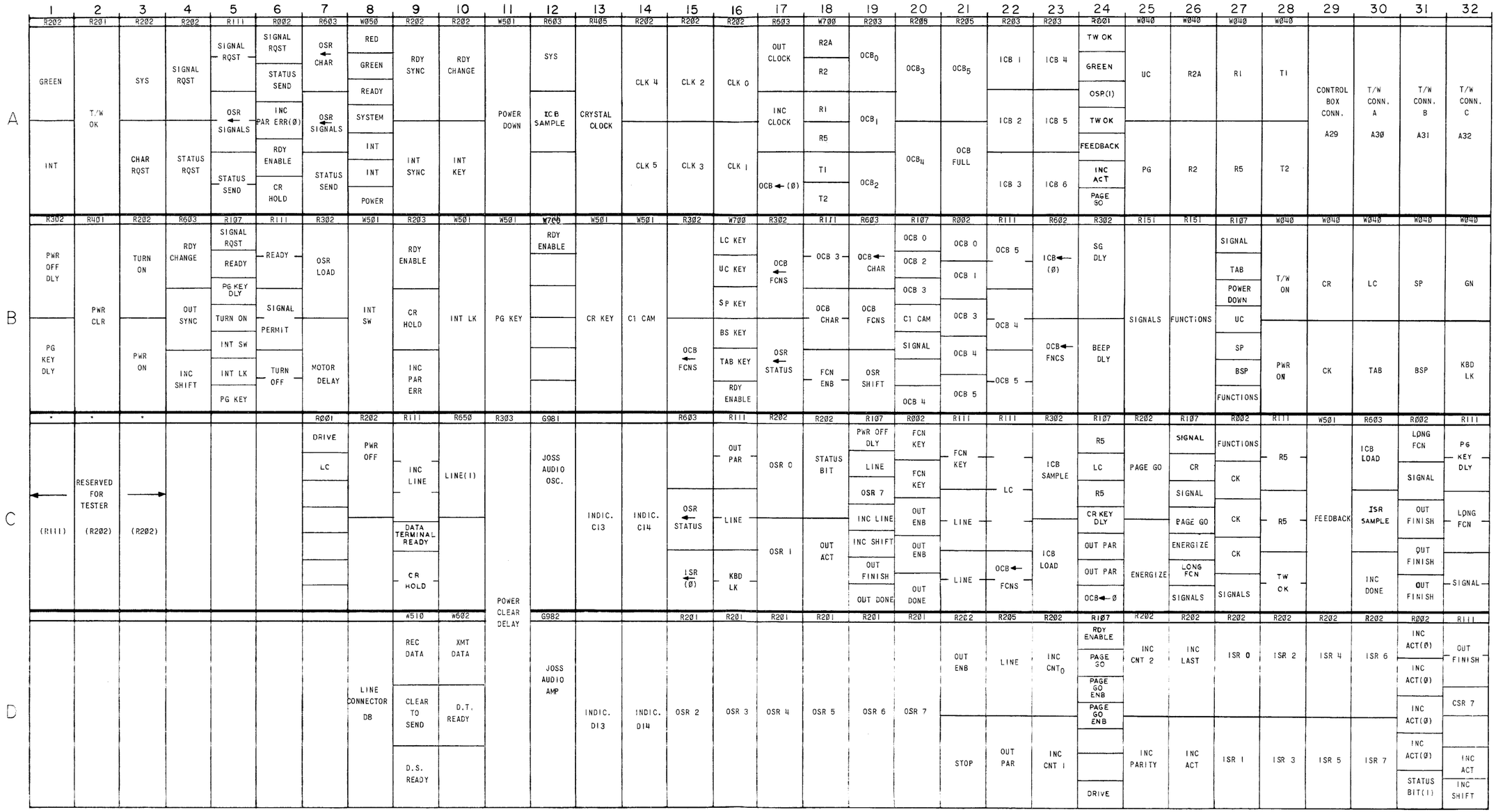
Inter-Panel Connector Typewriter Console (Sheet 4) WS-A-616-0-13



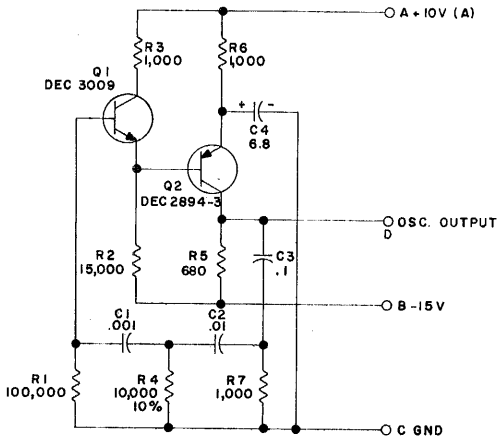
NOTES:
D1,D2,D3,D4 - IN3208 (RECTIFIER - #DM- MOTOROLA)
RY_1 + RY_2 - P+B KRPII(D) OR(DG) 12VDC COIL DPDT
D7,D8 THYRECTOR G.E. 20-SP4-B4,115V



Bus Schedule WD-D-616-0-15

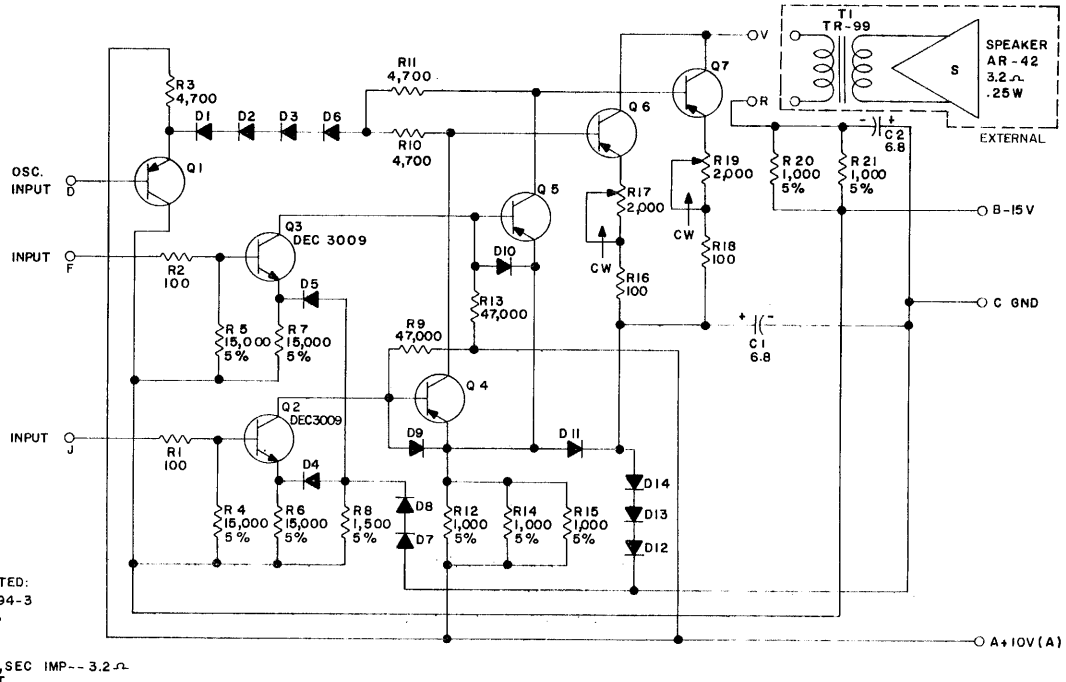


* FOR OFF-LINE PURPOSES ONLY. NOT INCLUDED AS PART OF UML MODULES.



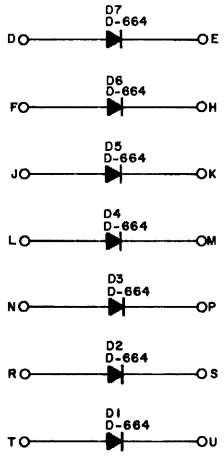
UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W, 5%
CAPACITORS ARE MFD

JOSS Audio Oscillator RS-B-G981

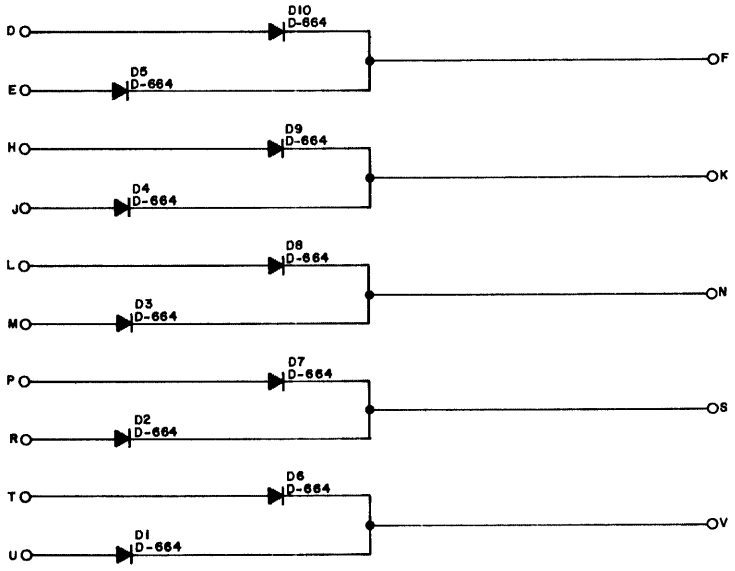


UNLESS OTHERWISE INDICATED:
TRANSISTORS ARE DEC 2894-3
RESISTORS ARE 1/4W, 10%
CAPACITORS ARE MFD
DIODES ARE D-662
T1 IS PRI IMP -- 500Ω, SEC IMP -- 3.2Ω
R17, R19 ARE BOURNS POT

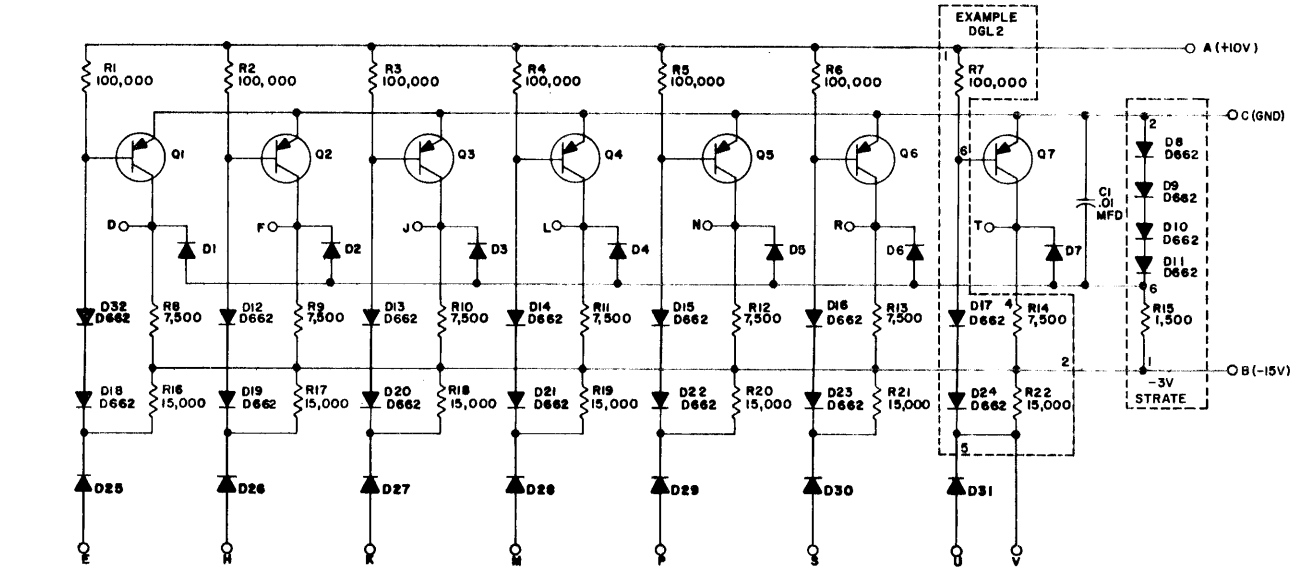
JOSS Audio Amplifier RS-B-G982



Diode Network RS-B-R001

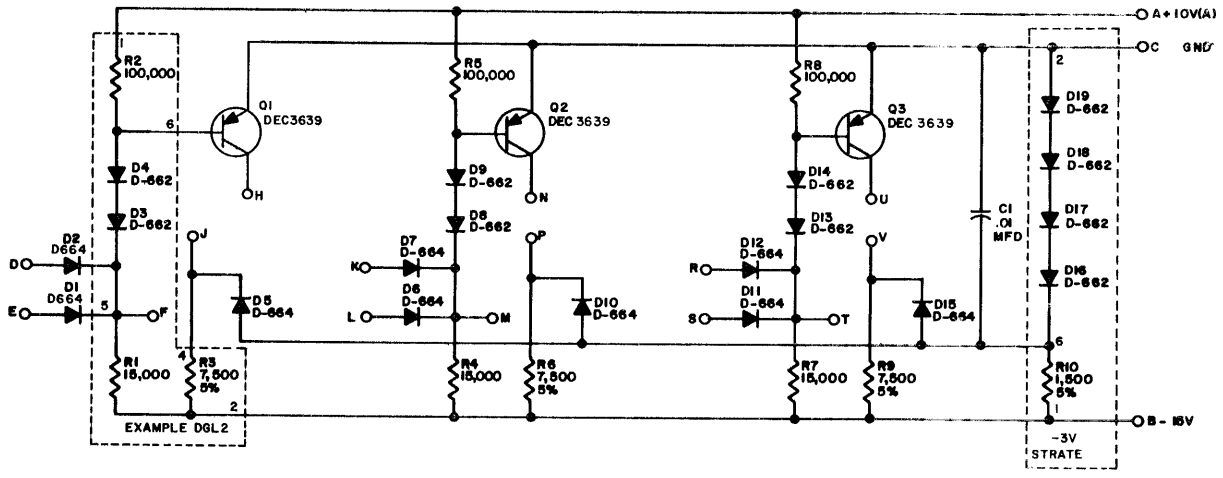


Diode Cluster RS-B-R002



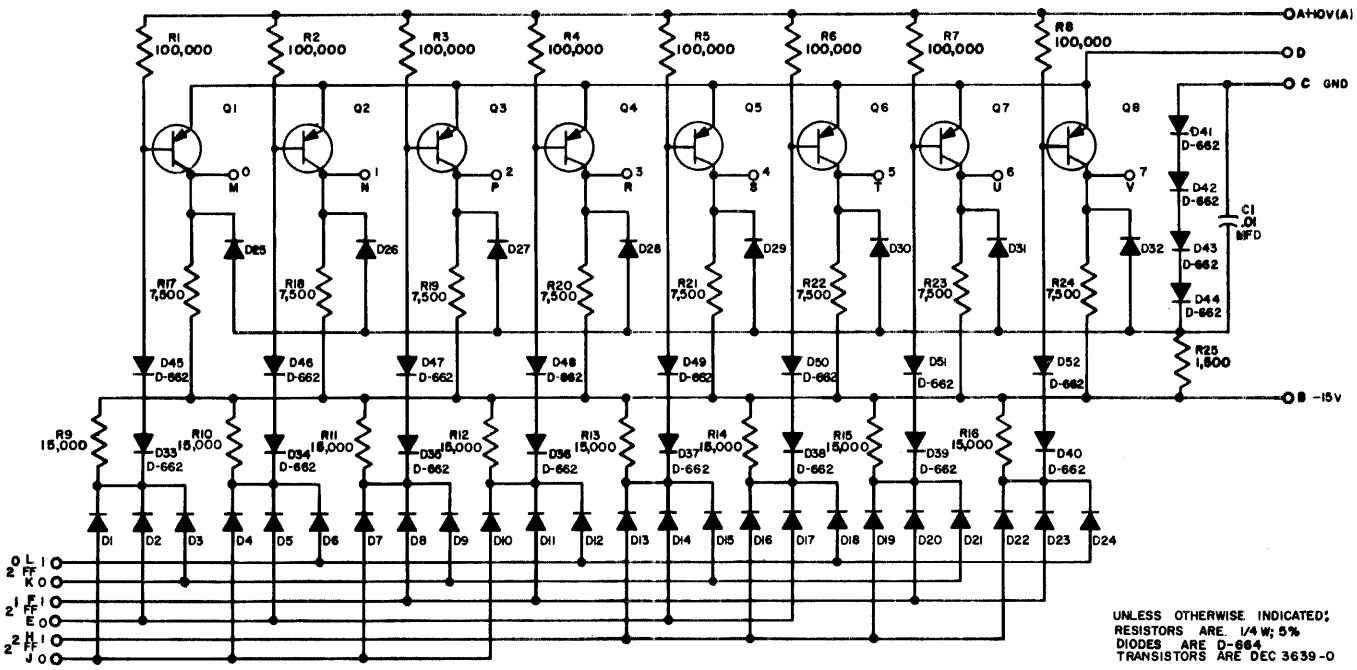
UNLESS OTHERWISE INDICATED;
RESISTORS ARE 1/4W; 5%
DIODES ARE D-664
TRANSISTORS ARE DEC 3639-0
PRINTED CIRCUIT REV. FOR
DGL BOARD IS SIA

Inverter RS-B-R107

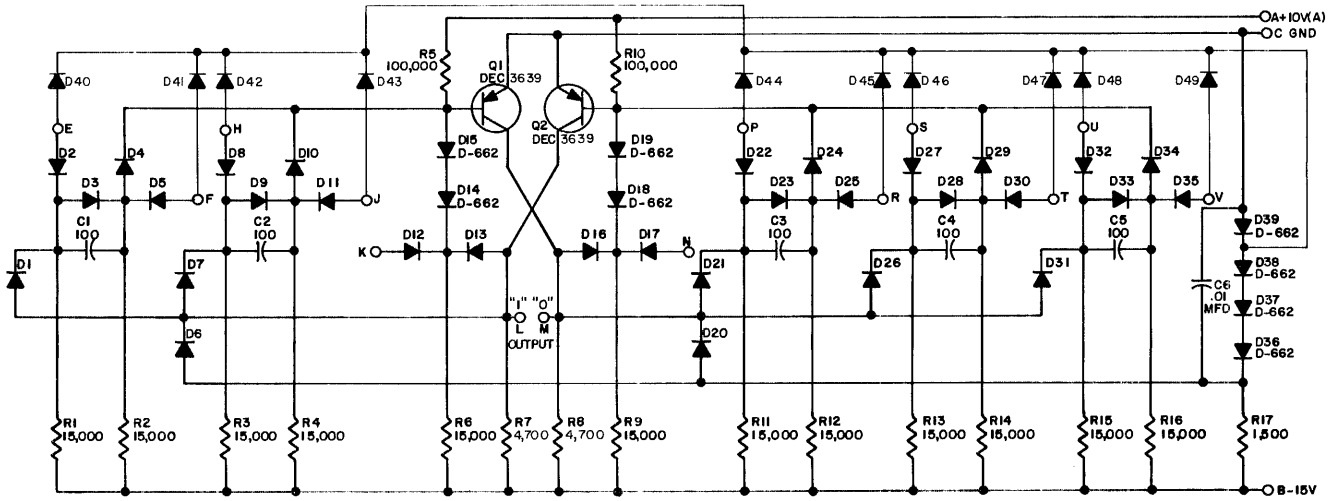


UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W; 5%
PRINTED CIRCUIT REV. FOR
DGL BOARD IS SIA

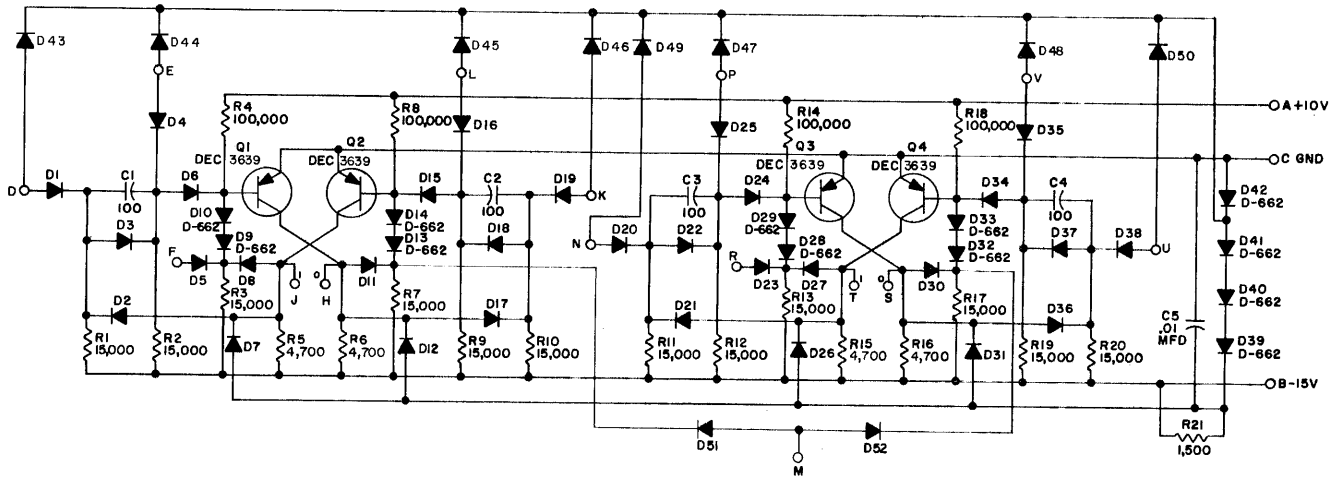
Diode Gate RS-B-R111



Binary-to-Octal Decoder RS-B-R151

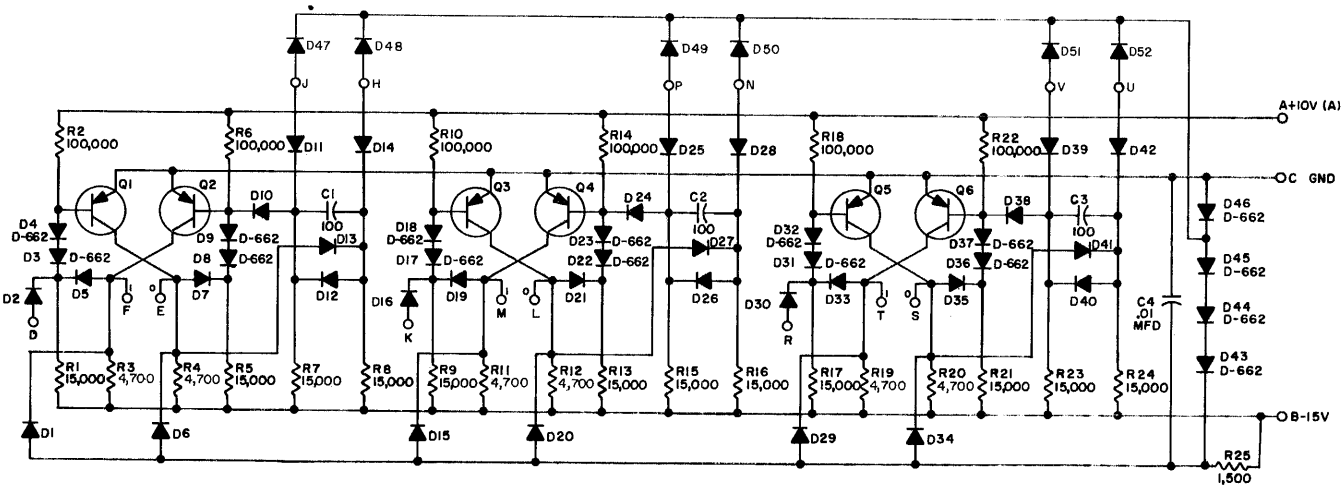


Flip-Flop RS-B-R201



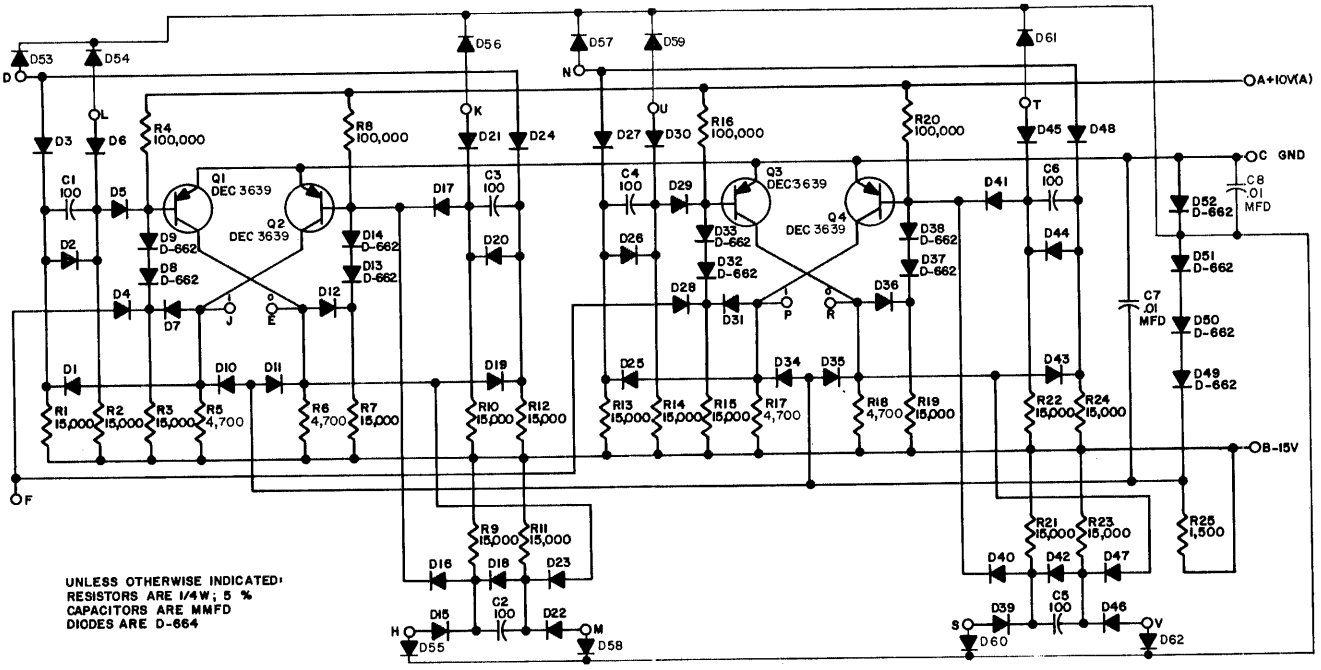
UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W, 5%
CAPACITORS ARE MMFD
DIODES ARE D-664

Dual Flip-Flop RS-B-R202

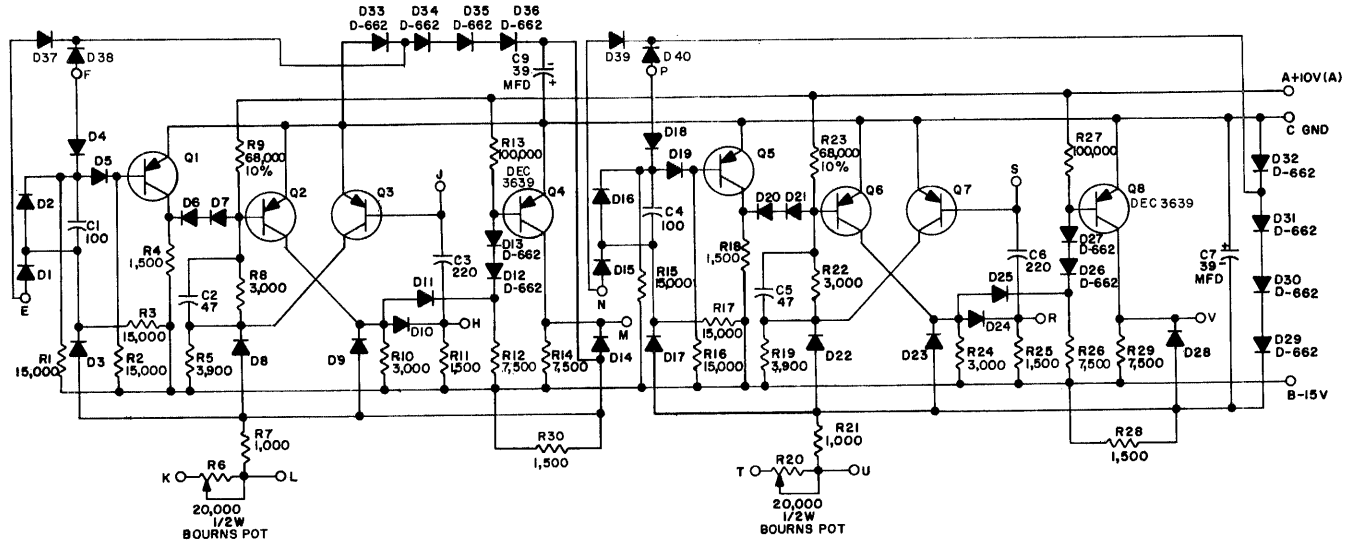


UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W, 5%
CAPACITORS ARE MMFD
DIODES ARE D-664
TRANSISTORS ARE DEC 3639

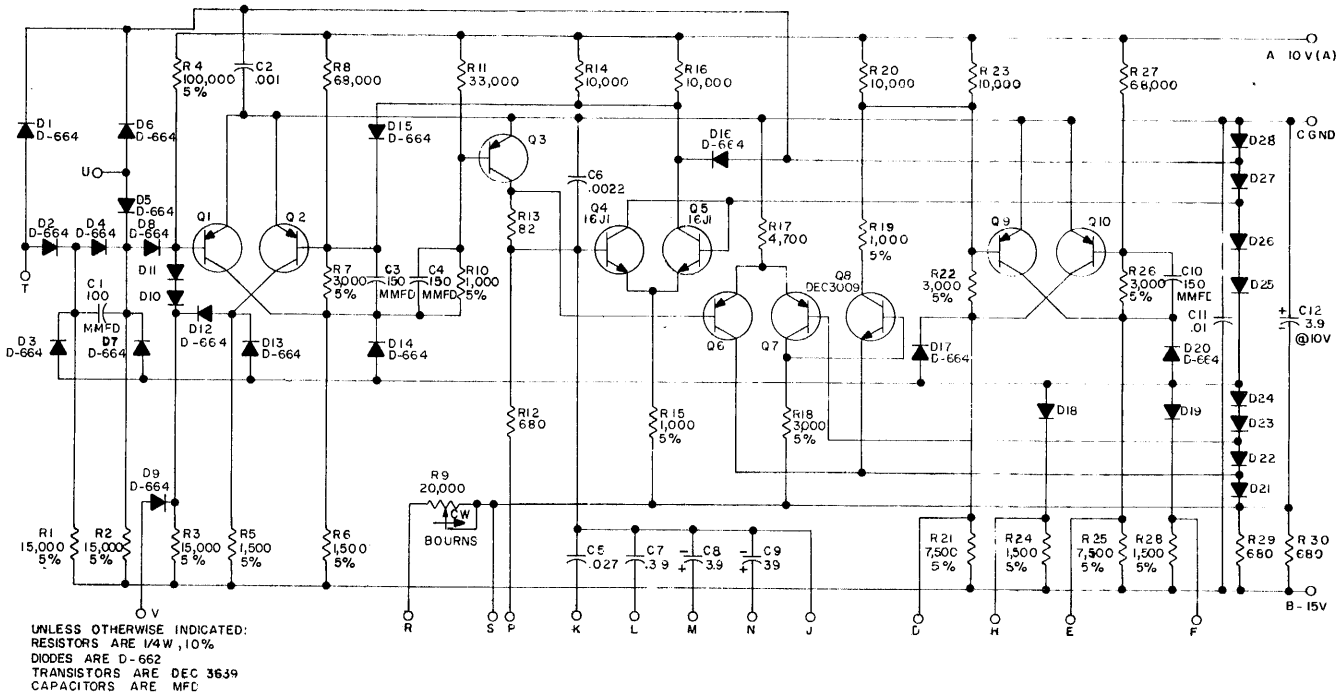
Triple Flip-Flop RS-B-R203



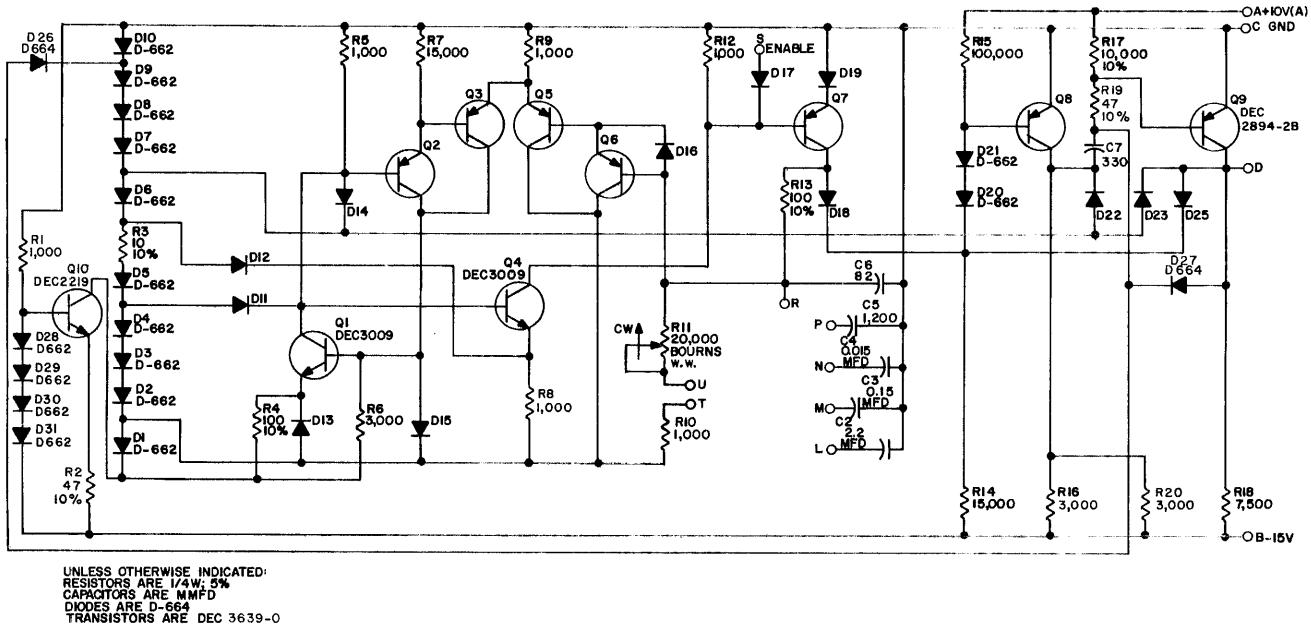
Dual Flip-Flop RS-B-R205



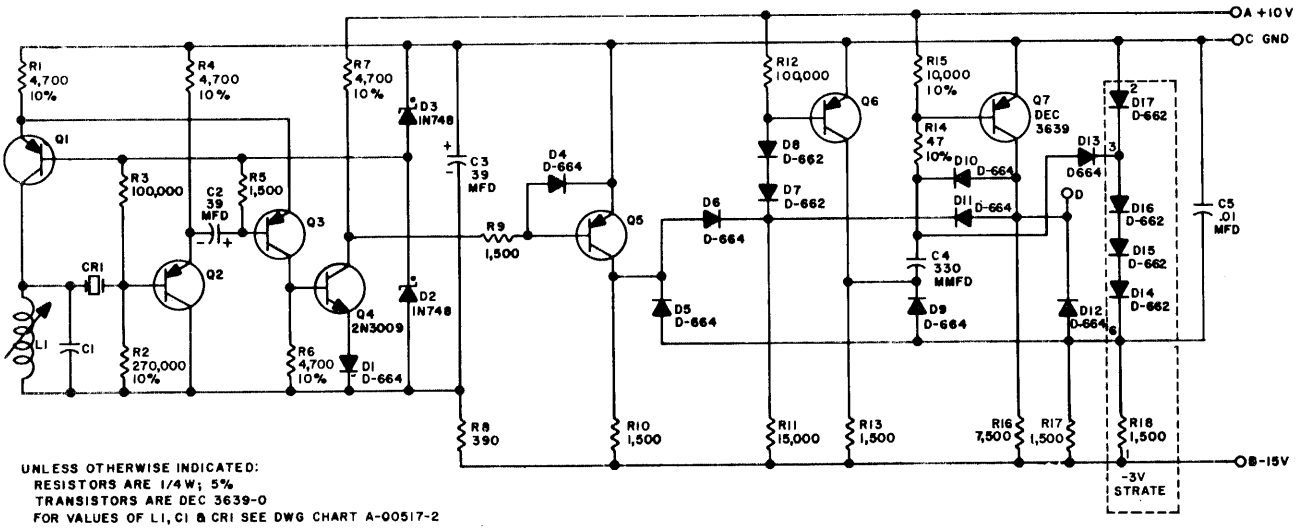
Delay RS-B-R302



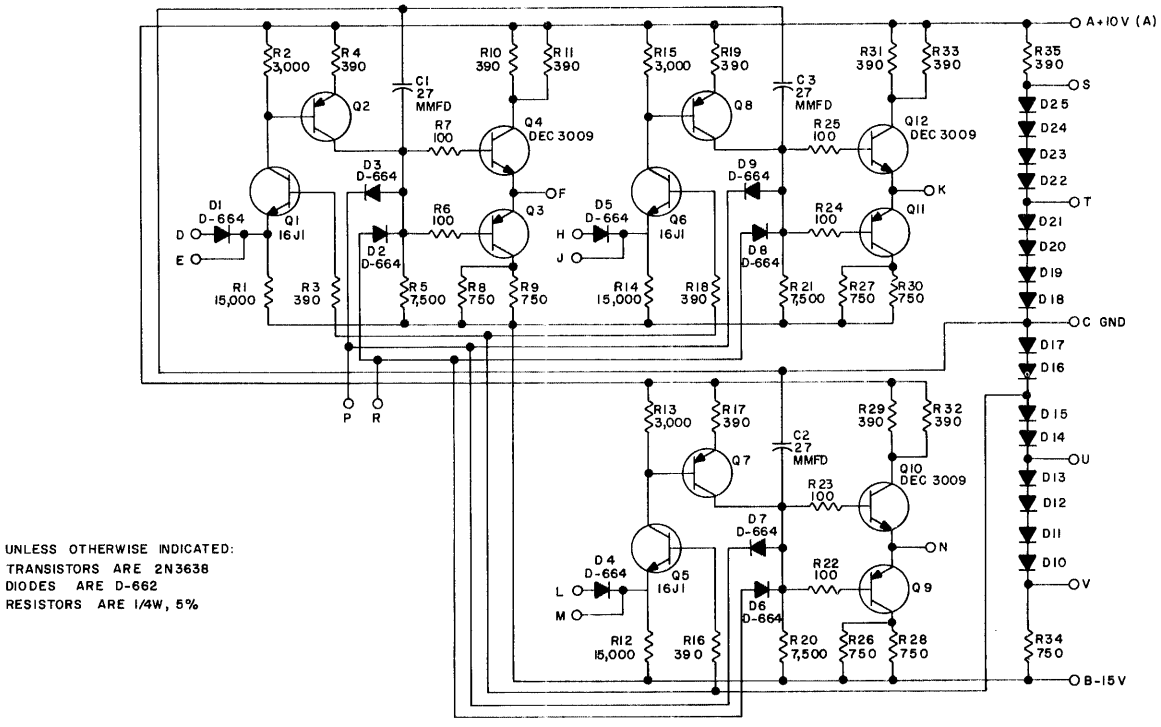
Integrating One Shot RS-B-R303



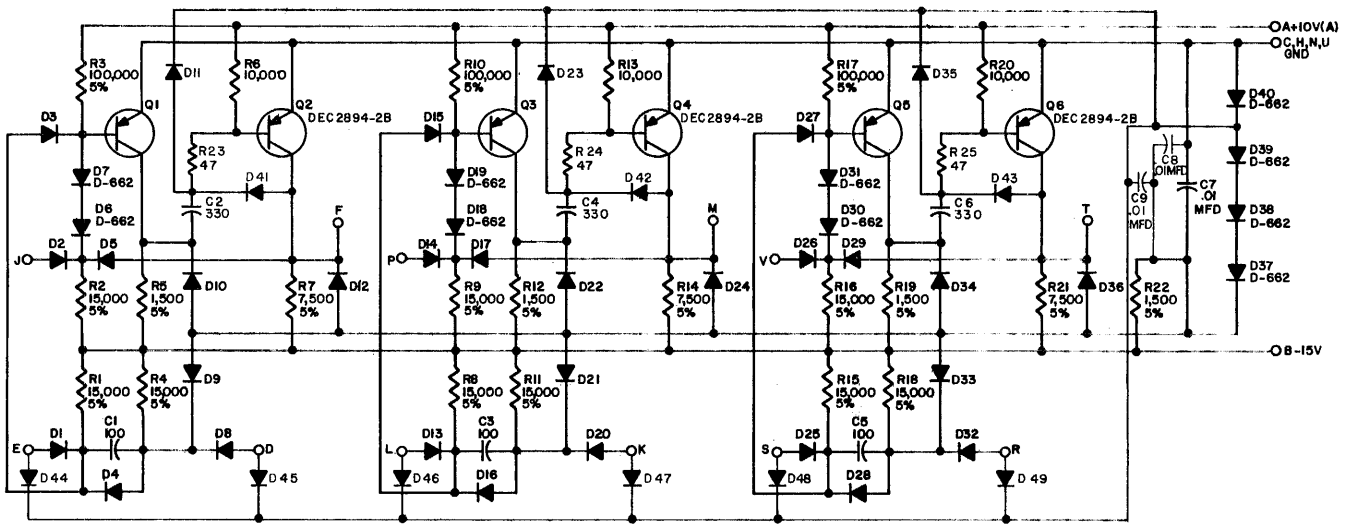
Clock RS-B-R401



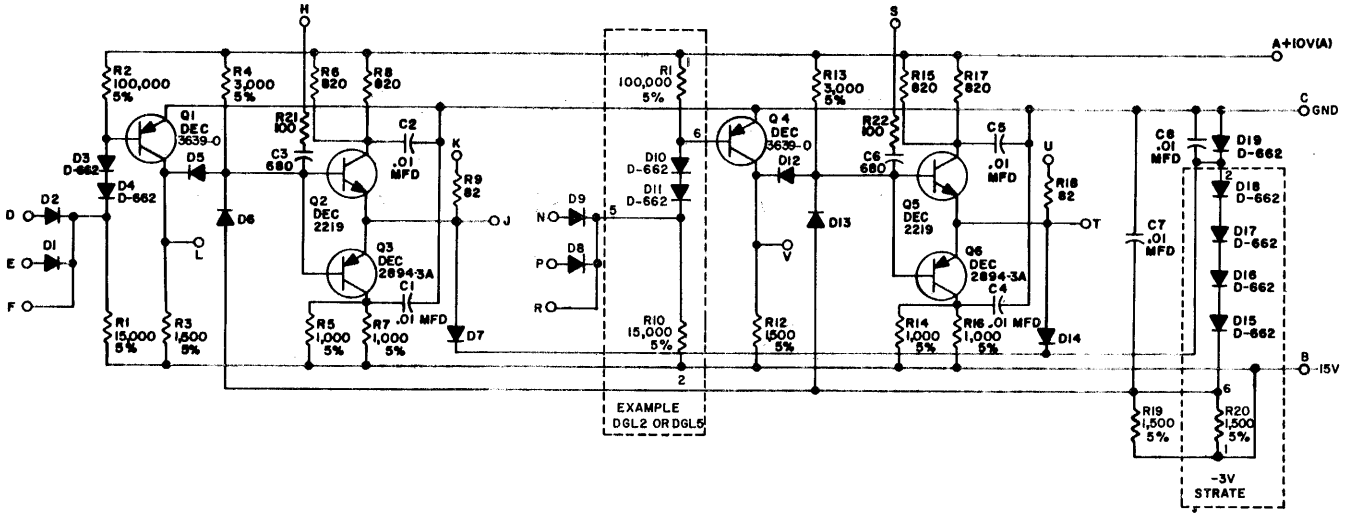
Crystal Clock RS-B-R405



Pulse Amplifier RS-B-R602

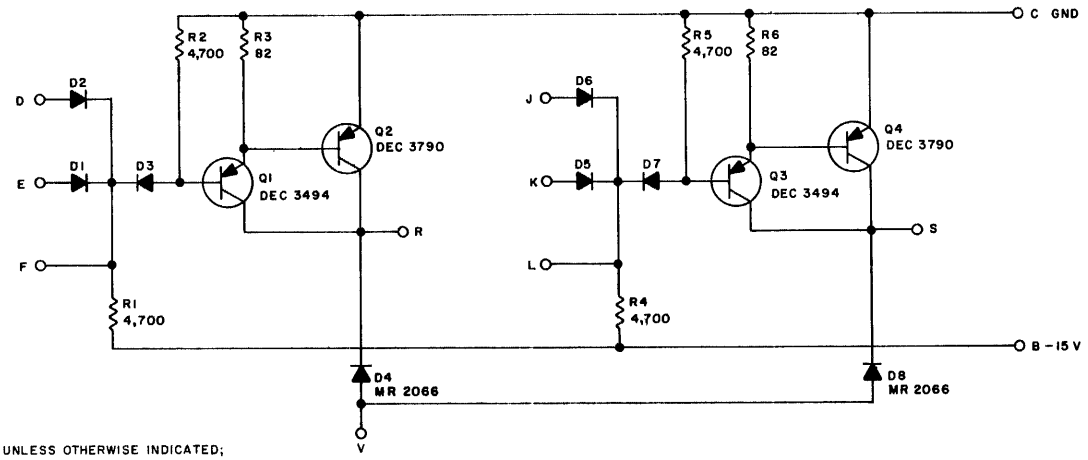


Pulse Amplifier RS-B-R603



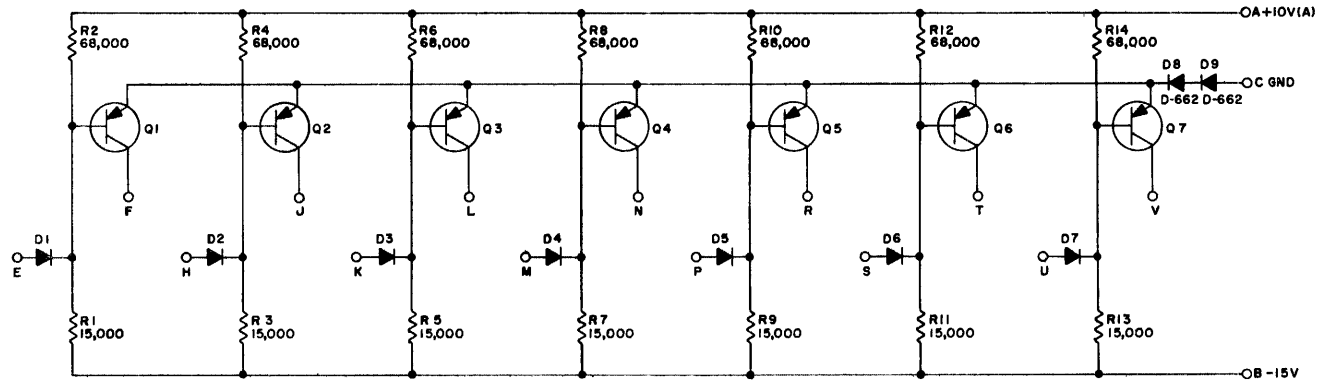
UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W, 10%
CAPACITORS ARE MMFD
DIODES ARE D-664
PRINTED CIRCUIT REV. FOR DGL BOARD IS SJA

Bus Driver RS-B-R650



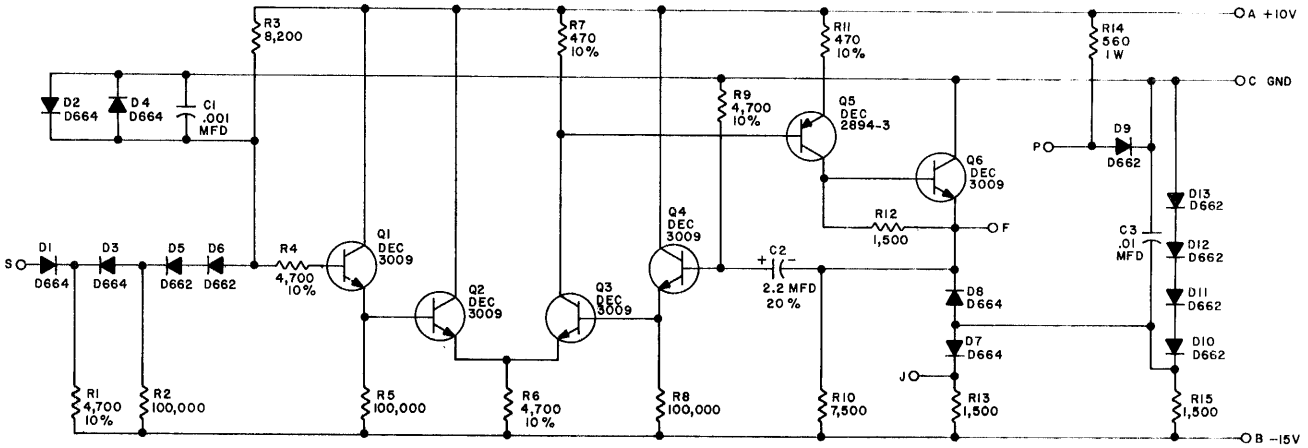
UNLESS OTHERWISE INDICATED;
RESISTORS ARE 1/4W; 10%
DIODES ARE D-664

Solenoid Driver RS-B-W040



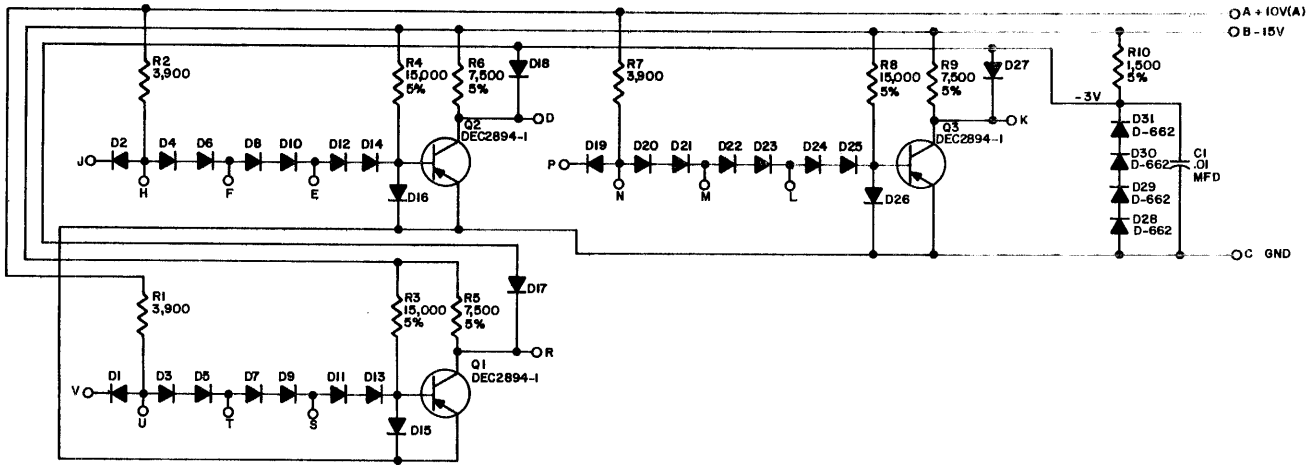
UNLESS OTHERWISE INDICATED;
RESISTORS ARE 1/4W; 10%
DIODES ARE D-664
TRANSISTORS ARE DEC 3638AB OR DEC 6534B

Indicator Driver RS-B-W050



UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W, 5%

Initial Transient Detector RS-B-W504

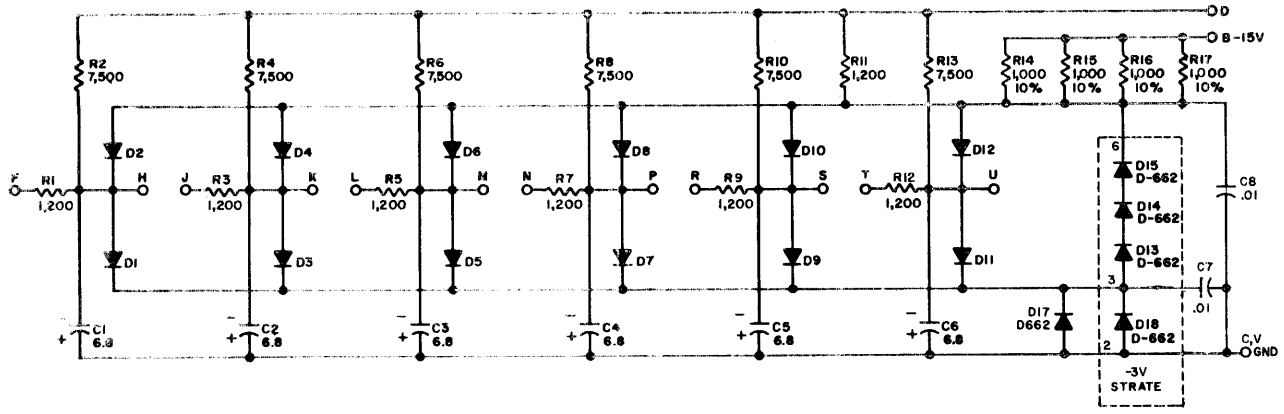


UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W, 10%
DIODES ARE D-664

Positive Level Converter RS-B-W510

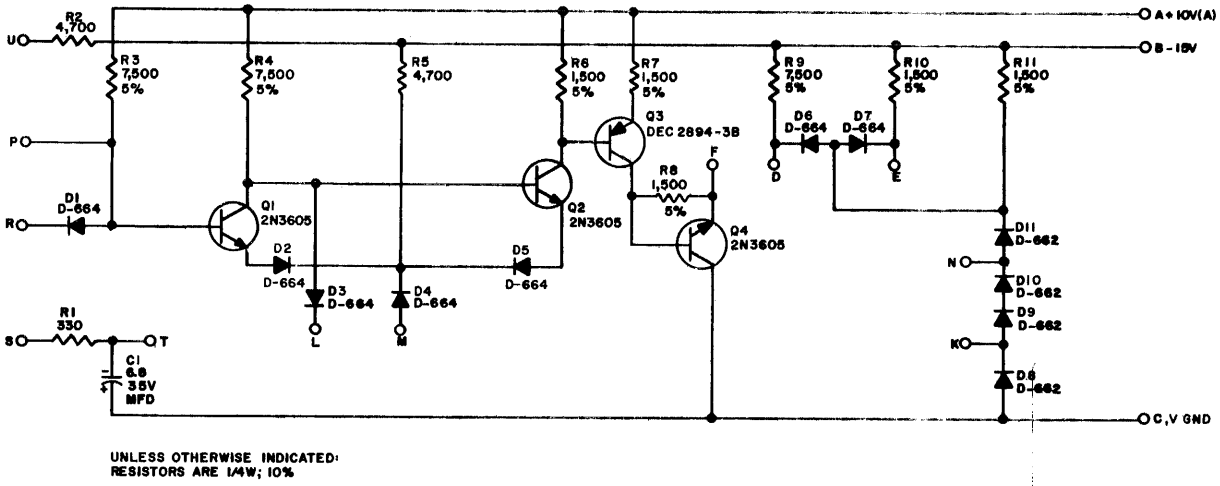
(To be supplied)

Bipolar Level Amplifier RS-B-W602



UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4 W, 5%
CAPACITORS ARE MFD
DIODES ARE D-664

Switch Filter RS-B-W700



UNLESS OTHERWISE INDICATED:
RESISTORS ARE 1/4W; 10%

Schmitt Trigger RS-B-W501

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