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Keyer Memory

OPERATIONS MANUAL

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LIST OF ILLUSTRATIONS

KEYER MEMORY

Weight and Power

Total Weight Less Batteries	3.8 lbs.
Case Weight	2.7 lbs.
Net Weight	1.1 lbs.
Equivalent Case Weight in Aluminum	0.9 lbs.
Net Weight	1.1 lbs.
Theoretical Total Weight	2.0 lbs.

Battery Drain

Function Switch Position	D-C Current Milliampers	Power Milliwatts
Standby (S)	218	544
Receive (R)	238	595
Idle (I)	230	575
Transmit (X) Standby	270	675
Transmit (X) Operating	240	600

Battery Source - Sonotone nickel cadium size D rechargeable cells - terminal voltage 1.25 volts each.

INTRODUCTION

This manual covers the operating procedures for the NORTHVILLE Keyer Memory. Included are a complete description of the equipment and types of circuits utilized and an itemized parts list. Since the equipment has not been designed for maintainence by the operator, maintenance instructions are limited to the procedures for disassembly and reassembly.

The NORTHVILLE Keyer Memory is a portable storage device which generates teletype code. It is intended for use with the RT-6 transmitter. The Keyer Memory replaces the KE/B-9P portable automatic keyer.

The NORTHVILLE Keyer Memory has the following features:

- battery powered
- asynchronous input
- synchronous teletype-code output
- storage capacity of 2560, 1-bit words
- modified coincident-current memory
- completely portable storage device

Although not designed to withstand stringent environment, the Keyer Memory does conform closely to certain military specifications in choice of components.

DESCRIPTION

The Keyer Memory is enclosed in a brass case which is 8 inches by 4 inches by 1 5/8 inches with the battery holder closed (figure 1). The complete unit weighs pounds without batteries. On top of the case are mounted the battery holder, a keyboard, an indicator light and GO and CLEAR pushbuttons and the selector switch lock. A 5-position mode selector switch is mounted on the end of the case and the output cable plug receptacle is mounted on the side.

BATTERY MOUNT

The battery mount is designed to fold flat against the cover when batteries are not in place. This fixture holds two D-size batteries. Battery polarity is inscribed on the mount.

5-POSITION MODE SELECTOR SWITCH

This switch controls and indicates the mode of the machine. When the shaft is all the way in, the equipment is in the OFF position. Operating modes are selected by pulling the shaft outward for each of the sequential mode positions until the appropriate mode indication is exposed. The operating modes are STANDBY (S), RECEIVE (R), IDLE (I) and TRANSMIT (X). The selector switch lock retains the shaft in the selected position and must be disengaged to move the shaft to another position.

CABLE PLUG RECEPTACLE

The plug receptacle used with the Keyer Memory is located on the side of the case and is provided with a built-in ground lug. The plug connecting output to receiving equipment can be inserted only in a manner ensuring proper polarity.

INDICATOR

The indicator consists of a miniature, incandescent, low-voltage lamp housed within a plexiglass body. The body has been designed to provide maximum illumination through the convex lens on top. A lit condition indicates that battery power is sufficient and in some cases that the equipment is functioning properly.

KEYER

The keyboard comprises pushbuttons for characters 1 through 0, ERROR (E) and SPACE (S) and is used to provide the information to be stored in the memory. Depression of a pushbutton inserts one character into the memory.

GO AND CLEAR SWITCHES

These are miniature pushbutton switches. To avoid projection above the top surface of the Keyer Memory, these switches have been recessed in the cover. The pushbuttons are used to commence transmission of characters and to clear the memory.

BATTERIES

Power for operating the equipment is furnished by two series-connected Nicad batteries. These size D, 2.5-volt batteries provide power for 2 unregulated and 4 regulated voltages.

ADAPTER CORDS

The two adapter cords provide a choice of either frequency shift keying (FSK) or on-off keying (CW). In either case, a single plug-type connection to the transmitter is required.

CIRCUITS

The Keyer Memory uses a Mode Selector Switch circuit, a power supply, a modified coincident current memory, pulse generators, driver and switch circuits, address circuits, a sense amplifier, an indicator circuit, a one-shot multivibrator, logic circuits, a master oscillator, and an output buffer.

Mode Selector Switch Circuit

This circuit consists of a 3-deck, ganged, 5-position switch and the gating necessary to provide the logical bias outputs.

Power Supply

The power supply is composed of the Nicad batteries, a dc-to-dc converter and four transistor regulators. This supply provides six rectified output voltages; plus 2.0 volts, minus 2.0 volts, plus 5.0 volts, minus 5.0 volts, plus 7.5 volts and minus 7.5 volts. All voltages except the plus 7.5 and minus 7.5 are regulated. The dc-to-dc converter consists of a free-running multivibrator transformer coupled to rectifier circuits. The frequency of the power supply oscillator is 30 kilocycles $\pm$ 10 kilocycles.

Modified Coincident Current Memory

Ferrite cores are arranged in a 64 by 40 matrix. Bias current is carried by a single line threaded through all of the cores. X and Y currents are delivered through an 8 by 8 driver switch and a 4 by 10 driver switch, respectively. The use of a 1-bit word allows for a switching-to-no switching current ratio of 3 to 1.

Pulse Generators

There are three pulse generators providing, respectively, X-pulses, Y-pulses, and bias pulses. Each generator consists of two delay multivibrators in tandem followed by two stages of current amplification.

Driver and Switch Circuits

The purpose of the driver and switch circuits is to steer the current pulses of the X and Y current generators through the proper X and Y memory core lines in the proper direction and to steer the bias current in the proper direction through the bias winding.

Address Circuits

These circuits consist of 13 complemented flip-flops in tandem.

Sense Amplifier

The sense amplifier consists of three stages of differential amplification followed by a single-end output. Associated with the sense amplifier is a 1-transistor multivibrator which generates the strobe pulse and a 5-input AND gate which controls the sense amplifier output so that this amplifier core output is fed to other circuitry at the proper time.

Indicator Circuit

The indicator circuit consists of a series of AND and OR gates followed by a buffer stage. When activated, the light is connected across one of the batteries.

One-Shot Multivibrator

This is a standard one-shot. A negative pulse of a duration sufficient to permit feedback action is provided as an input. The output pulse is a function of the RC time constant.

Logic Circuits

Logic circuits used in the Keyer Memory consist of AND gates, OR gates, set-reset flip-flops, complemented flip-flops and inverters.

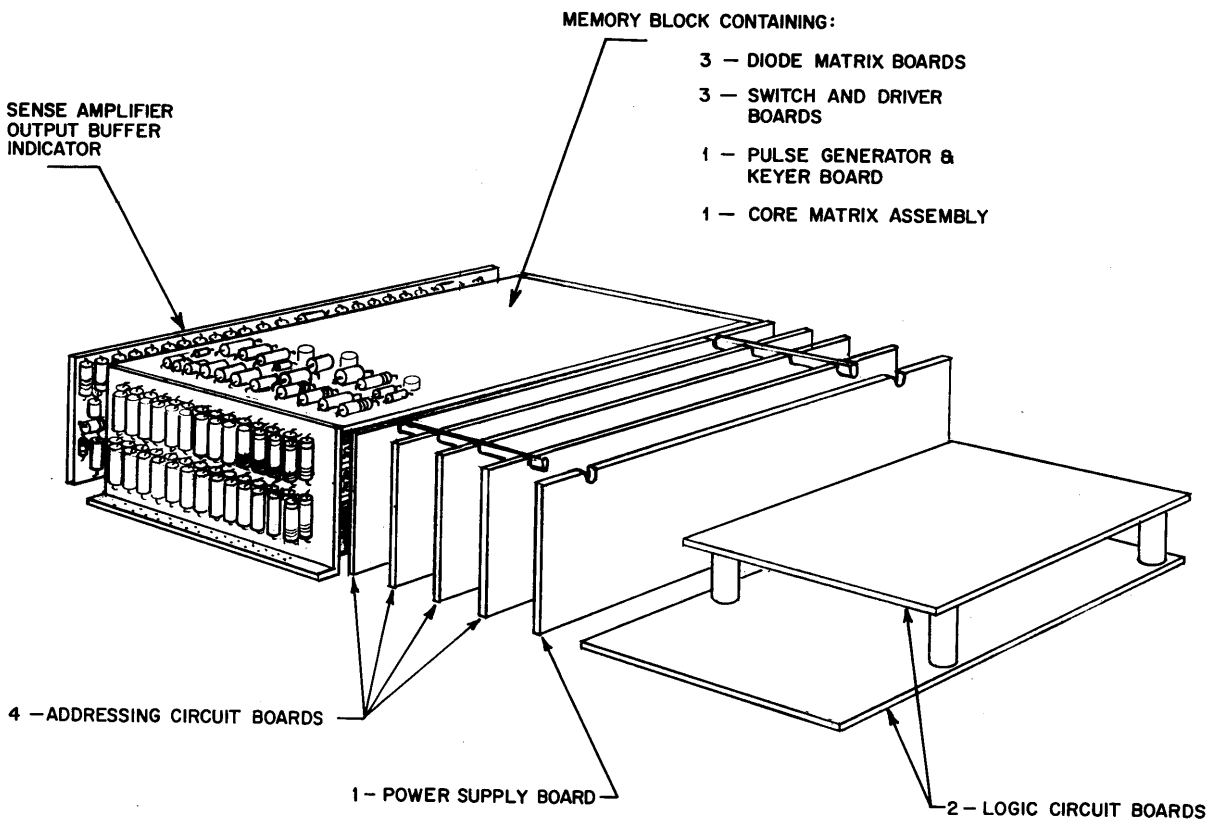


Figure 2. Arrangement of Assembled Printed Circuit Boards

Master Oscillator

The master oscillator is a free-running oscillator which produces a 50-μsec pulse every 176 msec.

Output Buffer

The output buffer consists of an integrator and three stages of current amplification.

DISASSEMBLY

Although no operator maintenance is intended, the equipment may be dissassembled when required. The procedure indicated here should be followed in disassembling the keyer Memory. To avoid damage to components and wiring, caution must be exercised when disassembling any of the interconnected assemblies. Figure 2 shows the arrangement of assembled printed circuit boards. The procedure is:

1. Carefully remove the cover.
2. Take the logic boards out of the case, after removing their holding screws, by lifting the boards from their pads.
3. Lift the power supply board out of its slide channels.
4. Lift the assembly of address boards out of the case.
5. Remove the complete memory assembly after first removing the holding screws on the underside of the case.
6. After the screws which hold together the individual boards of the memory assembly are removed, the pulse generator and X switches and drivers boards can be carefully folded back to inspect the lower board of the assembly (the Y switches and drivers).
7. Lift the Y board from its guide pins and carefully fold it back for inspection of the top of the memory matrix.

8. The diode boards are assembled on the same guide pins and must be removed from the pins very carefully to prevent damage to the fine wires between them and the core strips of the matrix. Because of the method used to wire the matrix it cannot be disassembled without major rewinding during reassembly and complete testing after reassembly.
9. Finally, lift the sense amplifier board out after removing the screws which hold it against the end of the case.

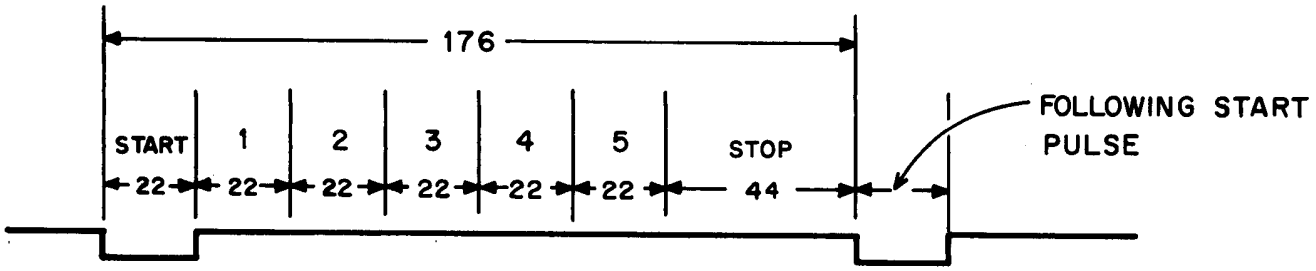
The reassembly procedure is the reverse of the disassembly procedure. Again, caution must be exercised to avoid damage to components and wiring.

PRINCIPLES OF OPERATION

The code transmitted by the Keyer Memory consists of letters of the alphabet in teletype (Baudot) code. Under favorable conditions, a standard teletype machine may be used at the receiving station for print-out of the message. The copy printed will be composed of the same alphabetical characters which may be easily converted into numerical form.

The teletype characters utilized in NORTHVILLE are shown in figure 3. All of these characters have marks in the fifth unit. In addition, the width of the stop pulse is 44 milliseconds rather than the conventional 31 milliseconds. The "letters" function is sent continuously, 56.8 times per minute, while the unit is in the IDLE mode. Keyboard button designations are listed below along with the corresponding teletype characters utilized.

Keyboard Button Designation	Teletype Character
1	V
2	0
3	B
4	Q
5	G
6	M
7	L
8	P



IDLING SIGNAL (START PULSES EVERY 176 MILLISEC.)

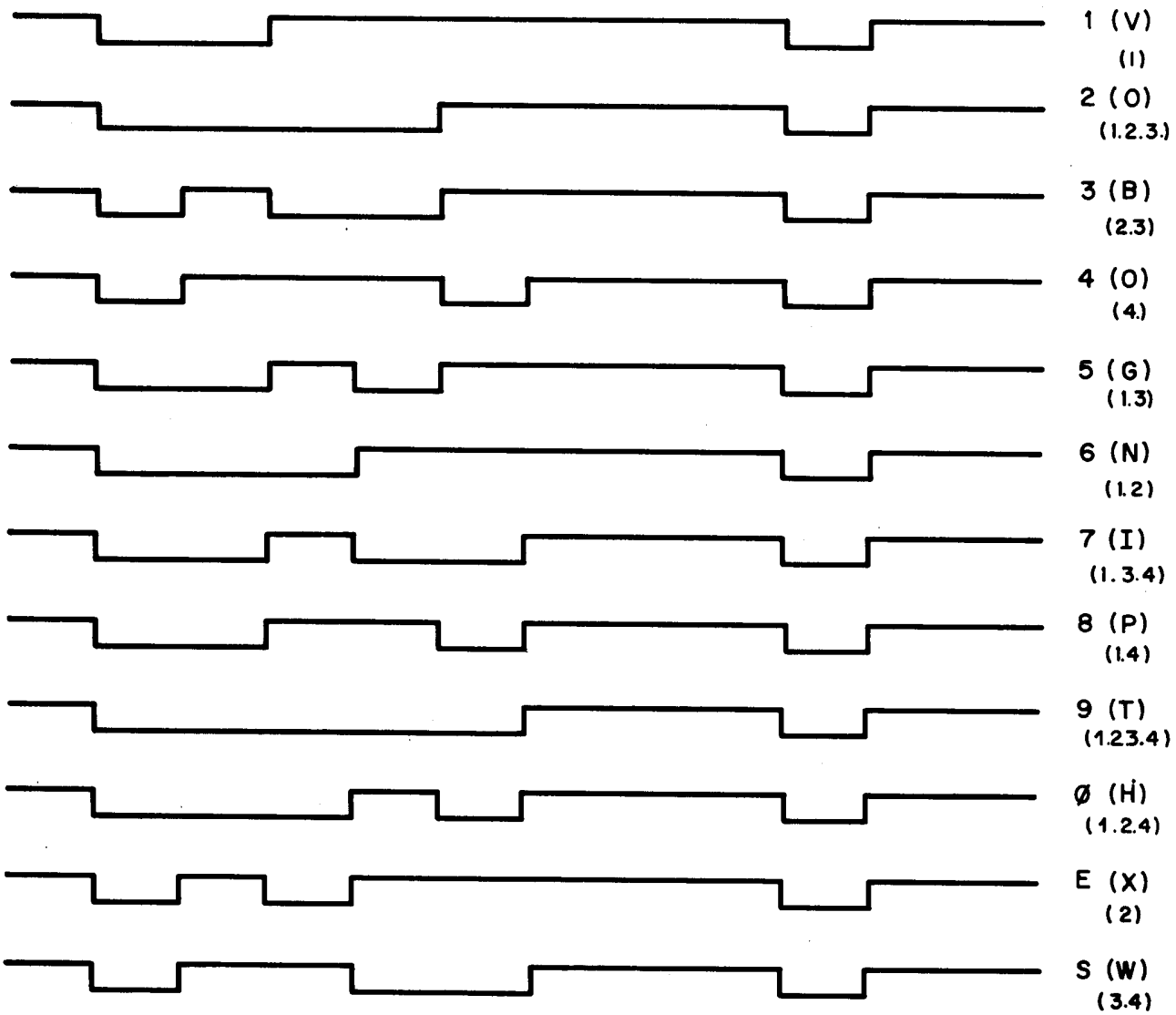


Figure 3. Teletype Characters Used in NORTHVILLE

Keyboard Button Designation	Teletype Character
9	T
Ø	H
E	X
S	W

The Keyer Memory has four distinct modes of operation: STANDBY (S), RECEIVE (R), IDLE (I) and TRANSMIT (T). These modes, their operational characteristics and the instructions for using them are described here.

The logic diagram of the Keyer Memory is shown in figure 4. Logical symbols are explained in figure 5. Operation is described for each mode. In the following discussion the modes of operation are described in the order in which they are selected by the mode selector switch.

OFF

No battery power is applied to the power converter, and the equipment is inoperative when the selector switch is pushed all the way in.

STANDBY

Battery voltage is supplied to the power converter through mode selector switch deck W1; all power supply voltages are generated. Ground potential applied to the X and Y current generators through switch deck W2 prevents turnon which might otherwise result from initial transients. The only connection of logical bias through switch deck W3 in this position is logical bias S. This bias holds the GO flip-flop in the ONE state. The master oscillator is started in this switch position although its output is blocked until the switch is advanced to an active position.

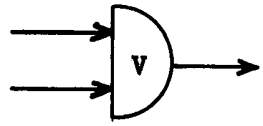
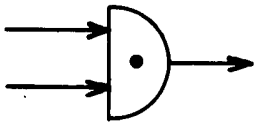
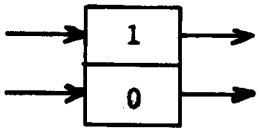
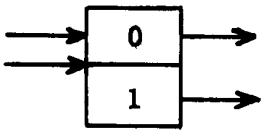
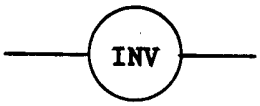
	OR Gate	Output is -2V with 1 or more inputs at -2V. OR gates have 2 to 4 inputs.
	AND Gate	Output is -2V when all inputs are -2V. No output when all inputs are not at -2V. AND gates have 2 to 5 inputs.
	Set-Reset Flip-Flop	A -2V input to either side will produce a -2V output at the same side. A -2V input to the other side will then reverse the state of the flip-flop.
	Complementing Flip-Flop	A +2V complement input reverses the state of the flip-flop. The ZERO input is the reset input.
	Inverter	Output is the complement of the input. -2V input = 0V output 0V input = -2V output.

Figure 4. NORTHVILLE Logic Symbols

RECEIVE

When the mode selector switch is in the RECEIVE (R) position logical biases, transient pulse output P and the steady-state outputs S', R, and RX are generated.

The P pulse triggers a 25-millisecond multivibrator (MV), the output of which: resets the counters to their starting position (000 output of the 5-DECODER), sets the reset flip-flop to the ONE state, and sets the GO flip-flop to the ONE state.

At this point information can be put into the memory. Depressing one of the keys of the keyer will produce an output at the start flip-flop and will also set up a particular combination in the four information flip-flops.

The start flip-flop output pulse is applied to the first 11-millisecond multivibrator. A pulse appearing at point A proceeds to generate the read-current pulse. When it arrives at point B it proceeds to generate the write-current pulse. However, the read pulse can only be applied to the current generators when the output of the 5-DECODER is $\overline{000}$. The write pulse requires the coincidence of information from one of the information flip-flops plus the 5-DECODER $\overline{000}$ output before it is applied to the current generators. The write pulse (at point B) is also applied after a short delay (40 microseconds) to step the address counters to the next count and to set the read-write flip-flop back into the READ state. The two 11-millisecond multivibrators in tandem produce the required 22-millisecond teletype baud-length. This is the read-write cycle time of the memory (with 11-millisecond separation between read and write).

When the START pulse is applied to the first 11-millisecond multivibrator, the pulse will end-around through the two multivibrators as long as the 5-DECODER output is $\overline{000}$ (during the 001, 010, 011, and 100 outputs of the 5-DECODER). The START pulse,

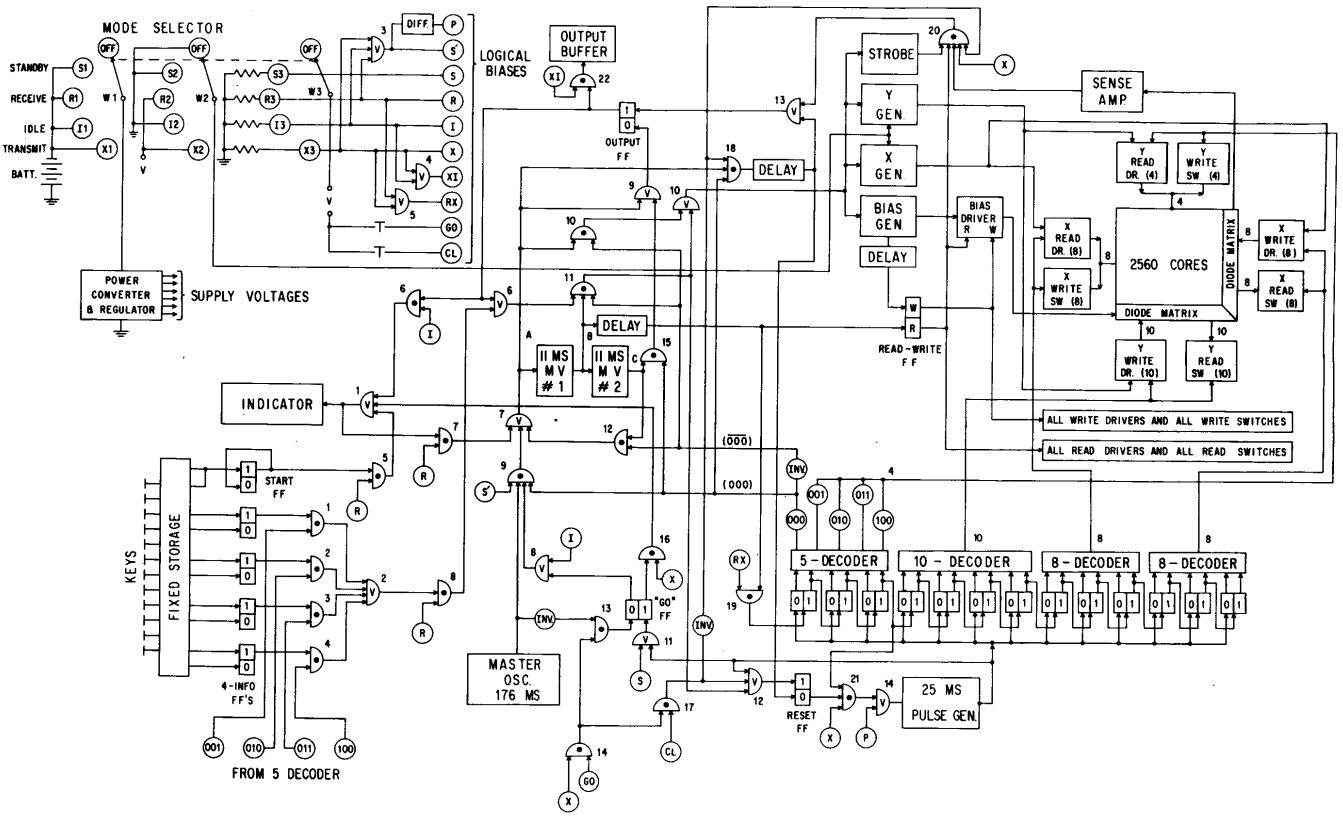


Figure 5. Keyer Memory Logic

arriving at point A does not affect the current generators, because of the $\overline{000}$ output. The pulse arrives at point B, 11 milliseconds later. (This pulse does not affect the current generators, either.) Shortly after, the address is stepped to the 001 output. Eleven milliseconds after the pulse arrives at B it again ends-around to point A. This time the 000 output is not present and the pulse at point A generates the first read pulse, reading the core in location 001 to the ZERO state and again arrives at point B, 11 milliseconds later. This pulse may or may not write a ONE into location 001, depending upon the output of the 001 information flip-flop. If this output is a ONE, then the pulse at point B produces the write current and a ONE is written. If the output is not a ONE, no write currents are generated, leaving a ZERO in location 001. This procedure is continued through the other three addresses. The 000 output then occurs again and stops the end-around process. All activity ceases, awaiting the depression of the next key which will place four more bits of information into the memory. This time the 10-DECODER flip-flops have stepped one count so that four new bits of information are written into four new cores. This process can continue until the entire memory (2560 bits) is filled with information. To permit proper operation in the TRANSMIT (X) mode, the last four bits in the memory must all be ZEROs. The keys cannot be depressed at a rate faster than once every 5 times 22 (110, plus tolerances) milliseconds, or approximately once every 0.15 seconds. The start flip-flop pulse is also applied to the indicator, providing visual indication that a key has been depressed and that a START pulse has been generated.

IDLE

The function in the IDLE (I) mode is to deliver idling characters (a ONE followed by all ZEROS) to the output buffer. In this position, provision is made for some visual indication of proper machine operation by the lighting of the indicator every time the ONE occurs.

When the mode selector switch is in this position the following logical biases are generated: the P pulse, which resets the address counter and sets the reset and GO flip-flops to the ONE state, and the d-c biases S', I, and X1.

The absence of logical bias RX prevents stepping of the address counters and the 5-DECODER output remains at 000. The master oscillator, which gives a pulse every 176 milliseconds (for generation of the START baud, 5 information bauds, and a 44 millisecond STOP baud), now generates the START baud.

The master oscillator pulse, after appearing at point A and passing through OR gate 9 sets the output flip-flop to the ZERO state. A few microseconds later, this same pulse places the output flip-flop in the ONE state. The pulse arrives 22 milliseconds later at point C to again set the output flip-flop in the ZERO state; it then remains in the ZERO state until the next output from the master oscillator. The output to the output buffer is a 22-millisecond START baud (ONE) occurring every 176 milliseconds. This output is the idling character; its presence is indicated visually at the indicator.

TRANSMIT

With the mode-selector switch in the TRANSMIT (X) position, information in the memory is transferred in teletype form to the output buffer. Information consists of a START baud, four information bauds, an unused fifth information baud, and the STOP baud. In the explanation to follow:

START baud = space = ONE output (22 milliseconds)

STOP baud = mark = ZERO output (44 milliseconds).

The following logical biases are generated when the mode selector switch is in the TRANSMIT (X) position: pulse P, which resets the address counter and sets the RESET and GO flip-flops to the ONE state, and the d-c biases S', X, XI, and RX.

Until the GO button is depressed no action takes place and the indicator light remains on, since the GO flip-flop is in the ONE state.

Depressing the GO pushbutton causes the GO flip-flop to be reset to the ZERO state. After depression of the GO button the output of the master oscillator (after arriving at point A and appearing as output of OR-gate 9) sets the output flip-flop to the ONE state but does not operate the current generators, because of the 000 address output. Eleven milliseconds later the pulse arrives at point B and after a short delay, steps the address to 001 but does not activate the current generators. Eleven milliseconds after the change of address the pulse arrives at point C and then ends-around to point A (through AND gate 12 and OR gate 7). The pulse then resets the output flip-flop to the ZERO state (through OR gate 9) and also operates the current generators, producing a READ pulse. If the information in the core location addressed is a ONE, an output voltage is produced on the sense line. This output voltage, amplified by the sense amplifier, sets the output flip-flop (through AND gate 20 and OR gate 13) to the ONE state. With a ZERO in the core, no output will be produced and the output flip-flop will remain in the ZERO state.

Eleven milliseconds later, when the pulse again arrives at point B, it is desirable to write into the core the same information which was read out during the read cycle (the information which is now in the output flip-flop). The pulse arriving at point B (now a write pulse) will be applied to the current generators if the output flip-flop is in the ONE state. If this flip-flop is in the ZERO state the pulse is prevented from activating the current generators. If the current generators are turned on, a ONE is written into the core.

This process continues for three more cores. The 000 output then occurs and the end-around ceases. (The last pulse appearing at point C then serves to reset the output flip-flop to the ZERO state during the unused fifth information baud and during the STOP baud.) Action then ceases until the next pulse from the master oscillator. The process of reading out four more cores and rewriting their information back into the memory is then repeated for four new core locations. This process continues until all of the information in the memory has been read out and restored, at which time the machine shuts down. This shutdown occurs because the remaining information in the memory is all ZEROs (the four remaining ZEROs after all of the useful information is read out). The machine detects all ZEROs and shuts down by the following procedure: The master oscillator output pulse arriving at point A proceeds through AND gate 18 to the reset flip-flop, resetting it to the ZERO state. If the information is all ZEROs no write pulse occurs (at the output of AND gate 11) to set the reset flip-flop to the ONE state. At the end of the four information bauds (all ZEROs in this case) a pulse from the first three address counters steps the next address flip-flop.

This pulse also triggers the 25-millisecond multivibrator, resetting the address to the starting position and setting the GO flip-flop to the ONE state. This blocks all master oscillator outputs and causes all action to cease. The GO flip-flop being set to the ONE state causes the indicator to light and indicates to the operator that the message is complete. The entire process may be repeated by again depressing the GO pushbutton.

To clear the memory, the GO and CL pushbuttons must be depressed simultaneously. When this is done the output from AND gate 17 prevents the reset flip-flop from starting shutdown because of an all-ZEROs condition and also opens the line between the sense amplifier and the output flip-flop. The machine now operates through all addresses,

reading all cores to the ZERO state. (The output flip-flop remains in the ZERO state, so that only ZEROs are written back into the cores.) The memory is then cleared. When the GO and CL pushbuttons are released the machine will detect the reading of all ZEROs (four of them) and shut down.

TRANSMITTED CODE UNITS

Two types of transmission are provided, frequency shift keying (FSK) and continuous wave (CW). The type keying to be used determines the selection of adapter cords but does not otherwise affect operating procedures of the Keyer Memory itself.

Frequency Shift Keying

Spaces appear at the higher of the two carrier frequencies and marks at the lower frequency.

Figure 6 shows the frequency-shift characteristics of CR-18 and CR-27 crystals. Although the amount of shift varies between different units cut to the same frequency, a given crystal can be expected to retain a given approximate shift permanently. Number CR-18 or CR-27 crystals have been encountered which display frequency shift of two small a value for reception on standard equipment. When doubling or tripling in the transmitter the frequency shift transmitted will be correspondingly doubled or tripled and shifts as great as 3000 cps could result. One method for receiving shifts greater than 1000 cps is to zero-beat the receiver BFO on the "mark" carrier frequency and treat the result as if it were CW keying. Another method is to set receiver selectivity to minimum value and tune in on the mark carrier. Perhaps the best practice is to precheck the desired crystals for shift, and if doubling or tripling would cause shifts greater than 1000 cps, use the CW ADAPTER CORD for transmitting. Use of CW keying would not provide the 3 db advantage of FSK.

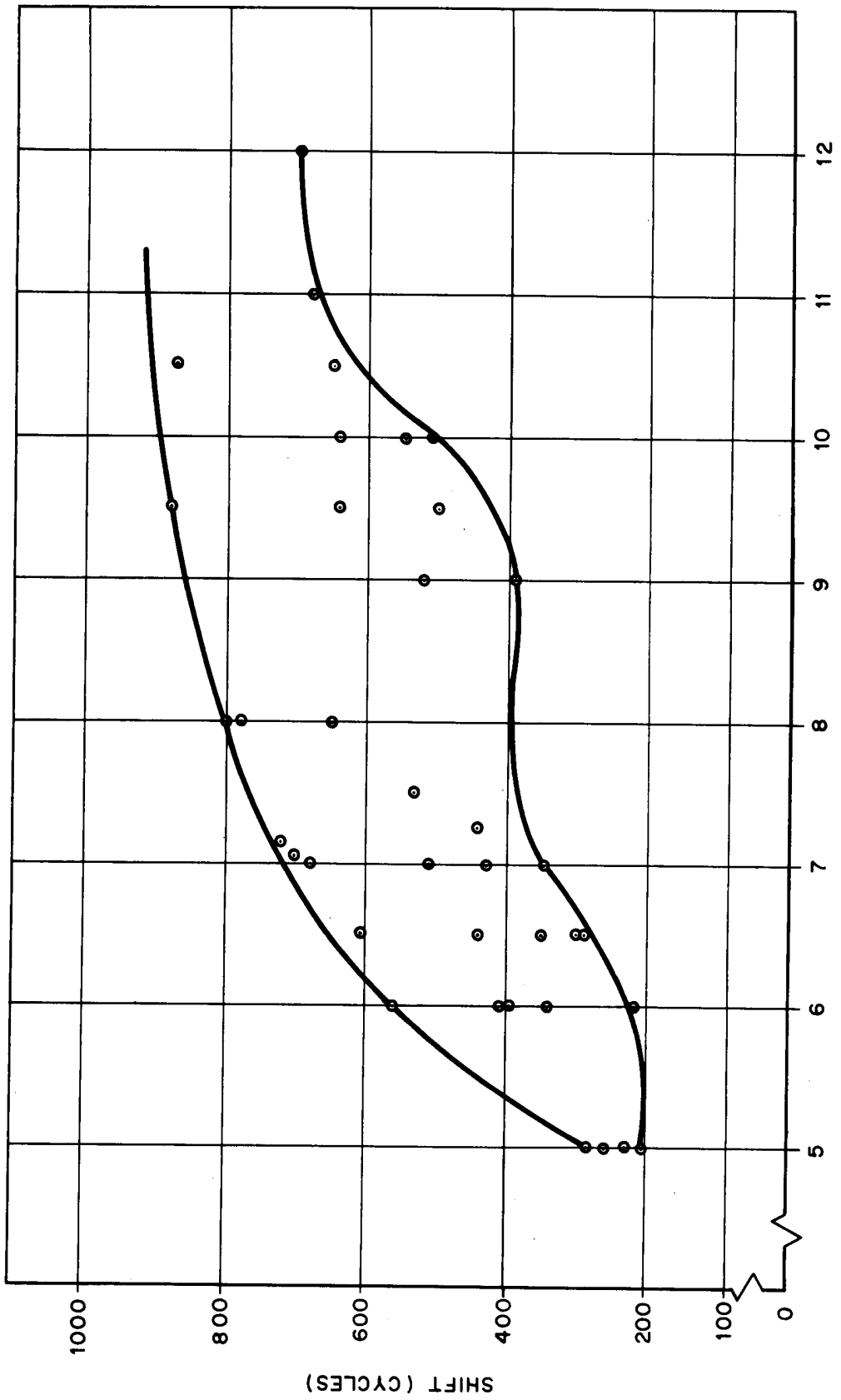


Figure 6. Shift vs. Frequency of Types CR18 and CR27 Crystals

The frequency shift of the transmitting crystal does not vary with the battery voltage of the keyer memory, but ± 10 percent voltage fluctuations of the transmitting power source may cause variations of ± 2 percent.

CW Keying

The transmitter is keyed off only during spaces and remains on during marks.

ADAPTER CORD OPERATION

Both the FSK and CW adapter cords contain semiconductor circuitry within the black plastic encapsulation and should be regarded as parts of the keyer memory.

FSK Adapter Cord

A Varicap semiconductor diode is paralleled through a small capacitor with the transmitting crystal (figure 7). During transmission of a space, a d-c voltage, obtained from rectification of rf by the Varicap itself is permitted to appear across the Varicap. This voltage, whose magnitude is limited to about 10 volts by a resistor, causes the Varicap to assume minimum capacitance. During a mark, the output amplifier shorts the d-c voltage through an r-f choke, thereby increasing the varicap capacitance and dropping the crystal frequency.

CW Adapter Cord

When the CW adapter plug is inserted in the KEY JACK of the transmitter, certain cathode returns in the transmitter are broken and placed in series with the silicon power transistor in the adapter plug (figure 8). During a mark, this transistor is saturated by current from the output amplifier, keying the carrier on. During a space, the transistor is cut off. This interrupts the cathode returns in the transmitter, keying the carrier off.

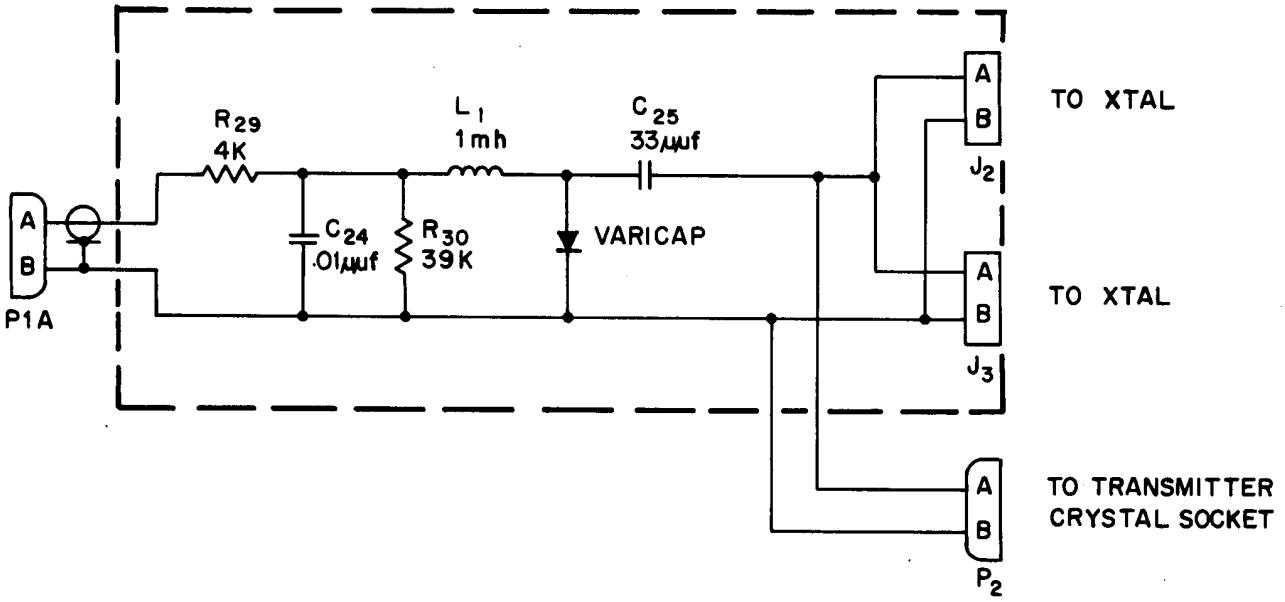
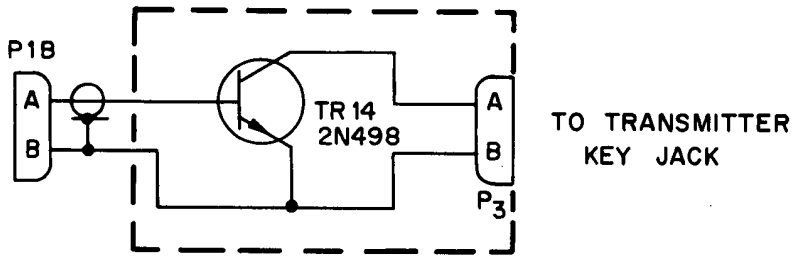


Figure 7. Schematic Diagram of FSK Adapter Cord



NOTE: P_3 IS A MODIFIED PL-55 TYPE PLUG
A = TIP, B = SLEEVE

Figure 8. Schematic Diagram of CW Adapter Cord

INSTRUCTIONS FOR USE

Lighting of the indicator (regardless how dim) indicates that the battery voltage is sufficient for proper operation. The unit will operate satisfactorily for a while after the indicator stops functioning and may be so used in an emergency. Normally, the batteries should be replaced or recharged when the indicator stops functioning. With the mode-selector switch in the OFF position, insert the batteries. Battery polarity is inscribed on the battery mount.

STANDBY

Move the mode selector switch to the STANDBY (S) position. In switching from one position to the next allow one or two seconds in each position to permit stabilization. This is essential in the S position, since the power converter is converting the battery voltage to supply voltages, the oscillator is starting, and transients are being generated. If possible, the switch should remain in the S position for from 5 to 10 seconds.

Switch to the desired operating position, stopping for one to two seconds in each sequential position.

RECEIVE

To store new information in the memory, switch to the RECEIVE (R) position. Keyer buttons are then depressed to write information into the memory; a firm depression of each key is required. The time between releasing one key and depressing the next key should be greater than 1/4 second. Each time a key is depressed the indicator will flash. Although the circuits are designed to allow for the effects of switch contact bounce, an unsteady depression of the key may cause multiple contact with sufficient time between each contact to write the same information two or more times (indicated by more than one flash of the indicator light). The same information will be written into successive word locations in the memory as many times as the indicator flashes.

Write into the memory no more than 639 characters. The 639-character figure is the maximum storage capacity of the memory. If 640 characters are written, no idling character will be available to initiate automatic shutdown of the unit after transmission of information. The unit will continue to transmit information and recycle until the selector switch is moved out of the Transmit (X) position, with a probable loss of some information.

If more than 640 characters are written into the memory, characters in excess of 640 will erase the first part of the information and will be written into locations formerly occupied by the first part of the information. Thus, to store character no. 641, character no. 1 will be erased and character no. 641 will be written in its place.

The unit may be turned off from this position by switching to STANDBY (S) for a few seconds and then to the OFF position. (Information stored will not be lost when turning the unit off from the RECEIVE position.)

IDLE

To transmit idling characters from the unit move the mode-selector switch to the (I) position. Transmission is automatic when in this mode of operation. The indicator lights once every character time (176 milliseconds) providing visual evidence that the batteries are good and part of the unit is operating properly.

TRANSMIT

To transmit information from the unit, switch to the Transmit (X) position. The indicator will light immediately. Depress the GO pushbutton momentarily. The indicator will go off and the transmission of information will be started. When all information in the memory has been transmitted and recycling has been completed, the unit will turn itself off and the indicator will again be lit. Depress the GO pushbutton to again trans-

mit the same information. With the mode-selector switch in this position the indicator is continually lit except when information is being transmitted. Since this is a waste of battery power, the switch should not remain in this position longer than necessary.

When the information has been transmitted and the indicator is again lit the unit may be turned off by moving the mode-selector switch to the OFF position (pausing a second or two in each sequential position). To again transmit information switch to the TRANSMIT (X) position and push the GO pushbutton.

C A U T I O N

The unit cannot be switched from the TRANSMIT (X) position while information is being transmitted or while the unit is recycling (indicator off) without probable loss of information from the memory.

To clear the memory of information the unit must be in the TRANSMIT mode. Hold both the GO and CL pushbuttons in the depressed position for a length of time calculated as follows:

$$\text{Depressed time (seconds)} = \frac{\text{number of characters stored}}{5}$$

This time applies only if clearing is started at the beginning of the information cycle (indicator lit). The CL pushbutton must be depressed before the GO pushbutton; otherwise some information may recycle before start of the clearing action.

Automatic shutdown, after transmission of information, requires that an idling character be stored after the last information character. Shutdown is initiated upon detection of the idling character. Since idling characters are written into the memory cores during memory clearing, clearing should extend beyond core locations to be used by the

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next information which will be written into the memory. The safest procedure is to clear the memory completely, which is accomplished in about 2 minutes and 40 seconds.

Use of the Keyer Memory with the RT-6

Assemble and tune the RT-6 or 6A transmitter, following the normal procedure as outlined in Instruction Book for Radio Station RS-6. Turn off the transmitter when adjustments are complete and connect the keyer memory for use with FSK or CW. When ready to transmit turn on the transmitter and allow for warmup. Retuning of the transmitter is not necessary but slight readjustment may be made if desired. Transmission is then accomplished by the steps outlined under TRANSMISSION in this section.

Frequency Shift Keying. Remove the crystal from the transmitter crystal socket and in its place connect the FSK adapter card with the cord leading directly away to the left as in figure 9. Reinsert the transmitting crystal in the best-fitting of the two sockets provided in the top of the FSK ADAPTER. The crystal will normally protrude quite a distance above the adapter. Fold the transmitters attached sending key to the RETRACTED position. Only type CR-18 and CR-27 crystals are recommended for use with the FSK adapter.

Continuous Wave Keying. Leaving the crystal in the transmitter crystal socket, connect the CW ADAPTER CORD to the KEY JACK of the RT-6 transmitter being sure that it is fully seated. The transmitters attached sending key should be left in the extended position.

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PARTS LIST

This section contains an itemized breakdown of electronic components used in the Keyer Memory.

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
Q1		Raytheon		CK28	A216	99	1006
Q2	Same as Q1				A216		1006
Q3-1/-12		Raytheon		CK26	A214 A215	80	1006
Q4-1/-12	Same as Q3				A214 A215		1006
Q5		Gen. Trans.		2N358	A218	4	1004
Q6	Same as Q5				A218		1004
Q7	Same as Q1				A218		1004
Q8	Same as Q1				A218		1004
Q9		Fairchild		2N706	A213	13	1039
Q10	Same as Q9				A213		1039
Q11	Same as Q9				A213		1039
Q12	Same as Q1				A213		1039
Q13	Same as Q1				A213		1039
Q14	Same as Q1				A213		1039
Q15	Same as Q1				A213		1039
Q16	Same as Q1				A213		1039
Q17-1/-4	Same as Q1				A212		1007
Q18-1/-4	Same as Q1				A212		1007
Q19	Same as Q3				A220		1002
Q20	Same as Q3				A220		1002
Q21	Same as Q1				A220		1002
Q22	Same as Q1				A220		1002
Q23-1/-10	Same as Q1				A212		1007
Q24-1/-10	Same as Q1				A212		1007
Q25	Same as Q3				A213		1039

Component Type - Transistor (Q)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
Q26	Same as Q3				A213		1039
Q27	Same as Q3				A213		1039
Q28	Same as Q3				A213		1039
Q29	Same as Q3				A213		1039
Q30	Same as Q3				A213		1039
Q31	Same as Q3				A213		1039
Q32	Same as Q3				A213		1039
Q33	Same as Q3				A213		1039
Q34	Same as Q3				A213		1039
Q35	Same as Q3				A213		1039
Q36	Same as Q3				A213		1039
Q37	Same as Q3				A213		1039
Q38	Same as Q3				A213		1039
Q39	Same as Q3				A213		1039
Q40	Same as Q3				A220		1002
Q41	Same as Q3				A221		1002
Q42	Same as Q3				A221		1002
Q43	Same as Q3				A221		1002
Q44	Same as Q3				A221		1002
Q45	Same as Q3				A220		1002
Q46	Same as Q1				A221		1002
Q47	Same as Q1				A221		1002
Q48	Same as Q1				A221		1002
Q49	Same as Q1				A221		1002
Q50	Same as Q3				A220		1002

Component Type - Transistor (Q)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
Q51	Same as Q3				A220		1002
Q52							
Q53	Same as Q3				A221		1002
Q54							
Q55	Same as Q3				A220		1002
Q56	Same as Q3				A220		1002
Q57	Same as Q3				A220		1002
Q58	Same as Q1				A221		1002
Q59	Same as Q3				A221		1002
Q60-1/-2	Same as Q3				A216		1006
Q61-1/-2	Same as Q3				A216		1006
Q62-1/-2	Same as Q3				A216		1006
Q63-1/-2	Same as Q3				A216		1006
Q64	Same as Q9				A213		1039
Q65	Same as Q9				A213		1039
Q66	Same as Q9				A213		1039
Q67	Same as Q9				A213		1039
Q68	Same as Q9				A213		1039
Q69	Same as Q9				A213		1039
Q70	Same as Q1				A213		1039
Q71	Same as Q1				A213		1039
Q72	Same as Q5				A202		1004
Q73	Same as Q5				A202		1004
Q74	Same as Q1				A220		1002
Q75	Same as Q1				A220		1002

Component Type - Transistors (Q)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
Q76	Same as Q1				A220		1002
Q77	Same as Q1				A220		1002
Q78	Same as Q1				A220		1002
Q79	Same as Q1				A220		1002
Q80	Same as Q1				A220		1002
Q81	Same as Q1				A220		1002
Q82	Same as Q3				A220		1002
Q83	Same as Q3				A220		1002
Q84	Same as Q3				A220		1002
Q85	Same as Q3				A221		1002
Q86	Same as Q1				A221		1002
Q87	Same as Q1				A221		1002
Q88	Same as Q1				A221		1002
Q90	Same as Q1				A219		1005
Q91	Same as Q1				A219		1005
Q92	Same as Q1				A219		1005
Q93	Same as Q3				A219		1005
Q94	Same as Q3				A219		1005
Q95	Same as Q3				A219		1005
Q96	Same as Q3				A219		1005
Q97	Same as Q3				A219		1005
Q98	Same as Q3				A219		1005
Q99	2N496	Philco			A219	8	1005
Q100	Same as Q99				A219		1005

Component Type - Transistor (Q)

Sheet 4 of 6

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
Q101	Same as Q99				A219		1005
Q102	Same as Q99				A219		1005
Q103	Same as Q9				A219		1005
Q104	Same as Q9				A219		1005
Q105	Same as Q9				A219		1005
Q106-1/8	Same as Q1				A206 A210		1007
Q107-1/8	Same as Q1				A206 A210		1007
Q108-1/8	Same as Q1				A206 A210		1007
Q109-1/8	Same as Q1				A206 A210		1007
Q110	Same as Q3				A221		1002
Q111	Same as Q3				A221		1002
Q112	Same as Q3				A221		1002
Q113	Same as Q3				A221		1002
Q114	Same as Q3				A221		1002
Q115	Same as Q3				A221		1002
Q116	Same as Q3				A221		1002
Q117	Same as Q3				A221		1002
Q118	Same as Q1				A220		1002
Q119	Same as Q1				A220		1002
Q120	Same as Q1				A220		1002
Q121	Same as Q1				A220		1002
Q122	Same as Q1				A220		1002
Q123	Same as Q1				A220		1002
Q124	Same as Q1				A220		1002
Q125	Same as Q99				A220		1002

Component Type - Transistors

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
Q126	Same as Q99				A220		1002
Q127	Same as Q99				A220		1002
Q128	Same as Q99				A220		1002

Component Type - Transistors

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR1	1N695	Sylvania			A217	673	1006
CR2	Same as CR1				A217		1006
CR3	Same as CR1				A217		1006
CR4	Same as CR1				A217		1006
CR5	Same as CR1				A217		1006
CR6	Same as CR1				A217		1006
CR7	Same as CR1				A217		1006
CR8	Same as CR1				A217		1006
CR9	Same as CR1				A217		1006
CR10-1/-4	Same as CR1				A212		1007
CR11-1/-4	Same as CR1				A212		1007
CR12-1/-4	Same as CR1				A212		1007
CR13-1/-4	Same as CR1				A212		1007
CR14-1/-4	Same as CR1				A212		1007
CR15-1/-8	Same as CR1				A206-1/4 A210-5/8		1007
CR16-1/-8	Same as CR1				A206-1/4 A210-5/8		1007
CR17-1/-8	Same as CR1				A206-1/4 A210-5/8		1007
CR18-1/-8	Same as CR1				A206-1/4 A210-5/8		1007
CR19-1/-8	Same as CR1				A206-1/4 A210-5/8		1007
CR20-1/-8	Same as CR1				A206-5/8 A210-1/4		1007
CR21-1/-8	Same as CR1				A206-5/8 A210-1/4		1007
CR22-1/-8	Same as CR1				A206-5/8 A210-1/4		1007
CR23-1/-8	Same as CR1				A206-5/8 A210-1/4		1007
CR24-1/-8	Same as CR1				A206-5/8 A210-1/4		1007
CR25-1/10	Same as CR1				A212		1007

Component Type - Diodes (CR)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR26-1/-10	Same as CR1				A212		1007
CR27-1/-10	Same as CR1				A212		1007
CR28-1/-10	Same as CR1				A212		1007
CR29-1/-10	Same as CR1				A212		1007
CR30-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR31-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR32-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR33-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR34-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR35-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR36-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR37-1/-8	Same as CR1				A207-5/8 A209-1/4		1007
CR38-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR39-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR40-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR41-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR42-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR43-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR44-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR45-1/-8	Same as CR1				A207-1/4 A209-5/8		1007
CR46-1/10	Same as CR1				A211		1007
CR47-1/10	Same as CR1				A211		1007
CR48-1/10	Same as CR1				A211		1007
CR49-1/10	Same as CR1				A211		1007
CR50-1/10	Same as CR1				A211		1007

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR51-1/-10	Same as CR1				A211		1007
CR52-1/-10	Same as CR1				A211		1007
CR53-1/-10	Same as CR1				A211		1007
CR54	Same as CR1				A217		1007
CR55	Same as CR1				A217		1007
CR56	Same as CR1				A217		1007
CR57	Same as CR1				A217		1007
CR58	Same as CR1				A217		1007
CR59	Same as CR1				A217		1007
CR60	Same as CR1				A217		1007
CR61	Same as CR1				A217		1007
CR62	Same as CR1				A217		1007
CR63	Same as CR1				A217		1007
CR64	Same as CR1				A217		1007
CR65	Same as CR1				A217		1007
CR66	Same as CR1				A217		1007
CR67	Same as CR1				A217		1007
CR68	Same as CR1				A217		1007
CR69	Same as CR1				A217		1007
CR70	Same as CR1				A217		1007
CR71	Same as CR1				A217		1007
CR72	Same as CR1				A217		1007
CR73	Same as CR1				A216		1006
CR74	Same as CR1				A216		1006
CR75	Same as CR1				A217		1006

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR76	Same as CR1				A217		1006
CR77	Same as CR1				A217		1006
CR78	Same as CR1				A217		1006
CR79	Same as CR1				A217		1006
CR80-1/12	Same as CR1				A214 A215		1006
CR81-1/12	Same as CR1				A214 A215		1006
CR82	Same as CR1				A217		1006
CR83	Same as CR1				A217		1006
CR84	Same as CR1				A217		1006
CR85	Same as CR1				A217		1006
CR86	Same as CR1				A217		1006
CR87	Same as CR1				A217		1006
CR88	Same as CR1				A217		1006
CR89	Same as CR1				A217		1006
CR90	Same as CR1				A217		1006
CR91	Same as CR1				A216		1006
CR92	Same as CR1				A216		1006
CR93	Same as CR1				A216		1006
CR94	Same as CR1				A217		1006
CR95	Same as CR1				A217		1006
CR96-1/12	Same as CR1				A214 A215		1006
CR97-1/12	Same as CR1				A214 A215		1006
CR98-1/12	Same as CR1				A214 A215		1006
CR99	Same as CR1				A217		1006
CR100-1/2	Same as CR1				A216		1006

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR101-1/2	Same as CR1				A216		1006
CR102-1/2	Same as CR1				A216		1006
CR103	Same as CR1				A217		1006
CR104	Same as CR1				A217		1006
CR105	Same as CR1				A217		1006
CR106	Same as CR1				A217		1006
CR107	Same as CR1				A217		1006
CR108	Same as CR1				A217		1006
CR109	Same as CR1				A217		1006
CR110	Same as CR1				A217		1006
CR111	Same as CR1				A217		1006
CR112	Same as CR1				A217		1006
CR113	Same as CR1				A217		1006
CR114	Same as CR1				A217		1006
CR115	Same as CR1				A217		1006
CR116	Same as CR1				A217		1006
CR117	Same as CR1				A217		1006
CR118	Same as CR1				A217		1006
CR119	Same as CR1				A217		1006
CR120	Same as CR1				A217		1006
CR121	Same as CR1				A217		1006
CR122	Same as CR1				A217		1006
CR123	Same as CR1				A217		1006
CR124	Same as CR1				A217		1006
CR125	Same as CR1				A217		1006

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR126	Same as CR1				A217		1006
CR127	Same as CR1				A218		1004
CR128	Same as CR1				A218		1004
CR129	Same as CR1				A218		1004
CR130	Same as CR1				A218		1004
CR131	Same as CR1				A218		1004
CR132	Same as CR1				A218		1004
CR133	Same as CR1				A218		1004
CR134	Same as CR1				A218		1004
CR135	Same as CR1				A218		1004
CR136	Same as CR1				A218		1004
CR137	Same as CR1				A218		1004
CR138	Same as CR1				A218		1004
CR139	Same as CR1				A217		1006
CR140	Same as CR1				A217		1006
CR141	Same as CR1				A217		1006
CR142	Same as CR1				A217		1006
CR143	Same as CR1				A217		1006
CR144	Same as CR1				A217		1006
CR145	Same as CR1				A217		1006
CR146	Same as CR1				A217		1006
CR147	Same as CR1				A217		1006
CR148	Same as CR1				A217		1006
CR149	Same as CR1				A217		1006
CR150	Same as CR1				A217		1006

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR151	Same as CR1				A217		1006
CR152	Same as CR1				A217		1006
CR153	Same as CR1				A217		1006
CR154	Same as CR1				A217		1006
CR155	Same as CR1				A217		1006
CR156	Same as CR1				A217		1006
CR157	Same as CR1				A217		1006
CR158	Same as CR1				A217		1006
CR159	Same as CR1				A217		1006
CR160	Same as CR1				A217		1006
CR161	Same as CR1				A217		1006
CR162	Same as CR1				A217		1006
CR163	Same as CR1				A217		1006
CR164	Same as CR1				A217		1006
CR165	Same as CR1				A217		1006
CR166	Same as CR1				A217		1006
CR167	Same as CR1				A217		1006
CR168	Same as CR1				A217		1006
CR169	Same as CR1				A217		1006
CR170	Same as CR1				A217		1006
CR171	Same as CR1				A217		1006
CR172	Same as CR1				A217		1006
CR173	Same as CR1				A217		1006
CR174	Same as CR1				A217		1006
CR175	Same as CR1				A217		1006

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR176	Same as CR1				A217		1006
CR177	Same as CR1				A217		1006
CR178	Same as CR1				A217		1006
CR179	Same as CR1				A217		1006
CR180	Same as CR1				A217		1006
CR181	Same as CR1				A217		1006
CR182	Same as CR1				A217		1006
CR183	Same as CR1				A213		1039
CR184	Same as CR1				A213		1039
CR185	Same as CR1				A213		1039
CR186	Same as CR1				A213		1039
CR187	Same as CR1				A213		1039
CR188	Same as CR1				A213		1039
CR189	Same as CR1				A213		1039
CR190	Same as CR1				A213		1039
CR191	Same as CR1				A213		1039
CR192	Same as CR1				A213		1039
CR193	Same as CR1				A213		1039
CR194	Same as CR1				A213		1039
CR195	Same as CR1				A213		1039
CR196	Same as CR1				A213		1039
CR197	Same as CR1				A213		1039
CR198	Same as CR1				A213		1039
CR199	Same as CR1				A213		1039
CR200	Same as CR1				A213		1039

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR201	Same as CR1				A213		1039
CR202	Same as CR1				A213		1039
CR203	Same as CR1				A213		1039
CR204	Same as CR1				A213		1039
CR205	Same as CR1				A213		1039
CR206	Same as CR1				A213		1039
CR207	Same as CR1				A213		1039
CR208	Same as CR1				A213		1039
CR209	Same as CR1				A213		1039
CR210	Same as CR1				A213		1039
CR211	Same as CR1				A213		1039
CR212	Same as CR1				A213		1039
CR213	Same as CR1				A213		1039
CR214	Same as CR1				A213		1039
CR215	Same as CR1				A213		1039
CR216	Same as CR1				A213		1039
CR217	Same as CR1				A213		1039
CR218	SG22	Transitron			A220	4	1002
CR219	Same as CR218				A220		1002
CR220	Same as CR1				A220		1002
CR221	Same as CR1				A220		1002
CR222	Same as CR1				A220		1002
CR223	Same as CR1				A220		1002
CR224	Same as CR1				A220		1002
CR225	Same as CR1				A220		1002

Component Type - Diodes (CR)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR226	Same as CR1				A220		1002
CR227	Same as CR1				A220		1002
CR228	Same as CR1				A220		1002
CR229	Same as CR1				A220		1002
CR230	Same as CR1				A220		1002
CR231	Same as CR1				A220		1002
CR232	Same as CR1				A220		1002
CR233	Same as CR1				A220		1002
CR234	Same as CR1				A220		1002
CR235	Same as CR1				A220		1002
CR236	Same as CR1				A220		1002
CR237	Same as CR1				A220		1002
CR238	Same as CR1				A220		1002
CR239	Same as CR1				A220		1002
CR240	Same as CR1				A220		1002
CR241	Same as CR1				A220		1002
CR242	Same as CR1				A220		1002
CR243	Same as CR1				A220		1002
CR244	Same as CR1				A220		1002
CR245	Same as CR1				A220		1002
CR246	Same as CR1				A220		1002
CR247	Same as CR1				A220		1002
CR248	Same as CR1				A220		1002
CR249	Same as CR1				A220		1002
CR250	Same as CR1				A220		1002

Component Type - Diodes (CR)

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR251	Same as CR1				A220		1002
CR252	Same as CR1				A219		1005
CR253	Same as CR1				A219		1005
CR254	Same as CR1				A219		1005
CR255	Same as CR1				A219		1005
CR256	Same as CR1				A219		1005
CR257	Same as CR1				A219		1005
CR258	Same as CR1				A219		1005
CR259	Same as CR1				A219		1005
CR260	Same as CR1				A219		1005
CR261	Same as CR1				A219		1005
CR262	Same as CR1				A219		1005
CR263	Same as CR1				A219		1005
CR264	Same as CR1				A219		1005
CR265	Same as CR1				A219		1005
CR266	Same as CR1				A219		1005
CR267	Same as CR1				A219		1005
CR268	Same as CR1				A219		1005
CR269	Same as CR1				A219		1005
CR270	Same as CR1				A219		1005
CR271	Same as CR1				A219		1005
CR272	Same as CR1				A219		1005
CR273	Same as CR1				A219		1005
CR274	Same as CR218				A221		1002
CR275	Same as CR218				A221		1002

Component Type - Diodes (CR)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR276	Same as CR1				A221		1002
CR277	Same as CR1				A221		1002
CR278	Same as CR1				A221		1002
CR279	Same as CR1				A221		1002
CR280	Same as CR1				A221		1002
CR281	Same as CR1				A221		1002
CR282	Same as CR1				A221		1002
CR283	Same as CR1				A221		1002
CR284	Same as CR1				A221		1002
CR285	Same as CR1				A221		1002
CR286	Same as CR1				A221		1002
CR287	Same as CR1				A221		1002
CR288	Same as CR1				A221		1002
CR289	Same as CR1				A221		1002
CR290	Same as CR1				A221		1002
CR291	Same as CR1				A221		1002
CR292	Same as CR1				A221		1002
CR293	Same as CR1				A221		1002
CR294	Same as CR1				A221		1002
CR295	Same as CR1				A221		1002
CR296	Same as CR1				A221		1002
CR297	Same as CR1				A221		1002
CR298	Same as CR1				A221		1002
CR299	Same as CR1				A221		1002
CR300	Zener, 5.2V ±.1V, 250MW	Hoffman	(1N705)		A218	2	1004

Component Type - Diodes

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
CR301	Same as CR300				A218		1004
CR302	Zener 2.2V, ±.1V, 250MW	Hoffman	(1N705)		A218	2	1004
CR303	Same as CR302				A218		1004

Component Type - Diodes

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
C1	470UF, 10%	Corning Glass		CY15C471K	A216	2	1006
C2	Same as C1				A216		1006
C3-1/-12	220UF, 10%	Corning Glass		CY10C221K	A214 A215	24	1006
C4-1/-12	Same as C3				A214 A215		1006
C5	10UF, 15V, 10%	Sprague		150D106X 9015B2	A218	9	1004
C6	4.7UF, 10V, 10%	Sprague		150D475X 9010A2	A218	2	1004
C7	Same as C6				A218		1004
C8	Same as C5				A218		1004
C9	Same as C5				A218		1004
C10	Same as C5				A218		1004
C11	Same as C5				A218		1004
C12	Same as C5				A218		1004
C13	Same as C5				A218		1004
C14	Same as C5				A218		1004
C15	0.1UF, 10%, 20V	Sprague		15D104X 9020A2	A213	2	1039
C16	.05UF, 10%	Fan Steel	STA	5169-1	A213	43	1039
C17	0.1UF, 10%	Fan Steel	STA	5173-1	A213	7	1039
C18	Same as C17				A213		1039
C19-1/-4	.042UF, 10V, 10%	Fan Steel	STA	5168-1	A212	30	1007
C20-1/-4	Same as C16				A212		
C21-1/-8	Same as C16				A206-1/4 A210-5/8		1007
C22-1/-8	Same as C19				A206-1/4 A210-5/8		1007
C23-1/-8	Same as C19				A206-5/8 A210-1/4		1007
C24-1/-8	Same as C16				A206-5/8 A210-1/4		1007
C25-1/-10	Same as C16				A212		1007

Component Type - Capacitor (C)

Sheet 1 of 5

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
C26-1/-40	Same as C19				A212		1007
C27	Same as C17				A212		1007
C28	Same as C17				A212		1007
C29	.47UF, 10%	Fan Steel	STA	5181-1	A213	1	1039
C30	1.0UF, 35V, 10%	ASTRON		TKSM-1M-35-10	A213	1	1039
C31	240UUF, 300V, 2%	Corning Glass		CY10C241G	A220	7	1002
C32	220UUF, 300V, 2%	Corning Glass		CY10C221G	A221	3	1002
C33							
C34							
C35							
C36	.1UF, 10%, .35V	Sprague		150D104X 9035A2	A221	3	1002
C37	Same as C36				A221		1002
C38	Same as C36				A221		1002
C39	Same as C31				A220		1002
C40	1000UUF, 200V, 20%	Vitramon		VK20CW102K	A220	2	1002
C41-1/-2	.01UF, 10%	Fan Steel	STA	5161-1	A216	2	1006
C42	100UUF, 10%	Corning Glass		CY10C101K	A216	2	1006
C43	Same as C42				A216		1006
C44	1UF, 10%	Fan Steel	STA	5185-1	A216	1	1006
C45	Same as C16				A216		1006
C46	2UF, 10%	Fan Steel	STA	5156-1	A216	1	1006
C47	180UUF, 1%	Corning Glass		CY10C181F	A213	1	1039
C48	360UUF, 1%	Corning Glass		CY15C361F	A213	1	1039
C49	270UUF, 1%	Corning Glass		CY15C271F	A213	1	1039
C50	620UUF, 1%	Corning Glass		CY15C621F	A213	1	1039

Component Type - Capacitor (C)

Sheet 2 of 5

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
C51	160UUF, 1%	Corning Glass		CY10C161F	A213	1	1039
C52	820UUF, 1%	Corning Glass		CY15C821F	A213	1	1039
C53	10UF, 10%	Fan Steel	STA	673-1	A213	2	1039
C54	Same as C54				A213		1039
C55	Same as C17				A213		1039
C56	Same as C17				A213		1039
C57	Same as C17				A213		1039
C58	Same as C15				A213		1039
C59	Same as C16				A213		1039
C60	4.7UF, 10%	Fan Steel	STA	5108-1	A213		1039
C61	27UF, 10V, 10%	Sprague		150D276X 9010B2	A202	1	1004
C62	Same as C5				A202		1004
C63	Same as C40				A202		1004
C64	Same as C31				A220		1002
C65	Same as C31				A220		1002
C66	Same as C31				A220		1002
C67	Same as C31				A220		1002
C68	Same as C31				A220		1002
C69	220UUF, 300V, ± 5%	Corning Glass		CY1DC221J	A220	2	1002
C70	Same as C69				A220		1002
C71	180UUF, 500V, ± 2%	Corning Glass		CY10C181G	A220	1	1002
C72	150UUF, 500V, ± 2%	Corning Glass		CY10C151G	A220	1	1002
C73	150UUF, 500V, ± 1%	Corning Glass		CY10C151F	A220	1	1002
C74	680UUF, 300V, ±5%	Corning Glass		CY15C681J	A220	2	1002
C75	Same as C74				A220		1002

Component Type - Capacitor (C)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
C76	1500μμf, 500V, + 5%	Corning Glass		CY20C152J	A220	1	1002
C77	.01μf, 35V, + 10%	Sprague		150D103X 9035A2	A220	3	1002
C78	.5μf	Aerovox			A220	2	1002
C79	Same as C78				A220		1002
C80	.1μf	Aerovox			A220	1	1002
C81	Same as C36				A221		1002
C82	100μμf, 500V, +5%	Corning Glass		CY10C101J	A221	3	1002
C83	Same as C82				A221		1002
C84	Same as C82				A221		1002
C85	110μμf, 500V, +2%	Corning Glass		CY10C111G	A221	2	1002
C86	Same as C85				A221		1002
C87	150μμf, 500V, +5%	Corning Glass		CY10C151J	A221	6	1002
C88	Same as C32				A221		1002
C89	Same as C32				A221		1002
C90	2000μμf, 500V, +5%	Corning Glass		CY20C202J	A221	1	1002
C91	1.5μf, 20V, +10%	Corning Glass		150D155X 902A2	A221	1	1002
C92	Same as C87				A219		1005
C93	1000μμf, 300V, 5%	Corning Glass		CY15C102J	A219	4	1005
C94	Same as C93				A219		1005
C95	Same as C93				A219		1005
C96	Same as C93				A219		1005
C97	Same as C82				A219		1005
C98	Same as C77				A219		1005
C99	Same as C77				A219		1005
C100	.047μf, 35V, 10%	Sprague		150D473X 9035A2	A219		1005

Component Type - Capacitor (C)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
C101	2700μμf, 200V, 10%	Vitramon		VK30CW272K	A219	1	1005
C102	Same as C87				A220	4	1002
C103	Same as C87				A220		1002
C104	Same as C87				A220		1002
C105	Same as C87				A220		1002

Component Type - Capacitors

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R1	1K, 1/10W, 5%	Allen Bradley	TR	1025	A216	34	1006
R2	Same as R1				A216		1006
R3	Same as R1				A216		1006
R4	20K, 1/10W, 5%	Allen Bradley	TR	2035	A216	31	1006
R5	56K, 1/10W, 5%	Allen Bradley	TR	5635	A216	63	1006
R6	Same as R5				A216		1006
R7	Same as R4				A216		1006
R8-1/-12	Same as R4				A214 A215		1006
R9-1/-12	Same as R5				A214 A215		1006
R10-1/-12	Same as R5				A214 A215		1006
R11-1/-12	Same as R4				A214 A215		1006
R12	27K, 1/10W, 5%	Allen Bradley	TR	2735	A216	24	1006
R13	Same as R1				A218		1004
R14	1.5K, 1/10W, 5%	Allen Bradley	TR	1525	A218	2	1004
R15	Same as R14				A218		1004
R16	Same as R1				A218		1004
R17-1/-12	68K, 1/10W, 5%	Allen Bradley	TR	6835	A214 A215	80	1006
R18-1/-6	Same as R17				A214 A215		1006
R19-1/-12	1 Meg, 1/10W, 5%	Allen Bradley	TR	1055	A214 A215	24	1006
R20-1/-2	18K, 1/10W, 5%	Allen Bradley	TR	1835	A216	6	1006
R21-1/-2	47K, 1/10W, 5%	Allen Bradley	TR	4735	A216	10	1006
R22-1/-2	22K, 1/10W, 5%	Allen Bradley	TR	2235	A216	7	1006
R23-1/-2	91K, 1/10W, 5%	Allen Bradley	TR	9135	A216	2	1006
R24-1/-2	39K, 1/10W, 5%	Allen Bradley	TR	3935	A216	13	1006
R25-1/-2	Same as R24				A216		1006

Component Type - Resistor (R)

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R26-1/-2	Same as R21				A216		1006
R27-1/-2	Same as R17				A216		1006
R28-1/-4	330K, 1/10W, 5%	Allen Bradley	TR	3345	A216	30	1007
R29-1/-4	Same as R5				A212		1007
R30-1/-8	Same as R5				A206-1/4 A210-5/8		1007
R31-1/-8	Same as R28				A206-1/4 A210-5/8		1007
R32-1/-8	Same as R28				A210-1/4 A206-5/8		1007
R33-1/-8	Same as R5				A210-1/4 A206-5/8		1007
R34-1/-10	Same as R5				A212		1007
R35-1/-10	Same as R28				A212		1007
R36	Same as R1				A217		1006
R37	Same as R1				A217		1006
R38	Same as R1				A217		1006
R39	Same as R1				A217		1006
R40	Same as R1				A217		1006
R41	Same as R1				A217		1006
R42	Same as R1				A217		1006
R43	Same as R1				A217		1006
R44	Same as R1				A217		1006
R45	Same as R1				A217		1006
R46	Same as R1				A217		1006
R47	Same as R1				A217		1006
R48	Same as R1				A217		1006
R49	Same as R1				A217		1006
R50	Same as R1				A217		1006

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R51	Same as R1				A217		1006
R52	Same as R1				A217		1006
R53	Same as R1				A217		1006
R54	Same as R1				A217		1006
R55	Same as R1				A217		1006
R56	Same as R1				A217		1006
R57	Same as R1				A216		1006
R58	27 Ω , 1/10W, 5%	Allen Bradley	TR	2705	A216	1	1006
R59	30K, 1/10W, 5%	Allen Bradley	TR	3035	A213	8	1001
R60	Same as R17				A213		1001
R61	Same as R17				A213		1001
R62	Same as R59				A213		1001
R63	Same as R12				A213		1001
R64	Same as R17				A213		1039
R65	7.5K, 1/10W, 5%	Allen Bradley	TR	7525	A213	1	1001
R66	Same as R17				A213		1001
R67	Same as R17				A213		1001
R68	10K, 1/10W, 5%	Allen Bradley	TR	1035	A213	16	1001
R69	Same as R24				A213		1001
R70	Same as R21				A213		1001
R71	Same as R24				A213		1001
R72	43K, 1/10W, 5%	Allen Bradley	TR	4335	A220	1	1002
R73	Same as R17				A220		1002
R74	Same as R24				A220		1002
R75	Same as R22				A220		1002

Component Type - Resistor

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R76							
R77	Same as R68				A213		1001
R78	Same as R68				A213		1001
R79	Same as R68				A213		1001
R80	Same as R68				A213		1001
R81	Same as R68				A213		1001
R82	Same as R68				A213		1001
R83	Same as R68				A213		1001
R84	Same as R68				A213		1001
R85	Same as R68				A213		1001
R86	33K, 1/10W, 5%	Allen Bradley	TR	3335	A221	10	1002
R87	Same as R86				A221		1002
R88	Same as R86				A221		1002
R89	Same as R17				A221		1002
R90	Same as R17				A221		1002
R91	Same as R17				A221		1002
R92	Same as R17				A221		1002
R93	Same as R21				A220		1002
R94	Same as R12				A220		1002
R95	Same as R17				A220		1002
R96							
R97							
R98	1.8K, 1/10W, 5%	Allen Bradley	TR	1825	A220	2	1002
R99	8.2K, 1/10W, 5%	Allen Bradley	TR	8225	A221	2	1002
R100	24K, 1/10W, 5%	Allen Bradley	TR	2435	A221	6	1002

Component Type - Resistor

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R101	Same as R100				A221		1002
R102	Same as R17				A221		1002
R103	Same as R17				A221		1002
R104	Same as R17				A221		1002
R105							
R106	Same as R68				A221		1002
R107	220 Ω, 1/10W, 5%	Allen Bradley	TR	2215	A221	2	1002
R108	Same as R17				A221		1002
R109	Same as R107				A221		1002
R110	9.1K, 1/10W, 5%	Allen Bradley	TR	9125	A221	1	1002
R111	Same as R17				A221		1002
R112	Same as R24				A220		1002
R113	12K, 1/10W, 5%	Allen Bradley	TR	1235	A221	5	1002
R114	Same as R20				A220		1002
R115	82K, 1/10W, 5%	Allen Bradley	TR	8235	A221	4	1002
R116	Same as R22				A221		1002
R117	Same as R113				A221		1002
R118	Same as R17				A221		1002
R119-1/012	Same as R19				A214 A215		1006
R120	Same as R17				A216		1006
R121	Same as R17				A216		1006
R122-1/-2	Same as R113				A216		1006
R123-1/-2	Same as R21				A216		1006
R124-1/-2	100K, 1/10W, 5%	Allen Bradley	TR	1045	A216	3	1006
R125	Same as R12				A216		1006

Component Type - Resistor

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R126	Same as R1				A217		1006
R127	Same as R1				A217		1006
R128	Same as R1				A217		1006
R129	Same as R1				A217		1006
R130	Same as R1				A217		1006
R131	91K, 1/8W, 1%	I.R.C.	CEA		A213	1	1039
R132	24K, 1/8W,1%	I.R.C.	CEA		A213	1	1039
R133	30K, 1/8W, 1%	I.R.C.	CEA		A213	2	1039
R134	Same as R133				A213		1039
R135	3.9K, 1/8W, 1%	I.R.C.	CEA		A213	3	1039
R136	Same as R135				A213		1039
R137	220 Ω, 1/8	I.R.C.	CEA		A213	3	1039
R138	47K, 1/8W, 1%	I.R.C.	CEA		A213	3	1039
R139	Same as R138				A213		1039
R140	Same as R138				A213		1039
R141	11K, 1/8W, 1%	I.R.C.	CEA		A213	1	1039
R142	8.2K, 1/8W, 1%	I.R.C.	CEA		A213	1	1039
R143	Same as R135				A213		1039
R144	2.7K, 1/10, 5%	Allen Bradley	TR	2725	A213	3	1039
R145	Same as R144				A213		1039
R146	Same as R144				A213		1039
R147	470 Ω, 1/10W, 5%	Allen Bradley	TR	4715	A213	2	1039
R148	Same as R147				A213		1039
R149	150K, 1/10W, 5%	Allen Bradley	TR	1545	A213	4	1039
R150	Same as R149				A213		1039

Component Type - Resistor

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R151	Same as R5				A213		1039
R152	Same as R5				A213		1039
R153	5Ω to 15 Ω, 1/10W, 5%	Allen Bradley	TR		A213	1	1039
R154	5Ω to 15 Ω, 1/10W, 5%	Allen Bradley	TR		A213	1	1039
R155	5Ω to 15 Ω, 1/10W, 5%	Allen Bradley	TR		A213	1	1039
R156	Same as R12				A213		1001
R157	Same as R12				A213		1001
R158	Same as R12				A213		1001
R159	Same as R12				A213		1001
R160	Same as R12				A213		1001
R161	Same as R12				A213		1001
R162	Same as R12				A213		1001
R163	Same as R59				A213		1001
R164	Same as R59				A213		1001
R165	Same as R59				A213		1001
R166	Same as R59				A213		1001
R167	Same as R59				A213		1001
R168	Same as R59				A213		1001
R169	Same as R17				A213		1001
R170	Same as R17				A213		1001
R171	Same as R17				A213		1001
R172	Same as R17				A213		1001
R173	Same as R17				A213		1001
R174	Same as R17				A213		1001
R175	Same as R17				A213		1001

Component Type - Resistors

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R176	Same as R17				A213		1001
R177	Same as R17				A213		1001
R178	Same as R124				A213		1001
R179	Same as R137				A213		1039
R180	Same as R137				A213		1039
R181	390 Ω, 1/10W, 5%	Allen Bradley	TR	3915	A202	1	1004
R182	Same as R20				A220		1002
R183	Same as R20				A220		1002
R184	Same as R113				A220		1002
R185	Same as R4				A220		1002
R186	Same as R4				A220		1002
R187	Same as R4				A220		1002
R188	Same as R4				A220		1002
R189	Same as R22				A220		1002
R190	Same as R22				A220		1002
R191	Same as R24				A220		1002
R192	Same as R24				A220		1002
R193	Same as R24				A220		1002
R194	Same as R5				A220		1002
R195	Same as R5				A220		1002
R196	Same as R21				A220		1002
R197	Same as R17				A220		1002
R198	Same as R17				A220		1002
R199	Same as R17				A220		1002
R200	Same as R17				A220		1002

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R201	Same as R17				A220		1002
R202	Same as R17				A220		1002
R203	Same as R17				A220		1002
R204	Same as R17				A220		1002
R205	Same as R17				A220		1002
R206	Same as R17				A220		1002
R207	Same as R17				A220		1002
R208	Same as R17				A220		1002
R209	Same as R86				A220		1002
R210	Same as R86				A220		1002
R211	15K, 1/10W, 5%	Allen Bradley	TR	1535	A220	4	1002
R212	Same as R211				A220		1002
R213	Same as R115				A220		1002
R214	Same as R12				A220		1002
R215	Same as R12				A220		1002
R216	75K, 1/10W, 5%	Allen Bradley	TR	7535	A220	1	1002
R217	Same as R68				A220		1002
R218	Same as R149				A220		1002
R219	Same as R149				A220		1002
R220	Same as R100				A220		1002
R221	2.7 Meg, 1/10W, 5%	Allen Bradley	TR	2755	A220	1	1002
R222	44K, 1/8W, 1%, T-2 FA	I.R.C.	CEA		A220	2	1002
R223	Same as R222				A220		1002
R224	75K, 1/8W, 1%, T-2	I.R.C.	CEA		A220	3	1002
R225	56K, 1/8W, 1%, T-2	I.R.C.	CEA		A220	1	1002

Component Type - Resistors

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R226	Same as R99				221		1002
R227	Same as R68				221		1002
R228	Same as R86				221		1002
R229	Same as R115				221		1002
R230	Same as R17				221		1002
R231	3.9K, 1/10W, 5%	Allen Bradley	TR	3925	R219	2	1005
R232	Same as R231				R219		1005
R233	510 Ω, 1/10W, 5%	Allen Bradley	TR	5115	R219	2	1005
R234	Same as R233				R219		1005
R235	820 Ω, 1/10W, 5%	Allen Bradley	TR	8215	R219	1	1005
R236	Same as R20				R219		1005
R237	Same as R12				R219		1005
R238	Same as R12				R219		1005
R239	Same as R12				R219		1005
R240	Same as R17				R219		1005
R241	Same as R17				R219		1005
R242	Same as R17				R219		1005
R243	Same as R4				R219		1005
R244	4.7K, 1/10W, 5%	Allen Bradley	TR	4725	R219	1	1005
R245	Same as R86				R219		1005
R246	Same as R86				R219		1005
R247	Same as R68				R219		1005
R248	Same as R68				R219		1005
R249	Same as R68				R219		1005
R250	Same as R1				R219		1005

Component Type - Resistor (R)

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R251	Same as R1				A219		1005
R252	Same as R24				A219		1005
R253	560, 1/10W, 5%	Allen Bradley	TR	5615	A219	1	1005
R254	Same as R22				A219		1005
R255	Same as R5				A219		1005
R256	Same as R115				A219		1005
R257	Same as R100				A219		1005
R258	Same as R100				A219		1005
R259	Same as R100				A219		1005
R260	680, 1/0 W, 5%	Allen Bradley	TR	6815	A219	1	1005
R261	13K, 1/8W, 1%, T-2	I.R.C.	CEA		A219	2	1005
R262	Same as R261				A219		1005
R263	10K	I.R.C.	CEA		A219	2	1005
R264	Same as R263				A219		1005
R265	Same as R224				A219		1005
R266	Same as R224				A219		1005
R267	330	I.R.C.	CEA		A219	4	1005
R268	Same as R267				A219		1005
R269	Same as R267				A219		1005
R270	Same as R267				A219		1005
R271	2.4 Meg.	I.R.C.	CEA		A219	2	1005
R272	Same as R271				A219		1005
R273	33K	I.R.C.	CEA		A219	2	1005
R274	Same as R273				A219		1005
R275	1.8K	I.R.C.	CEA		R219	1	1005

Component Type - Resistor

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R276	3.6K, 1/8W, 1%, T-2	I.R.C.	CEA		A219	2	1005
R277	3.6K, 1/8W, 1%, T-2	I.R.C.	CEA		A219	2	1005
R278	100 Ω, 1/10W, 5%	Allen Bradley	TR	1015	A219	1	1005
R279	Same as R86				A221		1005
R280	Same as R86				A221		1005
R281	Same as R21				A221		1005
R282	Same as R21				A221		1005
R283	Same as R5				A221		1005
R284	Same as R5				A221		1005
R285	62K, 1/10W, 5%	Allen Bradley	TR	6235	A221	1	1005
R286	110K, 1/10W, 5%	Allen Bradley	TR	1145	A221	1	1005
R287	Same as R17				A221		1005
R288	Same as R17				A221		1005
R289	Same as R17				A221		1005
R290	Same as R17				A221		1005
R291	Same as R17				A221		1005
R292	Same as R17				A221		1005
R293	Same as R17				A221		1005
R294	Same as R17				A221		1005
R295	Same as R17				A221		1005
R296	Same as R17				A221		1005
R297	Same as R17				A221		1005
R298	Same as R17				A221		1005
R299	Same as R17				A221		1005
R300	Same as R17				A221		1005

Component Type - Resistor

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Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
R301	Same as R17				A221		1005
R302	Same as R17				A221		1005
R303	Same as R98				A221		1005
R304	6.2K, 1/10W, 5%	Allen Bradley	TR	6225	A221	1	1005
R305	Same as R211				A221		1005
R306	Same as R211				A221		1005
R307	Same as R12				A221		1005
R308	Same as R12				A221		1005
R309	Same as R12				A221		1005
R310	Same as R12				A221		1005
R311	Same as R12				A221		1005
R312	Same as R12				A221		1005
R313	Same as R12				A221		1005
R314	Same as R12				A221		1005
R315	Same as R24				A221		1005

Component Type - Resistor

Sheet 13 of 13

Reference Symbol	Description	Manufacturer	Type	Part No.	Assy. No.	Total Used	Schematic No.
T1		per 4093-1004			A202	1	1004
T2		4093-1051			A220	1	1002

Component Type - Transformers (T)

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