ISIS-II 8080/8085 MACRO ASSEMBLER, V3.0   MODULE   PAGE   1

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LOC  OBJ          LINE      SOURCE STATEMENT

                  1 ;       THIS SERIES OF PROGRAMS IS DESIGNED TO SHOW THE "EXPLORER-85" USER
                  2 ; HOW TO USE THE SERIAL I/O FUNCTIONS OF THE SYSTEM.  UNLIKE MOST SMALL
                  3 ; COMPUTERS WHICH USE A HARDWARE UART (UNIVERSAL ASCYNCHRONOUS RECIEVER
                  4 ; AND TRANSMITTER) FOR SERIAL COMMUNICATIONS, THE "EXPLORER-85" USES MONITOR
                  5 ; SOFTWARE TO DRIVE THE "SID" AND "SOD" (SERIAL INPUT DATA AND SERIAL OUTPUT
                  6 ; DATA) PINS OF THE 8085 CPU.  THE GREATEST ADVANTAGE OF THIS METHOD IS
                  7 ; THAT THE CPU CAN DETERMINE THE BAUD (BIT) RATE OF THE TERMINAL AUTO-
                  8 ; MATICALLY.
                  9 ;
                 10 ;       WHEN THE "EXPLORER-85" IS RESET, A PROGRAM CALLED "SIOTST" (SERIAL
                 11 ; I/O TEST) IS CALLED.  THIS PROGRAM ASSUMES THAT THE USER WILL TYPE A
                 12 ; SPACE (00100000) CHARACTER ON HIS TERMINAL.  THE TIME DURATION BETWEEN
                 13 ; THE START BIT AND THE "1" IS MEASURED AND THE BAUD RATE OF THE TERMINAL
                 14 ; IS COMPUTED.  THIS DATA IS STORED AT LOCATIONS F8E9 THROUGH F8EC, AND
                 15 ; IS USED AS THE BASIS FOR ALL FURTHER COMMUNICATIONS UNTIL ANOTHER RE-
                 16 ; SET IS SEEN.  THEREFORE IT IS IMPORTANT THE USER NEVER CHANGE THESE BYTES
                 17 ; OF DATA.
                 18 ;
                 19 ;       TO COMMUNICATE WITH THE SERIAL I/O PROGRAMS, THE USER MUST FOLLOW
                 20 ; A SPECIFIC PROTOCOL, WHICH WILL BE OUTLINED IN THE NEXT FEW PARAGRAPHS.
                 21 ; FAILURE TO FOLLOW THESE RULES WILL MAKE IT IMPOSSIBLE TO COMMUNICATE
                 22 ; WITH A TERMINAL.
                 23 ;
                 24 ;********************************************************************************
                 25 ;
                 26 ;                       SERIAL INPUT DATA
                 27 ;
                 28 ;       THE SERIAL INPUT PROGRAM "CI" (CONSOLE INPUT) MUST BE CALLED BY
                 29 ; THE USERS PROGRAM.  IT WILL THEN WAIT FOR A CHARACTER TO BE ENTERED, AND
                 30 ; AFTER RECIEVING IT EXECUTE A RETURN TO THE USERS PROGRAM WITH THE ENTERED
                 31 ; CHARACTER LEFT IN THE ACCUMULATOR.  THIS PROGRAM DOES NOT TRANSMIT THE
                 32 ; CHARACTER BACK TO THE CONSOLE.  THE ADDRESS OF "CI" IS F47F.
                 33 ;
                 34 ;
                 35 ;       AS AN EXAMPLE, THE FOLLOWING PROGRAM INPUTS A STRING OF FOUR
                 36 ; CHARACTERS AND STORES THEM IN MEMORY LOCATIONS F880, F881, F882 AND F883.
                 37 ;
                 38 ;
F810             39          ORG      0F810H ;  ASSEMBLER ORIGINATE STATEMENT
                 40 ;
                 41 EXMPL1:
F810 2180F8      42          LXI      H, 0F880H       ;  LOAD THE H&L REGISTERS WITH THE FIRST
                 43                                  ;  MEMORY ADDRESS TO BE USED.
F813 0604        44          MVI      B, 4            ;  PUT THE NUMBER OF CHARACTERS TO BE ENTERED
                 45                                  ;  IN THE B REGISTER.
                 46 ;
F815 CD7FF4      47 EXM1A:   CALL     0F47FH ;  CALL THE CONSOLE IN PROGRAM.  REMEMBER
                 48                                  ;  THE DATA RECIEVED WILL BE IN THE ACCUM-
                 49                                  ;  ULATOR WHEN CI RETURNS.
F818 E67F        50          ANI      7FH    ;  STRIP PARITY BIT **ON ASCII DATA ONLY**
F81A 77          51          MOV      M, A   ;  STORE THE DATA IN MEMORY
F81B 23          52          INX      H      ;  INCREMENT THE POINTER TO THE NEXT LOCATION
F81C 05          53          DCR      B      ;  DECREMENT THE CHARACTER COUNT
F81D C215F8      54          JNZ      EXM1A  ;  CONTINUE UNTIL FOUR CHARACTERS HAVE
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LOC OBJ   LINE   SOURCE STATEMENT

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                  55                        ;  BEEN ENTERED.
                  56 ;
                  57 ;
                  58 ;********************************************************************************
                  59 ;
                  60 ;                              SERIAL OUTPUT
                  61 ;
                  62 ;
                  63 ;      TO OUTPUT DATA TO THE SERIAL I/O LINES IS SOMEWHAT DIFFERENT FROM
                  64 ; THE INPUT FUNCTION, BUT IT STILL MUST BE DONE AS A "CALL" FROM THE
                  65 ; THE USERS PROGRAM.
                  66 ;      THE BASIC SERIAL OUTPUT PROGRAM IS CALLED "ECHO".  WHEN CALLED,
                  67 ; IT TAKES THE CONTENTS OF THE "C" REGISTER AND OUTPUTS IT TO THE SERIAL
                  68 ; OUTPUT LINES, AT THE APPROPRIATE BAUD RATE.  WHEN IT RETURNS TO THE
                  69 ; USER PROGRAM, THE CONTENTS OF THE "C" REGISTER ALSO APPEAR IN THE
                  70 ; ACCUMULATOR.
                  71 ;
                  72 ; NOTE:  FOR THOSE USERS WHO HAVE A DISK BASED BASIC, WHICH USES THE
                  73 ;      "B" REGISTER FOR OUTPUT DATA, A PROGRAM CALLED "ECHOB" IS PROVIDED
                  74 ;      IN THE SYSTEM MONITOR FOR YOUR USE.  THIS PROGRAM TRANSMITS THE
                  75 ;      CONTENTS OF THE "B" REGISTER RATHER THAN THE "C" REGISTER, AND RE-
                  76 ;      TURNS WITH THE OUTPUT CHARACTER IN THE ACCUMULATOR
                  77 ;
                  78 ;      THE ADDRESS OF "ECHO" IS F514, AND ECHOB IS F50C
                  79 ;
                  80 ;
                  81 ;
                  82 ;      AS A DEMONSTRATION, WE'LL MODIFY THE PREVIOUS PROGRAM TO DISPLAY
                  83 ; THE INPUT DATA, AS IT IS ENTERED.
                  84 ;
F810              85            ORG     0F810H
                  86 ;
                  87 EXMPL2:
F810 2180F8       88            LXI     H, 0F880H
F813 0604         89            MVI     B, 4
F815 CD7FF4       90 EXM2A:     CALL    0F47FH  ;  GET A CHARACTER
F818 77           91            MOV     M, A    ;  STORE IT IN MEMORY
F819 4F           92            MOV     C, A    ;  PUT THE DATA IN THE "C" REGISTER
F81A CD14F5       93            CALL    0F514H  ;  OUTPUT THE CHARACTER TO THE SERIAL I/O
F81D 23           94            INX     H
F81E 05           95            DCR     B
F81F C215F8       96            JNZ     EXM2A
                  97 ;
                  98 ;
                  99 ;      AS THE PROGRAM STANDS, IT WILL RECIEVE AND TRANSMIT FOUR CHARACTERS
                 100 ; VIA THE SERIAL I/O LINES AND STORE IT IN MEMORY.
                 101 ;
                 102 ;
                 103 ;
                 104 ;      BEFORE CONTINUING, IT IS IMPORTANT TO UNDERSTAND THE MEANS OF COM-
                 105 ; MUNICATION BETWEEN YOUR TERMINAL AND THE EXPLORER-85.  EACH CHARACTER IS
                 106 ; A SEVEN BIT ASCII CODE   TO DISPLAY A NUMBER, THE DIGITS MUST BE CONVER-
                 107 ; TED TO THE ASCII CODE AND TRANSMITTED SEPARATELY   THIS MEANS THAT IF YOU
                 108 ; ATTEMPT TO TRANSMIT THE BINARY NUMBER "25" (0010 0101) TO THE TERMINAL
                 109 ; DIRECTLY THE RESULT WOULD BE "%".  TO PROPERLY TRANSMIT THE NUMBER THE
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LOC OBJ   LINE   SOURCE STATEMENT

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              110 ;  UPPER FOUR BITS MUST BE CONVERTED TO THE ASCII CODE FOR "2" (0011 0010)
              111 ;  AND TRANSMITTED, THEN THE LOWER FOUR BITS ARE CONVERTED TO THE ASCII
              112 ;  CODE FOR "5" (0011 0101) AND TRANSMITTED.  THE RESULT WILL BE "25" ON
              113 ;  THE TERMINAL.
              114 ;      THE EXPLORER-85 HAS A PROGRAM IN THE SYSTEM MONITOR WHICH CAN BE
              115 ;  CALLED BY THE USER TO OUTPUT AN 8-BIT BYTE OF DATA AS TWO NUMBERS.
              116 ;  THE PROGRAM, CALLED "NUMOUT", TAKES THE CONTENTS OF THE ACCUMULATOR
              117 ;  AND CONVERTS IT TO THE PROPER ASCII CODES, THEN TRANSMITS IT TO THE CON-
              118 ;  SOLE AT THE CURRENT PRINT POSITION.  THE ONLY DISADVANTAGE OF THIS PRO-
              119 ;  GRAM IS THAT THE CONTENTS OF THE B&C REGISTERS, THE ACCUMULATOR, AND THE
              120 ;  STATUS FLAGS ARE ALTERED   THEREFORE, BEFORE CALLING NUMOUT, YOU SHOULD
              121 ;  SAVE THE B&C REGISTERS USING A "PUSH  B" STATEMENT AND AFTER CALLING
              122 ;  RESTORE THEM USING A "POP   B" STATEMENT.
              123 ;
              124 ;      AS AN EXAMPLE, WRITE A PROGRAM TO OUTPUT THE NUMBER 25 TO THE CON-
              125 ;  SOLE.
              126 ;
F800          127      ORG      0F800H ;  ASSEMBLER ORIGINATE STATEMENT
              128 ;
              129 EXMPL3:
F800 3E25     130      MVI      A,25H  ;  MOVE THE NUMBER 25 TO THE ACCUMULATOR
F802 CD45F6   131      CALL     0F645H :  CALL NUMOUT AT ADDRESS  F645
F805 C380F0   132      JMP      0F080H ;  RETURN TO THE MONITOR AT ADDRESS F080
              133 ;
              134 ;
              135 ;      THIS WILL ACCOMPLISH THE TASK, AND THE TERMINAL WILL RECIEVE THE
              136 ;  NUMBER THEN A CARRIAGE RETURN/LINE FEED WILL BE OUTPUT AND THE MONITOR
              137 ;  WILL BE READY FOR ANOTHER COMMAND.  NOTICE THE "JMP   0F080H" STATE-
              138 ;  MENT AT THE END OF THE PROGRAM.  THIS TELLS THE EXPLORER TO JUMP BACK
              139 ;  TO THE MONITOR AND WAIT FOR ANOTHER COMMAND.  THIS IS THE BEST METHOD
              140 ;  FOR A USER TO TERMINATE HIS PROGRAMS.  IN MACHINE LANGUAGE THIS WOULD
              141 ;  APPEAR AS "C3 80 F0" AS THE LAST THREE BYTES OF PROGRAM CODE.
              142 ;
              143 ;
              144 ;      AS YOU MIGHT EXPECT, GETTING A NUMBER FROM THE TERMINAL TO THE
              145 ;  COMPUTER ISN'T VERY SIMPLE EITHER, SINCE THE TERMINAL COMMUNICATES IN
              146 ;  ASCII CODE ALSO.  AGAIN THE MONITOR COMES TO THE RESCUE WITH "GETHX",
              147 ;  A PROGRAM WHICH GETS NUMBERS FROM THE CONSOLE, CONVERTS THEM TO BINARY
              148 ;  AND STORES THEM FOR PROGRAM USE.  WHEN CALLED, GETHX LOOKS FOR A 4 DIGIT
              149 ;  HEXADECIMAL NUMBER IN THE RANGE OF 0000 TO FFFF, FOLLOWED BY A DELIMITER
              150 ;  (COMMA, SPACE OR CARRIAGE RETURN).  THE BINARY EQUIVALENT OF THE NUM-
              151 ;  BER IS LEFT IN THE B&C REGISTERS, AND THE DELIMITER IS PLACED IN THE
              152 ;  D REGISTER BEFORE RETURNING TO THE CALLING PROGRAM.  THE CONFIGURATION
              153 ;  OF THE PROGRAM IS SUCH THAT ANY NUMBER OF DIGITS MAY BE ENTERED, AND
              154 ;  ONLY THE LAST 4 BEFORE THE DELIMITER ARE CONVERTED.  IF YOU HAPPEN TO
              155 ;  BE LOOKING FOR LESS THAN 4 DIGITS, THE REMAINDER OF THE B&C REGISTER PAIR
              156 ;  IS SET TO 0'S.  THIS MEANS THAT IF YOU ENTER "5," THE PROGRAM WILL RE-
              157 ;  TURN WITH B=00 AND C=05, IF YOU ENTER "25" THE PROGRAM RETURNS B=00 AND
              158 ;  C=25, IF YOU ENTER "1528," THEN B=15 AND C=28 AND IF YOU ENTER "15280004,"
              159 ;  THE PROGRAM RETURNS WITH B=00 AND C=04.  NOTE THAT THE LAST EXAMPLE
              160 ;  DEMONSTRATES THAT ONLY THE LAST 4 NUMBERS ENTERED ARE CONVERTED TO
              161 ;  BINARY AND RETURNED.
              162 ;
              163 ;
              164 ;      EXAMPLE #4:
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        LOC  OBJ        LINE       SOURCE STATEMENT

                        165 ;  GET THE CURRENT TIME OF DAY (HOURS AND MINUTES) FROM THE CONSOLE AND
                        166 ;  STORE THEM IN MEMORY AT LOCATIONS F880 AND F881  (F880=HOURS AND F881=
                        167 ;  MINUTES)
                        168 ;
                        169 ;
        F800            170        ORG     0F800H ;  MONITOR ORIGINATE STATEMENT
                        171 ;
          CAF5          172 EXMPL4:
        U F800 CD0000   173        CALL    GETHX  ;  GET THE NUMBERS
          (   0)
        F803 78         174        MOV     A,B    ;  GET THE HOURS TO THE ACCUMULATOR FROM THE B REG.
        F804 3290F8     175        STA     0F880H ;  AND STORE IT
        F807 79         176        MOV     A,C    ;  GET THE MINUTES TO THE ACCUMULATOR
        F808 3281F8     177        STA     0F881H ;  AND STORE IT
        F80B C380F0     178        JMP     0F080H ;  JUMP BACK TO THE MONITOR
                        179 ;
                        180 ;
                        181 ;**********************************************************************************
                        182 ;
                        183 ;                  REVIEW OF SERIAL COMMUNICATIONS PROGRAMS
                        184 ;
                        185 ;
                        186 ;       1.      TO GET A CHARACTER FROM THE CONSOLE TO THE ACCUMULATOR,
                        187 ;               CALL CI
                        188 ;               "CD 7F F4"
                        189 ;
                        190 ;       2.      TO OUTPUT A CHARACTER FROM THE C REGISTER TO THE CONSOLE,
                        191 ;               CALL ECHO
                        192 ;               "CD 14 F5"
                        193 ;
                        194 ;       3.      TO OUTPUT A CHARACTER FROM THE B REGISTER TO THE CONSOLE,
                        195 ;               CALL ECHOB
                        196 ;               "CD 0C F5"
                        197 ;
                        198 ;       4.      TO OUTPUT A TWO DIGIT NUMBER FROM THE ACCUMULATOR TO THE
                        199 ;               CONSOLE, CALL NMOUT.
                        200 ;               "CD 45 F6"
                        201 ;
                        202 ;       5.      TO GET A 1 TO 4 DIGIT NUMBER FROM THE CONSOLE TO THE B&C
                        203 ;               REGISTERS, CALL GETHX
                        204 ;               "CD 6A F5"
                        205 ;
                        206 ;       6.      TO RETURN FROM YOUR PROGRAM TO THE SYSTEM MONITOR,
                        207 ;               JMP MONITR
                        208 ;               "C3 80 F0"
                        209 ;
                        210 ;
                        211 ;**********************************************************************************
                        212 ;
                        213
                        214 ;
                        215        END
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