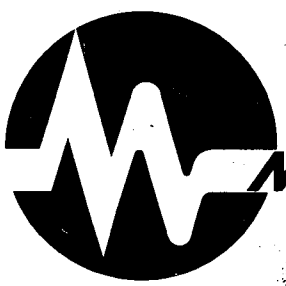
MACROTRONICS M80

HAM INTERFACE FOR THE TRS-80 MICRO COMPUTER

INSTRUCTION MANUAL



MACROTRONICS, inc.®

Printed in the U.S.A. 1/1/79

M - 8 0 90 DAY LIMITED WARRANTY

FOR A PERIOD OF NINETY (90) DAYS AFTER PURCHASE, MACROTRONICS WILL REFUND IN FULL THE PURCHASE PRICE MINUS POSTAGE OF ANY FACTORY ASSEMBLED M-80 WHICH IS FOUND TO BE UNSATISFACTORY BY THE PURCHASER. AT THE PURCHASER'S DISCRETION, MACROTRONICS WILL REPLACE OR REPAIR FREE OF CHARGE ANY M-80 WHICH IS FOUND DEFECTIVE.

FOR A PERIOD OF NINETY (90) DAYS AFTER PURCHASE, MACROTRONICS WILL REPLACE OR REPAIR (AT MACROTRONICS DISCRETION) FREE OF CHARGE, ANY PARTS THAT ARE DEFECTIVE EITHER IN MATERIALS OR WORKMANSHIP, ON ANY M-80 PURCHASED IN KIT FORM. YOU CAN OBTAIN PARTS BY WRITING TO US AT THE ADDRESS BELOW OR BY TELEPHONING US AT (209) 667-2888. IF A DEFECTIVE PART OR ERROR IN DESIGN HAS CAUSED YOUR M-80 TO MALFUNCTION DURING THE WARRANTY PERIOD THROUGH NO FAULT OF YOURS, WE WILL SERVICE IT FREE UPON PROOF OF PURCHASE AND DELIVERY AT YOUR EXPENSE TO THE ADDRESS BELOW.

OUR WARRANTY DOES NOT COVER, AND WE WILL NOT BE RESPONSIBLE FOR DAMAGE CAUSED BY THE USE OF ANY SOLDER OTHER THAN THAT PROVIDED WITH THE KIT, DEFECTIVE TOOLS, EXCESSIVE HEAT WHILE SOLDERING, INCORRECT ASSEMBLY, MISUSE, IMPROPER WIRING OR HANDLING OF CONNECTORS, FIRE, OR BY UNAUTHORIZED MODIFICATIONS. THIS WARRANTY DOES NOT COVER REIMBURSEMENT FOR CUSTOMER ASSEMBLY OR SET-UP TIME.

THIS WARRANTY COVERS ONLY MACROTRONICS PRODUCTS AND IS NOT EXTENDED TO ALLIED EQUIPMENT OR COMPONENTS USED IN CONJUNCTION WITH OUR PRODUCTS. WE ARE NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

M A C R O T R O N I C S
5943 PIONEER ROAD
HUGHSON, CALIFORNIA 95326
(209) 667-2888

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F O R E W O R D

CONGRATULATIONS! WITH THE PURCHASE OF THE M-80 YOU HAVE CONVERTED YOUR TRS-80 MICROCOMPUTER INTO A STATE-OF-THE-ART HAM COMPUTER SYSTEM. WHAT IS ESPECIALLY EXCITING IS THAT YOU NOW HAVE A POWERFUL, GENERAL PURPOSE COMPUTER WHICH, AMONG MANY OTHER THINGS, WILL ALSO GIVE YOU ALL-MODE HAM CAPABILITIES. AND THE CONVERSION COST LESS THAN A GOOD MEMORY KEYER ALONE!! WHETHER IT WAS THE 'PERFECT' CODE, THE EXTENSIVE PROGRAMMED MESSAGE MEMORIES, THE AVAILABILITY OF BOTH RTTY AND MORSE CODE SENDING AND RECEIVING, THE VERY HIGH SPEED (399 WPM!) CW CAPABILITY, OR ONE OF THE MANY OTHER FEATURES OF THIS SYSTEM WHICH INFLUENCED YOU TO BUY THE M-80, WE FEEL THAT YOU WILL FIND THAT IT ADDS A WHOLE NEW DIMENSION TO YOUR "SHACK". IT REALLY IS A THRILL TO ADD TO A QSO:
RIG HR IS .... AND TRS-80 MICROCOMPUTER WITH M-80 HAM INTERFACE !

IF YOU HAVE NOT ALREADY DONE SO, PLEASE SEND IN THE WARRANTY REGISTRATION CARD. IT NOT ONLY SERVES TO VALIDATE YOUR WARRANTY, BUT WILL ALSO ALLOW US TO KEEP YOU INFORMED OF NEW DEVELOPMENTS FOR YOUR M-80 (AND MANY EXCITING FEATURES WILL BE ANNOUNCED IN THE NEAR FUTURE). WE WELCOME COMMENTS AND SUGGESTIONS FOR IMPROVING OUR PRODUCT. PLEASE DROP US A LINE IF YOU HAVE ANY SUGGESTIONS OR QUESTIONS.

ON A PERSONAL NOTE, I ASK YOUR COOPERATION AND UNDERSTANDING IN RESPECTING OUR COPYRIGHTS. I HAVE PERSONALLY INVESTED MY LIFE SAVINGS AND ONE ENTIRE YEAR OF MY TIME TO DEVELOP THE M-80 AND GET MACROTRONICS OFF THE GROUND. THE SUCCESS OF THIS VENTURE, AND THE LIKLIHOOD OF FUTURE SOFTWARE DEVELOPMENTS -OF A NONTRIVIAL KIND- CRITICALLY DEPEND ON AUTHORS NOT GETTING "RIPPED OFF". SO PLEASE, WHEN YOUR CLUB OR BUDDY ASKS FOR A FREE COPY- LET THEM KNOW IT IS UNETHICAL AS WELL AS ILLEGAL AND TELL HIM TO BUY HIS OWN COPY.

BEST OF LUCK AND HOPE TO MEET YOU ON THE AIR.

73,
RON LODEWYCK, N6EE

PRESIDENT

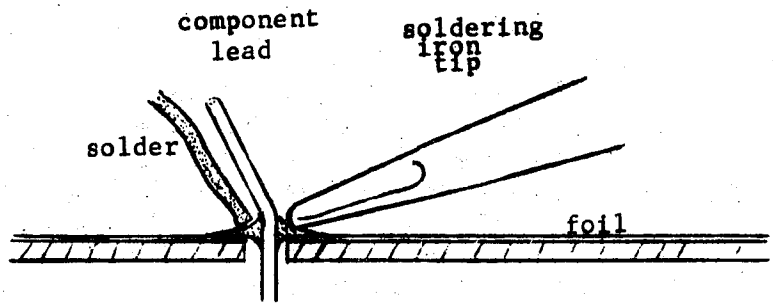
ASSEMBLY INSTRUCTIONS

IF YOUR M-80 WAS PURCHASED IN ASSEMBLED FORM, SKIP THIS SECTION AND PROCEED DIRECTLY TO THE SECTION LABELED OPERATING INSTRUCTIONS.

GENERAL INFORMATION

1. TOOLS. YOU WILL NEED: LONG NOSE PLIERS, DIAGONAL CUTTERS, WIRE STRIPPERS, AND A SMALL TIP (1/8" CHISEL) LOW WATTAGE (25 TO 40 WATTS) PENCIL TYPE IRON.

2. SOLDERING TECHNIQUE. DO NOT USE A SOLDERING GUN OR AN IRON WITH MORE THAN A 40 WATT RATING. KEEP YOUR SOLDERING TIP CLEAN WITH A DAMP CLOTH OR SPONGE. PRESS THE SOLDERING TIP AGAINST THE COMPONENT LEAD AND THE CIRCUIT BOARD FOIL. HEAT BOTH FOR A SECOND OR TWO. APPLY SOLDER TO THE OPPOSITE SIDE OF THE COMPONENT LEAD AS SHOWN BELOW:



DO NOT FEED THE SOLDER TO THE IRON TIP - LET THE LEAD AND FOIL MELT THE SOLDER. THE SOLDER SHOULD FLOW EVENLY AND SMOOTHLY AROUND THE CONNECTION. REMOVE THE IRON QUICKLY - NEVER HEAT THE FOIL OR THE COMPONENT MORE THAN A FEW SECONDS. EXCESSIVE HEAT WILL DAMAGE MOST COMPONENTS - ESPECIALLY DIODES, LEDS, TRANSISTORS, AND ICS - AND CAUSE THE FOIL TO SEPARATE FROM THE BOARD (CAUSING IRREPARABLE DAMAGE).

3. COMPONENT MOUNTING. ALL COMPONENTS SHOULD BE INSERTED FROM THE TOP (SILK-SCREENED) SIDE OF THE BOARD.

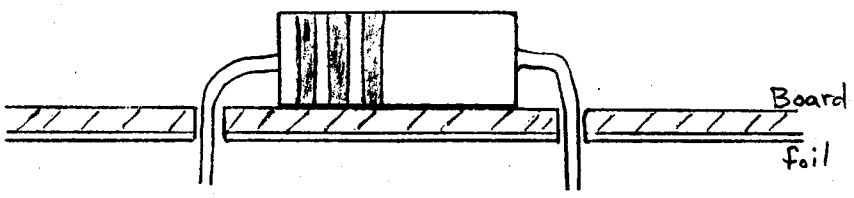
PROCEDURE

INSTALL ALL COMPONENTS IN THE ORDER GIVEN BELOW:

1. JUMPER WIRES. YOU WILL NOTICE SEVERAL HOLES ON THE BOARD MARKED WITH NUMBERS RANGING FROM 1 TO 24 (AND ALSO +12). CONNECT THESE HOLES, IN PAIRS, WITH THE SINGLE CONDUCTOR HOOKUP WIRE IN THE FOLLOWING ORDER:

+12 TO 1
2 TO 18
3 TO 9
13 TO 14
7 TO 8
4 TO 20
19 TO 24
22 TO 23
16 TO 21
12 TO 17
11 TO 15 NOTE: HOLE 11 WILL BE LOCATED UNDER THE 7486 SOCKET. ROUTE THE WIRE IN A "U" SHAPE SO THAT THE WIRE ENTERS FROM THE END OF THE SOCKET (A NOTCH IS PROVIDED ON THE END OF THE SOCKET).

2. RESISTORS. MOUNT ALL RESISTORS IN A HORIZONTAL POSITION BY BENDING BOTH LEADS DOWN PERPENDICULAR TO THE BODY:



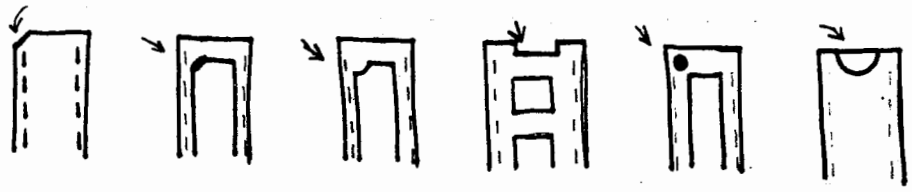
INSERT AND SOLDER ALL RESISTORS AS FOLLOWS:

R1 330 ORG/ORG/BRN	R8 10K BRN/BLK/ORG	R15 1K BRN/BLK/R
R2 2.2K R/R/R	R9 3.3K ORG/ORG/R	R16 10K BRN/BLK/ORG
R3 10K BRN/BLK/ORG	R10 10K BRN/BLK/ORG	R17 1K BRN/BLK/R
R4 10K BRN/BLK/ORG	R11 330 ORG/ORG/BRN	R18 68K BLU/GRA/ORG
R5 1K BRN/BLK/R	R12 4.7K Y/VIO/R	R19 2.2K R/R/R
R6 330 ORG/ORG/BRN	R13 4.7K Y/VIO/R	R20 470 Y/VIO/BRN
R7 5.6K GRN//BLU/R	R14 270 R/VIO/BRN	

3. DIODES. THE BANDED ENDS OF DIODES CAN BE MARKED IN A NUMBER OF WAYS:

DIODES ARE VERY HEAT SENSITIVE - HEAT SINK THE LEADS WITH A LONG NOSE PLIERS WHILE SOLDERING AND USE A MINIMUM OF HEAT. INSERT AND SOLDER CR2, CR3, AND CR4. WATCH FOR POLARITY. MATCH THE BANDS.

4. IC SOCKETS. LINE UP THE NOTCHED END OF THE SOCKET WITH THE SEMICIRCLE ON THE BOARD. THE NOTCH MAY BE INDICATED IN SEVERAL WAYS ON THE SOCKET (LOOK CAREFULLY):



INSERT AND SOLDER ALL SOCKETS AS FOLLOWS:

555, 567, AND OPTO	8 PIN
74LS04, 7486, & RELAY	14 PIN
7476 AND 74LS367	16 PIN
74154	24 PIN

5. CAPACITORS. MOUNT DISC, MYLAR, OR TANTALUM TYPES VERTICAL BY SIMPLY INSERTING BOTH LEADS IN THE APPROPRIATE HOLES IN THE BOARD. POSITIVE POLARITY WILL BE INDICATED ON SOME CAPACITORS WITH A + MARKING OR A COLOR DOT. POLARITY OF ELECTROLYTICS WILL BE MARKED WITH A + OR A -. POSITION THE LEADS SO THAT THE + LEAD IS CLOSEST TO THE + MARK ON THE BOARD.

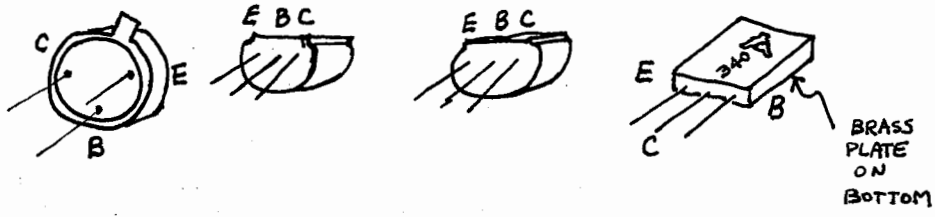
Disc Tantalum Mylar Electrolytic

INSERT AND SOLDER ALL CAPACITORS AS FOLLOWS:

C1	2.2 TANT	C6	.047 MYLAR (MARKED 2A473K)	C10	0.1 TANT
C2	0.1 TANT	C7	1.0 TANT	C11	22 MFD ELECTRO
C3	2200 MFD ELECTRO	C8	0.1 TANT	C12	0.1 400 V. MYLAR
C4	0.1 TANT	C9	.022 MYLAR (MARKED 2A223K)	C13	.01 DISC (MARKED 103)
C5	1.0 TANT				

6. TRANSISTORS. TRANSISTORS ARE ALSO VERY HEAT SENSITIVE - HEAT SINK WHILE SOLDERING. LEAVE ABOUT 1/2" OF LEADS ABOVE THE BOARD. PIN OUTS VARY WITH CASE STYLE - USE THE DIAGRAM BELOW TO LOCATE CORRECT LEADS:

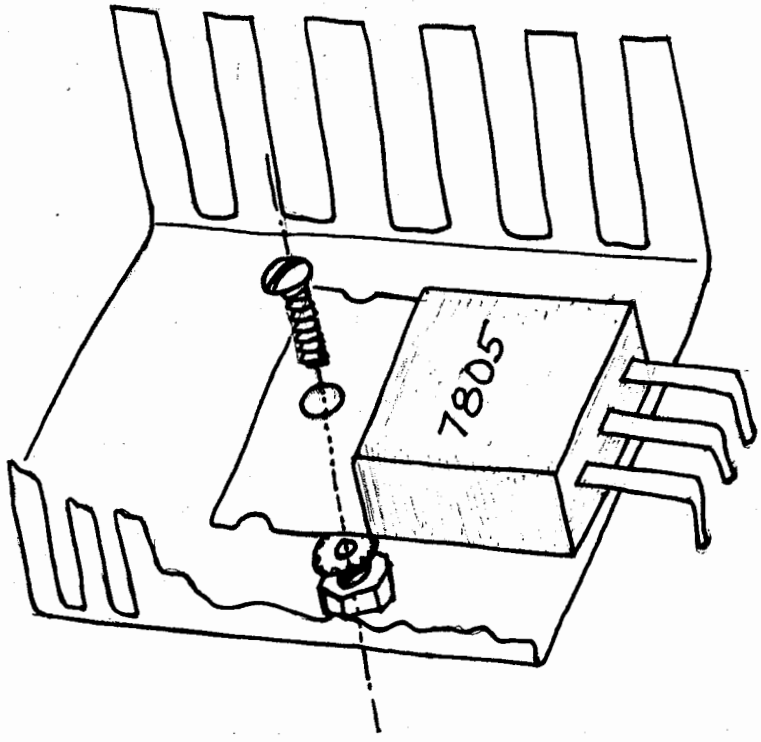
TO 18	TO 92	TO 92+	CASE 77
METAL	PLASTIC	PLASTIC	MJE340
2N2222A	2N2222	2N4888	



INSERT AND SOLDER ALL TRANSISTORS AS FOLLOWS:

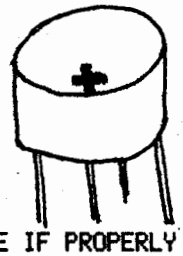
Q1	MJE340	
Q2,4,5,6	2N2222	OR 2N2222A
Q3	2N4888	

7. VOLTAGE REGULATOR (7805). THE VOLTAGE REGULATOR IS MOUNTED ON THE HEAT SINK USING A 4 - 40 MACHINE SCREW, WASHER AND NUT. BEND THE LEADS OF THE REGULATOR AT A 90 DEGREE ANGLE AT THE POINT WHERE THE LEADS CHANGE THICKNESS:



SOLDER THE LEADS.

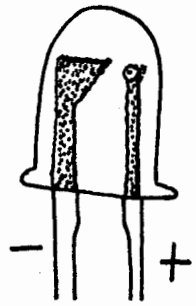
8. BRIDGE RECTIFIER (CR1). MATCH THE + LEAD WITH THE + MARK ON THE BOARD. LEAVE 1/2" LEADS ABOVE THE BOARD. SOLDER.



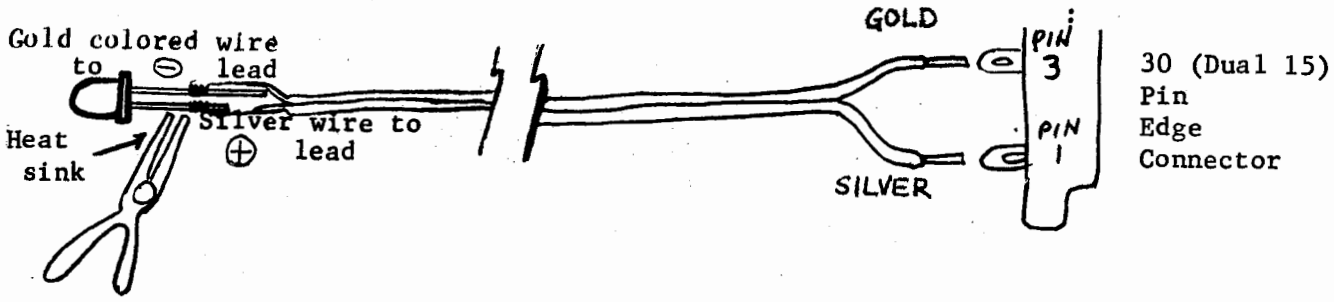
9. TRIM POTS. THE LEADS WILL SNAP IN PLACE IF PROPERLY INSERTED. SINCE THE HOLES ARE MUCH LARGER THAN THE LEADS, MAKE CERTAIN EACH LEAD IS TOUCHING THE FOIL AND IS WELL SOLDERED. INSERT AND SOLDER AS FOLLOWS:

PLL ADJUST	10K	(RED OR WHITE BODY)
VOLUME	50K	(BLACK OR BLUE BODY)

10. LEDS. THERE ARE TWO LIGHT EMITTING DIODES - ONE IS ON THE PC BOARD AND IS USED TO INDICATE "POWER ON". THE SECOND LED IS ATTACHED TO THE 30 PIN CONNECTOR VIA A LENGTH OF 2 CONDUCTOR CABLE AND IS USED AS THE VISUAL INDICATOR FOR TUNING. UNFORTUNATELY, LED POLARITY INDICATION IS NON-UNIFORM. TO DETERMINE THE "+" LEAD, HOLD THE LED UP TO A LIGHT. LINE UP THE LEADS ACCORDING TO:



INSERT THE LED ON THE BOARD WITH THE "+" LEAD ALIGNED WITH THE "+" ON THE BOARD. SOLDER. ATTACH THE OTHER LED TO THE 30 PIN CONNECTOR AS FOLLOWS:

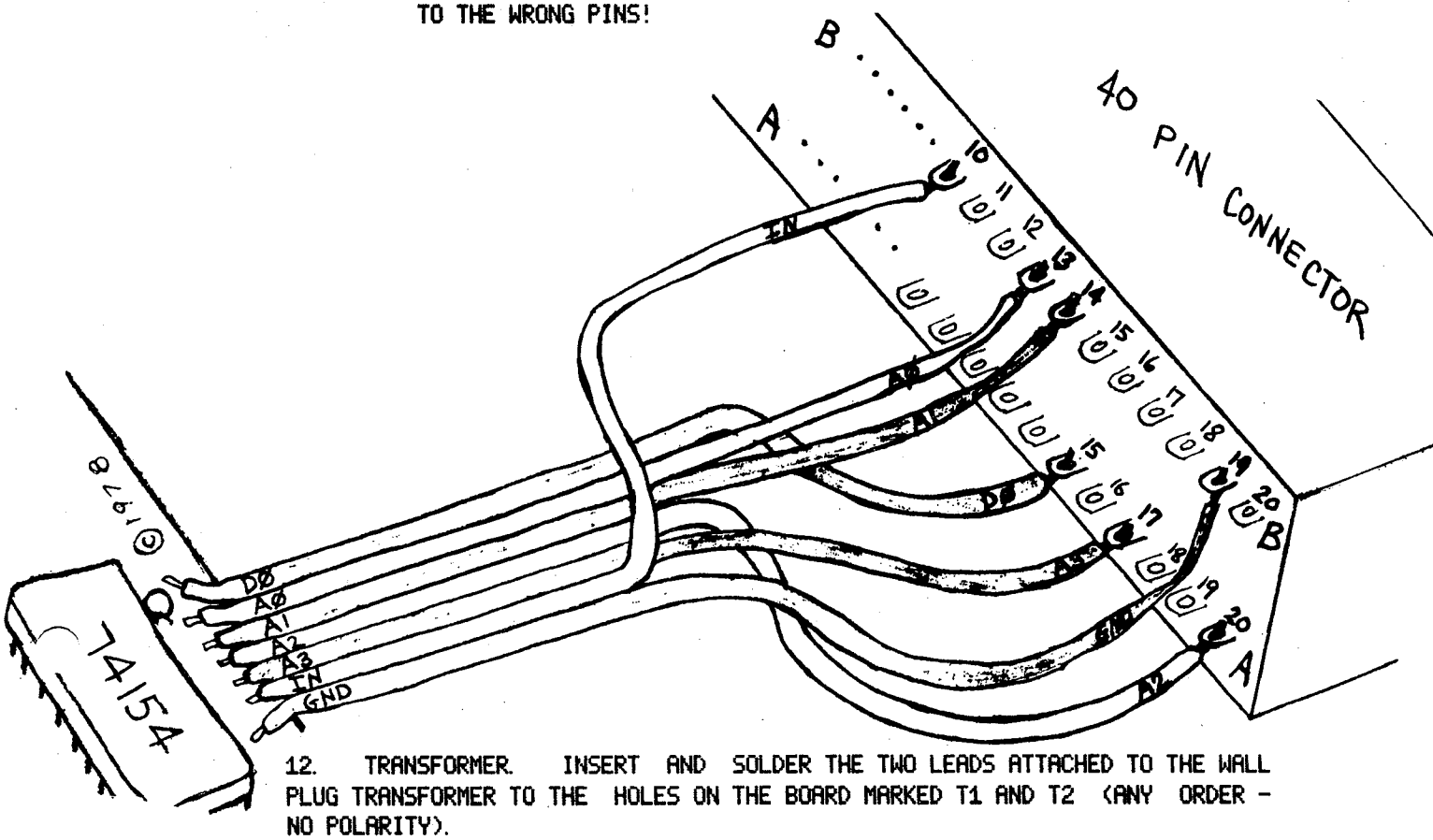


COVER THE LED BODY AND LEADS WITH HEAT SHRINK TUBING. USE A HIGH WATTAGE HAIR DRYER, OR -
CAUTIOUSLY - AN ELECTRIC RANGE BURNER, TO SHRINK THE TUBING. USE A RAZOR BLADE TO TRIM THE TUBING AROUND THE BODY OF THE LED FOR NICER APPEARANCE. THE HEAT SHRINK TUBING ALSO HELPS FOCUS THE LIGHT OF THE LED BETTER.

11. RIBBON CABLE

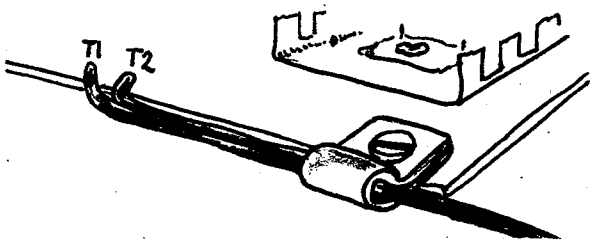
A. PEEL BACK INDIVIDUAL WIRES 1 1/4" ON ONE END AND 3/4" ON THE OTHER END.
B. STRIP 1/8" INSULATION OFF THE END OF EACH WIRE AND SOLDER TIN.
C. CUT THE 3/32" HEAT SHRINK TUBING INTO 1/2" LENGTHS AND INSERT ONE PIECE ON EACH OF THE 1 1/4" WIRES.
D. SOLDER THE 1 1/4" WIRES TO THE 40 PIN EDGE CONNECTOR AS SHOWN IN THE DIAGRAM BELOW.
E. PUSH THE TUBING COMPLETELY OVER EACH EYELET AND SHRINK THE TUBING WITH A HIGH WATTAGE HAIR DRYER OR -CAREFULLY- OVER AN ELECTRIC RANGE BURNER.
F. CONNECT THE OTHER END OF THE RIBBON CABLE TO THE TOP OF THE PC BOARD AS SHOWN IN THE DIAGRAM BELOW.

CAUTION! BEFORE PLUGGING THE M80 INTO YOUR TRS80 , USE AN OHMMETER TO CHECK CONTINUITY BETWEEN THE PC BOARD AND EDGE CONNECTOR INDIVIDUAL PINS (WITH THE 74154 REMOVED). ALSO CHECK PIN BY PIN FOR ADJACENT PIN SHORTS. IT IS QUITE IMPORTANT THAT THE WIRES DO NOT GO TO THE WRONG PINS!



12. TRANSFORMER. INSERT AND SOLDER THE TWO LEADS ATTACHED TO THE WALL PLUG TRANSFORMER TO THE HOLES ON THE BOARD MARKED T1 AND T2 (ANY ORDER - NO POLARITY).

13. CABLE CLAMP. PROVIDE A STRAIN RELIEF FOR THE TRANSFORMER LEADS USING A 1/8" NYLON CABLE CLAMP ATTACHED WITH A 4 - 40 X 3/8 SCREW, #6 SAE FLAT WASHER ON TOP AND A 4 - 40 NUT ON THE FOIL SIDE. ATTACH AS INDICATED:



14. ATTACH THE FOUR SELF STICKING BUMPER FEET TO THE FOIL SIDE OF THE BOARD AT EACH OF THE FOUR CORNERS.

15. PLUG THE WALL PLUG INTO A 115 VOLT AC OUTLET. THE ON BOARD LED SHOULD LIGHT. MEASURE THE + LEAD OF THE 2200 MFD CAPACITOR TO GROUND. YOU SHOULD HAVE APPROXIMATELY 14 TO 16 VOLTS. MEASURE 'OUT' PIN OF VR1 TO GROUND. IT SHOULD BE +5.0 VOLTS. IF YOU DO NOT OBSERVE THE CORRECT VOLTAGES - CHECK YOUR WIRING BEFORE PROCEEDING! UNPLUG THE TRANSFORMER.

16. INSERT ALL ICS AND THE RELAY AS INDICATED ON THE BOARD. OBSERVE PIN 1 POLARITY AS INDICATED BY THE SOCKET. THE OPTO GOES IN THE PINS CLOSEST TO C12.

17. PLUG THE TRANSFORMER IN AGAIN. TEMPORARILY CONNECT A JUMPER FROM PIN 4 TO PIN 15 ON THE 30 PIN CONNECTOR. (NOTE: ALL CONNECTIONS TO THE 30 PIN CONNECTOR ARE MADE ON THE BOTTOM ROW OF CONTACTS). THE INDICATOR LED SHOULD LIGHT. DISCONNECT THE JUMPER. THE LED SHOULD GO OFF.

THIS COMPLETES THE ASSEMBLY OF YOUR M-80 KIT. PROCEED TO THE NEXT SECTION FOR ADJUSTMENTS AND CONNECTIONS TO YOUR RIG.

OPERATING INSTRUCTIONS

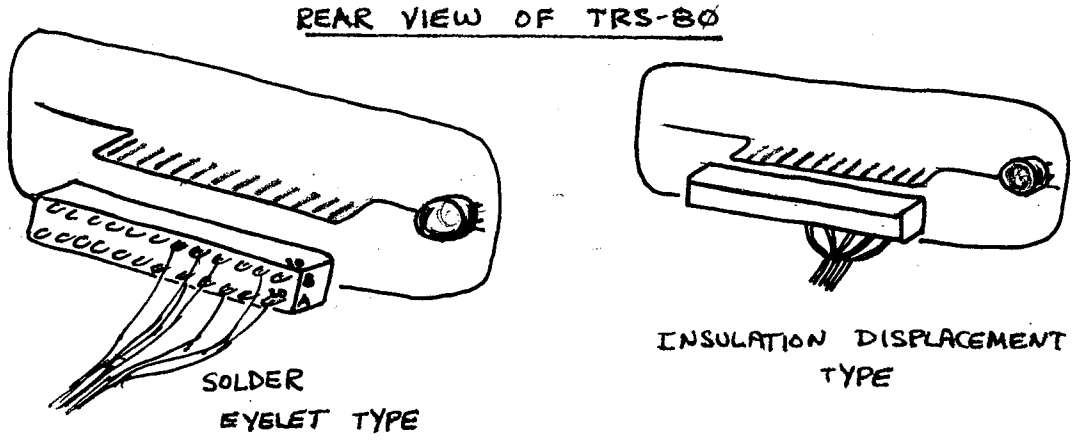
SETTING UP

THE M80 SYSTEM WILL RUN ON ANY TRS-80 WITH LEVEL II BASIC AND 16 K (OR MORE) RAM. IF YOU HAVE THE DISK VERSION OF THE SOFTWARE, IT WILL ALSO RUN UNDER DISK BASIC WITH 32 K (OR MORE) RAM. TO OBTAIN SATISFACTORY RESULTS ON RECEIVING, IT IS ASSUMED THAT YOU HAVE EITHER AN HF RECEIVER COVERING THE AMATEUR FREQUENCIES OR A VHF-FM RECEIVER.

IN GENERAL, THE M80 SYSTEM WILL NOT WORK SATISFACTORILY WITH TYPICAL GENERAL COVERAGE SHORTWAVE RECEIVERS. FREQUENCY STABILITY AND SELECTIVITY ARE CRITICAL FACTORS. YOU MUST HAVE AT LEAST SINGLE-SIDEBAND QUALITY EQUIPMENT TO PROPERLY RECEIVE BOTH MORSE CODE AND RTTY. AM OR BROADCAST BAND EQUIPMENT SIMPLY WON'T WORK.

TO TRANSMIT MORSE CODE, YOU WILL NEED A CW TRANSMITTER. TO TRANSMIT RTTY, YOU WILL NEED EITHER: 1) A TRANSMITTER WITH DIRECT FSK INPUT, OR 2) AN AFSK UNIT IN ADDITION TO THE TRANSMITTER.
THE M80 IS ATTACHED TO YOUR RADIO EQUIPMENT AND TO YOUR TRS80 BY MEANS OF TWO EDGE CONNECTORS. TURN OFF THE TRS80. PLUG IN THE 40 PIN (DUAL 20) CONNECTOR TO THE EXPANSION PORT (ADJACENT TO THE RESET SWITCH) SO THAT THE SIDE WITH MOST OF THE WIRES IS CLOSEST TO THE RESET SWITCH:

REAR VIEW OF TRS-80



PLUG IN THE M-80 WALL PLUG TRANSFORMER TO A 115 VOLT AC OUTLET. THE M-80 WILL OPERATE OFF OF EITHER 50 OR 60 HERTZ. USE A 220 V. TO 115 V. ADAPTER TO CONNECT TO 220 VOLT AC. CONNECT THE 30 PIN (DUAL 15) CONNECTOR TO YOUR RIG AS DESCRIBED BELOW.

PIN	DESCRIPTION	CONNECT TO
1	+5VOLTS TO LED INDICATOR	+ LEAD OF LED
2	RECEIVER AUDIO INPUT	LO Z HEADPHONE JACK OR SPEAKER TERMINALS
3	LED	- LEAD OF LED
4	KEY IN - HI ON KEY OPEN, LO ON KEY CLOSED. HI ON MARK LO ON SPACE.	STRAIGHT KEY, BUG OR KEYER FOR 'LOCAL' CW DECODING. RELAY OR KEYER OUTPUT FROM A TU (MUST BE TTL COMPATIBLE)
7	GROUND	EQUIPMENT GROUND
8	LOW VOLTAGE (LESS THAN 12V) TTY LOOP KEYER. GIVES HARD COPY ON XMT AND RCV WHEN USING BUILTIN PLL DEMOD.	LOW VOLTAGE TTY LOOP. CONNECTION TO HIGH VOLTAGE 60 MIL LOOPS IS NOT RECOMMENDED.
9	NEGATIVE VOLTAGE SOLID STATE KEYER (PNP 150V 0.3 W) KEYS ON CW ONLY.	CW JACK ON GRID BLOCK KEYED TRANSMITTERS.
10	SIDETONE OUTPUT. KEYS ON CW OR KEY IN LINE LO.	SMALL, LO-Z SPKR OR HEADPHONES.
11	POSITIVE VOLTAGE SOLID STATE KEYER. (NPN 30 V. 0.5 W) KEYS ON RTTY OR ON CW IF KEYBOARD SELECTED.	CW JACK ON SOLID STATE XMTR OR CW ID ON AFSK UNIT.
12	RELAY COMMON	COMMON (USUALLY GROUNDED) DO NOT USE TO KEY HV LOOPS!
13	RELAY NORMALLY OPEN	SEE NOTE BELOW.
14	RELAY NORMALLY CLOSED	SEE NOTE BELOW.

. NOTE: THE RELAY ALWAYS KEYS ON RTTY AND MAY BE USED TO KEY AN FSK INPUT TO A TRANSMIITER OR THE INPUT TO AN AFSK. ON SOME UNITS THIS MAY REQUIRE A 'PULL-UP' RESISTOR CONNECTED TO EITHER +5 OR +12 VOLTS. THESE ARE BOTH AVAILABLE ON THE M-80 BOARD. THE RELAY SHOULD NOT BE USED TO KEY A 60 MIL LOOP DIRECTLY AS IT WILL UNDOUBTEDLY BURN UP. IF IT IS DESIRED TO USE THE M-80 IN A 60 MIL LOOP, USE THE OPTIONAL MLK-1 LOOP KEYER MODULE IN PLACE OF THE RELAY. THE RELAY ALSO WILL KEY ON CW IF 'POSITIVE KEYING' IS SELECTED FROM THE KEYBOARD UNDER THE MORSE SEND MODE. IT MAY THEN BE USED ON CW TO KEY A TRANSMITTER, OR ON RTTY TO KEY THE CW ID INPUT OF AN AFSK UNIT.

IF YOU WANT TO TRY OUT THE M-80 QUICKLY, YOU WILL NEED TO MAKE THE FOLLOWING MINIMUM CONNECTIONS:

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NOTE: ALL CONNECTIONS ARE MADE TO THE BOTTOM ROW OF THE 30 PIN (DUAL 15) CONNECTOR. USE THE TOP SET AS A CONVENIENT GROUND BUS STRIP BY CONNECTING ALL OF THEM TO PIN 15. WHEN ONLY ONE PIN IS MENTIONED, THE OTHER WIRE IS ASSUMED TO GO TO PIN 7 OR 15 (GROUND).

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1. TO GENERATE CODE PRACTICE AND/OR LISTEN TO KEYBOARD SENT CODE; CONNECT A SMALL LOW IMPEDANCE (4-8 OHMS) SPEAKER OR HEADPHONES TO PIN 10.

2. TO RECEIVE CW OR RTTY: CONNECT THE AUDIO OUT (HEADPHONE OR SPEAKER JACK) FROM YOUR RECEIVER TO PIN 2. THE M80 ACCEPTS A WIDE RANGE OF INPUT IMPEDANCE, HOWEVER, LOW IMPEDANCE WORKS BEST.

3. TO TRANSMIT CW: YOU MUST FIRST DETERMINE WHAT TYPE OF KEYING YOUR TRANSMITTER USES. REFER TO THE OWNERS MANUAL OR MEASURE WITH A VOLTMETER BETWEEN THE CENTER PIN OF THE CW KEY JACK AND GROUND. IF THE VOLTAGE IS NEGATIVE (AS FOR EXAMPLE WITH GRID BLOCK KEYING), USE PIN 9 FOR KEYING. IF THE VOLTAGE IS POSITIVE (AS FOR EXAMPLE WITH MOST SOLID STATE RIGS), USE PIN 11 FOR KEYING. SOME TRANSMITTERS SIMPLY WON'T KEY WITH EITHER OF THE SOLID STATE SWITCHES PROVIDED. IN
THIS CASE, CONNECT YOUR CW JACK TO PIN 13 AND CONNECT PIN 12 TO GROUND ON YOUR RIG. (THIS USES THE RELAY TO KEY YOUR TRANSMITTER).

4. TO TRANSMIT RTTY: IF YOUR TRANSMITTER HAS DIRECT FSK KEYING (E.G. TS820, FT901, FT301, 1C701, ETC.), CONNECT PIN 12 TO GROUND ON THE TRANSMITTER AND EITHER PIN 13 OR 14 (DEPENDING ON YOUR KEYING CIRCUIT) TO THE FSK INPUT. SOME TRANSMITTERS USE NORMALLY OPEN (NO) ON MARK, OTHERS USE NORMALLY CLOSED (NC) ON MARK. YOU WILL HAVE TO DETERMINE WHICH IS "RIGHT-SIDE-UP" FOR YOUR PARTICULAR RADIO. IF YOUR TRANSMITTER DOES NOT HAVE FSK, YOU WILL NEED AN AFSK UNIT. THIS MAKES CONNECTION MORE DIFICULT. REFER TO APPENDIX 2 FOR DETAILS.

ADJUSTMENTS

TWO PC TRIM POTS (POTENTIOMETERS) ALLOW ADJUSTMENT OF THE PHASE LOCKED LOOP (PLL) FREQUENCY AND THE SIDE TONE VOLUME.

PLL ADJUSTMENT - IT WILL BE NECESSARY TO ADJUST THIS CONTROL TO CORRESPOND TO THE DESIRED FREQUENCY OF THE AUDIO SIGNAL COMING INTO THE M80 (PIN 2). THIS CONTROL IS SET ONLY ONCE - ALL SUBSEQUENT TUNING IS DONE WITH THE RECEIVER VFO. THE PLL SHOULD BE SET TO A FREQUENCY WITHIN THE RECEIVER PASSBAND. THE RANGE OF THIS ADJUSTMENT IS APPROXIMATELY 800 TO 2200 HERTZ. FOR BEST RESULTS, AND EASE OF TUNING, IT IS RECOMMENDED THAT THE PLL BE SET TO A FREQUENCY OF AT LEAST 1500 HZ.
THE BANDWIDTH OF THE PLL IS APPROXIMATELY 14% OF THE CENTER FREQUENCY. THIS MEANS THAT, AT 2000 HZ, THE BANDWIDTH IS APPROXIMATELY 280 HZ. AT 800 HZ, HOWEVER, THE BANDWIDTH IS ONLY 112 HZ - WHICH IS VERY DIFFICULT TO TUNE IN AND KEEP TUNED IN. TO ADJUST THE PLL, CONNECT THE RECEIVER AUDIO TO PIN 2, PLUG IN THE M80 WALL PLUG, AND TURN ON YOUR RECEIVER.

HF RECEPTION - TURN ON THE RECEIVER CALIBRATOR. SELECT THE DESIRED FILTER SELECTIVITY (USB, LSB, CW, FSK, ETC.) ON YOUR RECEIVER. TUNE IN THE CALIBRATOR FOR MAXIMUM SIGNAL STRENGTH ON THE S-METER. TUNE TO THE

HIGHEST AUDIO TONE WHICH STILL GIVES THE HIGHEST S-METER INDICATION). NOW TURN THE PLL ADJUSTMENT UNTIL THE LED LIGHTS BRIGHTLY (IF A SPEAKER IS CONNECTED TO PIN 10, YOU WILL ALSO BE ABLE TO HEAR THE SIDETONE OSCILLATOR COME ON). THE PLL IS NOW SET AND DOES NOT HAVE TO BE REALIGNED UNLESS A DIFFERENT PASSBAND FILTER IS USED.
TURN THE CALIBRATOR OFF. USING THE RECEIVER VFO, TUNE IN A CW SIGNAL SO THAT IT INDICATES MAXIMUM S-METER READING. NOW SLOWLY ROCK THE VFO DIAL BACK AND FORTH UNTIL THE LED FLICKERS (AND/OR THE SIDETONE IS HEARD) IN SYNCHRONIZATION WITH THE SIGNAL. ON SOME RECEIVERS, TUNING MAY BE QUITE CRITICAL DEPENDING ON THE DIAL TUNING-RATIO. YOU MIGHT PREFER DOING THE TUNING USING AN RIT CONTROL IF YOUR RIG HAS ONE.
TO TUNE AN RTTY STATION, SET THE RECEIVER TO THE SPACE FREQUENCY. IF THE LED LIGHTS WHEN THE STATION IS PAUSING, YOU ARE TUNED TO THE MARK, NOT THE SPACE - MOVE THE DIAL SLIGHTLY SO THAT THE LED IS OFF ON MARK (STATION IS NOT SENDING ANY CHARACTERS), BUT FLICKERS BRIGHTLY WHEN A CHARACTER IS SENT.

VHF-FM RECEPTION: ON RTTY, HAVE A FRIEND SEND INTERMITTENT RY'S ON THE CHANNEL, TURN THE PLL SLOWLY UNTIL THE LED FLICKERS ON SPACE (CHARACTERS ARE BEING SENT) BUT IS OFF ON MARK (SENDING STATION IDLE). THE PLL IS NOW SET AND NEEDS NO FURTHER ADJUSTMENT.
ON CW, HAVE A FRIEND SEND A CONTINUOUS TONE ON THE CHANNEL. TURN THE PLL ADJUSTMENT UNTIL THE LED LIGHTS BRIGHTLY. NOTE THAT THE LED IS NOW SET FOR THIS SPECIFIC TONE, SO THAT THE SENDING STATION MUST SEND THE SAME TONE ALL THE TIME.

VOLUME - CONTROLS AUDIO LEVEL OUTPUT FROM THE SIDE TONE OSCILLATOR. ADJUST FOR COMFORTABLE LISTENING LEVEL ON EITHER HEADPHONES OR A SPEAKER.

OPERATING

AFTER ALL THE CONNECTIONS AND ADJUSTMENTS INDICATED IN THE PRECEEDING SECTION HAVE BEEN MADE, YOU ARE READY TO LOAD THE SOFTWARE. THE M80 CONSISTS OF TWO SEPARATE PROGRAMS: A MACHINE LANGUAGE SUBPROGRAM AND A BASIC MAIN PROGRAM. TURN ON YOUR TRS80 AND PROCEED AS FOLLOWS:

I. LEVEL II BASIC (16K OR MORE RAM REQUIRED)

1. ENTER MEMORY SIZE OF 30000 *7530H*
2. LOAD THE MACHINE LANGUAGE SUBPROGRAM BY ENTERING:
   SYSTEM
3. THE COMPUTER WILL RESPOND WITH *?
4. ENTER: M80
5. REWIND THE TAPE. SET THE VOLUME AT 5 1/2, TONE AT HI. PRESS PLAY. YOU SHOULD SEE THE FAMILIAR FLASHING ASTERISKS IN THE UPPER RIGHT HAND CORNER. (IF A "C" APPEARS, THE PROGRAM MUST BE RELOADED.)
6. WHEN THE PROGRAM HAS BEEN LOADED, THE COMPUTER WILL DISPLAY *?
7. PRESS THE BREAK KEY.
8. LOAD THE BASIC MAIN PROGRAM BY ENTERING CLOAD.

9. AGAIN, THE FLASHING ASTERISKS INDICATE THE PROGRAM IS LOADING. (THE TAPE COUNTER SHOULD BE AROUND 50 WHEN THE ASTERISKS BEGIN AND 120 WHEN THE PROGRAM IS LOADED.)

10. WHEN READY APPEARS, ENTER RUN.

II. DISK BASIC (32K OR MORE RAM REQUIRED)

THE M80 SOFTWARE MAY BE EITHER ON A FORMATTED DISKETTE WITH NO DOS (FOR MULTIDRIVE SYSTEMS) OR ON A DISKETTE CONTAINING DOS (FOR SINGLE DRIVE SYSTEMS). WITH A MULTI- DRIVE SYSTEM, PLACE ANY DISKETTE CONTAINING DOS IN DRIVE 0 AND THE M80 DISKETTE IN ANOTHER DRIVE. WITH A SINGLE DRIVE, PLACE THE M80 DISKETTE IN THE DISK DRIVE.

1. BOOT THE SYSTEM (PRESS THE RESET BUTTON).
2. UNDER DOS, TYPE:
   LOAD M80/CIM
3. CALL IN DISK BASIC BY ENTERING:
   BASIC
4. IN RESPONSE TO
   HOW MANY FILES?
   PRESS "ENTER"
5. IN RESPONSE TO
   MEMORY SIZE?
   ENTER:
   46000 B3B0 ld
6. ENTER
   RUN "M80"

THE PROGRAM HAS FIVE MAJOR MODES OF OPERATION: MORSE SEND, MORSE RECEIVE, CODE PRACTICE, RTTY SEND, AND RTTY RECEIVE. BEGIN BY SELECTING EITHER MORSE OR RTTY SEND MODES WHEN ASKED.

MORSE

IF YOU SELECT THE MORSE SEND MODE, YOU WILL BE ASKED TO ENTER THE SPEED IN WORDS PER MINUTE (WPM). THE RANGE OF ALLOWABLE SPEEDS IS 1 TO 399 WORDS PER MINUTE. THE NUMBER OF WORDS PER MINUTE IS DEFINED HERE AS THE NUMBER OF 50 BAUDS PER MINUTE - I.E. THE NUMBER OF TIMES THE WORD PARIS WILL BE SENT IN ONE MINUTE. SPACING IS INITIATED AT THE RATIO: 1 FOR DIT, 3 FOR DAH, 1 FOR INTERELEMENT SPACE, 3 FOR CHARACTER SPACE AND 7 FOR WORD SPACE. AT SLOWER SPEEDS, YOU MAY WANT TO CHANGE THIS RATIO. THIS OPTION IS EXPLAINED BELOW. THIS SETS THE SENDING SPEED, THE CODE PRACTICE SPEED, AND ALSO INITIALIZES THE RECEIVE SPEED. WHILE IN THE MORSE SEND MODE, YOU HAVE A VARIETY OF OPTIONS:

1. KEYBOARD SENDING - TYPE ANY LETTER, NUMBER OR PUNCTUATION (? . / OR ,). YOU CAN ALSO SELECT FROM THREE SPECIAL CHARACTERS:

TO SEND	PRESS
$\overline{AR}$.-.-.	@
$\overline{KN}$ -.--.	<
$\overline{SK}$ ...-.-	>

(NOTE: .-... AND ..... ARE NOT SUPPORTED. WE SUGGEST YOU USE 'QRX' AND 'E E E' RESPECTIVELY.)
SINCE THE KEYBOARD IS "BUFFERED", YOU CAN TYPE AHEAD UP TO 255 CHARACTERS.

==========
NOTE: THERE IS NO WARNING GIVEN IF YOU ARE ABOUT TO EXCEED THE TYPE-AHEAD BUFFER. THE PROGRAM WILL "CRASH" IF THE BUFFER IS EXCEEDED. IF THIS SHOULD ACCIDENTLY HAPPEN, YOU MAY QUICKLY RESTORE EXECUTION BY TYPING
GO TO 10000
THIS WILL PUT YOU BACK IN THE SEND MODE AND YOU MAY CONTINUE TYPING AFTER LETTING THE BUFFER EMPTY SOME OF THE MESSAGE TO MAKE ROOM FOR MORE.
==========

NON-MORSE CHARACTERS WILL BE IGNORED BY THE PROGRAM. FOR EXAMPLE, * OR # HAVE NO MORSE EQUIVALENT AND WILL BE IGNORED IF TYPED.

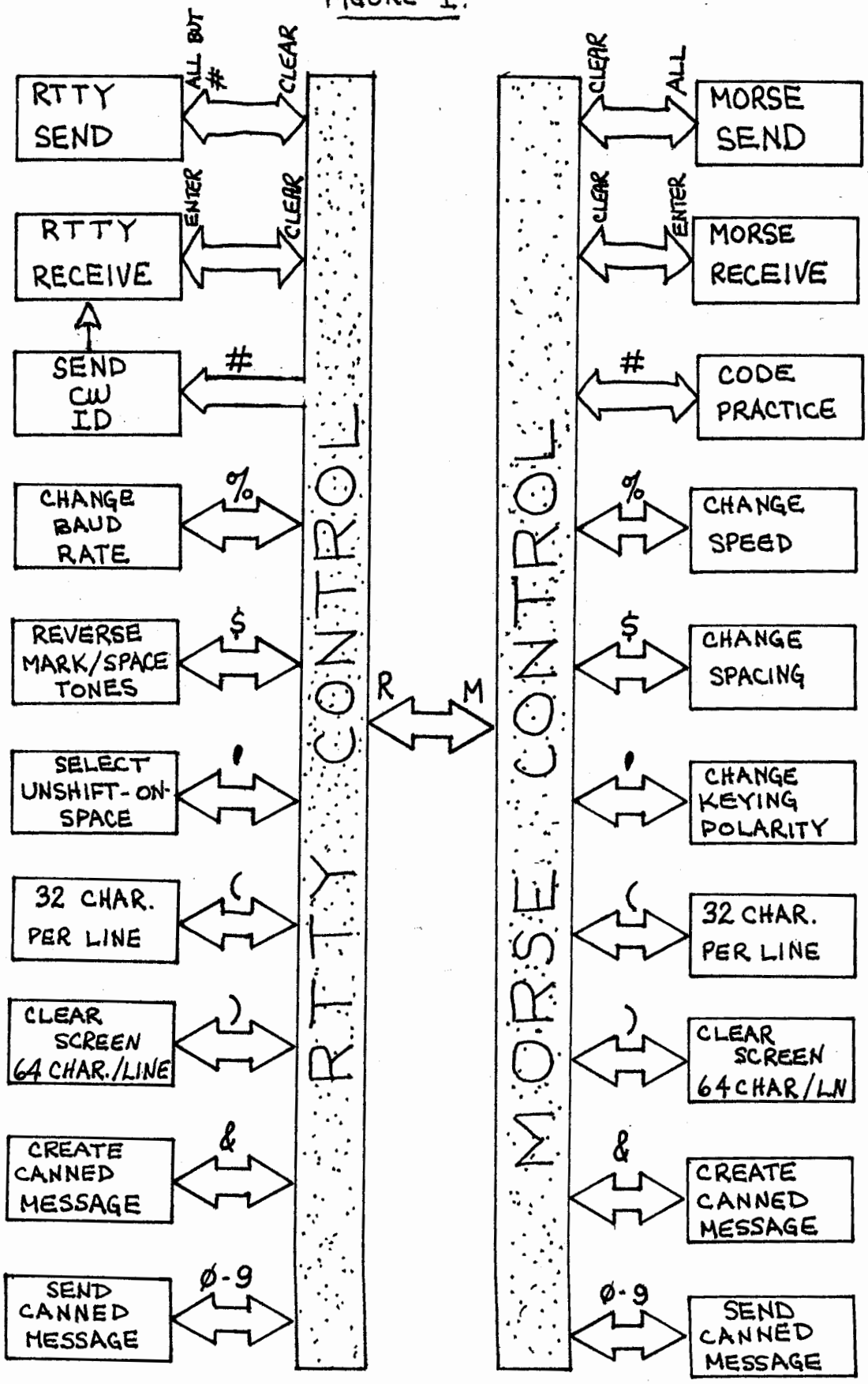
2. SPECIAL CONTROL FUNCTIONS - ANY OF SEVERAL CONTROL OPTIONS MAY BE SELECTED BY FIRST PRESSING THE "CLEAR" KEY AND THEN ONE OF THE "SPECIAL FUNCTION" KEYS AS
DESCRIBED BELOW AND ILLUSTRATED IN BLOCK DIAGRAM FORM IN FIGURE 1.

==========
NOTE: MOST OF THESE KEYS ARE UPPER CASE AND THEREFORE REQUIRE THE SIMULTANEOUS DEPRESSING OF THE SHIFT KEY. FOR EXAMPLE, PRESS 'CLEAR' THEN HOLD DOWN THE SHIFT KEY AND PRESS THE (#/3) KEY.
$ % & ' (AND) ALL REQUIRE USE OF THE SHIFT.
==========

START CODE PRACTICE. EXPLAINED LATER IN DETAIL.

$ CHANGE SPACING. YOU CAN SELECT THE DESIRED CHARACTER AND/OR WORD SPACING (BUT NOT THE DIT TO DAH OR INTERELEMENT RATIO).
THE PROGRAM INITIALIZES WITH CHARACTER SPACING SET TO THREE TIMES THE LENGTH OF A
DIT AND WORD SPACING AT SEVEN TIMES THE LENGTH OF A DIT. ONE COMMON USE FOR DIFFERENT SPACING IS AT LOW SPEED CODE, E.G. BELOW 13 WPM. MANY PEOPLE PREFER TO LEARN AND SEND SLOW CODE WITH INDIVIDUAL CHARACTERS FORMED

FIGURE 1.


RTTY SEND
ALL BUT #
CLEAR
RTTY RECEIVE
ENTER
CLEAR
SEND CW ID
#
CHANGE BAUD RATE
%
REVERSE MARK/SPACE TONES
$
SELECT UNSHIFT-ON-SPACE
'
32 CHAR. PER LINE
(
CLEAR SCREEN 64 CHAR./LINE
)
CREATE CANNED MESSAGE
&
SEND CANNED MESSAGE
ø-9
RTTY CONTROL
R
M
MORSE CONTROL
CLEAR
ALL
MORSE SEND
CLEAR
ENTER
MORSE RECEIVE
#
CODE PRACTICE
%
CHANGE SPEED
$
CHANGE SPACING
'
CHANGE KEYING POLARITY
(
32 CHAR. PER LINE
)
CLEAR SCREEN 64 CHAR/LN
&
CREATE CANNED MESSAGE
ø-9
SEND CANNED MESSAGE

AT A HIGHER RATE, SAY 13 WPM, BUT LONG PAUSES BETWEEN CHARACTERS AND WORDS. THIS GIVES A SLOW OVERALL NUMBER OF WORDS PER MINUTE, BUT MAKES THE TRANSITION TO FASTER CODE EASIER. AS AN EXAMPLE, SUPPOSE IT IS DESIRED TO HAVE AN OVERALL WPM OF 5 BUT CHARACTERS AT 13 WPM. SELECT A SPEED OF 13 WPM, THEN SELECT A CHARACTER SPACING OF 16 AND A WORD SPACING OF 35. SOME EXPERIMENTATION WILL BE NECESSARY TO FIND THE OPTIMUM SPACING DESIRED.

% CHANGE SPEED. SETS THE CHARACTER RATE IN WPM FOR KEYBOARD SENDING, CODE PRACTICE, AND INITIAL RECEIVING SPEED. (A VARIATION OF APPROXIMATELY + OR - 10 WPM ON RECEIVE IS AUTOMATICALLY COMPENSATED FOR.)

& CREATE A CANNED MESSAGE. YOU HAVE TEN PROGRAMMABLE MESSAGE MEMORIES AVAILABLE: 1 THROUGH 0. ENTER THE MESSAGE NUMBER. ANYTHING NOW TYPED WILL NOT BE SENT OVER THE AIR, BUT RATHER, WILL BE STORED IN MEMORY FOR LATER RECALL. TERMINATE THE MESSAGE BY PRESSING THE "CLEAR" KEY. EDIT CAPABILITY IS PROVIDED IN THIS MODE, SO YOU CAN DELETE PREVIOUSLY TYPED CHARACTERS BY PRESSING THE BACKARROW KEY. SINCE THE EDITING IS BEING DONE IN BASIC, THE INPUT TIME REQUIRED PER CHARACTER IS LONGER THAN YOU MIGHT EXPECT. IF YOU TYPE TOO FAST FOR INSTANCE, YOU WILL GET AHEAD OF THE INPUT AND MISS ONE OR MORE CHARACTERS. A GOOD PROCEDURE WOULD BE TO TYPE SLOW AND STEADY WHILE INPUTTING INTO A MESSAGE MEMORY. YOU WILL NOTE A "COUNT DOWN" COUNTER IN THE UPPER LEFT CORNER OF THE SCREEN. THIS IS AN INDICATOR OF REMAINING MEMORY FOR THIS MESSAGE. EACH TIME A PARTICULAR MESSAGE NUMBER IS SELECTED, THE PREVIOUS CONTENTS WILL BE DELETED AND THE COUNTER WILL BE SET TO 255.
THE MESSAGE MEMORY CAPABILITY IS QUITE POWERFUL, AND ALLOWS YOU TO SAVE A GREAT DEAL OF TIME AND ENERGY. COMMON USES WOULD BE TO STORE: CQ MESSAGES, CONTEST EXCHANGES, DX QSO'S, TRAFFIC, "BRAG TAPES", TEST SEQUENCES, ETC. THE SAME MESSAGE MEMORIES ARE USED IN BOTH MORSE AND RTTY MODES.

' CHANGE CW OUTPUT KEYING. AS EXPLAINED PREVIOUSLY, SOME CW TRANSMITTERS USE NEGATIVE VOLTAGE KEYING AND OTHERS USE POSITIVE VOLTAGE KEYING. THE PROGRAM IS INITIALIZED TO SEND MORSE CODE TO THE NEGATIVE KEYER (PIN 9) AND THE SIDE TONE OSCILLATOR. IF YOU WISH TO USE THE POSITIVE KEYER (PIN 11) OR THE RELAY TO KEY CW, YOU CAN CHANGE THE TYPE OF KEYING WITH THIS FUNCTION. YOU MIGHT ALSO SELECT POSITIVE KEYING TO GIVE A CW ID THROUGH THE FSK JACK IF YOU ARE USING FSK ON RTTY.

(CHANGE TO DOUBLE SIZE CHARACTERS - 32 CHARACTERS PER LINE.

) CLEAR SCREEN AND BEGIN NORMAL SIZE LETTERS - 64 CHARACTERS PER LINE.

0 THROUGH 9 SEND MESSAGE MEMORY NUMBER N. SIMPLY PRESS "CLEAR" AND THEN THE MESSAGE NUMBER FROM 0 TO 9. THE ENTIRE MESSAGE WILL BE AUTOMATICALLY SENT.

==========
NOTE: THERE IS NO WAY TO STOP A MESSAGE FROM SENDING ITS ENTIRE CONTENTS ONCE IT HAS BEEN SELECTED (SHORT OF RESET - WHICH DESTROYS THE ENTIRE PROGRAM). IT IS A GOOD PRACTICE TO KEEP EACH MESSAGE SHORT AND STRING TOGETHER SEVERAL MESSAGES IF POSSIBLE. THIS GIVES BETTER CONTROL OVER EXECUTION.
==========

AN EXAMPLE WILL ILLUSTRATE THE PROCESS OF CREATING AND SENDING CANNED MESSAGES:

```
CLEAR &
ENTER MESSAGE # (0 THRU 9) ?  1
ENTER MESSAGE NUMBER 1 - USE "CLEAR" TO TERMINATE
CQ CQ CQ DE N6EE N6EE N6EE "CLEAR"
ENTERED - BACK TO SEND MODE
"CLEAR" &
ENTER MESSAGE # (0 THRU 9) ?  2
ENTER MESSAGE NUMBER 2 - USE "CLEAR" TO TERMINATE
DX PSE @ K "CLEAR"
ENTERED - BACK TO SEND MODE
CLEAR 1
CQ CQ CQ DE N6EE N6EE N6EE
CLEAR 1
CQ CQ CQ DE N6EE N6EE N6EE
CLEAR 1
CQ CQ CQ DE N6EE N6EE N6EE
CLEAR 2
DX PSE AR K
```

R TRANSFER TO RTTY SEND MODE.

ENTER TRANSFER TO MORSE RECEIVE MODE.

MORSE RECEIVE MODE

THE SPEED IS INITIALIZED IN THE SEND MODE. THE PROGRAM WILL AUTOMATICALLY ADJUST FOR VARIATIONS IN THE RECEIVED SIGNALS SPEED WITHIN A RANGE OF APPROXIMATELY + OR - 10 WPM. IF THE STATION IS SENDING OUTSIDE THIS RANGE, RETURN TO THE SEND MODE (BY HOLDING DOWN THE "CLEAR" KEY) AND RESET THE SPEED.

==========
NOTE: THE RECEIVER AUDIO MUST BE TURNED DOWN IF A SIGNAL IS STILL LIGHTING THE LED - OTHERWISE THE PROGRAM WILL REMAIN IN THE RECEIVE MODE.
==========

THE SYSTEM WILL DECODE WELL-SENT MORSE CODE AND DISPLAY IT ON THE VIDEO MONITOR. DUE TO NOISE (QRN), INTERFERENCE (QRM), FADING (QSB), AND NON-UNIFORMITY OF HAND SENT CODE, 100% PERFECT COPY IS NOT USUALLY ATTAINABLE. OF COURSE, COMPUTER OR "MACHINE" GENERATED CODE WILL BE EASIER TO COPY (E.G. WIAW), BUT IS STILL SUBJECT TO QRN, QRM, AND QSB.

VERY HIGH SPEED CW (GREATER THAN 100 WPM) IS ESPECIALLY SUBJECT TO ERRORS CAUSED BY QRN, QRM, AND QSB. THESE PROBLEMS ARE ALMOST NON-EXISTENT ON VHF-FM, THEREBY MAKING HIGH SPEED CW MUCH MORE PRACTICAL ON THIS MODE. WITH REGARD TO TUNING, THE FOLLOWING FACTORS SHOULD BE KEPT IN MIND:

1. THE BACKGROUND NOISE IN THE RECEIVER MUST BE REDUCED TO A LEVEL SUCH THAT NO CHARACTERS APPEAR ON THE SCREEN WHEN THERE IS NO INCOMING SIGNAL. (TURN DOWN THE RF GAIN CONTROL OR INSERT AN RF ATTENUATOR).

2. EVEN THOUGH MOST CW FILTERS HAVE A CENTER PASSBAND FREQUENCY OF AROUND 1000 HZ, THE PLL WORKS BEST AT HIGHER FREQUENCIES. UNLESS AN IFSHIFT CONTROL IS AVAILABLE TO INCREASE THE CENTER FREQUENCY, IT IS RECOMMENDED THAT THE USB (AND NOT THE CW) FILTER BE USED TO COPY CW. SET THE PLL TO AROUND 2000 HZ FOR BEST DEMODULATION.

3. A DRIFTING SIGNAL WILL REQUIRE FREQUENT RETUNING OF THE RECEIVER VFO TO KEEP GOOD COPY. (THE PLL DOES COMPENSATE FOR SMALL FREQUENCY DRIFT.)

4. THE SPEED SETTING ALLOWS A VARIATION OF APPROXIMATELY + OR - 10 WPM IN THE RECEIVED SIGNALS SPEED. WITHIN THIS RANGE, GOOD COPY SHOULD RESULT. HOWEVER, SOME PROBLEMS WITH CHARACTER AND WORD SPACING MAY STILL OCCUR, PARTICULARLY NEAR THE "EXTREMES" OF THE RANGE OF VARIATION. AS A GUIDE TO CORRECT SPEED SETTING, THERE ARE SEVERAL TYPES OF ERROR WHICH MIGHT BE OBSERVED DUE TO AN INCORRECT SPEED SETTING (OR INCONSISTENCY ON THE PART OF THE SENDING STATION): SUPPOSE WE RECEIVE AN "IDEAL" SEQUENCE OF MORSE CHARACTERS AS FOLLOWS:

AT E

THIS MIGHT BE INCORRECTLY INTERPRETTED AS:

PRINTS	SPEED SET
MTT OR OT	TOO HIGH
IE E OR SE	TOO LOW
ETT T	TOO HIGH
WE	TOO LOW
A T E	TOO HIGH
ATE	TOO LOW

CODE PRACTICE MODE

THE PROGRAM WILL GENERATE RANDOM MORSE CODE FOR TRAINING PURPOSES. USE SPECIAL FUNCTION # TO TRANSFER FROM THE MORSE SEND MODE. SELECT EITHER CHARACTERS OR FIVE LETTER WORDS WHEN ASKED TO DO SO. "CHARACTERS" MEANS ANY OF THE LETTERS, NUMBERS, OR PUNCTUATION. FOR EXAMPLE:

XJ6/A VCE4. -UIOP 20Z/S DSEET

IF "WORDS" ARE SELECTED, THE PROGRAM SELECTS RANDOMLY FROM A LIST OF STORED

HAM-RADIO RELATED WORDS. FOR EXAMPLE:

RADIO CHINA LIGHT FINAL PLATE

THE DISPLAY WILL BE IN 32 CHARACTER PER LINE FORMAT FOR EASY VIEWING. THE PROGRAM CAN BE MADE TO PAUSE AT ANY TIME BY PRESSING THE SPACE BAR. THIS WILL GIVE YOU TIME TO CHECK YOUR COPY. RESUME CODE SENDING BY AGAIN DEPRESSING SPACE BAR. YOU CAN RESET THE SPEED BY RETURNING TO THE MORSE SEND MODE BY HOLDING DOWN THE "CLEAR" KEY. RETURN TO CODE PRACTICE WITH THE "#" SPECIAL FUNCTION.

RTTY SEND MODE

ENTER THE RTTY SEND MODE AT THE OUTSET OF THE PROGRAM IN RESPONSE TO THE QUESTION:

MORSE OR BAUDOT RTTY?

OR SELECT THE "R" SPECIAL FUNCTION KEY IN THE MORSE SEND MODE. TYPING ON THE KEYBOARD WILL KEY THE RELAY AND ALSO A SOLID STATE SWITCH (FOR NORMALLY POSITIVE VOLTAGES). TO SEND RTTY YOU MUST EITHER HAVE FSK (FREQUENCY SHIFT KEYING) CAPABILITY ON YOUR TRANSMITTER OR ELSE USE AN AFSK (AUDIO FREQUENCY SHIFT KEYING) UNIT (NOT PROVIDED WITH THE M80). EITHER OF THE RELAY CONTACTS, (NORMALLY OPEN, NORMALLY CLOSED) OR THE SOLID STATE SWITCH MAY BE USED AS APPROPRIATE. WITH RIGS LIKE THE KENWOOD T.S820 FOR EXAMPLE, SIMPLY CONNECT THE NC RELAY CONTACTS TO THE FSK JACK AND PUT THE TRANSCEIVER MODE SWITCH TO FSK. REFER TO APPENDIX 2 FOR TYPICAL RTTY INTERCONNECTIONS.

==========

NOTE: IF YOU ARE NEW TO RTTY, YOU WOULD DO WELL TO READ A LITTLE BEFORE SENDING ON THE AIR. GOOD INTRODUCTIONS ARE CONTAINED IN:

RTTY HANDBOOK, 73 MAGAZINE, PETERBOROUGH, NH 03458

RTTY BEGINNERS HANDBOOK, RTTY JOURNAL, PO BOX RY, CARDIFF BY TH SEA, CA 92007

SPECIALIZED COMMUNICATION TECHNIQUES, ARRL, NEWINGTON, CT.

==========

THE KEYBOARD IS BUFFERED, ALLOWING YOU TO TYPE AHEAD UP TO 255 CHARACTERS. PRESSING THE ENTER KEY SENDS A CARRIAGE RETURN AND A LINE FEED. SINCE MOST RTTYERS USE TTY MACHINES HAVING 72 CHARACTERS PER LINE, THE ENTER KEY SHOULD BE PRESSED AT LEAST ONCE EVERY 72 CHARACTERS. THE BAUDOT CODE REQUIRES THE SPECIAL LTRS AND FIGS CHARACTERS TO BE SENT WHEN SHIFTING BETWEEN UPPER AND LOWER CASE. THIS IS DONE AUTOMATICALLY BY THE M80 SOFTWARE. (IF YOU WISH TO SEND THESE CHARACTERS MANUALLY, ">" GENERATES "LTRS" AND "<" GENERATES "FIGS" - THIS FEATURE COULD BE USED TO MANUALLY CREATE A "DIDDLE").

SEVERAL SPECIAL FEATURES ARE AVAILABLE IN THE RTTY SEND MODE. THESE ARE SELECTED BY FIRST PRESSING THE "CLEAR" KEY AND THEN ONE OF THE SPECIAL FUNCTION KEYS EXPLAINED BELOW:

AUTO CWID - THIS GENERATES THE FOLLOWING SEQUENCE:

1. THE MESSAGE:
   CW ID FOLLOWS -
   IS SENT IN BAUDOT.
2. THE CONTENTS OF MESSAGE MEMORY 0 IS SENT IN MORSE CODE.
3. THE PROGRAM TRANSFERS TO THE RTTY RECEIVE MODE.

BEFORE SELECTING THE AUTO CW ID, YOU SHOULD ENTER THE DESIRED MORSE CHARACTERS IN MESSAGE MEMORY 0 (USING SPECIAL FUNCTION "&"). A TYPICAL MORSE ID WOULD BE:

DE N6EE K

REFER TO APPENDIX 2 FOR EQUIPMENT INTERCONNECTIONS.

$ REVERSE MARK AND SPACE RECEIVE TONES. THE PROGRAM IS INITIALIZED SO THAT THE LED SHOULD BE OFF ON MARK AND ON ON SPACE. IF YOU PREFER TO HAVE THE LED LIGHT ON MARK AND OFF OF SPACE, USE THIS SPECIAL FUNCTION.

==========

NOTE: ONCE THE MARK AND SPACE TONES ARE REVERSED, THE PROGRAM ASSUMES THAT THE LED WILL BE ON WITH NO SIGNAL PRESENT. THIS WILL BE THE CASE ONLY IF A STATION IS ACTUALLY TUNED IN OR IF A TU IS USED WHICH HAS A NORMALLY CLOSED OUTPUT. IN THE ABSENCE OF AN INCOMING SIGNAL, THE LED WOULD BE OFF - THEREBY 'TRICKING' THE PROGRAMM INTO THINKING A CONTINUOUS SPACE TONE IS PRESENT. THIS RESULTS IN A CONTINUOUS STRING OF LEFT PARENTHESES

(((((((((((((((((((((((((. . .

IN ORDER TO ESCAPE THIS "TRAP", SIMPLY TUNE IN A SIGNAL SO THAT THE LED IS ON; THEN HOLD DOWN THE "CLEAR" KEY.

==========

% CHANGE BAUD RATE. SELECT 60,66, OR 75 OR 100 WPM. INITIALIZED AT 60 WPM.

& CREATE A CANNED MESSAGE. (0 THRU 9) 255 CHARACTERS MAX. EACH . SAME AS MORSE SEND MODE.

' SELECT AUTOMATIC UNSHIFT-ON-SPACE OR TURN IT OFF. INITIALIZED ON. THIS FEATURE IS GOOD UNDER NOISY RECEPTION CONDITIONS. IF THE LTRS CHARACTER IS MISSED WHILE RECEIVING, IT WILL BE AUTOMATICALLY INSERTED WITH THE FIRST OCCURRENCE OF A SPACE. ONE DISADVANTAGE OF THE AUTO UNSHIFT IS THAT IT WILL GARBLE SEQUENCES OF UPPER CASE CHARACTERS SEPARATED BY SPACES. FOR EXAMPLE, SUPPOSE THE OTHER STATION SENDS:

1234<SPACE> 56TH

WITH AUTO UNSHIFT, YOU WILL COPY:

1234<SPACE> TYTH

(CHANGE TO 32 CHARACTER / LINE MODE.

) CLEAR SCREEN AND BEGIN 64 CHARACTER / LINE MODE.

0 THRU 9 SEND MESSAGE NUMBER N. WORKS SAME AS MORSE SEND MODE ONLY IN BAUDOT.

M TRANSFER TO MORSE SEND MODE.

ENTER TRANSFER TO RTTY RECEIVE MODE.

RTTY RECEIVE MODE

IN THE RTTY RECEIVE MODE, THE SYSTEM WILL DECODE A PROPERLY TUNED RTTY SIGNAL AND DISPLAY IT ON THE SCREEN. TUNING IS CRITICAL - GARBLE WILL RESULT FROM A POORLY TUNED SIGNAL. YOU HAVE YOUR RECEIVING VFO TUNED PROPERLY IF:

1. THE LED IS OFF ON MARK (SENDING STATION IDLE).
2. THE LED IS ON ON SPACE (THE LED FLICKERS BRIGHTLY AS RTTY CHARACTERS ARE RECEIVED).
3. GOOD COPY IS BEING DISPLAYED ON THE SCREEN.

IT WILL TAKE SOME PRACTICE TO QUICKLY ADJUST THE RECEIVER VFO TO OBTAIN GOOD COPY. UNDER GOOD SIGNAL CONDITIONS, 100% COPY IS CERTAINLY ATTAINABLE USING THE M80. KEEP IN MIND, HOWEVER, THAT QRN, QRM, AND QSB MAY CAUSE SOME LOSS OF COPY ("HITS"). A BETTER TERMINAL UNIT (TU) MIGHT BE USED TO IMPROVE COPY UNDER MARGINAL SIGNAL CONDITIONS. THIS IS RECOMMENDED FOR SERIOUS RTTYERS. YOUR M80 IS COMPATIBLE WITH VIRTUALLY EVERY POPULAR TU. SEE APPENDIX 2 FOR DETAILS.

MOST RTTY STATIONS USE A 72 CHARACTER LINE OF TEXT. THE TRS 80 DISPLAYS A MAXIMUM OF 64 CHARACTERS PER LINE. THEREFORE, MOST TEXT WILL REQUIRE TWO LINES ON THE TRS 80 DISPLAY FOR EACH LINE AT THE OTHER STATION.

TO RETURN TO THE RTTY SEND MODE, HOLD DOWN THE "CLEAR" KEY. AS IN THE MORSE RECEIVE MODE, IT IS ESSENTIAL THAT THE LED BE OFF IN ORDER TO RETURN TO THE SEND MODE. IF A STATION IS STILL BEING RECEIVED, THIS MEANS THAT THE AUDIO WILL HAVE TO BE TURNED DOWN.

HINTS AND KINKS

THIS SECTION CONTAINS INFORMATION ON HOW TO GET A GREATDEAL MORE ENJOYMENT OUT OF YOUR M80 SYSTEM.
SOME VERY WORTHWHILE "PLUSES" ARE INCLUDED WHICH WILL ADD GREATLY TO THE VALUE OF THIS ALREADY VERSATILE SYSTEM.

1. ADDING "PERMANENT" MESSAGES

THE M80 ALLOWS UP TO TEN KEYBOARD PROGRAMMABLE MESSAGES TO BE STORED IN MEMORY FOR RECALL AT ANY TIME. ONE DISADVANTAGE OF THE PROGRAMMABLE MESSAGE IS THAT IT IS LOST EACH TIME THE COMPUTER IS TURNED OFF OR RESET. YOU CAN EASILY CHANGE THE M80 PROGRAM TO SAVE ANY DESIRED MESSAGE ON TAPE ALONG WITH THE M80 BASIC MAIN PROGRAM.
THE MESSAGES ARE STORED IN A STRING ARRAY LABELED M$. SIMPLY ADD ONE ASSIGNMENT STATEMENT TO THE BASIC PROGRAM FOR EACH MESSAGE YOU WISH TO SAVE. FOR EXAMPLE:

```
81 M$(1) = "CQ CQ CQ DE N6EE N6EE N6EE K"
82 M$(1) = "THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK
1234567890 TIMES."
84 M$(3) = CHR$(13) + "*****************************************"
         + CHR$(13) + "*       STATION N6EE                    *"
         + CHR$(13) + "*****************************************"
```

ONCE THE STATEMENTS HAVE BEEN ADDED TO THE PROGAM, SAVE IT ON ANOTHER CASSETTE WITH THE CSAVE COMMAND. ONE NICE THING ABOUT THIS TECHNIQUE IS THAT IT ALLOWS YOU TO REPROGRAM ANY OF THE MEMORIES FROM THE KEYBOARD AT ANY TIME. THE PERMANENT MESSAGE WILL BE REPLACED (TEMPORARILY) WITH THE MESSAGE ENTERED FROM THE KEYBOARD. THE NEXT TIME THE PROGRAM IS LOADED, THE "PERMANENT" MESSAGE WILL AGAIN BE IN MEMORY. NOTE THE USE OF THE CHR$(13) TO INSERT A CARRIAGE RETURN AND LINE FEED IN MESSAGE #3. THIS IS NECESSARY, SINCE YOU WILL NOT BE ABLE TO TYPE A CARRIAGE RETURN INTO THE STRING.

2. USING THE M80 AS A LINE PRINTER DRIVER

YOUR M80 SYSTEM CAN BE USED TO OBTAIN PROGRAM LISTINGS AND OTHER PRINTOUTS ON A BAUDOT LINE PRINTER! THIS FEATURE ALONE IS WORTH THE PRICE OF THE M80. HERE'S ALL YOU NEED:

1. M80 SYSTEM
2. MLK-1 LOOP KEYER MODULE (AVAILABLE FROM MACROTRONICS)
3. BAUDOT PRINTER - E.G. TELETYPE MODELS 15, 19, 28, 32. (THESE ARE AVAILABLE FOR PRICES RANGING FROM $50.00 TO $300.00).
4. 20 OR 60 MA LOOP SUPPLY (INCLUDED ON MOST MACHINES) NOTICE THAT YOU DO NOT NEED THE RADIO SHACK EXPANSION INTERFACE ($299) OR THE RS232 INTERFACE ($99) OR THE CENTRONICS LINE PRINTER ($1300) TO USE THE LLIST AND LPRINT COMMANDS. OF COURSE, THERE ARE SOME COMPROMISES - FOR EXAMPLE, A

BAUDOT PRINTER DOES NOT HAVE THE FULL ASCII CHARACTER SET (NOTABLY > < = AND *). ALSO, THE M80 MACHINE LANGUAGE PROGRAM MUST BE LOADED INTO THE COMPUTER IN ADDITION TO ANY OTHER PROGRAMS YOU PUT IN. THE M80 MACHINE LANGUAGE PROGRAM REQUIRES APPROXIMATELY 2.5K BYTES.

TO LINK THE M80 WITH THE LLIST AND LPRINT STATEMENTS, YOU SHOULD USE THE FOLLOWING SEQUENCE OF STEPS:

1. SET THE MEMORY SIZE TO 30000 (LEVEL II) OR 46000 (DISK BASIC).
2. LOAD THE M80 MACHINE LANGUAGE PROGRAM.
3. RUN THE FOLLOWING BASIC PROGRAM:

UNDER LEVEL II BASIC

```
1 POKE 16421, 2  :  POKE 16422, 246  :  POKE 16423, 117
2 FOR I = 30198 TO 30206  :  READ N  :  POKE I, N  :  NEXT
3 DATA 121, 221, 33, 103, 119, 205, 47, 127, 201
```

UNDER DISK BASIC

```
1 POKE 16421, 2  :  POKE 16422, &HF6  :  POKE 16423, &H75
2 FOR I = 1 TO 9 : READ N  :  POKE &HB5F5 + I, N  :  NEXT
3 DATA 121, 221, 33, 103, 119, 205, 47, 127, 201
```

4. LOAD OR CREATE PROGRAMS AS USUAL. WHEN YOU DESIREA LISTING TYPE: LLIST

USE THE LPRINT STATEMENT TO DIRECT OUTPUT TO THE BAUDOT PRINTER THROUGH THE M80. TO USE THE M80 AT SPEEDS OTHER THAN 60 WPM, YOU WILL ALSO HAVE TO RUN THE M80 BASIC MAIN PROGRAM, SELECT THE DESIRED BAUD RATE, BREAK THE PROGRAM, "NEW" IT OUT OF MEMORY, THEN PROCEED AS ABOVE WITH YOUR OWN PROGRAMMING.

IF YOU PREFER TO AVOID ALL THE POKE'S AND REDUCE THE SIZE OF THE MACHINE LANGUAGE PROGRAM, MACROTRONICS OFFERS A SEPARATE PROGRAM (MBL-1) WHICH WORKS WITH THE M80.

ONE ADDITIONAL POINT WORTH NOTING - YOU CAN ALSO USE THE ABOVE PROCEDURE TO SEND LISTINGS OF PROGRAMS OVER THE AIR! (ALTHOUGH IT IS QUITE AWKWARD TO DO SO UNLESS YOU CAN ALSO TYPE FROM THE TTY KEYBOARD). SEE APPENDIX 2 FOR EQUIPMENT INTERCONNECTION TO A LOCAL LOOP USING THE MLK-1.

3. OBTAINING HARD COPY OFF THE AIR USING THE RADIO SHACK LINE PRINTER.

IF YOU DO HAPPEN TO HAVE A LINE PRINTER CONNECTED TO THE PARALLEL PRINTER PORT (OR RS232 SERIAL PORT), YOU CAN DIRECT OUTPUT TO IT RATHER THAN THE VIDEO MONITOR AS FOLLOWS:

```
   POKE 16414, 141  :  POKE 16415, 5
```

THIS CAN BE DONE AT ANY TIME IN THE IMMEDIATE MODE BY BREAKING THE PROGRAM. OR, IT COULD BE ADDED AS A 'SPECIAL FUNCTION' IN THE BASIC MAIN PROGRAM.

4. MAKING A BACKUP COPY OF THE M80 LEVELII SOFTWARE

```
==========================================
WARNING!  WARNING!  WARNING!  WARNING!
THE FOLLOWING INFORMATION IS PROVIDED  AS  A
CONVENIENCE   TO   OUR  CUSTOMERS  FOR THEIR
PROTECTION. IT IS   ILLEGAL   TO MAKE COPIES
OF THE M80 SOFTWARE FOR ANYONE ELSE'S USE OR
BENEFIT.  THAT INCLUDES 'FOR  A  FRIEND' ,
CLUB MEMBERS, OR FOR RESALE.
==========================================
```

1). LOAD THE M80 MACHINE LANGUAGE PROGRAM USING THE SYSTEM COMMAND.
2). LOAD TBUG USING THE SYSTEM COMMAND.
3). EXECUTE TBUG.
4). PUNCH A TAPE: START = 7600H, END = 7FFFH, TRA = 7A00.
5). THE BASIC MAIN PROGRAM CAN THEN BE PUT ON THE TAPE BY USING CSAVE.

5. USING THE M80 AS A GENERAL PURPOSE I/O BOARD.

HERE AGAIN, THIS FEATURE ALONE IS WORTH THE ENTIRE PRICE OF THE M80! YOU CAN EASILY USE THE M80 TO CONTROL A WIDE VARIETY OF "OUTSIDE WORLD" PERIPHERAL DEVICES. YOU CAN MAKE USE OF FIVE SEPARATE OUTPUT SWITCHES: 3 SOLID STATE AND 2 RELAY CONTACTS. IN A BASIC PROGRAM, YOU CAN TURN THE SWITCHES ON OR OFF USING THE INP STATEMENTS. IN A MACHINE LANGUAGE PROGRAM, USE THE IN INSTRUCTION (NOT OUT). THE FOLLOWING TABLE LISTS EACH SWITCH AND THE PORTS WHICH TURN IT ON OR OFF:

PINS	TYPE OF SWITCHING	PORTS
12,13	RELAY NORMALLY OPEN	3 & 4
12,14	RELAY NORMALLY CLOSED	3 & 4
11,17	NPN SOLID STATE	3 & 4
9,17	PNP SOLID STATE	0 & 1
8,17	NPN SOLID STATE	3 & 4

FOR EXAMPLE, SUPPOSE YOU WISH TO TURN AN AUDIO CASSETTE RECORDER ON AND OFF IN SYNCHRONIZATION WITH A TUTORIAL PROGRAM YOU HAVE WRITTEN IN BASIC. AT THE APPROPRIATE POINTS IN THE PROGRAM, INSERT:

```
100 X = INP(3)    :REM TURNS ON RECORDER WITH RELAY
200 X = INP(4)    :REM TURNS OFF RECORDER WITH RELAY
```

TO USE THE M80 AS AN INPUT DEVICE, YOU MUST HAVE THE DATA IN THE FORM OF MAKE-BREAK CONTACTS - AS FOR EXAMPLE FROM A RELAY OR NPN OPEN COLLECTOR CIRCUIT. CONNECT THE DATA IN TO THE M80 VIA PINS 4 AND 7. WHEN PIN 4 IS GROUNDED, PORT 2 WILL HAVE A VALUE OF 254. WHEN PIN 4 IS OPEN (UNGROUNDED), PORT 2 WILL HAVE A VALUE OF 255. THEREFORE, YOU CAN TEST THE VALUE OF PORT 2 TO INPUT DATA TO YOUR PROGRAM. FOR EXAMPLE, SUPPOSE PIN 4

AND 7 ARE CONNECTED TO A TIMER RELAY WHICH IS SET TO GO ON AND OFF AT CERTAIN TIMES DURING THE DAY. YOU COULD USE THIS TO TELL YOUR TRS80 TO PERFORM CERTAIN FUNCTIONS - LIKE TURN ON YOUR SPRINKLERS, HOUSE LIGHTS, TOASTER, DINNER, ETC. HERE'S HOW THIS MIGHT BE INSERTED IN A BASIC PROGRAM:

```
100 X= INP(2)
110 IF X = 255 THEN 100 ELSE GOSUB 1000
        :
        :
1000 X = INP(3)      :REM TURNS ON POWER RELAY
```

6. CHANGING THE PITCH OF THE SIDE TONE OSCILLATOR.

THE FREQUENCY OF THE SIDE TONE MAY BE CHANGED BY REPLACING RESISTOR R18. REDUCING THE RESISTANCE INCREASES THE FREQUENCY. A 100 K POT COULD BE INSERTED IN PLACE OF R11 TO GIVE AN ADJUSTABLE SIDE TONE FREQUENCY. IT SHOULD BE NOTED THAT THE PRESENT SIDE TONE FREQUENCY IS AROUND 600 HERTZ WHICH IS TOO LOW TO BE DEMODULATED BY THE PLL. THUS, IF YOU WANTED TO TAPE THE OUTPUT OF THE SIDE TONE AND THEN PLAY IT BACK TO THE M80 RECEIVE PROGRAM FOR TESTING PURPOSES, YOU WOULD HAVE TO INCREASE THE SIDE TONE FREQUENCY (PREFERABLY TO AROUND 2000 HERTZ).

TROUBLE SHOOTING

IF YOUR M80 IS NOT FUNCTIONING PROPERLY, CHECK OUT THE FOLLOWING BEFORE SENDING THE UNIT BACK TO THE FACTORY FOR REPAIR:

MAKE SURE THAT -

1. THE WALL PLUG IS CONNECTED TO 115 VOLTS AC, THE 40 PIN CONNECTOR IS ATTACHED TO THE TRS80 EXPANSION PORT WITH THE BULK OF THE WIRES CLOSEST TO THE RESET BUUTTON, AND THAT THE 30 PIN (DUAL 15) CONNECTOR PINS ARE PROPERLY ALIGNED WITH THE "FINGERS" ON THE M80 BOARD.
2. THE WIRES ARE MAKING GOOD CONTACT WITH THE 40 PIN CONNECTOR. THE INSULATION DISPLACEMENT CONNECTORS ARE NOTORIOUS FOR LOOSENING UP DURING HANDLING OR SHIPMENT. WITH THE CONNECTOR FLAT ON A TABLE, RAP THE BACK EDGE FIRMLY A FEW TIMES WITH A LARGE SCREWDRIVER HANDLE TO SEAT THE WIRES.
3. THE BOARD IS NOT SHORTING AGAINST A METAL CASE OR TABLE.
4. THE LED ON THE BOARD IS LIGHTING.
5. THE PLL HAS BEEN PROPERLY ADJUSTED AS EXPLAINED IN THE OPERAING INSTRUCTIONS.
6. THE VOLUME CONTROL ON THE BOARD IS TURNED UP SO THAT YOU CAN HEAR THE SIDE TONE IN A SPEAKER.
7. THE WIRES CONNECTED FROM YOUR RADIO EQUIPMENT TO THE M80 ARE ON THE FOIL SIDE (BOTTOM) OF THE 30 PIN CONNECTOR.

IF THESE CHECKS HAVE ALL BEEN MADE AND THERE IS STILL A PROBLEM, REFER TO THE TROUBLE-SHOOTING GUIDE WHICH FOLLOWS.

8. ALL IC'S AND THE RELAY ARE PROPERLY ALIGNED IN THEIR SOCKETS.
9. THE TEMPERATURE OF ALL IC'S SHOULD BE COOL OR WARM AT MOST. NONE SHOULD BE "HOT" TO THE TOUCH.

TROUBLE SHOOTING GUIDE

SYMPTOM	POSSIBLE PROBLEM(S)	CHECK OUT PROCEDURE
LED INDICATOR WON'T LIGHT	1. LED BAD OR POLARITY REVERSED.	JUMPER PIN 4 TO GROUND. LED SHOULD LIGHT, AND SIDE TONE OSCILLATE. IF NOT: MEASURE VOLTAGE FROM PIN 3 TO PIN 1. SHOULD BE +2 VOLTS WITH PIN 4 GROUNDED, +0.75 VOLTS UNGROUNDED. IF CORRECT VOLTAGE IS PRESENT, REVERSE LED LEADS OR REPLACE LED.
	2. BAD 567 OR PLL CIRCUIT	VOLTAGE FROM PIN 3 TO PIN 1 SHOULD VARY WITH PRESENCE OF SIGNAL. IF IT DOES NOT: A. REPLACE 567 B. CHECK ALL WIRING TO THE 567 AND PIN 2.
SIDETONE COMES ON WHEN M80 PLUGGED IN.	1. 7476 LATCHED ON POWER UP.	THIS IS NORMAL AND HAPPENS FREQUENTLY. RUN M80 PROGRAM. SEND A MORSE CHARACTER. TONE SHOULD STOP. IF NOT, CHECK:
	2. BAD 567	PULL OUT THE 567. IF TONE STOPS - REPLACE 567. IF NOT, CHECK.
	3. BAD OPTOISOLATOR	PULL OUT THE OPTO. IF TONE STOPS - REPLACE THE OPTO (MCT2, 4N33, IL-1, ETC.). IF NOT, CHECK:
	4. BAD 74LS04, 7486, OR 7476	REPLACE EACH IN TURN.
NO SIDE TONE	BAD 555, 74LS04, OR 7486	CHECK VOLTAGE AT PIN 4 OF THE 555. SHOULD BE FLUCTUATING FROM HI TO LOW AS CHARACTERS ARE SENT FROM KEYBOARD OR AS PIN 4 ON THE 30 PIN CONNECTOR IS GROUNDED. IF NOT, CHECK 74LS04 AND 7486. IF IT IS, REPLACE THE 555. PIN 8 OF THE 555 SHOULD MEASURE 5 VOLTS.
"FUZZY" SOUND IN SIDE TONE	BAD CAPACITOR C1	IF OSCILLOSCOPE SHOWS HIGH FREQUENCY OSCILLATION ON 5 V. TRACE, REPLACE C1 WITH 2.2 MFD TANTALUM.
RELAY NOT KEYING	1. "POSITIVE KEYING" NOT SELECTED	THE RELAY KEYS IN RTTY SEND MODE ALL THE TIME, BUT MUST BE SELECTED TO OPERATE IN MORSE SEND MODE. ATTACH OHMMETER TO PINS 12 AND 13 OF THE 30 PIN CONNECTOR
	2. BAD RELAY	WHILE SENDING RTTY. SHOULD MAKE AND BREAK. REPEAT FOR PINS 12 AND 14

CONTINUED

SYMPTOM	POSSIBLE PROBLEM (S)	CHECK OUT PROCEDURE
PLL SEEMS TO REQUIRE VERY HIGH AUDIO LEVEL	1. CONNECTED TO HIGH IMPEDANCE.	THE PLL WORKS BEST WITH A 4-8 OHM INPUT IMPEDANCE. CHECK YOUR RECEIVER OWNERS MANUAL. SOME HEADPHONE JACKS USE HIGH IMPEDANCE. TRY CONNECTING DIRECT TO THE SPEAKER TERMINALS. THE AUDIO GAIN CONTROL ON MOST RECEIVERS SHOULD NOT HAVE TO BE OPEN MORE THAN 1/4 VOLUME.
	2. SHORTED LIMITER DIODES CR2, CR3	REPLACE WITH 1N914 OR 1N4148.
	3. OPEN OR REVERSED BLOCKING CAPACITOR C5	REPLACE WITH 22 MFD ELECTROLYTIC. CHECK POLARITY.
PLL SUPER CRITICAL TO TUNE	1. PLL FREQUENCY SET TOO LOW 2. PLL FREQUENCY SET OUT OF RECEIVER PASSBAND.	TRY USING THE USB FILTER POSITION AND SET TO AROUND 2000 HZ. WITH THE RECEIVER CALIBRATOR TUNED TO THE DESIRED AUDIO TONE, TURN PLL UNTIL LED LIGHTS AND SIDETONE HEARD.
RECEIVE NOTHING - LED LIGHTS AND SIDETONE HAS CLEAN ON/OFF SOUND WHEN SIGNAL TUNED IN.	1. INTERMITTENT OR BROKEN WIRE TO 40 PIN CONNECTOR. 2. BAD 74LS367 OR 74154.	CHECK CONTINUITY OF 40 PIN CONNECTOR WITH 74154 OUT OF ITS SOCKET. TAP THE CONNECTOR TO BETTER SEAT THE WIRES. THESE ARE TOUGHIES TO CHECK. TRY REPLACING THEM. LOOK FOR BENT OR POORLY SEATED PINS.
RECEIVES ONLY GARBLE - LOTS OF E I S H 5 ETC.	1. BACKGROUND NOISE TOO HIGH.	WITH NO SIGNAL IN THE RECEIVER PASSBAND, YOU SHOULD GET NOTHING PRINTED ON THE SCREEN (WITH THE AUDIO SET TO A COMFORTABLE LEVEL). BACK OFF ON THE RF GAIN UNTIL NOTHING APPEARS ON THE SCREEN WITH NO SIGNAL PRESENT.
	2. SPEED SET TOO LOW.	TRY HIGHER SPEED SETTING. WE FIND 25 WPM GOOD FOR MOST GENERAL TUNING.
SENDS ONLY COMMAS - DISPLAYS OK	BAD ROM	BEFORE RUNNING THE PROGRAM, ENTER: POKE 16553, 255 (THIS IS A PROBLEM CAUSED BY ONE LEVEL II ROM SUPPLIER).
PROGRAM CRASHES WHEN I TRANSMIT	EXCESSIVE RF IN SHACK.	REDUCE RF OUTPUT. CHECK COAX CONNECTIONS. INSTALL A BETTER EARTH GROUND TO YOUR TRANSMITTER. THIS SHOULDN'T HAPPEN IN A "CLEAN" SHACK. (WE RUN 1 KW WITH NO PROBLEMS).
PROGRAM CRASHES AS SOON AS I ENTER A MESSAGE INTO MEMORY OR IN THE CODE PRACTICE MODE.	MEMORY SIZE NOT SET CORRECTLY.	SET MEMORY SIZE TO 30000 (LEVEL II) OR 46000 (DISK VERSION)

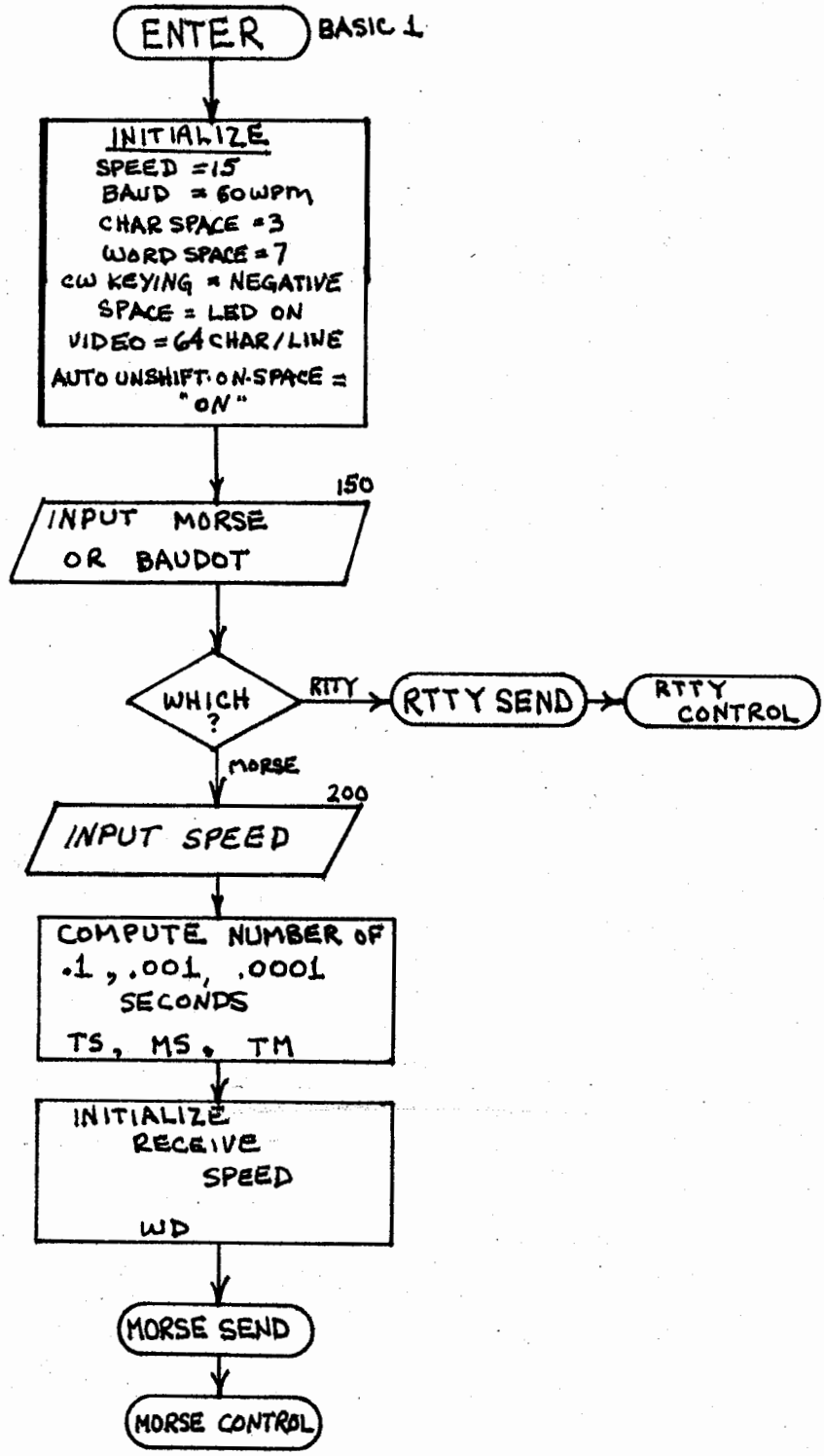
THEORY OF OPERATION - SOFTWARE

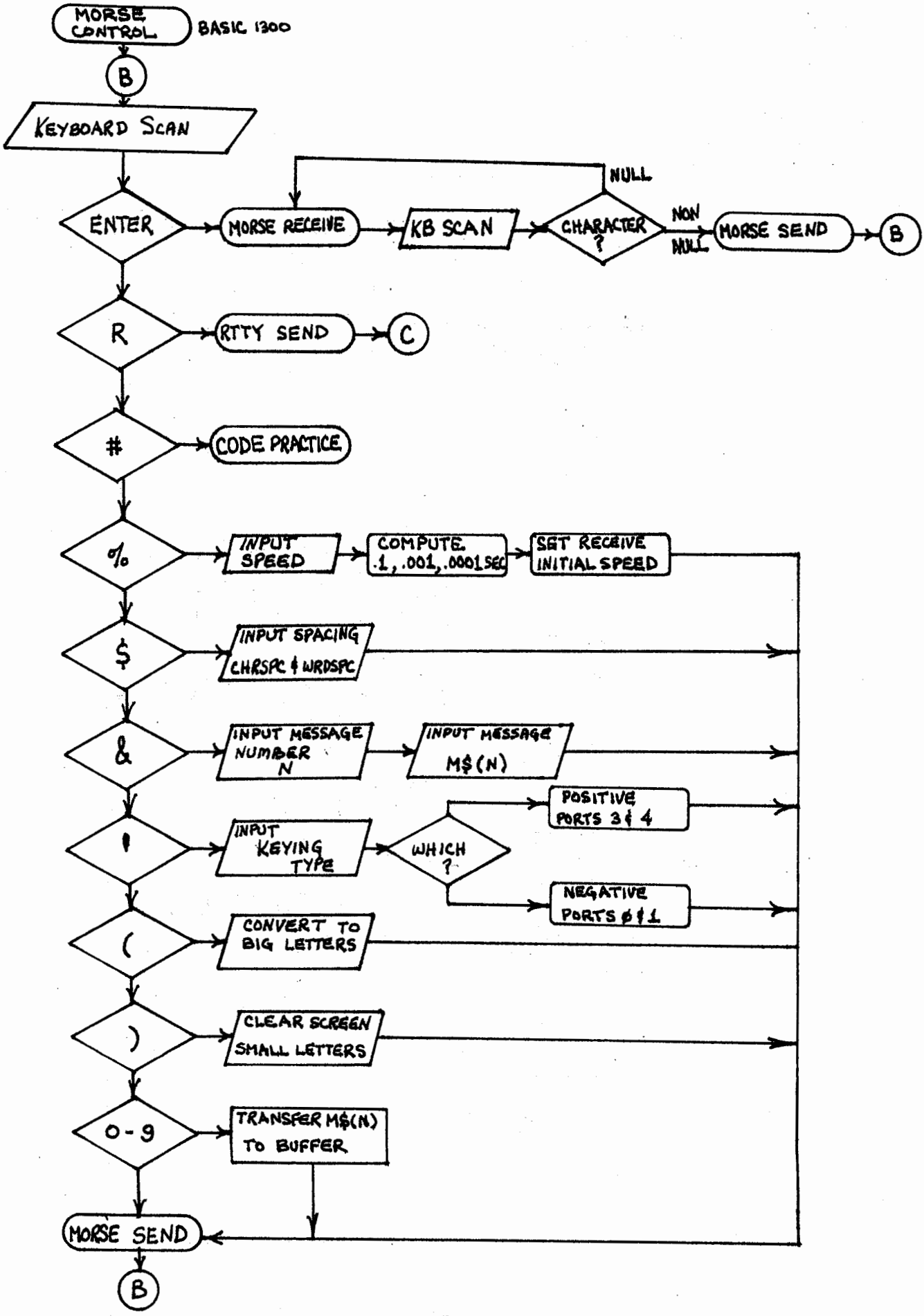
THE M80 SOFTWARE CONSISTS OF TWO PROGRAMS: A BASIC MAIN PROGRAM AND A MACHINE LANGUAGE SUBPROGRAM. BEING IN BASIC, THE MAIN PROGRAM IS EASILY MODIFIED TO SUIT INDIVIDUAL USER NEEDS (E.G. LINKING TO A LOGGING PROGRAM, MODIFYING MESSAGES TO PERFORM NUMBERICAL SEQUENCING FOR CONTEST OPERATION, ETC.). THE BASIC PROGRAM REQUIRES APPROXIMATELY 10K RAM. A LISTING OF THE BASIC PROGRAM IS GIVEN IN APPENDIX 3.
THE MACHINE LANGUAGE SUBPROGRAM IS LOCATED AT THE HIGH END OF 16K MEMORY FROM 7600H TO 7FFFH. ALL CRITICAL TIMING IS PERFORMED IN MACHINE LANGUAGE. CONTROL IS RETURNED TO BASIC WHEN THE "CLEAR" KEY IS DEPRESSED. A COMPLETE FLOWCHART IS GIVEN TO HELP EXPLAIN THE LOGIC OF THE M80 SOFTWARE. IN ADDITION, TABLE 1. IS A MEMORY MAP GIVING USEFUL ENTRY POINTS AND EXPLAINING KEY VARIABLES. IT SHOULD BE NOTED THAT THE PROGRAM UTILIZES THE ROM VIDEO OUTPUT ROUTINE (0033H) BUT HAS ITS OWN KEYBOARD SCAN ROUTINE TO ELIMINATE THE BOTHERSOME "KEYBOUNCE" CHARACTERISTIC OF THE TRS80 LEVEL II ROM ROUTINE.

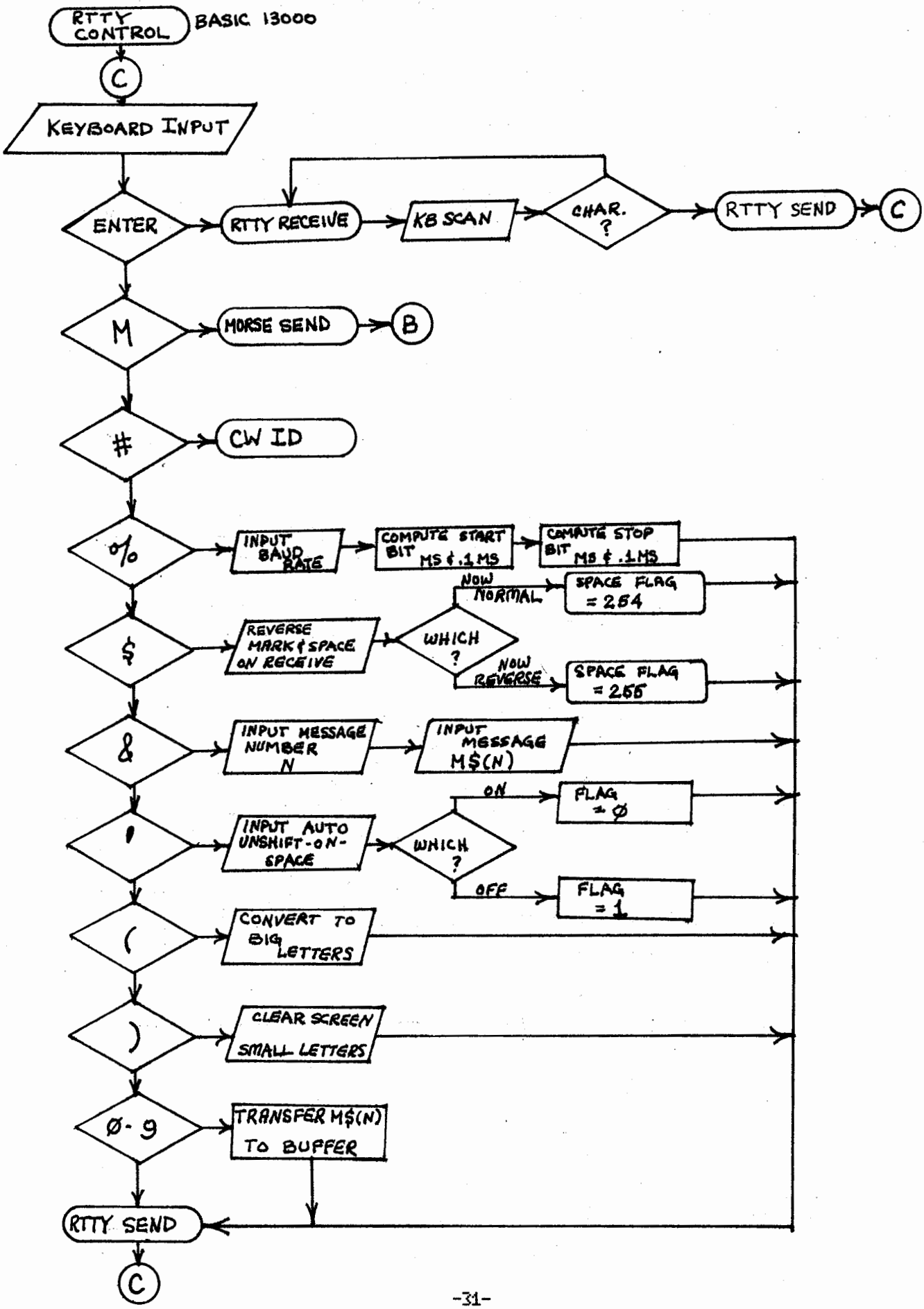
TABLE 1.

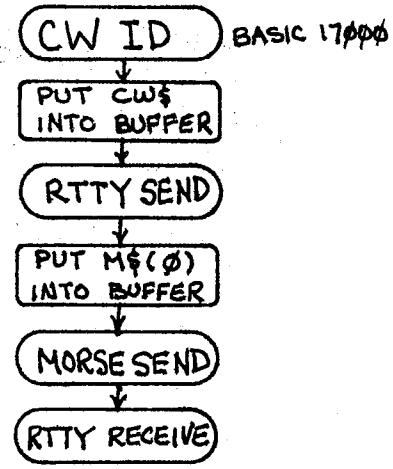
LOCATIONS	ROUTINE OR VARIABLE NAME	PURPOSE
7A00H	MORSE SEND	INPUT KEYBOARD CHAR. - SEND IN MORSE CODE.
7AF0H	MORSE RECEIVE	INPUT MORSE CODE - DISPLAY ASCII ON VIDEO
7606H	SEND FROM BUFFER	TRANSFERS STRING TO BUFFER - THEN CALLS EITHER MORSE OR RTTY SEND .
7E9AH	RTTY SEND	INPUT KEYBOARD CHAR. - SEND IN BAUDOT
7D66H	RTTY RECEIVE	INPUT BAUDOT - DISPLAY ASCII ON VIDEO
7D1D	.1MS TIMER	DELAY TIMER - .0001 SECOND
7D14	1MS TIMER	DELAY TIMER - .001 SECOND
791A,B,C	MORSE SPEED	TIMING CONSTANTS IN .1, .001, AND .0001 SECONDS
7924 -7988	MORSE SEND TABLE	BIT PATTERNS + NO. BITS TO SEND
7600	MODE FLAG	1=RTTY, 0=MORSE
7601	LENGTH	NO. OF BYTES IN STRING
7602	STRING ADR.1	LSB OF START OF STRING
7603	STRING ADR 2	MSB OF START OF STRING
7681-7	MORSE RECEIVE TABLE	LOOK UP TABLE-ASCII EQUIVALENT
7991,2	L4, L5	DIT LENGTH ON RECEIVE
		NO. OF .1 AND .001 SECONDS
7995,6	L6, L7	DAH LENGTH ON RECEIVE
		NO. OF .1 AND .001 SECONDS
7997	KEY STATE	BYTE VALUE REQUIRED FOR KEY UP
7FE1,E2	OM, OT	START BIT LENGTH: .001 AND .0001 SECONDS
7FE3,E4	TM,TT	RTTY RECEIVE DELAY LENGTH: .0001 AND .001 SEC = (START - 7) / 2 MILLISECONDS.
7FE5	SP	BYTE VALUE REQUIRED FOR SPACE: NORMAL = 254
7FE8	LEVEL	#BITS TO SEND FOR EACH RTTY CHAR(BAUDOT=5)
7FEA,B	HM, HT	STOP BIT LENGTH: .001 AND .0001 SECONDS
7FEC	SHIFT	UNSHIFT FLAG: 0 = AUTO ON, 1 = AUTO OFF

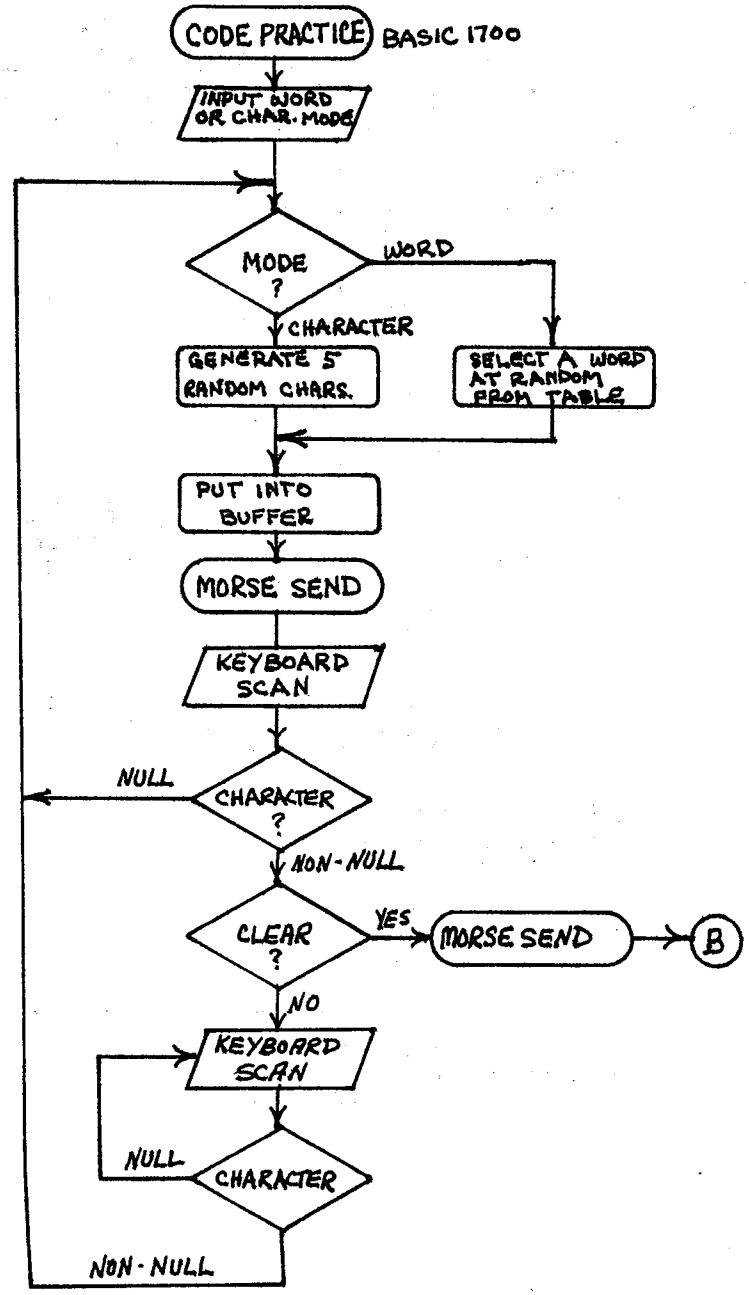
USED TO PUSH STRING INTO BUFFER FROM BASIC.

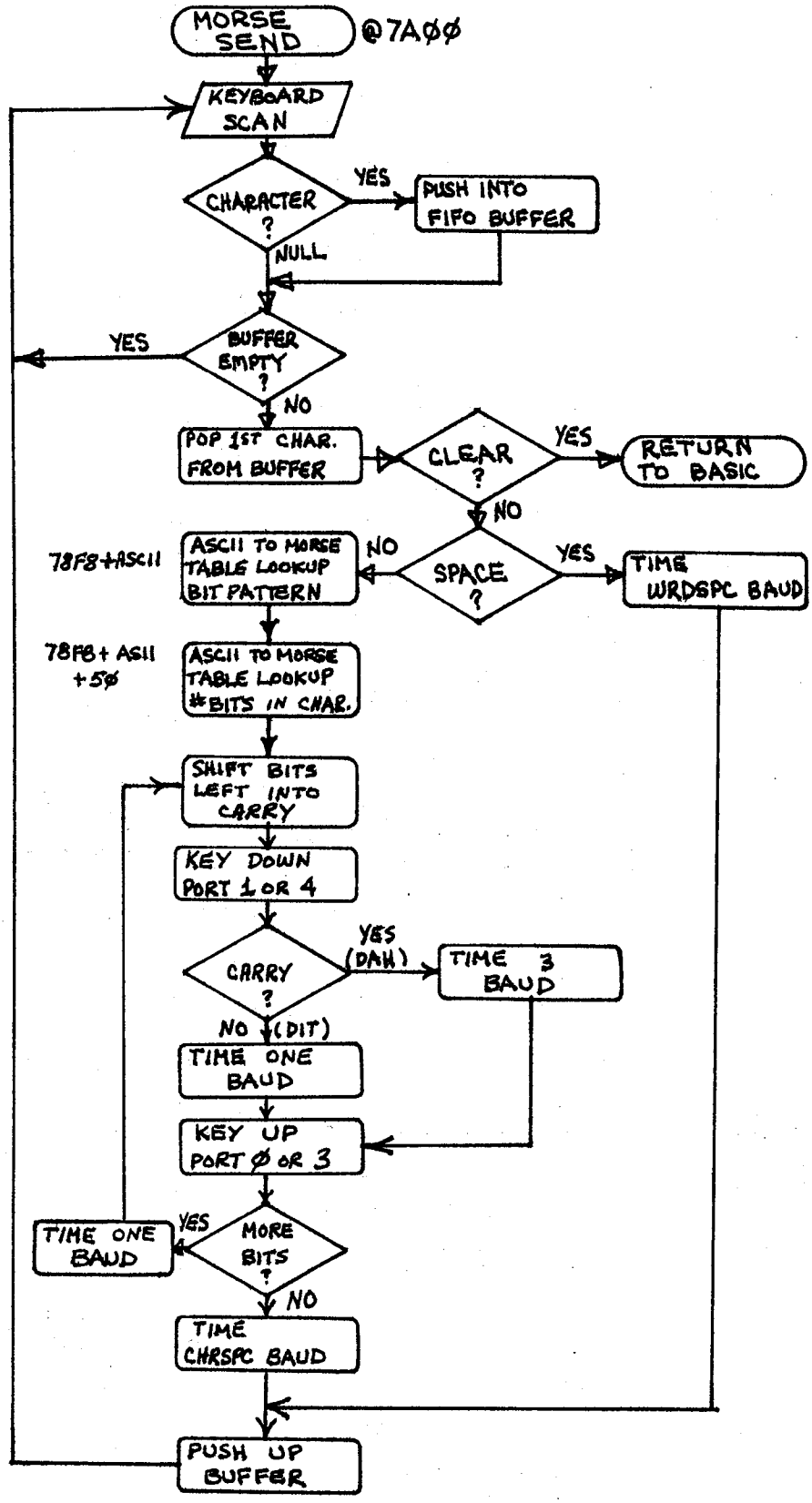

ENTER
BASIC 1
INITIALIZE
SPEED =15
BAUD = 60WPM
CHAR SPACE =3
WORD SPACE =7
CW KEYING = NEGATIVE
SPACE = LED ON
VIDEO = 64 CHAR/LINE
AUTO UNSHIFT ON SPACE = "ON"
150
INPUT MORSE OR BAUDOT
WHICH ?
RTTY
RTTY SEND
RTTY CONTROL
MORSE
200
INPUT SPEED
COMPUTE NUMBER OF .1, .001, .0001 SECONDS
TS, MS, TM
INITIALIZE RECEIVE SPEED
WD
MORSE SEND
MORSE CONTROL

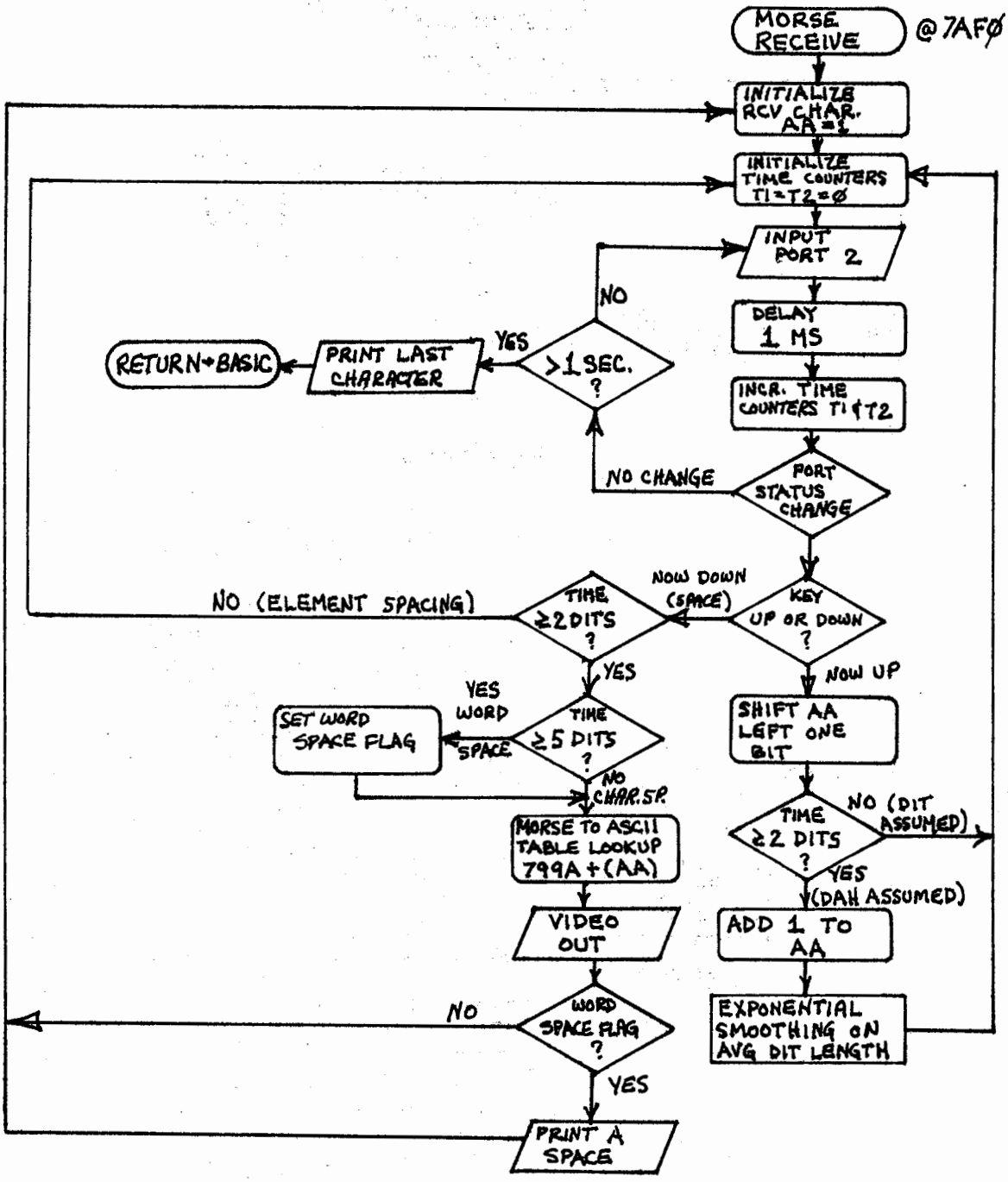

MORSE CONTROL
BASIC 1300
B
KEYBOARD SCAN
ENTER
MORSE RECEIVE
KB SCAN
CHARACTER ?
NULL
NON NULL
MORSE SEND
B
R
RTTY SEND
C
#
CODE PRACTICE
%
INPUT SPEED
COMPUTE .1, .001, .0001 SEC
SET RECEIVE INITIAL SPEED
$
INPUT SPACING CHRSPC & WRDSPC
&
INPUT MESSAGE NUMBER N
INPUT MESSAGE M$(N)
!
INPUT KEYING TYPE
WHICH ?
POSITIVE PORTS 3 & 4
NEGATIVE PORTS 0 & 1
(
CONVERT TO BIG LETTERS
)
CLEAR SCREEN SMALL LETTERS
0-9
TRANSFER M$(N) TO BUFFER
MORSE SEND
B

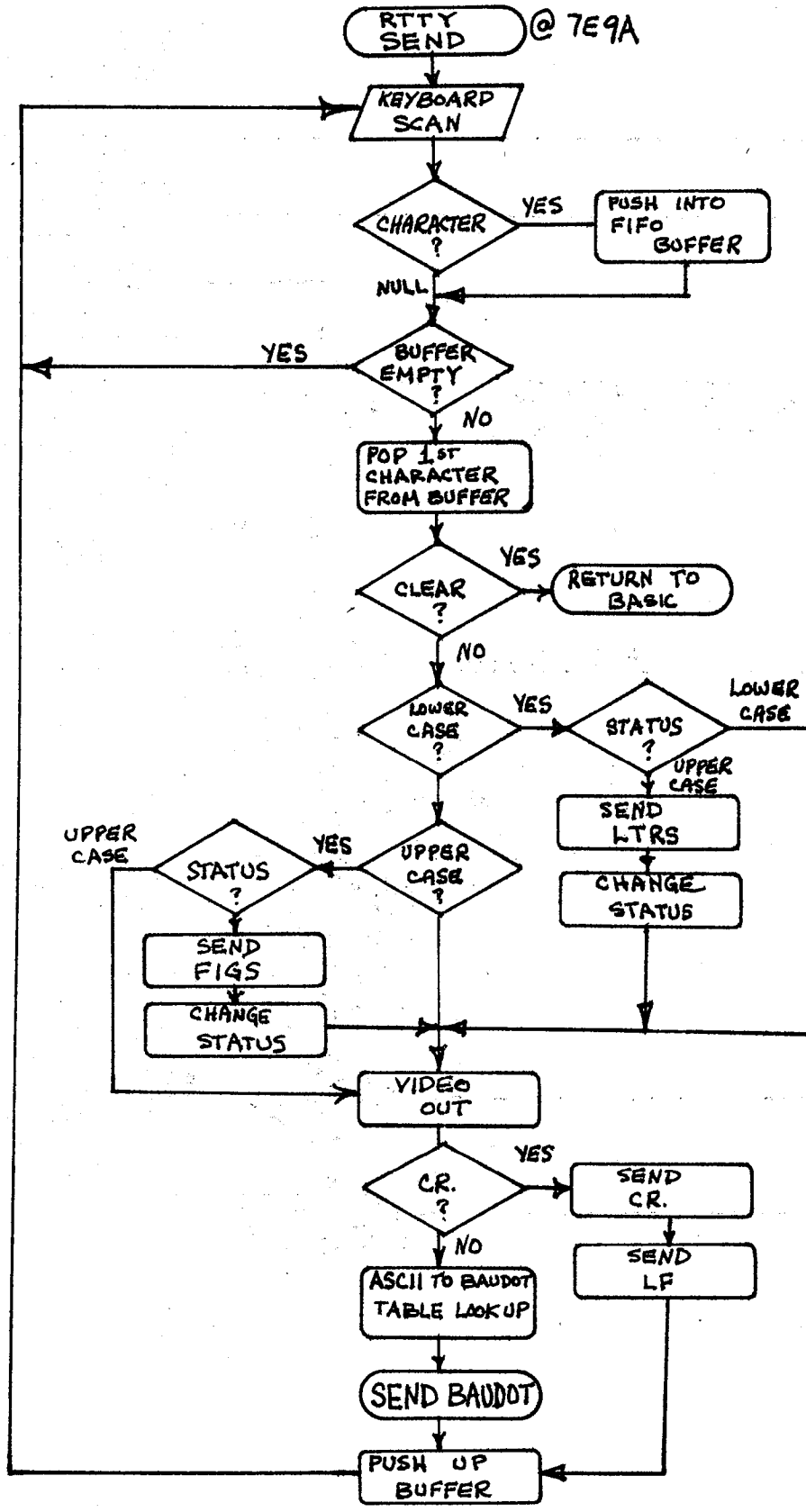

RTTY CONTROL
BASIC 13000
C
KEYBOARD INPUT
ENTER
RTTY RECEIVE
KB SCAN
CHAR. ?
RTTY SEND
C
M
MORSE SEND
B
#
CW ID
%
INPUT BAUD RATE
COMPUTE START BIT MS & .1 MS
COMPUTE STOP BIT MS & .1 MS
NOW NORMAL
SPACE FLAG = 254
$
REVERSE MARK & SPACE ON RECEIVE
WHICH ?
NOW REVERSE
SPACE FLAG = 255
&
INPUT MESSAGE NUMBER N
INPUT MESSAGE M$(N)
'
INPUT AUTO UNSHIFT-ON-SPACE
WHICH ?
ON
FLAG = 0
OFF
FLAG = 1
(
CONVERT TO BIG LETTERS
)
CLEAR SCREEN SMALL LETTERS
0-9
TRANSFER M$(N) TO BUFFER
RTTY SEND
C

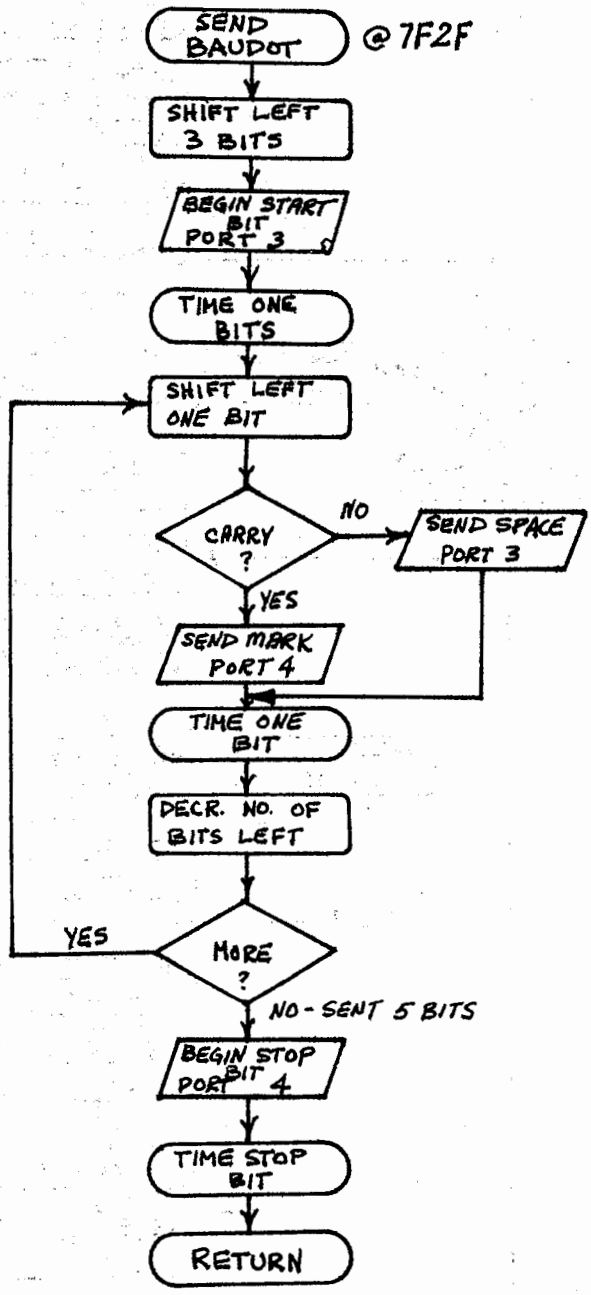

CW ID
BASIC 17000
PUT CW$ INTO BUFFER
RTTY SEND
PUT M$(0) INTO BUFFER
MORSE SEND
RTTY RECEIVE

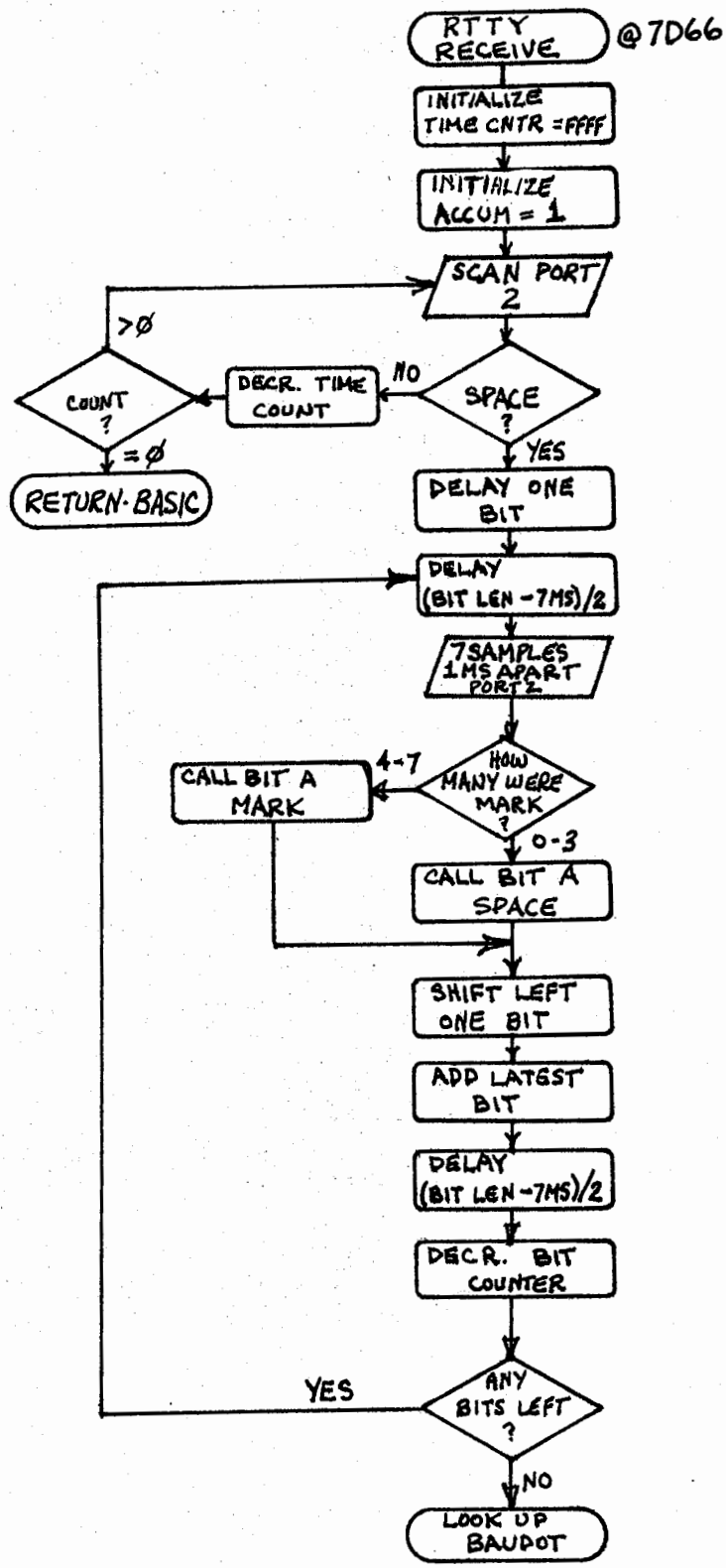

CODE PRACTICE
BASIC 1700
INPUT WORD OR CHAR. MODE
MODE ?
WORD
CHARACTER
GENERATE 5 RANDOM CHARS.
SELECT A WORD AT RANDOM FROM TABLE
PUT INTO BUFFER
MORSE SEND
KEYBOARD SCAN
NULL
CHARACTER ?
NON-NULL
CLEAR ?
YES
MORSE SEND
B
NO
KEYBOARD SCAN
NULL
CHARACTER
NON-NULL

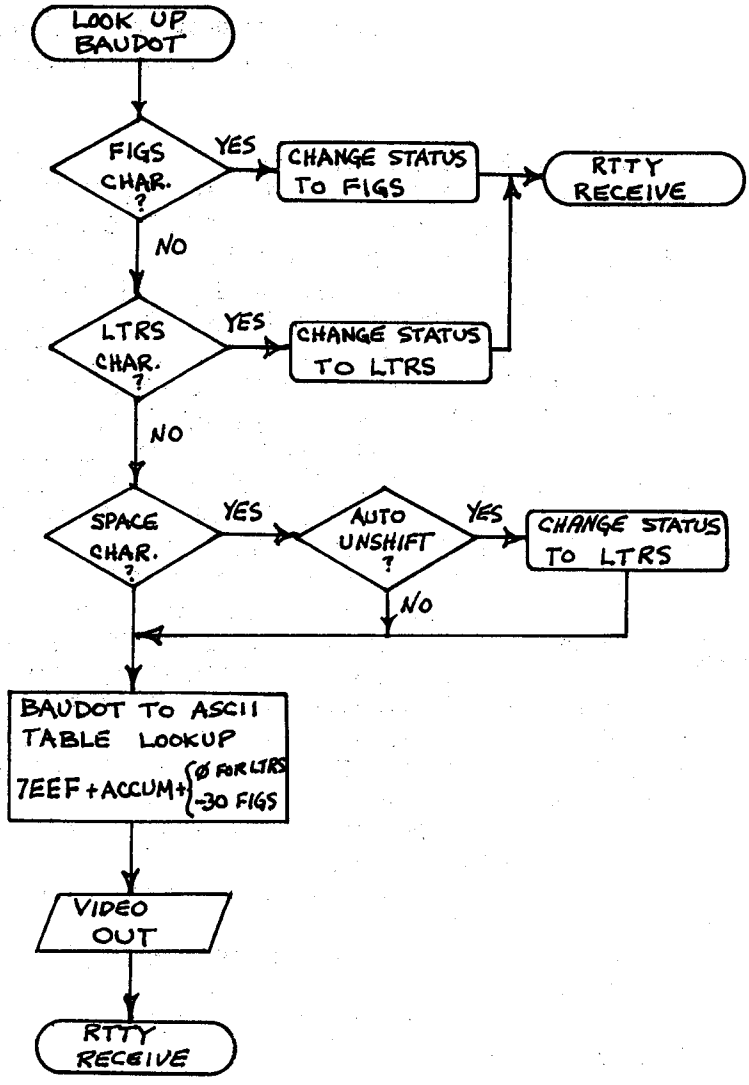

MORSE SEND
@7AØØ
KEYBOARD SCAN
CHARACTER ?
YES
PUSH INTO FIFO BUFFER
NULL
BUFFER EMPTY ?
YES
NO
POP 1ST CHAR. FROM BUFFER
CLEAR ?
YES
RETURN TO BASIC
NO
78F8+ASCII
ASCII TO MORSE TABLE LOOKUP BIT PATTERN
NO
SPACE ?
YES
TIME WRDSPC BAUD
78F8+ ASII +5Ø
ASCII TO MORSE TABLE LOOKUP #BITS IN CHAR.
SHIFT BITS LEFT INTO CARRY
KEY DOWN PORT 1 OR 4
CARRY ?
YES (DAH)
TIME 3 BAUD
NO (DIT)
TIME ONE BAUD
KEY UP PORT Ø OR 3
TIME ONE BAUD
YES
MORE BITS ?
NO
TIME CHRSPC BAUD
PUSH UP BUFFER


MORSE RECEIVE
@7AFØ
INITIALIZE RCV CHAR. AA=1
INITIALIZE TIME COUNTERS T1=T2=Ø
INPUT PORT 2
DELAY 1 MS
INCR. TIME COUNTERS T1 & T2
PORT STATUS CHANGE
NO CHANGE
>1 SEC. ?
NO
YES
PRINT LAST CHARACTER
RETURN→BASIC
KEY UP OR DOWN ?
NOW DOWN (SPACE)
NOW UP
TIME ≥2 DITS ?
NO (ELEMENT SPACING)
YES
SHIFT AA LEFT ONE BIT
TIME ≥5 DITS ?
YES
WORD SPACE
SET WORD SPACE FLAG
NO CHAR.SP.
TIME ≥2 DITS ?
NO (DIT ASSUMED)
YES (DAH ASSUMED)
ADD 1 TO AA
EXPONENTIAL SMOOTHING ON AVG DIT LENGTH
MORSE TO ASCII TABLE LOOKUP 799A+(AA)
VIDEO OUT
WORD SPACE FLAG ?
NO
YES
PRINT A SPACE


RTTY SEND
@ 7E9A
KEYBOARD SCAN
CHARACTER ?
YES
PUSH INTO FIFO BUFFER
NULL
BUFFER EMPTY ?
YES
NO
POP 1ST CHARACTER FROM BUFFER
CLEAR ?
YES
RETURN TO BASIC
NO
LOWER CASE ?
YES
STATUS ?
LOWER CASE
UPPER CASE
SEND LTRS
CHANGE STATUS
UPPER CASE
STATUS ?
YES
UPPER CASE ?
SEND FIGS
CHANGE STATUS
VIDEO OUT
CR. ?
YES
SEND CR.
SEND LF
NO
ASCII TO BAUDOT TABLE LOOKUP
SEND BAUDOT
PUSH UP BUFFER


SEND BAUDOT
@ 7F2F
SHIFT LEFT 3 BITS
BEGIN START BIT PORT 3
TIME ONE BITS
SHIFT LEFT ONE BIT
CARRY ?
NO
SEND SPACE PORT 3
YES
SEND MARK PORT 4
TIME ONE BIT
DECR. NO. OF BITS LEFT
MORE ?
YES
NO - SENT 5 BITS
BEGIN STOP BIT PORT 4
TIME STOP BIT
RETURN


RTTY RECEIVE
@7D66
INITIALIZE TIME CNTR =FFFF
INITIALIZE ACCUM = 1
SCAN PORT 2
SPACE ?
NO
DECR. TIME COUNT
COUNT ?
>Ø
=Ø
RETURN-BASIC
YES
DELAY ONE BIT
DELAY (BIT LEN -7MS)/2
7 SAMPLES 1 MS APART PORT 2
HOW MANY WERE MARK ?
4-7
CALL BIT A MARK
0-3
CALL BIT A SPACE
SHIFT LEFT ONE BIT
ADD LATEST BIT
DELAY (BIT LEN -7MS)/2
DECR. BIT COUNTER
ANY BITS LEFT ?
YES
NO
LOOK UP BAUDOT


LOOK UP BAUDOT
FIGS CHAR. ?
YES
CHANGE STATUS TO FIGS
RTTY RECEIVE
NO
LTRS CHAR. ?
YES
CHANGE STATUS TO LTRS
NO
SPACE CHAR. ?
YES
AUTO UNSHIFT ?
YES
CHANGE STATUS TO LTRS
NO
BAUDOT TO ASCII TABLE LOOKUP
7EEF + ACCUM+ Ø FOR LTRS -30 FIGS
VIDEO OUT
RTTY RECEIVE

THEORY OF OPERATION - HARDWARE

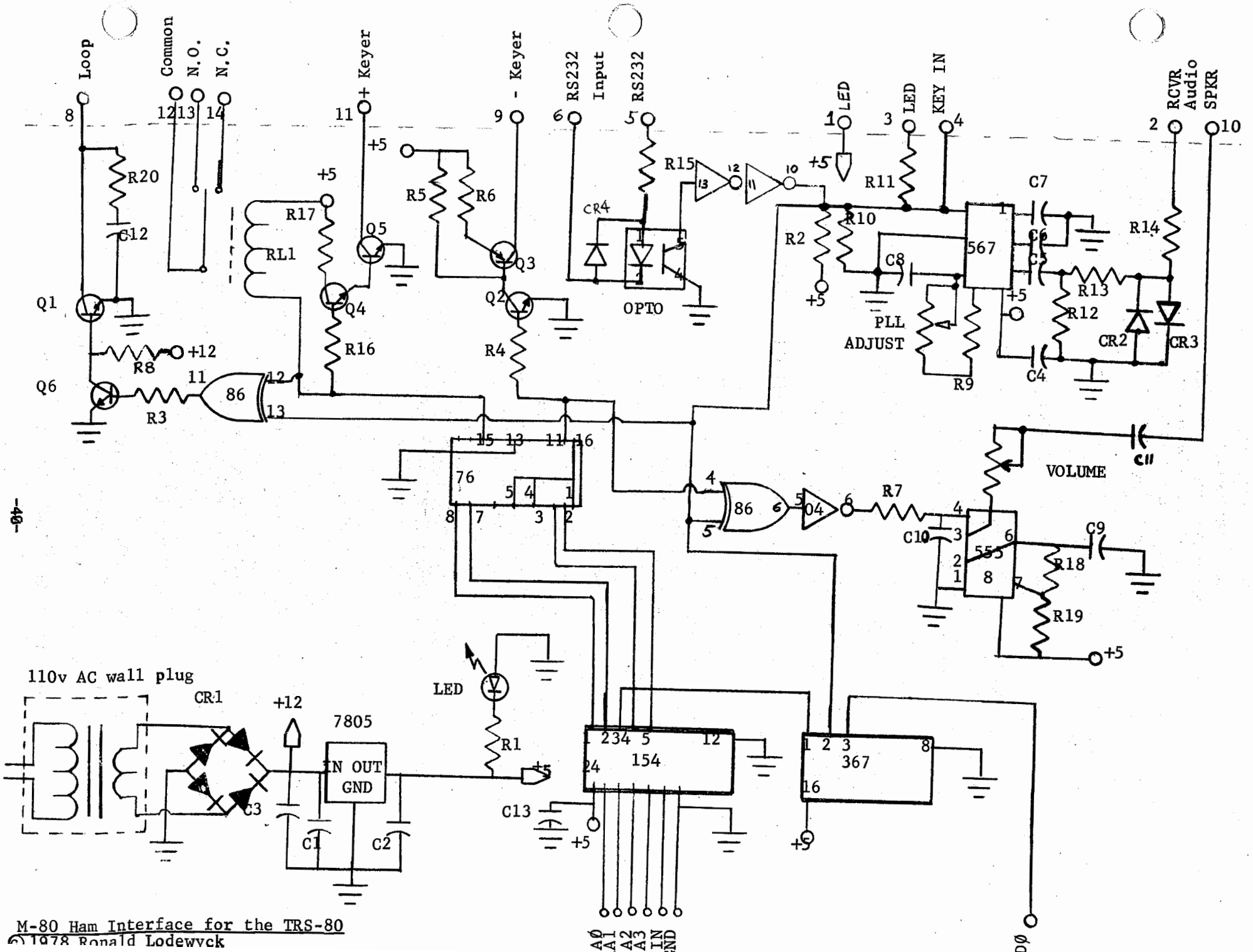
THE M80 SCHEMATIC IS GIVEN IN FIGURE 2 . ALL INTERFACING WITH THE TRS80 IS ACCOMPLISHED WITH PORT ADDRESSING THROUGH THE USE OF AN ADDRESS DECODER (74154) WHICH GENERATES A DEVICE SELECT PULSE WHEN THE DESIRED PORT IS REFERENCED WITH THE 'IN' STATEMENT. FOR EXAMPLE, THE Z80 INSTRUCTION: IN(3) WILL GENERATE A DEVICE SELECT PULSE FOR PORT 3. THE M80 LATCHES PORT PAIRS 0/1 AND 3/4 USING A DUAL J-K FLIP FLOP (7476). PINS 11 AND 15 OF THE 7476 ARE THE RESPECTIVE LATCHED OUTPUT BITS. PORT 2 IS USED FOR INPUT DATA USING A TRI-STATE BUFFER TO GATE THE PULSES ONTO THE DATA BUS.

LATCHED OUTPUT PIN 11 OF THE 7476 KEYS A PNP HI VOLTAGE TRANSISTOR (Q3) FOR NEGATIVE VOLTAGE KEYING ON CW. PIN 11 ALSO KEYS A 555 TIMER WHICH SERVES AS THE SIDE TONE OSCILLATOR. LATCHED OUTPUT PIN 15 OF THE 7476 KEYS A NPN TRANSISTOR (A5) FOR POSITIVE VOLTAGE KEYING ON EITHER CW (IF SELECTED) OR RTTY. PIN 15 ALSO LATCHES A REED RELAY FOR ISOLATED KEYING OF ANY POLARITY VOLTAGE ON EITHER CW (IF SELECTED) OR RTTY. (NOTE: THE REED RELAY IS NOT CAPABLE OF KEYING A HIGH VOLTAGE, HIGH CURRENT LOOP SUPPLY. KEEP THE VOLTAGE BELOW 100 V. AND CURRENT LESS THAN 20 MA.).

INPUT TO PORT 2 CORRESPONDS TO THE STATE OF PIN 2 ON THE 74LS367. WHEN THE INDICATOR LED IS OFF, PIN 2 WILL BE HIGH. WHEN THE LED IS TURNED ON, PIN 2 WILL BE LOW. THE CHANGE IN STATE OF PIN 2 IS INTERPRETED BY THE M80 SOFTWARE AS KEY UP OR DOWN (ON CW) AND MARK OR SPACE (ON RTTY). THERE ARE THREE WAYS TO INPUT DATA:

1. THE 567 PHASE LOCKED LOOP WILL DEMODULATE AN AUDIO SIGNAL WITHIN ITS PASSBAND AND PULL PIN 2 LOW.
2. THE OPTO ISOLATOR WILL PULL PIN 2 LOW WHEN A + VOLTAGE IS APPLIED ACROSS ITS INPUT.
3. IF KEY IN (PIN 4 OF THE 30 PIN CONNECTOR) IS GROUNDED, PIN 2 WILL BE PULLED LOW.

THE 7805 VOLTAGE REGULATOR SUPPLIES THE M80 HARDWARE WITH A HIGHLY REGULATED +5 VOLTS.



M-80 Ham Interface for the TRS-80

APPENDIX 1
TIPS ON LOADING PROGRAMS FROM CASSETTE

AS YOU ARE PROBABLY AWARE, LEVEL II TAPES CAN FREQUENTLY BE A "BEAR" TO LOAD. THIS IS ESPECIALLY TRUE FOR TAPES CREATED ON ANOTHER CASSETTE RECORDER. THE LONG LENGTH OF THE M80 PROGRAMS INCREASES THE LIKLIHOOD OF A BAD LOAD. YOU WILL KNOW THAT YOU HAVE NOT GOTTEN A PROPER LOAD IF ANY OF THE FOLLOWING CONDITIONS OCCUR:

1. ASTERISKS FAIL TO APPEAR OR FAIL TO FLASH PERIODICALLY.

2. THE TAPE KEEPS RUNNING BEYOND AROUND 40 FOR THE MACHINE LANGUAGE PART OR BEYOND AROUND 120 FOR THE BASIC PART.

3. A "C" APPEARS IN PLACE OF THE ASTERISK.

4. EVERYTHING LOOKS LIKE A GOOD LOAD UNTIL YOU RUN THE PROGRAM. THEN AN ERROR MESSAGE APPEARS.

5. PROGRAM APPEARS TO LOAD OK, EVEN RUN OK. BUT AT SOME POINT IN RUNNING THE PROGRAM IT EITHER "HANGS UP" OR "CRASHES" - GIVING AN ERROR MESSAGE.

ANY OF THESE CONDITIONS INDICATE A BAD LOAD, REQUIRING A RELOAD OF BOTH THE BASIC AND THE MACHINE LANGUAGE PARTS.

HOW TO AVOID BAD LOADS.

THERE ARE A VARIETY OF THINGS TO TRY IF THE PROGRAM WILL NOT LOAD "FIRST TIME". IN ORDER OF PRIORITY:

1. TRY THE REVERSE SIDE OF THE TAPE. THE PROGRAMS ARE RECORDED IDENTICALLY ON BOTH SIDES.

2. TRY VARIOUS LEVEL SETTINGS. WITH THE CTR-41 : FROM AROUND 3 1/2 TO 7 1/2 . WITH THE CTR-80 : FROM AROUND 1 TO 4. USE INCREMENTS OF 1/2. THIS IS ADMITTEDLY TIME CONSUMING, BUT ONCE THE PROPER SETTING IS FOUND IT SHOULD NOT HAVE TO BE CHANGED AGAIN.

3. CLEAN AND DEMAGNETIZE THE HEADS. USE A GOOD TAPE RECORDER HEAD CLEANING KIT AND DEMAGNETIZER. SEE YOUR RADIO SHACK STORE IF YOU DON'T OWN ONE.

4. IF YOU ARE USING A CTR41 RECORDER, TRY THE SIMPLE MODIFICATION SHOWN IN FIGURE 3 .

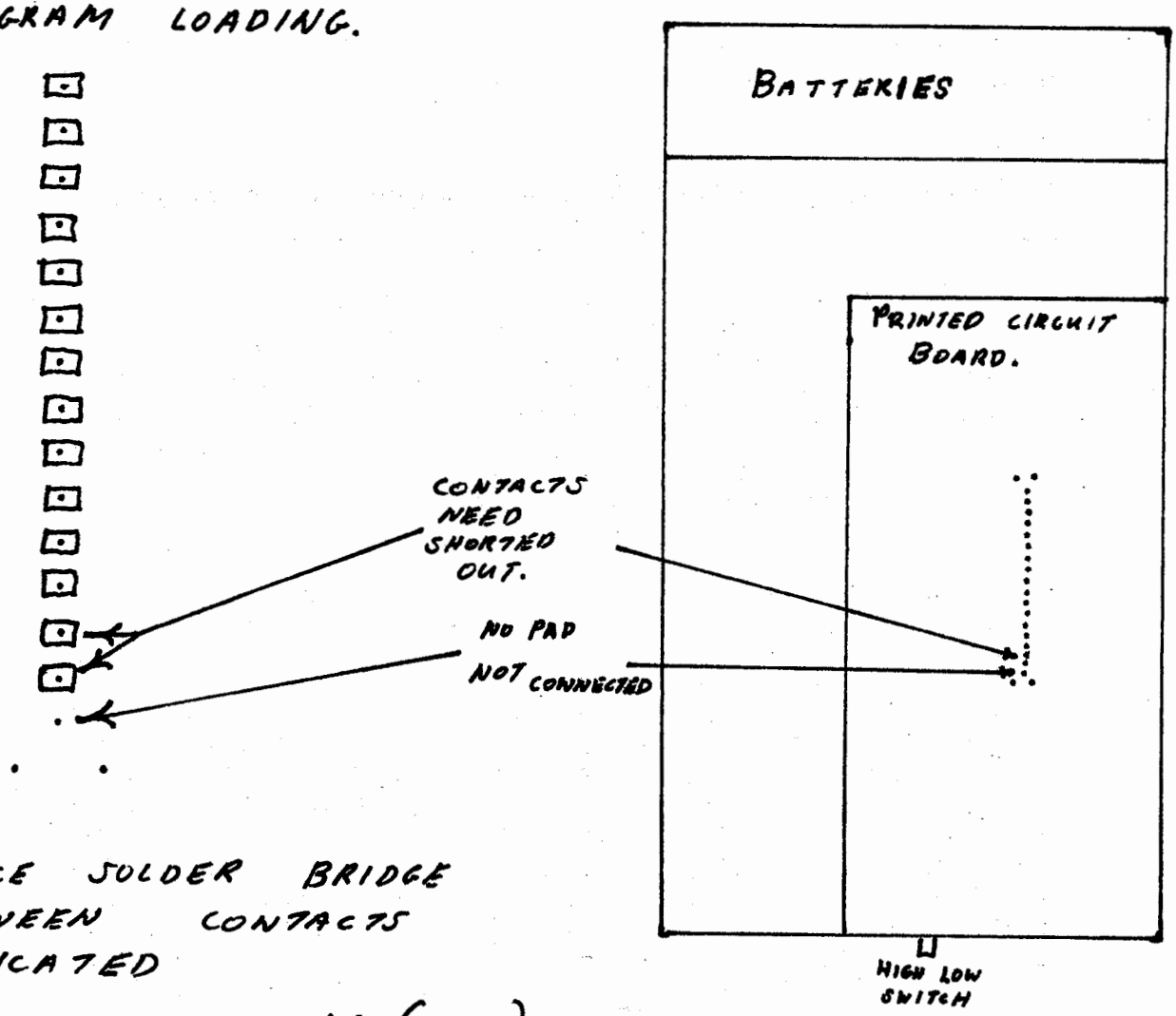
5. HAVE YOUR RADIO SHACK DEALER REALIGN THE HEAD. (NOTE: THIS IS EASY TO DO, BUT ON THE CTR41, REQUIRES REMOVING THE THIN ALUMINUM NAME PLATE - WHICH IS GLUED ON AND EASILY DAMAGED. IF YOU WANT TO RISK IT, PULL OFF THE NAME PLATE (THE PIECE WITH THE CONDENSER MIKE HOLES). YOU WILL SEE A ROUND HOLE ABOVE THE PLAY KEY EXPOSING A SMALL SCREW. ATTACH AN OSCILLOSCOPE TO THE TWO EARPHONE LEADS. PLAY A CASSETTE OF KNOWN HIGH QUALITY - PREFERABLY AN "ALIGNMENT" TAPE - AVAILABLE THROUGH HI FI STORES. SLOWLY TURN THE SCREW FOR MAXIMUM VOLTAGE AMPLITUDE WITH THE VOLUME SET AROUND 5 1/2.)

6. TRY ANOTHER CASSETTE RECORDER. WE HAVE NOTICED THAAT WE CAN GET A GOOD LOAD ON CERTAIN BRANDS OF RECORDERS (E. G. THE MARANTZ SUPERSCOPE MODEL C-190 WITH LEVEL AT 4.) USING A TAPE WHICH GIVES A BAD LOAD WITH THE CTR41.

7. RETURN THE TAPE TO THE FACTORY FOR A REPLACEMENT.

TAPE RECORDER MOD TO IMPROVE PROGRAM LOADING.

BACK VIEW WITH COVER REMOVED



PLACE SOLDER BRIDGE BETWEEN CONTACTS INDICATED

TURN VOL TO 10 (MAX)

MODIFICATION TO CTR41 CASSETTE RECORDER TO GREATLY IMPROVE LOADING LEVEL II AND MACHINE LANGUAGE PROGRAMS.

FIGURE 3.

APPENDIX 2
RTTY EQUIPMENT INTERCONNECTIONS

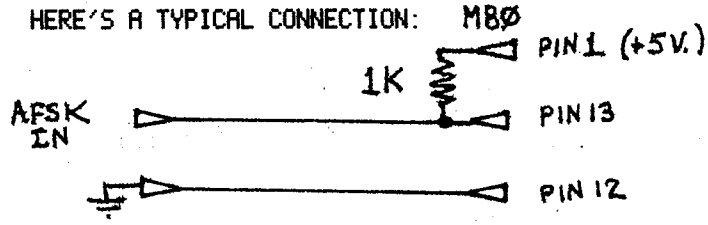
IF YOU ARE NEW TO RTTY, YOU SHOULD READ A GOOD INTRODUCTION BEFORE GOING ON THE AIR. SEE THE REFERENCES CITED EARLIER.

TRANSMITTING

TO SEND RTTY ON THE AMATEUR FREQUENCIES, YOU WILL REQUIRE A MEANS OF FREQUENCY MODULATING YOUR SIGNAL. TWO METHODS ARE IN COMMON USE TODAY:

1. FREQUENCY SHIFT KEY (FSK) THE TRANSMITTER VFO. (NOT USED ON VHF-FM) SOME TRANSMITTERS AND TRANSCEIVERS (SUCH AS KENWOOD TS820, YAESU FT901, ICOM 701, ETC.) HAVE THIS CAPABILITY BUILT IN. IN THIS CASE, SIMPLY CONNECT THE FSK JACK TO THE RELAY CONTACTS ON THE M80. YOU WILL NEED TO DETERMINE IF YOUR FSK CIRCUITRY REQUIRES MAKE-ON-SPACE OR MAKE-ON-MARK. BOTH ARE PROVIDED FOR ON THE M80 BOARD. IF YOUR TRANSMITTER DOES NOT HAVE THIS FEATURE, REFER TO CHAPTER V OF THE RTTY HANDBOOK OR THE RTTY SECTION OF THE SPECIALIZED COMMUNICATION TECHNIQUES HANDBOOK PUT OUT BY ARRL. TO OBTAIN CW ID THROUGH FSK, SELECT POSITIVE CW KEYING.

2. AUDIO FREQUENCY SHIFT KEY (AFSK) THROUGH THE MICROPHONE INPUT. THIS IS THE EASIEST AND PROBABLY MOST COMMON METHOD IN USE ON THE HAM BANDS TODAY. IT IS USED ON BOTH THE HF AND VHF BANDS. SEVERAL COMMERCIAL AFSK UNITS ARE AVAILABLE - LOOK THROUGH ANY ISSUE OF THE RTTY JOURNAL , HAM RADIO MAGAZINE , QST, 73 MAGAZINE, OR WORLD RADIO NEWS. LOUGHMILLER <<"DIGIRATT", HAM RADIO MAGAZINE, SEPT. 1977>> DESCRIBED A SIMPLE BUT VERY STABLE AFSK UNIT. A VERY SIMPLE CIRCUIT WAS DESIGNED BY WB2RHM AND DESCRIBED IN SEPT. 69 QST . IT SHOULD COST LESS THAN $10.00 AND HAS PROVISIONS FOR WIDE OR NARROW SHIFT, AND ALSO HAS A CW ID JACK WHICH MAKES IT IDEAL FOR USE WITH THE M80. EXACTLY HOW TO CONNECT THE AFSK UNIT TO THE M80 WILL DEPEND ON HOW IT IS TO BE KEYED. SOME UNITS, FOR EXAMPLE, HAVE A "GROUND ON SPACE" INPUT, SOME REQUIRE A POSITIVE VOLTAGE ON MARK AND NEGATIVE OR ZERO ON SPACE, AND OTHERS CONNECT ONLY THROUGH A LOCAL LOOP. THOSE WHICH REQUIRE A MAKE-BREAK SIMPLY CONNECT TO THE RELAY CONTACTS. THOSE WHICH REQUIRE A + VOLTAGE TO KEY CAN BE TIED TO A "PULL-UP" RESISTOR THROUGH THE RELAY. 5 VOLTS IS AVAILABLE ON PIN 1 OF THE EDGE CONNECTOR AND 12 VOLTS IS AVAILABLE AT THE HOLE MARKED +12. HERE'S A TYPICAL CONNECTION:



AFSK UNITS WHICH KEY THROUGH A LOCAL LOOP CAN BE ACCOMODATED BY REPLACING THE RELAY WITH THE OPTIONAL MLK-1 LOOP KEYER MODULE. THIS ALLOWS THE M80 TO CONNECT IN SERIES WITH THE LOCAL LOOP AND OPTICALLY ISOLATES THE HIGH VOLTAGE FROM THE M80 AND YOUR TRS80. WITH THE MLK-1 IN THE RELAY SOCKET, CONNECT THE 'LOOP + ' TO PIN 13 AND THE 'LOOP - ' TO PIN 14.

RECEIVING

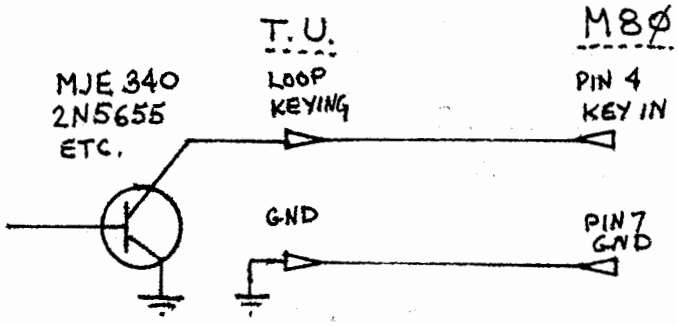
THE BUILT IN TERMINAL UNIT (TU) OF THE M80 CONSISTS OF A SINGLE IC - THE 567 PHASE LOCKED LOOP. THIS CIRCUIT IS ADEQUATE TO DEMODULATE A FSK SIGNAL OR CW SIGNAL UNDER GOOD SIGNAL CONDITIONS. IN THE PRESENCE OF HEAVY QRN, QRM, OR QSB, HOWEVER, PERFORMANCE WILL BE MARGINAL. SEVERAL ADVANCED DESIGN TU'S ARE AVAILABLE COMMERCIALLY, INCLUDING UNITS MADE BY HAL COMMUNICATIONS, FLESHER, DOVETRON, INFOTECH, AND ELECTROCOM. THE FLESHER TU170, IN OUR OPINION, IS AN OUTSTANDING TU FOR THE MONEY ($149 KIT FORM) AND ALSO INCLUDES AN AFSK UNIT. SEVERAL EXCELLENT TU'S HAVE BEEN DESCRIBED IN THE LITERATURE, AND MANY OF THE CIRCUITS ARE NOW AVAILABLE IN KIT FORM. LOOK THROUGH RECENT ISSUES OF THE MAGAZINES MENTIONED ABOVE.

AN EXTERNAL TU MAY BE CONNECTED TO THE M80 IN ANY OF SEVERAL WAYS.

1. THROUGH A LOCAL LOOP. WITH THE MLK-1 LOOP KEYER MODULE IN THE RELAY SOCKET, SIMPLY CONNECT 'LOOP + ' TO PIN 13 AND 'LOOP - ' TO PIN 14. NO OTHER CONNECTIONS ARE REQUIRED (FOR EITHER TRANSMITTING OR RECEIVING IF YOUR TU HAS AN AFSK UNIT KEYED THROUGH THE LOOP).

2. THROUGH THE RS232 INPUT. THE M80 ACCEPTS AN RS232 VOLTAGE INPUT (+ OR - 12 VOLTS) ON RECEIVE. MOST TU'S WILL HAVE SUCH AN OUTPUT MARKED EITHER RS232 OR FSK. THIS VOLTAGE IS USUALLY DERIVED FROM THE LOOP CURRENT, SO THE LOOP MUST BE CLOSED AND DRAWING 60 MA. ON MOST TU'S FOR THIS TO WORK. CONNECT TO PINS 5 AND 6 ON THE M80.

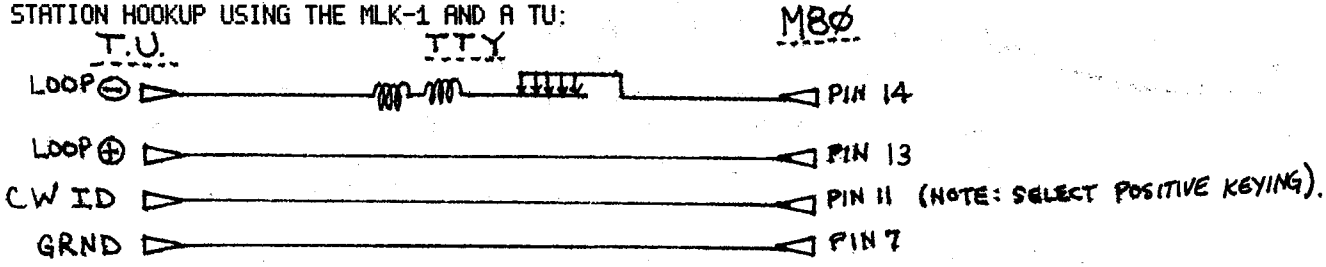
3. THROUGH THE KEY IN PIN. IF YOUR TU HAS A LOOP KEYER TRANSISTOR OR A RELAY OUTPUT, YOU CAN CONNECT DIRECTLY TO THE KEY IN CIRCUIT. MAKE CERTAIN YOU DO NOT CONNECT ANY VOLTAGE HIGHER THEN +5 VOLTS TO PIN 4! RIGHT SIDE UP SHOULD GIVE GROUND ON SPACE AND OPEN OR +5 VOLTS ON MARK. TO CONNECT THE LOOP KEYER TRANSISTOR:



NOTE: THE ABOVE CONFIGURATION WILL GIVE MARK/SPACE INVERTED. SELECT MARK/SPACE REVERSE ON THE M80.

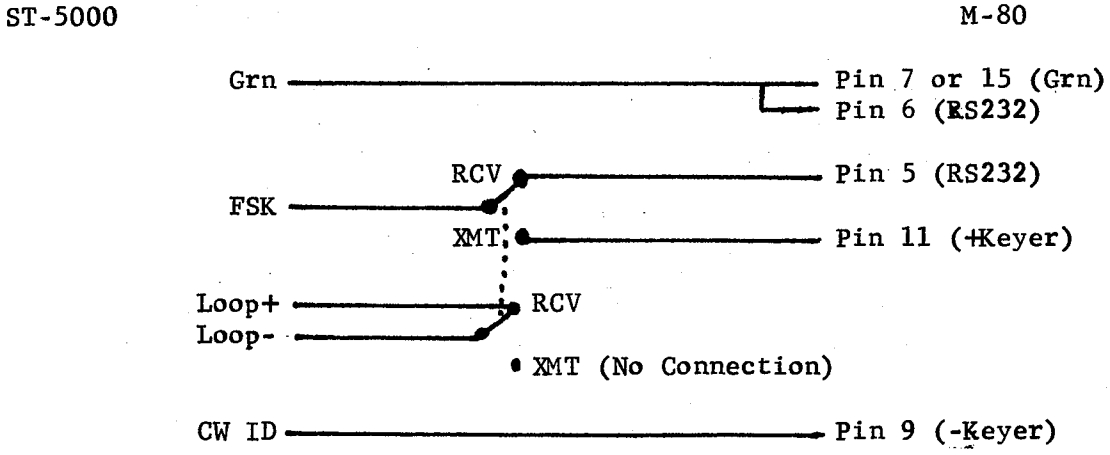
HARD COPY

YOU CAN USE YOUR M80 IN A LOCAL LOOP WITH A WIDE VARIETY OF TTY EQUIPMENT, INCLUDING A BAUDOT PRINTER. YOU MUST USE THE OPTIONAL MLK-1 LOOP KEYER MODULE IN PLLACE OF THE RELAY, HOWEVER. THE MLK-1 PROVIDES SIMPLE TWO WIRE CONNECTION TO THE LOOP FOR BOTH RECEIVE AND TRANSMIT CAPABILITY, THUS ALLOWING HARD COPY. ASSUMING YOU HAVE AN AFSK UNIT IN YOUR TU, NOTHING ELSE WOULD BE REQUIRED TO INTERFACE THE M80 FOR RTTY. HERE IS A TYPICAL STATION HOOKUP USING THE MLK-1 AND A TU:

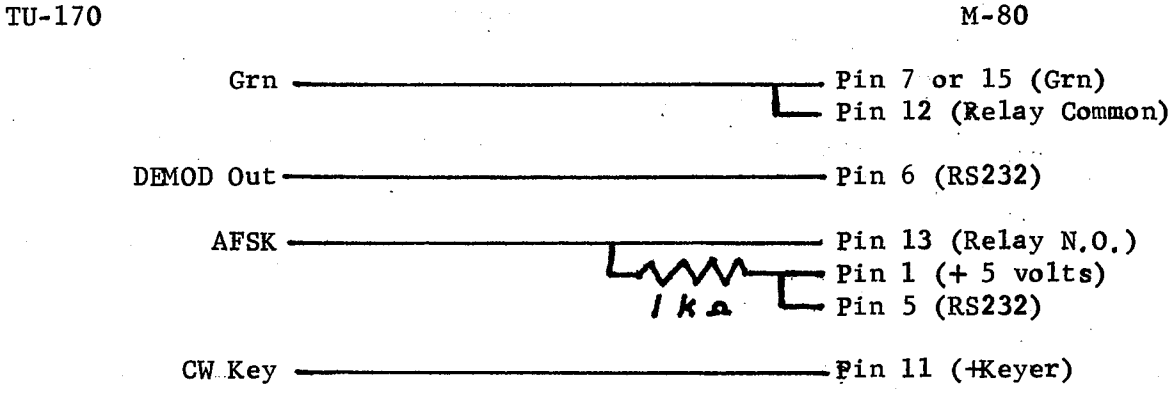


TWO ADDITIONAL EXAMPLES ON HOOKING UP TO THE EXTERNAL TU'S WITHOUT THE MLK-1 ARE GIVEN BELOW (NOTE: NO HARD COPY CAPABILITY).

Connecting the HAL ST-5000 to the MICROTRONICS M-80



Connecting the Flesher TU-170 to the MICROTRONICS M-80



Must select Positive (P) CW keying in Morse send mode and replace R15 on the M-80 board with a 270 ohm resistor instead of the 1k ohm resistor presently installed.

```
1 CLEAR3000:CLS:PRINTCHR$(23)"MICROTRONICS M-80 HAM INTERFACE":PRINT:PRINT" FOR THE TRS-80 MICROCOMPUTER":PRINTSTRING$(31,191);:PRIN
T@834,"COPYRIGHT 1978 R. LODEWYCK":PRINT@320,"DESIGNED BY RON LODEWYCK, N6EE
5 PRINT@592,"<VERSION 1.1>";
10 REM DEFUSR0=&H7A00:DEFUSR1=&H7A97:DEFUSR3=&H7A65:DEFUSR4=&H7AF0
12 POKE31002,0:POKE31003,60
15 DIMA%(49),D%(49):FORI=0TO49:READA%(I),D%(I):NEXT
16 DATA204,5,136,4,84,5,144,4,248,4,120,4,56,4,24,4,8,4,0,4,128,4,192,4,224,4,240,4,136,4,136,4,176,4,136,4,20,5,48,5,80,4,64,1,128,
3,160,3,128,2,0,0,32,3,192,2,0,3,0,1,112,3,160,2,64,3,192,1
18 DATA 128,1,224,2,96,3,208,3,64,2,0,2,128,0,32,2,16,3,96,2,144,3,176,3,192,3,64,4,0,6,0,6
20 L4=31121:L5=31122:L6=31125:L7=31126:L8=16416:L9=16417:L0=15360:EI%=0:FT%=255:FS=256:TW%=2:NF%=95:FF%=44:O=1:Z%=0:NI%=9:O%=1:MO=1
25 POKE31005,2:POKE31006,6:POKE31127,255
30 POKE31001,6
32 AA$="  ETIANMSURWDKGOHVF?L?PJBXCYZQ??54?3???2 ?0???16-/???(????8?90???)))?????????????.????????????????,,,,,,,,,,,,,,":FORI=
1TO116:POKE30337+I-1,ASC(MID$(AA$,I,1)):NEXT
40 FORI=0TO49:POKE31012+I,A%(I):NEXT:REM MORSE BIT PATTERNS
42 FORI=0TO49:POKE31012+50+I,D%(I):NEXT:REM # BITS IN CHAR
50 CW$=CHR$(13)+"CW ID FOLLOWS -"+CHR$(13)+CHR$(99)+" "
60 SFF=64:FF=55:SX=16:M=32000:O=1:O%=1:OM=32737:OT=32738:TM=32739:TT=32740:SP=32741:P=32742:Q=32743:LEVEL=32744:E=31:F%=32:FV%=59:ST
%=63:TR%=13:HM=32746:HT=32747:L%=O%
70 DIMC%(60):FORI=1TO58:READC%(I):NEXT
72 DATA 54,49,37,50,56,43,58,62,41,37,43,38,56,39,55,45,61,57,48,42,33,53,60,44,35,46,47,63,46,59,51,56,56,51,46,50,48,54,43,37,44,5
8,62,41,39,38,35,45,61,42,52,33,60,47,57,55,53,49
80 NW%=107:DIMW$(NW%):FORI=O%TONW%:READW$(I):NEXT
150 FORI=1TO1000:NEXT:CLS:INPUT"MODE (M=MORSE CODE, B=BAUDOT RTTY)";B$:IFB$="M"THENGOSUB200:GOTO1000ELSEGOTO9990
200 PRINT:PRINT"ENTER SPEED IN WPM";:INPUTSD
210 IFSD>399THEN200
212 PRINT"WPM NOW "SD:WD=SD*1.2:SD=SD*1.21
280 TT=INT(1.2/SD*10[4):TM=TT-INT(TT/10)*10:MS=(TT-TM)/10:TS=INT(MS/100)
290 MS=MS-TS*100:POKE31002,TM:IFTM=0POKE31002,1
300 POKE31003,MS
310 POKE31004,TS
314 T2=2400/WD:POKEL4,INT(T2/100):POKEL5,T2-INT(T2/100)*100:T5=8400/WD:POKEL6,INT(T5/100):POKEL7,T5-INT(T5/100)*100
320 RETURN
1000 PRINT:PRINT:PRINT"MORSE SEND MODE
1010 FORI=1TO2:NEXT:POKE16526,0:POKE16527,122:X=USR(0):GOTO1300          7A00 USRØ
1100 IFB$=" "POKE16526,151:POKE16527,122::X=USR(0):PRINT" ";:RETURN      7A97 USR1
1102 IFB$<","ORB$>"[ "RETURN
1110 POKE31000,A%(ASC(B$)-FF%):POKE31001,D%(ASC(B$)-FF%):POKE16526,101:X=USR(0):PRINTB$;:RETURN     7A65 USR3
1200 PRINT:PRINT:PRINT"MORSE RECEIVE MODE
1210 POKE16527,122:POKE16526,240:X=USR(0):B$=INKEY$:IFB$=""THEN1210ELSE1000     7AFØ USR4
1300 B$=INKEY$:IFB$=""THEN1300
1310 IFB$=CHR$(31)THEN1300
1312 IFB$>="0"ANDB$<="9"THEN1500
1315 IFB$="&"THENGOSUB1400:GOTO1010
1320 IFB$="%"THENGOSUB200:GOTO1000
1325 IFB$="-"THEN1900
1327 IFB$="/"THEN1890
1330 IFB$="R"THEN9990   'GO TO RTTY EXEC
1335 IFB$="+"THENINPUT"NR";NR:GOTO1900
1340 IFB$=CHR$(13)THEN1200
```

```
1345 IFB$=" "THENLPRINT"     ";:PRINT" ":GOTO1920
1350 IFB$="$"THEN1600
1360 IFB$="("PRINTCHR$(23):GOTO1010
1370 IFB$=")"CLS:GOTO1010
1372 IFB$="#"THEN1700
1380 IFB$="/"THEN1800
1390 GOTO1000
1400 REM ENTER MESSAGE
1410 PRINT:PRINT"ENTER MESSAGE NUMBER (0-9)";
1420 B$=INKEY$:IFB$=""THEN1420
1425 I=VAL(B$):IFI<Z%ORI>NI%THEN1410
1430 M$(I)="":MC%=FT%:PRINT:PRINT"ENTER MESSAGE #"B$"     (USE  'CLEAR'  TO TERMINATE)":PRINTCHR$(95);
1435 B$=INKEY$:IFB$=""THEN1435
1436 PRINTCHR$(EI%);B$;CHR$(NF%);:MC%=MC%-0%:CP=PEEK(L8)+FS*PEEK(L9):PRINT@Z,MC%:PRINT@CP-L0,"";:IFASC(B$)=EI%THENM$(I)=LEFT$(M$(I),
LEN(M$(I))-0):MC%=MC%+TW%:CP=PEEK(L8)+FS*PEEK(L9):PRINT@Z,MC%:PRINT@CP-L0,"";:GOTO1435
1437 IFASC(B$)=31PRINT:PRINT"ENTERED - BACK TO SEND":RETURN
1440 M$(I)=M$(I)+B$:GOTO1435
1500 REM SEND MESSAGE
1505 IFLEN(M$(VAL(B$)))=0GOTO1010
1510 J=VAL(B$):LE=LEN(M$(J)):POKE30208,0:POKE30209,LE:POKE30211,PEEK(VARPTR(M$(J))+2):POKE30210,PEEK(VARPTR(M$(J))+1)
1520 MS=INT(30214/256):POKE16527,MS:POKE16526,30214-MS*256:X=USR(X):GOTO1300
1530 NEXT:GOTO1010
1600 PRINT:INPUT"ENTER CHARACTER SPACING (THEORETICAL=3)";C%:IFC%<2C%=2
1610 POKE31005,C%-1:INPUT"ENTER WORD SPACING (THEORETICAL=7)";C%:IFC%<2C%=2
1620 POKE31006,C%-1:PRINT"ENTERED- BACK TO SEND":GOTO1010
1700 REM CODE PRACTICE GENERATOR
1710 CLS:PRINTCHR$(23)"CODE PRACTICE MODE":O=1:SI=5:ZF%=5:K%=47:KK%=44:FS%=57:ST%=63:ET%=8:SF%=64
1730 INPUT"CHARACTERS OR WORDS(C OR W)";B$:IFB$="W"THEN1744
1732 FORMI=0TOSI:FORMJ=0TOZF%:A%=RND(0)*K%+KK%:IFA%>FS%ANDA%<ST%A%=A%+ET%
1734 IFA%=SF%A%=65
1736 B$=CHR$(A%):GOSUB1100:NEXT
1738 B$=" ":GOSUB1100
1740 A$=INKEY$:IFA$=""THEN1742ELSEIFASC(A$)=31THEN1000
1741 A$=INKEY$:IFA$=""THEN1741ELSEIFASC(A$)=31THEN1000
1742 NEXT:PRINT:GOTO1732
1744 FORZZ=0TOSI:A%=RND(0)*NW%+0:FORZK=0TOZF%:B$=MID$(W$(A%),ZK,0):GOSUB1100:NEXT
1746 A$=INKEY$:IFA$=""THEN1748ELSEIFASC(A$)=31THEN1000
1747 A$=INKEY$:IFA$=""THEN1747ELSEIFASC(A$)=31THEN1000
1748 B$=" ":GOSUB1100:NEXT
1750 PRINT:GOTO1744
1752 DATA BREAK,AWARD,APRIL,BANDS,AMAZE,BOXED,ADDED,BASIC,BOARD
1754 DATA CABLE,DIODE,CRAZE,CRAZY,CLOCK,CLIPS,CODED,DIALS,DIGIT,COULD
1756 DATA ELECT,EIGHT,EVERY,EXIST,EARLY,EGYPT
1758 DATA FIXED,FLOPS,FANCY,FULLY,FIELD,FINAL,FARAD,FAULT,FIXED
1760 DATA GREAT,GLAZE,GIVEN,HEARD,GOING,HAITI
1762 DATA JAZZY,KOREA,LEVEL,LIGHT,LINES,LOGIC,LUNAR,LIMIT,LIBYA
1764 DATA MOTOR,METER,MOUNT,MIXED,MIXER,MERIT,MARCH,MELEE,MORSE
1766 DATA NOISE,NAMES,OCCUR,OTHER,OSCAR,PLAYS,POWER,PLATE,PANEL
1768 DATA PULSE,POINT,QUICK,QUIET,QUIRK,QUACK,QUITE
1770 DATA ROTOR,READY,RADIO,RELAY,RATED,RATES,RESET,SHIFT,SPEED
1772 DATA STATE,SHEET,SEVEN,SOLID,SLIDE,SINCE,SIDED,SHORT,SPIKE
1774 DATA SPAIN,TONES,THERE,THREE,TOTAL,TAXED,TAPED,TUNED,TAKES
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1776 DATA THOSE, TRIED, TRACK, TEXAS, TOKYO, THINK
1778 DATA WORLD, VISIT, WHITE, VOICE, WHICH, VOLTS, WIRED, VIDEO, UNITS
1800 PRINT:INPUT"WHAT TYPE OF CW KEYING (P=POSITIVE & RELAY, N=NEGATIVE)";B$:IFB$="P"THENPOKE31346,4:POKE31353,4:POKE31364,3
ELSE POKE31346,1:POKE31353,1:POKE31364,0
1805 PRINT"KEYING NOW ";:IFB$="P"THENPRINT"POSITIVE AND RELAY -":GOTO1000:ELSE PRINT"NEGATIVE -":GOTO1000
1890 NR=NR+1
1900 M$(1)="NR"+STR$(NR)+" B NGEE 57 SJV BK"+CHR$(99):LPRINTM$(1);:B$="1":GOTO1500
1920 A$=INKEY$:IFA$=""THEN1920
1930 IFA$=CHR$(13)THEN1960ELSELPRINTA$;:GOTO1920
1960 LPRINT"  ":PRINT:GOTO1010
9990 PRINT:PRINT"RTTY SEND MODE - ":PRINT
10000 MS=INT(32410/256):POKE16527,MS:POKE16526,32410-MS*256:X=USR(0)
10100 GOTO13000
11000 GOTO11020
11010 MS=INT(32288/256):POKE16527,MS:POKE16526,32288-MS*256:X=USR(0):RETURN
11020 IFB$<"A"ANDB$<>" "ANDL%=0%L%=Z%:POKEP,FV%:GOSUB11010
11030 IF(B$)"@"ORB$=" ")ANDL%=Z%L%=0%:POKEP,ST%:GOSUB11010
11040 PRINTB$;
11050 IFB$=CHR$(TR%)POKEP,34:GOSUB11010:POKEP,40:GOSUB11010:RETURN
11060 IFB$=" "POKEP,36:GOSUB11010:RETURN
11100 POKEP,C%(ASC(B$)-F%):GOSUB11010:RETURN
13000 B$=INKEY$:IFB$=""THEN13000
13100 IFB$=CHR$(31)THEN13000
13120 IFB$)="0"ANDB$<="9"THEN15000
13130 IFB$=CHR$(13)THEN20000  'ENTER KEY FOR RTTY RECEIVE
13140 IFB$="&"THENGOSUB1400:GOTO10000  'CREATE MESSAGE
13200 IFB$="%"THEN16000       'CHANGE BAUD RATE
13400 IFB$="@"THEN17000       'CW ID
13500 IFB$="M"THEN1000        'TRANSFER TO MORSE EXEC
13600 IFB$="("PRINTCHR$(23):GOTO10000 '32 CHARACTER/LINE
13700 IFB$=")"CLS:GOTO10000   'CLEAR SCREEN - 64 CHARACTER/LINE
13800 IFB$="$"THEN18000       'INVERT MARK/SPACE RECEIVE TONES
13850 IFB$="'"THEN18500       'UNSHIFT-ON-SPACE OPTION
13900 GOTO10000
15000 REM SEND MESSSAGE IN BAUDOT
15050 IFLEN(M$(VAL(B$)))=0GOTO10000
15100 J=VAL(B$):LE=LEN(M$(J)):POKE30208,1:POKE30209,LE:POKE30211,PEEK(VARPTR(M$(J))+2):POKE30210,PEEK(VARPTR(M$(J))+1)
15200 MS=INT(30214/256):POKE16527,MS:POKE16526,30214-MS*256:X=USR(X):GOTO13000
15300 GOSUB11000:NEXT:GOTO10000
16000 REM CHANGE BAUD RATE
16500 PRINT:INPUT"ENTER BAUD RATE AS WPM (60,66,75, OR 100)";WPM
16550 IFWPM=60THENM1%=22:T1%=Z%:M2%=7:T2%=5:M3%=31:T3%=Z%:GOTO16900
16600 IFWPM=66THENM1%=20:T1%=Z%:M2%=6:T2%=5:M3%=28:T3%=4:GOTO16900
16650 IFWPM=75M1%=17:T1%=6:M2%=5:T2%=3:M3%=25:T3%=Z%:GOTO16900
16700 IFWPM=100M1%=13:T1%=5:M2%=3:T2%=5:M3%=19:T3%=Z%:GOTO16900
16750 CLS:GOTO16500
16900 POKEOM,M1%:POKEOT,T1%:POKETM,M2%:POKETT,T2%:POKEHM,M3%:POKEHT,T3%:PRINT:PRINT"WPM NOW "WPM:GOTO10000
17000 POKE30208,1:POKE30209,LEN(CW$):POKE30211,PEEK(VARPTR(CW$)+2):POKE30210,PEEK(VARPTR(CW$)+1)
17005 MS=INT(30214/256):POKE16527,MS:POKE16526,30214-MS*256:X=USR(X):ID$="  "+M$(0)+CHR$(99):POKE30208,0:POKE30209,LEN(ID$):POKE3021
1,PEEK(VARPTR(ID$)+2):POKE30210,PEEK(VARPTR(ID$)+1)
17010 X=USR(X):GOTO20000
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18000 IFPEEK(SP)=254THENPOKESP,255
ELSE POKESP,254
18005 PRINT:PRINT"MARK/SPACE RECEIVE TONES REVERSED":PRINT"LED SHOULD LIGHT ON ";:IFPEEK(SP)=254THENPRINT"SPACE -":GOTO9990
ELSE PRINT"MARK -":GOTO9990
18500 PRINT:INPUT"A=AUTO UNSHIFT  M=MANUAL UNSHIFT   ";B$:
IFB$="A"THENPOKE32748,0
ELSE POKE32748,1
18505 PRINT:PRINT"AUTOMATIC UNSHIFT-ON-SPACE IS ";:IFB$="A"THENPRINT"ON -":GOTO9990
ELSE PRINT"OFF -":GOTO9990
20000 PRINT:PRINT:PRINT"RTTY RECEIVE MODE -":PRINT
20600 MS=INT(32182/256):POKE16527,MS:POKE16526,32182-MS*256:X=USR(0)
22000 B$=INKEY$:IFB$=""THEN20600
22010 GOTO9990
50000 A$=INKEY$:IFA$=""THEN50000
50001 PRINTA$;ASC(A$):GOTO50000
```