

TEXT LISTING

068-001120-00

PROGRAM

MICRO-NOVA 4300 DGDAC DIGITAL  
DIAGNOSTIC/EXERCISER

TEXT TAPE

097-001120-00

ABSTRACT

THIS PROGRAM IS A GATE BY GATE HARDWARE DIAGNOSTIC FOR THE 4300 DGDAC PROGRAMMED I/O SYSTEM. DUE TO THE MANY VARIATIONS OF USER MODULES, AND CONFIGURATIONS, THERE ARE SEVERAL SEPARATE PROGRAM OPTIONS AVAILABLE TO THE FIELD ENGINEER WHICH ARE DESCRIBED IN SECTION 7. REFER TO SECTION 6 FOR AN OVERVIEW OF THESE PROGRAMS, AND NECESSARY CONFIGURATION DATA.

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; NAME: DGDD.TX          PART NUMBER: 097-1120
;
; DESCRIPTION: MN 4300 DGDAC DIGITAL DIAGNOSTIC/EXERCISER
;
; REVISION HISTORY:
;
; REV.          DATE
; 00          12/15/78
;
; COPYRIGHT © DATA GENERAL CORPORATION, 1978
; ALL RIGHTS RESERVED.
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;1. PROGRAM NAME: DGDD.SR, 4300M DGDAC PROGRAMMED I/O DIAGNOSTIC
;2. REVISION HISTORY: N/A
;3. MACHINE REQUIREMENTS:
; 1. MINOVA CENTRAL PROCESSOR WITH AT
; 2. LEAST 8K READ/WRITE MEMORY
; 3. 4300M CHASSIS CONTROL CARD
; 4. BASIC I/O TELETYPE OR CRT AND 4010 CONTROL
;3.1 OPTIONAL EQUIPMENT TABLE
; BOARD TYPE          ID          BOARD #
; TTL INPUT          11          4291
; PULSE OUTPUT       05          4293
; TTL OUTPUT         01          4299
; RELAY OUTPUT       04          4296,7
; OPTICAL OUTPUT     02          4292
; TRIAC OUTPUT       05          4294
; G.P. INPUT         12          4290
; A/D CONVERTER     41          4280(SA'S 504,505)
; A/D MUX           42          4281( ONLY )
;3.2 THIS PROGRAM MAY BE RUN IN A HOST/DCU-50 COMPUTER
; CONFIGURATION.
;4. TEST REQUIREMENTS: N/A
;5. SUMMARY:
; THIS PROGRAM IS A GATE BY GATE HARDWARE DIAGNOSTIC
; FOR THE 4300 DGDAC PROGRAMMED I/O SYSTEM. DUE TO THE
; MANY VARIATIONS OF USER MODULES, AND CONFIGURATIONS
; THERE ARE SEVERAL SEPARATE PROGRAM OPTIONS AVAILABLE
; TO THE FIELD ENGINEER WHICH ARE DESCRIBED IN SECTION 7.
; REFER TO SECTION 6 FOR AN OVERVIEW OF THESE PROGRAMS,
; AND NECESSARY CONFIGURATION DATA.

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RESTRICTIONS:

THERE ARE FOUR MAJOR MODES OF TEST AVAILABLE WITH THIS DIAGNOSTIC:

MODE 1.  
THE SYSTEM IS INSTALLED WITH CUSTOMER HOOKUPS COMPLETED. THE STANDALONE MODE (MONITOR INPUTS AND SWITCH OUTPUTS) CAN BE USED TO OPERATE INDIVIDUAL CHANNELS WITH THE CUSTOMER LOADS ATTACHED. THE CHANNEL OPERATION CAN BE VERIFIED BY OBSERVING THE CUSTOMER EQUIPMENT OPERATION OR BY ELECTRICAL OBSERVATION OF THE LINES WITH A TEST METER OR OSCILLOSCOPE.

MODE 2.  
CUSTOMER HOOKUPS ON APPLICABLE MODULES ARE DISCONNECTED. THIS MODE IS TYPICALLY USED DURING DDC TEST OR UPON INSTALLATION VERIFICATION AT THE CUSTOMER SITE. AN OUTPUT CARD IS LOOPED AROUND, VIA LOOP AROUND CABLES AND AN ADAPTER CARD (1124A) TO A MATCHING INPUT CARD AND THIS WILL DYNAMICALLY TEST THE PARTICULAR I/O SETUP. AS OTHER I/O CARD COMBINATIONS ARE TO BE TESTED, THE LOOP AROUND SETUP IS MOVED TO OTHER CARDS. IT SHOULD BE NOTED THAT THIS IS A FULL TEST OF ALL OF THE CONTROL LOGIC ASSOCIATED WITH A SET OF I/O CARDS, BUT IT IS NOT A COMPLETE TEST OF FULL LOAD CAPABILITIES OF THE I/O CARD USED WITH THE TEST. THE WORST CASE CAPABILITIES CAN BE VERIFIED USING MODE 4 BELOW. THE FOLLOWING IS A CHART OF THE BASIC LOOP AROUND HOOKUPS THAT CAN BE CONFIGURED.

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TABLE 6.1

OUTPUT MODULE	PLUG	INPUT MODULE	PLUG	V+	V-	INVERT DATA
TTL	J1	TTL	J2	5	0	NO
TTL	J1	GP	J2	15	0	NO
ISO	J1	TTL	J2	5	5	YES
ISO	J1	GP	J2	15	5	YES
PULSE	J1	TTL	J2	5	5	YES
PULSE	J1	GP	J2	5	5	YES
TRIAC	J1	GP	J2	24 AC	5	YES
FORM A	J2	TTL	J1	5	0	NO
FORM A	J2	GP	J1	15	0	NO
NO - FORM C	J3	TTL	J2	5	0	NO
NO - FORM C	J3	GP	J2	15	0	NO
NC - FORM C	J3	TTL	J2	5	0	NO
NC - FORM C	J3	GP	J2	15	0	NO

NOTES:

- 1) ALL VOLTAGES ARE DC EXCEPT FOR TRIAC +24 AC. THE CURRENT REQUIREMENTS FOR THE V+V- VOLTAGES ARE AS FOLLOWS:  
+ 5 VDC @ .1 A  
+15 VDC @ .2 A  
- 5 VDC @ .2 A  
+24 VAC @ .3 A
- 2) NO AND NC (NORMALLY OPEN AND NORMALLY CLOSED) INDICATE THE SETTING OF THE FORM C SWITCH. THE POSITION OF THE SWITCH INDICATES THE CONTACT PAIR OF THE FORM C RELAY UNDER TEST.
- 3) NO INTERRUPT WILL BE GENERATED FOR THE ISOLATED OUT TO TTL IN, OR FOR THE PULSE OUT TO TTL IN, AS THE "EXT INT" LINES DOES NOT BECOME ASSERTED DURING TESTING.
- 4) THE PULSE OUT TO TTL IN/GP IN MUST BE RUN USING STARTING ADDRESS 507.
- 5) TEST CABLE (DIGITAL) PART # IS 005-7013
- 6) TEST ADAPTER IS MODEL 1124A (PART # 005-8418)

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MODE 3.  
CUSTOMER HOOKUPS ON THE APPLICABLE MODULES ARE DISCONNECTED. THIS MODE USES THE STANDALONE CAPABILITIES OF THE DIAGNOSTIC (SA'S 501,502,503) TO DRIVE AN OUTPUT MODULE OR DETECT CHANGES ON AN INPUT MODULE. TYPICALLY USED WHEN THERE IS NO MATCHING MODULE AVAILABLE OR SINGLE MODULE OPERATION IS DESIRED FOR TEST PURPOSES. THE 1124A ADAPTER IS HOOKED UP TO THE I/O CABLE OF THE SUBJECT MODULE WITH THE POWER APPLIED AS PER TABLE 6.1. THE END I/O CABLE IS NOT HOOKED IN TO THE ADAPTER. CIRCUIT OPERATION CAN BE VERIFIED AS FOLLOWS:  
INPUT CARDS-  
ONE CHANNEL AT A TIME, WITH THE CHANGE BEING DETECTED BY THE DIAGNOSTIC. !CAUTION! USE +5VDC FOR +V ON THE ADAPTER.  
OUTPUT CARDS-  
OUTPUT PINS CAN BE MONITORED WITH TWO OR EITHER OF TWO METHODS:  
VISUALLY BY LED'S ON THE 1124A ADAPTER WHICH WILL LIGHT AS CURRENT IS PASSED THROUGH THEM OR WITH A TEST METER OR OSCILLOSCOPE WHICH CAN MONITOR OUTPUT DEVICE PULSES OR SWITCHING VOLTAGE LEVELS AS THE CHANNELS ARE COMMANDED TO OPERATE VIA THE CPU SWPAK.  
MODE 4.  
CUSTOMER HOOKUPS ARE DISCONNECTED ON THE APPLICABLE MODULE. THIS MODE ALSO USES THE STANDALONE CAPABILITIES OF THE DIAGNOSTIC (SA'S 501,502,503) AS IN MODES 1 AND 3. THIS MODE IS USED WHEN NO TEST ADAPTERS ARE AVAILABLE OR WHEN VERIFICATION OF THE WORST CASE CAPABILITIES OF A CHANNEL IS DESIRED. A TEST VOLTAGE IS APPLIED VIA A LOAD RESISTOR TO THE CHANNEL INPUT OR OUTPUT PIN, (NOTE THAT FORM C RELAYS HAVE TWO SIGNAL PINS TO CHECK, OUT) AND THE RETURN PIN IS GROUNDED; WHEN TRIACS ARE BEING CHECKED OUT, THE TEST AC VOLTAGE MUST ALSO BE APPLIED TO THE SYNC INPUT (PINS 21&46) OF THE TRIAC CARD.  
TO VERIFY OUTPUT CARDS, THE CHANNEL IS OPERATED VIA THE CPU SWITCHES AND THE VOLTAGE ACROSS THE OUTPUT SHOULD DROP CLOSE TO, OR BELOW, A SPECIFIED VOLTAGE (SEE TABLE 6.2) WHEN THERE IS CURRENT THROUGH THE DEVICE. IT SHOULD ALSO BE NOTED THAT THE RELAY CARD OPERATIONS CAN BE VERIFIED WITH AN OHM METER.  
TO VERIFY INPUT CARDS, THE INPUT PIN IS GROUNDED AND THE CHANGE SHOULD BE DETECTED BY THE DIAGNOSTIC. TABLE 6.2 DESCRIBES TEST VOLTAGES AND RESISTORS THAT CAN BE USED TO VERIFY CHANNEL OPERATION. NOTE THAT THE CUSTOMER SHOULD SUPPLY THE HEAVY WATTAGE RESISTORS IF HE WANTS TO RUN A WORST CASE TEST OF HIS OWN. THE GENERAL TEST USES ONE( OR TWO IN SERIES) 1.2K 5 WATT RESISTOR.  
P/N 102-592.

TABLE 6.2  
WORST CASE VOLTAGES/NECESSARY LOAD RESISTORS

BOARD #	+V	LOAD (TERMINAL PANEL)	MAX LOW OUTPUT VOLTAGE
4299	24 VDC	NONE	.5 VDC
4292	48 VDC	35 OHM,100W	2.5 VDC
4293	48 VDC	35 OHM,100W	2.5 VDC
4294	120 VAC	62 OHM,300W	1.2 VAC
4296	120 VDC	560 OHM,50W	.5 VDC
4297	100 VDC	1.3 KOHM,10W	.5 VDC

\*\*\*NOTE- FORM C RELAY BOARD (4297) HAS TWO OUTPUT PINS TO VERIFY. WHEN THE TRIAC BOARD (4294) IS CHECKED THE TEST AC VOLTAGE MUST BE ALSO APPLIED TO THE SYNC INPUT (PINS 21 AND 46).  
MAX LOW OUTPUT VOLTAGE REFERS TO THE VOLTAGE MEASURED AT THE OUTPUT PIN WHEN THE CHANNEL IS IN THE ON STATE VIA THE STAND ALONE TEST SA 501.  
IF NO TEST ADAPTERS ARE AVAILABLE AND WORST CASE LOADS ARE NOT DESIRED, THE FOLLOWING VOLTAGE/RESISTOR COMBINATIONS MUST BE USED TO CHECK OUTPUTS.  
THE OUTPUT VOLTAGES OBSERVED SHOULD BE NO GREATER THAN THE MAX LOW OUTPUT VOLTAGES SHOWN ABOVE.

BOARD #	+V	LOAD RES.
4299	NONE	NONE
4292	+24 VDC	1.2K,5W
4293	+24 VDC	1.2K,5W
4294	120 VAC	2.4K,10W(2-1.2K'S IN SERIES)
4296	+24 VDC	1.2K,5W
4297	+24 VDC	1.2K,5W

SEE ALSO SECTION 7.0

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; PROGRAM DESCRIPTIONS/THEORY OF OPERATION:
;
;7. STARTING ADDRESS (500); BASIC I/O LOOP DIAGNOSTIC
;7.1 PROGRAM ASSUMES THAT ONE OUTPUT MODULE IS LINKED
; VIA CABLES AND NECESSARY ADAPTER TO ONE INPUT
; MODULE SUCH THAT A 16 BIT DATA WORD PROGRAMMED
; FOR OUTPUT WILL CAUSE OR ALLOW AN IDENTICAL 16 BIT WORD
; TO BE INPUT ON THE CORRESPONDING INPUT MODULE.
;
; THE OUTPUT PROCESS SHOULD CAUSE AN INTERRUPT VIA
; THE INPUT BOARD EITHER BY AN OUTPUT STROBE CONNECTED
; TO AN INPUT EXTERNAL INT LINE OR BY THE G.P. INPUT
; BOARD.
;
; IF A GP INPUT IS BEING TESTED, A PASS IS PRINTED EACH
; COMPLETION OF TESTS. IF A TTL INPUT IS IN TEST, PASS
; IS PRINTED AFTER 1ST PASS AND AFTER EVERY 16 THEREAFTER.
;
; IT SHOULD BE NOTED THAT WHILE THE LOOP TEST (SA 500)
; IS INTENDED TO FULLY CHECK THE LOGIC OF ALL CARDS
; INVOLVED, IF DOES NOT VERIFY SUCH SPECIFICATIONS AS
; CLOSED CONTACT RESISTANCE OR MAX LOW OUTPUT VOLTAGES.
; THESE WOULD HAVE TO BE MEASURED VIA THE STAND ALONE
; TESTS SA'S 501 AND 502.
;7.2 STARTING ADDRESS (501); OUTPUT DUMP
;
; OPERATOR SIMPLY SELECTS AN OUTPUT MODULE AND
; A TRANSFER DELAY IN MS.
; NOTE -THE TTL OUTPUT STROBE IS FACTORY SET TO 7 MS.
;
; THE PROGRAM THEN CONTINUOUSLY MONITERS THE TTL
; FOR ANY NEW OCTAL INPUTS, AND OUTPUTS THE OCTAL VALUES
; WITH THE SPECIFIED DELAY BETWEEN TRANSFERS
; UNTIL THE OPERATOR RESETS THE PROGRAM.
;
;7.3 STARTING ADDRESS (502); INTERRUPT INPUT SCAN
;
; PROGRAM STARTS ALL INPUT DEVICES AND THEN
; REPORTS THE ADDRESS AND DATA INPUT FROM ALL SUCCEEDING
; INTERRUPTS. IT IS UP TO THE OPERATOR, HOWEVER, TO
; MANUALLY INITIATE ANY SUCH INTERRUPTS.
;
;7.4 STARTING ADDRESS (503); INPUT SCAN PLUS OUTPUT DUMP
;
; COMBINES FUNCTIONS DESCRIBED IN 7.2 AND 7.3
;
;7.5 STARTING ADDRESS (504) MULTIPLE LOOP EXERCISER
;
; PROGRAM CONTINUOUSLY SENDS RANDOM NUMBERS ACROSS
; APPROPRIATELY ENTERED LOOPS(SEE TABLE 6.1).
; IF THE REAL TIME CLOCK OPTION IS PRESENT, MULTIPLE
; A/D HISTOGRAMS MAY BE RUN. THE PROGRAM WILL REPORT
; ALL DATA AND TIMEOUT ERRORS. AN ASCII L INPUT WILL
; GET A PRINTOUT OF LOOP ADDRESSES AND RESPECTIVE ERRORS
; AND TRANSFERS AS WELL AS HISTOGRAM INFORMATION IF
; A/D'S ARE INCLUDED. ALL COUNTS WILL BE IN DECIMAL WHILE
; ALL ADDRESS INFORMATION WILL BE IN OCTAL. THE HISTOGRAM
; INFORMATION WILL BE THE 13. BIN COUNTS, AROUND A CENTER
; VALUE INPUT TO THE PROGRAM, IN D.P. DECIMAL.
;
; UP TO 16. LOOPS RESIDING IN UP TO 2 CHASSIS MAY
; BE ENTERED.
;
; ALL DATA IN WORDS NOT MATCHING THE SEND WORD ARE
; IMMEDIATELY FLAGGED AS DATA ERRORS FOR THE TTL IN
; CARD ONLY. DUE TO LINE RINGING AND SKEWING ASSOCIATED
; WITH THE GP INPUT LOOPS, THE FOLLOWING SCHEME IS USED:
;
; THE PROGRAM DIVIDES ITS NON-INTERRUPT PROCESSING TIME
; INTO 10. 300.MS TIMESLOTS. DURING THE FIRST 9, OUTPUTS
; ARE RE-STIMULATED AS SOON AS A DATA MATCH OCCURS AT THE
; RESPECTIVE INPUT. DURING THE 10TH TIMESLOT, NO NEW
; OUTPUTS ARE STARTED AND ALL LOOPS ARE ALLOWED
; TO SETTLE. IF A REAL TIME CLOCK IS PRESENT, IT IS
; USED TO GENERATE THESE INTERVALS. OTHERWISE A PROGRAM
; TIMING LOOP IS USED.
;
; !ONLY! IF THE REAL TIME CLOCK IS PRESENT, MAY THE A/D
; HISTOGRAMS BE RUN.
;
; GP INPUTS WITH DATA WORDS NOT MATCHING THE SEND WORD ARE
; SIMPLY RE-STARTED UNTIL A MATCH DOES OCCUR OR UNTIL THE
; END OF THE TENTH TIMESLOT. AT THIS TIME, ALL
; INPUTS ARE CHECKED ANY DATA MISMATCHES ARE FLAGGED
; AS EITHER A DATA ERROR OR TIMEOUT.
; *****
; NOTE-IF THE REAL TIME CLOCK OPTION IS NOT PRESENT;
; IF TTL OUT/IN LOOPS WITH TTL OUT STROBES ALTERED;
; FOR VERY SHORT STROBE TIMES (<1 MS) ARE MIXED WITH
; SLOWER GP IN LOOPS, THE TIMEOUT CONDITION FOR THE GP IN
; LOOP MAY NEVER OCCUR.
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IF THIS PROGRAM IS TIMED, THE # OF TRANSFERS PER LOOP MAY BE CONVERTED TO DATA RATES TO GIVE A ROUGH MEASURE OF SETTLING AND SKEW TIMES.

\*\*\* THE DUAL CPU MODE MAY BE EXERCISED IN THE FOLLOWING MANNER:

IF TWO CPU/CONTROL UNITS ARE STARTED WITH THIS PROGRAM, THE CPU/CONTROL STARTED FIRST WILL BECOME THE MASTER AND THE CPU/CONTROL STARTED LAST WILL BECOME THE BACKUP. THE BACKUP CANNOT BE STARTED UNTIL THE MASTER IS OPERATIONAL AND RUNNING.

THE BACKUP WILL PULSE TESTOUT TO ACTIVE AND WAIT FOR THE MASTER TO RESPOND TO THE INTERRUPT GIVEN. IF NO RESPONSE IS RECEIVED IN 300MS THE BACKUP WILL OVERRIDE AND GAIN CONTROL. IF THE MASTER IS STOPPED, THE BACKUP WILL OVERRIDE AND BECOME THE MASTER. THE MASTER WILL THEN TAKEOVER THE BACKUP ROLE.

IF SWPAK7 IS SET, A PROGRAMMED SWAP CYCLE SUCH THAT AFTER EVERY 100 PROGRAM CYCLES (APPROX. 2-4 MIN.) THE PROGRAM IN CONTROL EXECUTES A 400 MS DELAY TO ALLOW THE OTHER CPU TO TAKE OVER CONTROL. SWPAK7 SHOULD BE SET IN BOTH CPU'S.

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THEORY OF OPERATION:

THE HISTOGRAM RESULTS ARE PRINTED OUT AS FOLLOWS:

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CO=XXXXXX          # OF SAMPLES=(#)
--: (DECIMAL #)
-5: "
-4: "
-3: "
-2: "
-1: "
C0: "
+1: "
+2: "
+3: "
+4: "
+5: "
++: "

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WHERE: XXXXXX IS THE OCTAL HISTOGRAM CENTER VALUE, # OF SAMPLES IS THE TOTAL # OF CONVERSIONS TAKEN AND SORTED IN DECIMAL.

THE HISTOGRAM SORTS DATA BY COMPARING EACH DATUM RECEIVED AGAINST THE CENTER VALUE. IF THEY ARE EQUAL, THE COUNT CORRESPONDING TO THE DATUM IS HISTOGRAM "CO" IS INCREMENTED. IF THE DATUM IS 1 TO 5 BITS GREATER THAN THE CENTER VALUE THEN ITS RESPECTIVE "+" BIN COUNT IS INCREMENTED. IF THE DATUM IS MORE THAN 5 LSB'S GREATER THAN CENTER, THEN THE "++" BIN COUNT IS INCREMENTED. SIMILARLY THE "-" BINS ARE INCREMENTED IF THE DATUM IS 1 TO 5 LSB'S LESS AND "--" IS INCREMENTED IF MORE 5 LSB'S LESS THAN THE CENTER VALUE.

HEREFORE THE SAMPLE COUNTS NEXT TO THE HISTOGRAM BIN LABELS REPRESENT THE # OF RECEIVED DATA THAT EQUATED THE CORRESPONDING # OF BITS ABOVE, BELOW OR EQUAL TO THE CENTER VALUE. FOR EXAMPLE "+1:349" INDICATES THAT 349 OF THE TOTAL SAMPLES TAKEN WAS 1 LEAST SIGNIFICANT BIT GREATER THAN THE CENTER VALUE.

BY LOOKING AT THE HISTOGRAM RESULTS ONE CAN GET A FEEL FOR THE A/D CONVERTER STABILITY. A STABLE A/D SHOULD HAVE A MAJOR PERCENTAGE OF THE TOTAL SAMPLES TAKEN EQUAL TO THE CENTER VALUE WITH RELATIVELY SMALL DISTRIBUTION AROUND IT, AND WITH THE SAMPLE COUNTS DECREASING RAPIDLY AS THE LSB DEVIATION INCREASES.

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17.58 HISTOGRAM OPERATION
; ASSUMING A DC VOLTAGE, WITH AN EXPECTED DIGITAL INPUT
; (AFTER A/D CONVERSION) EQUAL TO THE ENTERED CENTER
; VALUE (QUESTION 4), IS CONNECTED TO THE SELECTED MUX
; CARD, THE PROGRAM DOES THE FOLLOWING:
; A RANDOM CONVERSION COUNT IS LOADED
; INTO THE DCH CONVERSION COUNTER AND A
; DATA BLOCK STARTING ADDRESS INTO THE DCH
; ADDRESS REGISTER. THE DCH CYCLE IS STARTED
; AND CONTINUES UNTIL ALL OF THE CONVERSION
; SPECIFIED BY THE RANDOM COUNT ARE DONE. THE
; DATA IS STORED CONTIGUOUSLY IN THE DATA
; BLOCK. ON COMPLETION, THE DATA BLOCK IS
; SORTED INTO THE HISTOGRAM, AFTER SORTING,
; A NEW SAMPLE COUNT IS GENERATED AND THE
; CYCLE REPEATS.

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17.6
STARTING ADDRESS (505) MULTIPLE LOOP WITH CATS
;
; !IF! STANDALONE CATS PROGRAM (OTOS MH DISK DCH EXERCISER)
; HAS BEEN LOADED PREVIOUSLY AND RELATED TO HIGH CORE,
; THIS STARTING ADDRESS PROVIDES THE LINK BETWEEN THE
; DCH EXERCISER AND THE MULTILoop PROGRAM (SA 504).
; ***SEE PART NUMBER 094-0782 FOR INFORMATION ON THE
; OTOS MH DISK DCH EXERCISER.
;
17.7
STARTING ADDRESS (506) SLOT/ID PRINTOUT
;
; PROGRAM SIMPLY PRINTS THE SLOT VS ID INFORMATION
; FOR THE CHASSIS UNDER TEST THEN HALTS.
;
17.8
STARTING ADDRESS (507) PULSE OUTPUT TO TTL/G.P. INPUT
LOOP TEST (SINGLE LOOP)
;
; THIS PROGRAM ALLOWS A SINGLE TEST LOOP CONSISTING OF A
; PULSE OUTPUT BOARD (MODEL 4293) LOOPED BACK TO EITHER
; A TTL INPUT BOARD (MODEL 4291) OR A GENERAL PURPOSE
; INPUT BOARD (MODEL 4290) VIA AN 1124A DIGITAL TEST
; ADAPTER. HOOKUP PROCEDURES AND ADAPTER TEST VOLTAGES
; ARE GIVEN IN SECTION 6.
;
; TEST INITIALIZATION:
;
; "OUTPUT SLOT # = "
;
; INPUT THE PULSE OUTPUT BOARD'S SLOT # (0 - 17 OCTAL).
;
; "INPUT SLOT AND ID #'S = "
;
; INPUT THE TTL OR G.P INPUT SLOT # (0 - 17 OCTAL) AND
; ITS ID CODE (TTL IN = 11, GPIN = 12 OCTAL), SEPERATED
; WITH A COMMA OR SPACE.
;
; ALL RESPONSES MUST BE CORRECT OR THE QUESTIONS ARE
; ASKED AGAIN. IF OUTPUT SLOT = INPUT SLOT, BOTH WILL BE
; RE-ASKED.
;
; TEST PROCEDURES:
;
; THIS TEST SIMPLY SENDS DATA TO THE PULSE OUTPUT AND
; RETRIEVES IT FROM THE INPUT BOARD. THE DATA IS THEN
; CHECKED. IF THE DATA IS RETURNED INCORRECTLY, A
; DATA ERROR IS REPORTED. THE TEST DATA USED IS AS
; FOLLOWS:
;
; IF TTL INPUT/G.P. INPUT TYPE LOOP:
; A "1" IS FLOATED FROM CHANNEL 17 TO CHANNEL 0
; IF TTL INPUT TYPE LOOP:
; A "0" IS FLOATED FROM CHANNEL 0 TO CHANNEL 17
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;
; THE TEST DOES THE ABOVE 2048 TIMES FOR TTL TYPE LOOP
; AND 16 TIMES FOR G.P INPUT TYPE LOOP. IF NO DATA ERROR
; IS DETECTED IN THIS TIME, "PASS" IS PRINTED. IF A
; DATA ERROR OCCURS, YOU CAN LOOP ON THE BAD DATA
; PATTERN BY SETTING SWPAK1 = 0, OR
; CONTINUE WITH THE NEXT DATA PATTERN BY SETTING THE
; SWPAK1 = 1. SWPAK2 INHIBITS ERROR PRINTOUT.
;
; ONE PASS TAKES APPROX 1 - 1.5 MINUTES.
;
; THE METHOD OF TRANSFER DEPENDS ON THE TYPE OF INPUT
; BOARD IN THE LOOP. (NOTE THAT THE PULSE OUTPUT BOARD
; INVERTS THE DATA SENT TO IT).
;
; TTL INPUT TYPE:
;
; THE DATA IS SENT TO THE PULSE OUTPUT BOARD. AFTER
; A DELAY OF 5 MS, THE DATA IS STROBED INTO THE
; INPUT REGISTER. THE DATA IS READ AND THEN CHECKED
; AGAINST THE COMPLEMENT OF THE SEND DATA. AN ERROR
; IS REPORTED IF THE DATA IS INCORRECT. NOTE THAT
; SINCE THE "EXT INT" LINE DOES NOT BECOME ACTIVE,
; "DONE" WILL NOT SET, AND NO INTERRUPT WILL BE
; GENERATED (NO TIMEOUTS REPORTED).
;
; G.P. INPUT TYPE:
;
; THE FRONT END SECTION OF THE G.P. INPUT HAS A FILTER
; NETWORK FOR NOISE REJECTION. THE TYPICAL RISE TIME
; IS FROM 15 - 100 MS, AND THE TYPICAL FALL TIME IS
; FROM 30 - 200 MS. THE MINIMUM OUTPUT PULSE DURATION
; IS FROM 2 - 10 MS. THEREFORE, THE DATA IS OUTPUT TO THE
; PULSE BOARD 256 TIMES (EACH TIME FOLLOWED BY A 1 MS
; DELAY) TO INSURE THAT THE DATA WILL ASSERT ITSELF. AN
; INTERRUPT SHOULD BE GENERATED (INDICATING A DATA CHANGE).
; A TIMEOUT IS REPORTED IF NO INTERRUPT IS DETECTED. THE
; DATA IS READ AND CHECKED AGAINST THE COMPLEMENT OF THE
; SEND DATA. A DATA ERROR IS REPORTED IF INCORRECT.
; THE DATA LINES SHOULD THEN RETURN TO THEIR QUIESCENT
; STATE (ALL 1'S). ANOTHER INTERRUPT SHOULD BE DETECTED.
; A DATA ERROR IS REPORTED IF THE LINE DOES NOT RETURN
; TO THIS STATE, AND A TIMEOUT IS REPORTED IF AN INTERRUPT
; IS NOT DETECTED.

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:0013 .MAIN
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:0.1
:0.1 SWITCH SETTINGS
:
: LOCATION "SWREG" IS USED TO SELECT THE PROGRAM OPTIONS
: (NOT SYSTEM CONFIGURATION). WHILE RUNNING UNDER DTOS,
: THIS LOCATION WILL BE LOADED BY THE MONITOR.
: HOWEVER UNDER STAND ALONE AND PROGRAM LOAD MODES THIS
: LOCATION WILL BE SET ACCORDING TO THE ANSWERS SUPPLIED
: BY THE OPERATOR. IN ANY CASE THE OPTIONS CAN BE CHANGED
: OR VERIFIED BY USING ONE OF THE COMMANDS GIVEN IN SEC.
: 8.3
:
:0.2 SWITCH OPTIONS
: DIFFERENT BITS AND THEIR INTERPRETATION AT LOCATION
: "SWREG" IS AS FOLLOWS:
:
: BIT OCTAL RINARY INTERPRETATION
: VALUE VALUE
:
: 1 40000 1 LOOP ON ERROR
: SKIP LOOPING ON ERROR
:
: 2 20000 1 PRINT TO CONSOLE
: ABORT PRINT OUT TO CONSOLE
:
: 3 10000 1 DO NOT PRINT % FAILURE
: PRINT % FAILURE
:
: 5 02000 1 DO NOT PRINT ON THE LINE PRINTER
: PRINT ON THE LINE PRINTER
:
: 6 01000 1 DO NOT HALT ON ERROR
: HALT ON ERROR
:
:0.3 SWITCH COMMANDS
: ONCE THE PROGRAM STARTS EXECUTING THE STATE OF ANY OF
: THE BITS CAN BE CHANGED BY HITTING KEYS 1-9, A-F. THE
: PROGRAM WILL CONTINUE RUNNING AFTER UPDATING THE OPTIONS.
: EACH KEY WILL COMPLEMENT THE STATE OF THE BIT AFFILIAT-
: ED WITH IT, THUS BIT 4 CAN BE ALTERED BY HITTING KEY 4.
: SETTING OF ANY BIT OF LOCATION "SWREG" WILL SET BIT 0.
: (DEFAULT MODE IS DEFINED AS ALL BITS OF SWREG SET TO 0)
:
:0.4 OTHER COMMANDS (^ = CONTROL KEY)
:
: "CR" A "RETURN" CAN BE TYPED TO CONTINUE THE PROGRAM
: AFTER ITS LOCKED IN A SWITCH MODIFICATION MODE
:
: ^D THIS COMMAND GIVEN AT ANY TIME WILL RESET "SWREG"
: TO DEFAULT MODE AND RESTART THE PROGRAM.
:
: ^R THIS COMMAND GIVEN AT ANY TIME WILL RESTART THE
: PROGRAM. SWITCHES ARE LEFT WITH THE VALUES THEY
: HAD BEFORE THE COMMAND WAS ISSUED.
:
: ^O THIS COMMAND GIVEN AT ANY TIME WILL CAUSE THE
: PROGRAM CONTROL TO GO TO 00T (NOTE: THIS IS AN

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0014 .MAIN
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OPTIONAL COMMAND AND IS AVAILBLE ONLY IF
ODTPK IS PRESENT)
:
:
: THIS COMMAND GIVEN AT ANY TIME WILL PRINT THE
: CURRENT OPERATING MODES.
:
: THIS COMMAND GIVEN AT ANY TIME WILL LOCK THE
: PROGRAM INTO SWITCH MODIFICATION MODE WHERE
: MORE THAN 1 BIT CAN BE CHANGED.

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10015 *.MAIN
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19. OPERATING PROCEDURE/OPERATOR INPUT:
;
;
; 19.1
;   GENERAL
;   1.A LOAD PROGRAM VIA BINARY LOADER
;
;   1.B MAKE NECESSARY HARDWARE CONNECTIONS
;     PERTAINING TO THE INPUT/OUTPUT TYPES AND OR
;     SYSTEM CONFIGURATION.
;
;   **REFER TO SECTION 6. FOR HARDWARE/CONFIGURATION DATA.
;
;   1.C SET SWITCHES EQUAL TO ONE OF THE STARTING
;     ADDRESSES SHOWN BELOW
;     PRESS START
;
;   1.D STARTING ADDRESS
;
;     70 00T DIRECT ENTRY ONLY
;     200 BASIC I/O (1 OUTPUT / 1 INPUT DIAGNOSTIC)
;     500 BASIC I/O (1 OUTPUT / 1 INPUT DIAGNOSTIC)
;     501 OUTPUT DUMP (OUTPUTS SWITCHES TO DESIGNATED
;     OUTPUT SLOT)
;     502 INPUT SCAN - STARTS ALL INPUT DEVICES
;     AND REPORTS ADDRESS AND DATA RECEIVED FOR
;     ALL GENERATED INTERRUPTS
;     503 INPUT SCAN PLUS OUTPUT DUMP
;     COMBINES 501,502 FUNCTIONS
;     504 MULTILoop/CHASSIS EXERCISER
;     505 MULTILoop WITH CATS
;     506 CHASSIS SLOT/ID PRINTOUT
;     507 PULSE OUTPUT TO TTL/G.P. INPUT LOOP
;
; 19.2 OPERATOR INPUTS (IN PARENTHESIS)
;
;   GENERAL
;   T TO BAUD RATE ? (DDD)      -DEVICE BAUD RATE RE-
;                                QUESTED IN ABSENSE OF
;                                RTC FOR TIMING.
;
;   INITIALIZE ? (YES,NO,ESC KEY)
;                                = YES TO SETUP SYSTEM
;                                CONFIGURATION.
;                                = NO TO RETAIN PREVIOUS
;                                CONFIGURATION/START TEST
;                                = ESCAPE KEY BYPASSES
;                                CHAS INFO TO SLOT INFO
;                                NOTE-ESC FOLLOWED BY CR
;
;   IF YES TO ABOVE
;
;   CHASSIS DEVICE SELECT -(NN)  -2 OCT DIGIT SELECT CODE
;                                DEFAULT IS 40 **
;
;   CHASSIS MASK BIT -(NN)      - - 0-17, -DEFAULT IS 5

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10016 *.MAIN
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; DCU ? (YES OR NO)
;
; IF YES TO ABOVE
;
; DCU DEVICE SELECT -(NN)      -2 OCT DIGIT SELECT CODE
;                                DEFAULT IS 34 **
;
; IF SA 500
;
; OUTPUT SLOT AND ID#'S (N,N)  - 2 OCTAL NO.'S
;
; INPUT SLOT AND ID#'S (N,N)   -2 OCTAL NO.'S
;                                ## SEE 2.1 FOR ID #'S
; DOES ADAPTER (# NN) INVERT DATA(YES,NO) - SEE TABLE 6.1
;
; IF SA 501,503
;
; OUTPUT SLOT AND DELAY IN MS (N,N)   - 2 OCTAL NO.'S
; SEPERATED BY ,
; DELAY MAY BE 0
;
; IF SA 504,505
;
; INPUT SLOT, ID, AND SELECT (N,N,N)  - 3 OCTAL NO.'S
; CR ENDS INPUT
; **IF AN OUTPUT ONLY IS DESIRED/ANSWER NO TO ABOVE**
; ** SELECT REFER'S TO CHAS DEVICE CODE**
; **IF ID #(L/A/D) IS ENTERED, (QUESTIONS(1-4)
; **NEXT PAGE ARE ASKED FOR A/D SETUP(HISTOGRAM)
;
; OUTPUT SLOT, ID, SELECT (N,N,N)    - 3 OCTAL NO.'S
;
; DOES ADAPTER INVERT DATA (YES OR NO) - SEE TABLE 6.1
;
; 19.2A:
; SEQUENCE REPEATS UNTIL CR TO FIRST QUESTION
; BASIC A/D HISTOGRAM INITIALIZATION SEQUENCE
; **NOTE - TO EXERCISE THE A/D BOARDS, THE CPU
; **MUST! HAVE THE REAL TIME CLOCK OPTION.
;
; 1) "A/D INPUT TYPE (POLARITY,RANGE) ="
;     RESPOND USING THE FOLLOWING CODES:
;     POLARITY = U FOR UNIPOLAR (DEFAULT)
;               = B FOR BIPOLAR
;     RANGE = L FOR 0-5 UNIPOLAR, +/- 5 BIPOLAR (DEFAULT)
;            = H FOR 0-10 UNIPOLAR, +/- 10 BIPOLAR
;
; 2) "A/D TRIGGERING, MUX SLOT #"
;     RESPOND USING THE FOLLOWING CODES:
;     TRIGGERING = 1 FOR DCHI
;                 = 2 FOR EXTERNAL CLOCK
;                 = 3 FOR INTERNAL CLOCK
;                 = 0-17 OCTAL
; "MUX SLOT #" = " (0-17 OCTAL)
; (MUX SLOT # MUST BE > A/D SLOT #)

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10017 .MAIN

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3) "(SELECT #, CHANNEL #, GAIN) OF MUX - "  
 SELECT #/CHANNEL # BOTH 0-17 OCTAL;  
 GAIN = 0,1,2,3 CORRESPONDS TO GAIN X 1,2,4,8  
 (GAIN USED ONLY BY PROGRAMMABLE MUX'S)

NOTE: FOR QUESTIONS REQUIRING MULTIPLE INPUTS  
 (QUESTIONS 1,2,3), RESPONSES MUST BE  
 SEPERATED BY A COMMA OR SPACE.

4) "SAMPLE CENTER VALUE"-  
 THIS IS A 6- DIGIT OCTAL CODE  
 REPRESENTING THE HISTOGRAM CENTER  
 VALUE. THE 12- BIT A/D DATA WORD  
 CORRESPONDING TO THIS VALUE SHOULD BE  
 INPUT LEFT JUSTIFIED, WITH ALL UNUSED  
 BITS EQUAL TO 0. FOR EXAMPLE 1 LSB IS  
 REPRESENTED AS OCTAL 20, AND A FULL COUNT  
 CORRESPONDS TO OCTAL 17760. LEADING  
 ZEROS ARE NOT NECESSARY.

FOR HISTOGRAM EXPLANATION REFER TO SECTION 7.5B.

PROGRAM OUTPUT/ERROR DESCRIPTION:

WHEN AN ERROR IS DETECTED, THE PROGRAM PRINTS THE  
 VALUE OF THE PC ON THE CALL TO EHMT AND THE  
 CONTENTS OF AC'S 0-2, AND THEN LOOPS ALLOWING THE  
 OPERATOR TO SET SWPAK (SEE SWITCH SETTING).

THE PROGRAM MAY EITHER CONTINUE  
 ON TO THE NEXT TEST OR STAY IN THE SCOPE LOOP BETWEEN  
 THE LAST CALLS TO .LOOP AND .SETUP. DEPENDING ON SWPAK  
 SETTINGS.

THE PARTICULAR SIGNIFICANCE OF AC'S 0-2 IS EXPLAINED IN  
 THE LISTING FOR THE PARTICULAR TEST INVOLVED.

DEBUG HELP:

10018 .MAIN

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OCTAL DEBUG TOOL (ODT)

THE DIAGNOSTIC IS EQUIPPED WITH A BUILT IN ODT WHICH CAN  
 BE ACCESSED BY HITTING CONTROL 0 (0) AT ANY TIME DURING  
 THE EXECUTION OF THE PROGRAM (AFTER SETTING THE PARA-  
 METERS).

ON ENTERING ODT THE ADDRESS OF THE LOCATION HAVING THE  
 NEXT INSTRUCTION TO BE EXECUTED WILL BE TYPED-OUT.

CONVENTIONS AND SYMBOLS  
 THE FOLLOWING CONVENTIONS ARE USED BY THE ODT:  
 ? PRESSING ANY ILLEGAL KEY CAUSES THE ODT TO RES-  
 POND WITH A "2"  
 @ ODT IS READY AND AT YOUR SERVICE.

COMMAND STRUCTURE  
 AN OUT COMMAND HAS THE FOLLOWING FORMAT:  
 [ARGUMENT] [COMMAND]

AN ARGUMENT MAY BE ONE OF THE FOLLOWING:  
 "EXP" AN OCTAL EXPRESSION CONSISTING OF OCTAL NUMBERS  
 SEPARATED BY PLUS (+) OR MINUS (-) SIGNS. LEAD-  
 ING ZEROS NEED NOT BE TYPED.  
 "ADR" AN ADDRESS IS THE SAME AS AN EXPRESSION EXCEPT  
 THAT BIT 0 IS NEGLECTED.  
 A COMMAND IS A SINGLE TELETYPE CHARACTER

ODT COMMANDS  
 THE LOCATIONS THAT CAN BE EXAMINED AND MODIFIED BY THE  
 USER ARE CALLED CELLS. THESE CELLS ARE OF TWO TYPES:  
 INTERNAL CPU CELLS AND MEMORY LOCATIONS.

OPENING INTERNAL CELLS  
 THE COMMAND TO OPEN ONE OF THE INTERNAL REGISTERS IS OF  
 THE FORM "NA" WHERE N IS ANY OCTAL EXPRESSION BETWEEN  
 0 AND 7  
 0-5 FOR ACCUMULATORS 0-3  
 4 FOR PC OF THE NEXT INSTRUCTION TO BE EXECUTED IN  
 THE EVENT OF A "P" COMMAND.  
 5 CPU AND I/O STATUS  
 BIT INTERPRETATION  
 15 STATUS OF I/O DONE FLAG  
 14 STATUS OF INTERRUPTS (I/O FLAG)  
 13 STATUS OF CARRY BIT  
 6 ADDRESS OF THE LOCATION HAVING THE BREAK POINT (IF  
 ANY)  
 7 INSTRUCTION AT THE BREAK POINT LOCATION

OTHER COMMANDS TO OPEN CELLS ARE:

"ADR"/ OPEN THE CELL AND PRINT ITS CONTENTS  
 ./ OPEN THE CELL CURRENTLY POINTED TO BY THE POINTER  
 AND PRINT ITS CONTENTS.  
 + "ADR"/ ADD "ADR" TO THE POINTER, OPEN THE CELL  
 - "ADR"/ AND PRINT ITS CONTENTS.  
 \* "ADR"/ SUBTRACT "ADR" FROM THE POINTER, OPEN  
 THE CELL AND PRINT ITS CONTENTS.  
 "CR" THE RETURN KEY IS USED TO CLOSE THE OPEN CELL  
 WITH OR WITHOUT MODIFICATION.

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0019 .MAIN
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:12. SPECIAL NOTES/SPECIAL FEATURES:
:
: SEE SECTION 9.0
: SEE SECTION 7.6 FOR "CATS" OPERATION
:13. RUN TIME:
: WILL VARY DEPENDING ON CONFIGURATION TESTED.

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10020 .MAIN
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? "LF" LINE FEED IS USED TO CLOSE THE OPEN CELL WITH OR
? WITHOUT MODIFICATION AND TO OPEN THE SUCCEEDING
? CELL.
?
? CLOSE THE OPEN CELL WITH OR WITHOUT MODIFICATION
? AND OPEN THE PRECEDING CELL
? / CLOSE THE OPEN CELL WITHOUT MODIFICATION, AND
? OPEN THE CELL POINTED TO BY ITS CONTENTS.
? + "ADR"/ CLOSE THE OPEN CELL WITHOUT MODIFICATION, AND
? - "ADR"/ OPEN THE CELL POINTED TO BY ITS CONTENTS + "ADR".
? - "ADR"/ OPEN THE CELL POINTED TO BY ITS CONTENTS - "ADR".
?
?
? 11.3.2 MODIFICATION OF A CELL
? ONCE A CELL HAS BEEN OPENED ITS CONTENTS CAN BE MODIFIED
? BY TYPING THE NEW VALUE THE CELL IS TO CONTAIN IN THE
? FORM OF AN OCTAL EXPRESSION FOLLOWED BY "CR" OR "LF".
? IF A * OR _ IS TYPED AS THE FIRST CHARACTER OF THE EX-
? PRESSION THEN THE VALUE OF THE EXPRESSION IS ADDED TO OR
? SUBTRACTED FROM THE OLD CONTENTS OF THE CELL. THE
? ADDRESS ITSELF OR AN EXPRESSION RELATIVE TO THE ADDRESS
? CAN BE DEPOSITED BY TYPING A " ." OR ".??"-OCTAL EXPRESS-
? ION". A RUBOUT COMMAND GIVEN RIGHT AFTER OPENING A CELL
? ALLOWS THE MODIFICATION OF ITS CONTENTS AS IF THEY WERE
? TYPED IN JUST BEFORE THE COMMAND WAS ISSUED.
?
?
? 11.3.3 OTHER ODT COMMANDS
? RUBOUT THIS KEY IS USED TO DELETE ERRONEOUSLY TYPED
? DIGITS. EACH TIME THE KEY IS PRESSED THE RIGHT MOST
? DIGIT IS DELETED AND ECHOED ON THE TERMINAL. IF
? THE RUBOUT KEY IS PRESSED RIGHT AFTER OPENING A
? CELL THEN IT DELETES THE RIGHT MOST DIGIT OF THE CELLS
? CONTENTS. THIS ALLOWS THE MODIFICATION OF THE CELL
? AS IF ITS CONTENTS WERE TYPED IN JUST BEFORE THE
? KEY WAS PRESSED.
?
? "ADR"B INSERT A BREAK POINT AT LOCATION "ADR".
? ONLY ONE BREAK POINT CAN BE INSERTED AND ANY
? ENTRY TO ODT AFTER EXECUTING A BREAK POINT WILL
? CAUSE IT TO BE DELETED.
?
? D DELETE THE BREAK POINT IF ANY.
? P RESTART THE EXECUTION OF THE PROGRAM AT LOCATION
? POINTED BY 4A.
? "ADR"R START EXECUTING THE PROGRAM AT "ADR" AFTER AN
? IO-RESET.
?
? K KILL THE STRING TYPED SO FAR. THE ODT RESPONDS
? WITH A "2" AND THE OPEN CELL IS CLOSED WITHOUT
? MODIFICATION.
? = PRINT THE OCTAL VALUE OF THE INPUT ONLY.
? THIS WILL CLOSE ANY OPEN CELLS WITHOUT
? MODIFICATION AND WILL NOT OPEN A CELL
?
?
? NOTE: IN PROGRAMS WHICH RELOCATE THEMSELVES THE
? THE USER SHOULD PLACE BREAK POINTS ONLY IN THE
? ORIGINAL PROGRAM AREA. IF A BREAK POINT IS
? PLACED OUTSIDE THIS AREA THE RESULTS WILL
? BE UNPREDICTABLE.

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10021 .MAIN

\*\*00000 TOTAL ERRORS, 00000 PASS 1 ERRORS

0022 .MAIN

0?DTD 001551 MC 18/01