PERCOM DATA CO.

TECHNICAL MEMO

TM-CIS-3Ø-Ø3
CIS-3Ø+ CASSETTE INTERFACE
NOVEMBER 21, 1977

SUBJECT; PROBLEMS WITH THE MIKBUG(TM) INPUT/OUTPUT SUBROUTINES

THE MIKBUG(TM) OPERATING SYSTEM IN THE MP-68ØØ COMPUTER HAS HELPED TO MINIMIZE THE PROGRAMMING CHAOS THAT EXISTS IN COMPUTING SYSTEMS BASED ON OTHER MICRO PROCESSORS. MOST USERS OF THE 68ØØ MICRO PROCESSOR WRITE THEIR PROGRAMS SO THAT THE MEMORY AND I/O ASSIGNMENTS ARE COMPATIBLE WITH MIKBUG(TM).

BUT ALAS, THERE ARE PROBLEMS WITHIN MIKBUG(TM).

MOST ANYONE USING MIKBUG(TM) IS AWARE OF THE OPERATING INCONVENIENCES. HOWEVER, SINCE THIS HAS BEEN SUFFICIENTLY CUSSED BY OTHERS IT WILL NOT BE DISCUSSED IN THIS MEMO. HOPEFULLY THESE INCONVENIENCES WILL BE ELIMINATED WITH SWTBUG(TM).

THE PROBLEMS TO BE DISCUSSED IN THIS MEMO CONCERN THE INPUT AND OUTPUT ROUTINES. THIS DISCUSSION ASSUMES THE READER HAS ACCESS TO A MIKBUG(TM) PROGRAM LISTING SUCH AS IS CONTAINED IN MOTOROLA ENGINEERING NOTE 1ØØ.

TO INPUT A CHARACTER OF DATA INTO THE COMPUTER, MIKBUG(TM) USES A SUBROUTINE CALLED <u>INEEE</u> WHICH BEGINS AT LOCATION E1AC.

THIS SUBROUTINE INPUTS THE DATA A BIT AT A TIME AND ASSEMBLES THE COMPLETED CHARACTER IN ACCUMULATOR A. THE DATA BEING SENT TO THE COMPUTER (MIKBUG^{R}) IS FRAMED BY A START BIT AND ONE OR MORE STOP BITS. THESE FRAMING BITS IDENTIFY THE BEGINNING AND ENDING OF THE DATA CHARACTER. THIS PARTICULAR METHOD OF TRANSMITTING SERIAL DATA IS CALLED "START-STOP SERIAL ASYCHRONOUS" AND IS THE TECHNIQUE USED BY MOST DATA TERMINALS AND TELEPRINTERS.

THE MANNER IN WHICH MIKBUG(TM) HANDLES THE STOP BITS CREATES A PROBLEM.

THERE IS A CONVENTION IN ASYCHRONOUS SERIAL DATA TRANSMISSION THAT SAYS THAT THERE MUST BE A MINIMUM OF TWO STOP BITS BETWEEN CHARACTERS IF THE DATA IS TRANSMITTED AT 11Ø BAUD (1Ø CHAR/SEC) AND A MINIMUM OF ONE STOP BIT AT HIGHER SPEEDS. SUPPOSEDLY CONSISTENT WITH THIS CONVENTION, MIKBUG(TM) EXAMINES ONE OF THE INPUTS OF THE PIA IT USES TO DETERMINE IF IT SHOULD EXPECT ONE OR TWO STOP BITS. THIS IS UNNECESSARY AND IN FACT CREATES PROBLEMS AS WE SHALL SEE LATER. IT WOULD HAVE BEEN SUFFICIENT FOR MIKBUG(TM) TO ASSUME THE DATA WAS FRAMED BY ONLY ONE STOP BIT IN ALL CASES SINCE THE ADDITIONAL STOP BITS WOULD BE IGNORED.

BEFORE WE CAN UNDERSTAND WHY THIS MAY CAUSE A PROBLEM, IT IS NECESSARY TO INTRODUCE AN ADDITIONAL SET OF FACTS. THE ENCODING STANDARD USED BY THE PERCOM CIS-3Ø (AND THE SWTP AC-3Ø) TO RECORD DATA ON CASSETTE IS THE SO CALLED "KANSAS CITY" OR BYTE STANDARD. ONE OF THE REQUIREMENTS OF THE "KANSAS CITY" STANDARD IS THAT THE DATA BE RECORDED WITH TWO OR MORE STOP BITS. IN THE CASE OF THE MP-68ØØ COMPUTER THE NUMBER OF STOP BITS GENERATED IS DETERMINED BY THE CONNECTION TO PAD "C" OF THE MP-C CONTROL INTERFACE CARD. IF THE CONNECTION TO PAD "C" IS SELECTED FOR 3ØØ BAUD, ONLY ONE STOP BIT WILL BE GENERATED. NOW IF A CASSETTE RECORDED IN THIS MANNER IS PLAYED BACK INTO AN MP-68ØØ SYSTEM WITH THE "C" PAD SET FOR TWO STOP BITS (11Ø BAUD), THE DATA WILL NOT BE ACCEPTED BECAUSE MIKBUG(TM) IS EXPECTING TWO STOP BITS.

THIS IS NOT A PROBLEM WITHIN A GIVEN SYSTEM BECAUSE THE "C" STRAP IS SET IN ONE POSITION AND LEFT ALONG. HOWEVER, MANY MP-68ØØ USERS LIKE TO EXCHANGE CASSETTE PROGRAMS WITH OTHER USERS AND THE ONLY WAY FOR EVERYONE TO BE HAPPY IS FOR ALL CASSETTES TO BE RECORDED WITH TWO STOP BITS OR FOR THE MP-68ØØ TO BE CONFIGURED FOR ONE STOP BIT WHEN DATA IS READ FROM CASSETTE. SINCE THERE ARE MANY CASSETTES IN EXISTENCE WHICH WERE RECORDED WITH ONLY ONE STOP BIT, THE LATTER ALTERNATIVE IS PREFERRED.

SOLUTION:

INSTEAD OF CONNECTING PAD "C" ON THE MP-C INTERFACE TO 11Ø (2 STOP BITS) OR 3ØØ (1 STOP BIT), CONNECT IT INSTEAD TO IC5 PIN 3.

WHENEVER MIKBUG(TM) IS COMMANDED TO LOAD A PROGRAM, IC5 PIN 3 GOES LOW TO TURN ON THE READER CONTROL LINE. IF PAD "C" IS CONNECTED TO IC5 PIN 3, MIKBUG(TM) WILL EXPECT ONLY ONE STOP BIT DURING LOAD AND WILL GENERATE AND EXPECT TWO STOP BITS AT ALL OTHER TIMES. THIS MEANS THAT CASSETTE DATA WILL BE RECORDED WITH TWO STOP BITS AND MIKBUG(TM) WILL HAPPILY LOAD DATA WITH ONE OR MORE STOP BITS.

WARNING:

SOME PROGRAMS SUCH AS 8K BASIC DO NOT TURN ON THE READER CONTROL LINE WHEN THEY LOAD DATA. THIS MEANS MIKBUG(TM) WILL EXPECT TWO STOP BITS AND WILL NOT LOAD THE DATA IF THE CASSETTE WAS RECORDED WITH ONLY ONE STOP BIT. PERCOM TECHNICAL MEMO TM-CIS-3Ø-Ø2 CONTAINS INSTRUCTIONS FOR MODIFYING SWTP 8K BASIC (VERSION 2.Ø) SO THAT IT WILL TURN ON THE READER CONTROL LINE DURING A LOAD.

ONE ADDITIONAL PROBLEM WITH THE MIKBUG(TM) INPUT SUBROUTINE ROUTINE: IT CANNOT BE USED TO INPUT BINARY DATA. THE INPUT SUBROUTINE STRIPS OFF THE MOST SIGNIFICANT DATA BIT. THIS IS DESIRABLE IF THE INPUT IS ALWAYS 7-LEVEL ASCII IN WHICH THE MOST SIGNIFICANT BIT IS THE PARITY BIT; HOWEVER, IF YOU WISH TO LOAD DATA IN BINARY FORM TO REDUCE LOAD TIME YOU MUST USE A DIFFERENT INPUT ROUTINE. SUCH A ROUTINE IS USED IN THE BINARY LOADER SOFTWARE IN THE CIS-3Ø INSTRUCTION MANUAL, APPENDIX E.

THE MIKBUG(TM) OUTPUT SUBROUTINE WHICH BEGINS AT ADDRESS E1D1 CREATES A PROBLEM WITH THE CIS-3Ø AT THE HIGHER DATA RATES BECAUSE MIKBUG(TM) DOES NOT CAREFULLY CONTROL THE INTERCHARACTER TIMING. THIS IRREGULAR TIMING BETWEEN CHARACTERS IS OF MINOR CONSEQUENCE AT 3ØØ BAUD OR WHEN USED WITH A DATA TERMINAL BUT BECOMES QUITE SIGNIFICANT AT 12ØØ BAUD BECAUSE IT CAUSES EXCESSIVE JITTER IN THE IN THE PHASE LOCKED OSCILLATOR IN THE CIS-3Ø USED TO TRACK THE TAPE SPEED VARIATION DURING PLAYBACK. THIS IRREGULARITY DOES NOT PREVENT YOU FROM USING YOUR DATA TERMINAL AT 12ØØ BAUD, IN FACT THIS IS ENCOURAGED. THE DATA TERMINAL DOES NOT MODULATE AND DEMODULATE THE DATA IN THE MANNER REQUIRED FOR CASSETTE OPERATION AND THEREFORE IS NOT SENSITIVE TO INTERCHARACTER VARIATIONS.

THE PROBLEM OCCURS AT MIKBUG(TM) ADDRESS E1D8. THIS INSTRUCTION RESETS THE MP-C BIT TIMER INDISCRIMINATELY. IF THERE HAS BEEN SOME PROCESSING TIME BETWEEN THE END OF THE PREVIOUS CHARACTER AND THE CHARACTER NOW BEING OUTPUTTED, RESETTING THE BIT TIMER CARELESSLY CAUSES A PHASE DISCONTINUITY IN THE SIGNAL BEING RECORDED ON CASSETTE. DURING PLAYBACK, THIS DISCONTINUITY MAY CAUSE THE PHASE LOCKED OSCILLATOR IN THE CIS-3Ø+ TO TEMPORARILY LOSE PHASE LOCK.

THE SOLUTION IS QUITE SIMPLE, MERELY WAIT FOR THE BIT TIMER TO COMPLETE ITS CYCLE BEFORE RESETTING. THIS IS WHAT WAS DONE IN THE BINARY DUMP SOFTWARE CONTAINED IN APPENDIX E OR THE CIS-3Ø+ INSTRUCTION MANUAL. THE OUTPUT ROUTINE USED BY THE BINARY DUMP SOFTWARE FUNCTIONS IN MUCH THE SAME WAY AS THE MIKBUG(TM) OUTPUT ROUTINE EXCEPT THAT IT WAITS FOR THE BIT TIMER TO COMPLETE ITS NATURAL CYCLE BEFORE OUTPUTTING THE START BIT. IT WAS ALSO NECESSARY TO INITIALIZE THE B ACCUMULATOR WITH A "9" (INSTEAD OF "A") BECAUSE WAITING FOR THE BIT TIMER TO TIME OUT NATURALLY BETWEEN CHARACTERS CREATES AN ADDITIONAL STOP BIT WHICH DOES NO HARM BUT DECREASES THE DATA THROUGHPUT SPEED.

THIS REVISED OUTPUT ROUTINE HAS BEEN ALSO USED WITH THE SWTP CO-RESIDENT EDITOR/ASSEMBLER AND 8K BASIC. INSTRUCTIONS FOR PATCHING 8K BASIC ARE CONTAINED IN TM-CIS-3Ø-Ø2 (REVISED 11-1Ø-77). IF THERE IS SUFFICIENT INTEREST IN THE PATCHES TO THE CO-RESIDENT EDITOR/ASSEMBLER WE WILL PREPARE A SIMILAR TECHNICAL MEMO.

OBVIOUSLY, THE ABOVE PROBLEM DOES NOT OCCUR IN SYSTEMS WHICH UTILIZE AN ACIA OR UART FOR OURPUT. THE ACIA IS BUFFERED AND AS LONG AS THE "NEXT" CHARACTER IS LOADED INTO THE ACIA BUFFER BEFORE THE ACIA FINISHES OUTPUTTING THE "PREVIOUS" CHARACTER, THERE WILL BE NO DISCONTINUITY IN THE CASSETTE RECORDED WAVE-FORM.